

Use these links to rapidly review the document

[TABLE OF CONTENTS](#)

[TABLE OF CONTENTS 2](#)

[Table of Contents](#)

As filed with the Securities and Exchange Commission on April 30, 2019.

Registration No. 333-230822

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

Amendment No. 1
to
FORM S-1
REGISTRATION STATEMENT
UNDER
THE SECURITIES ACT OF 1933

AXCELLA HEALTH INC.
(Exact name of registrant as specified in its charter)

Delaware
(State or other jurisdiction of
incorporation or
organization)

2836
(Primary Standard Industrial
Classification Code Number)

26-3321056
(I.R.S. Employer
Identification Number)

840 Memorial Drive
Cambridge, MA 02139
(857) 320-2200
(Address, including zip code, and telephone number, including area code, of registrant's principal executive offices)

William Hinshaw
Chief Executive Officer
840 Memorial Drive
Cambridge, MA 02139
(857) 320-2200
(Name, address, including zip code, and telephone number, including area code, of agent for service)

Copies of all communications, including communications sent to agent for service, should be sent to:

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Laurie A. Burlingame
Goodwin Procter LLP
100 Northern Ave.
Boston, MA 02210
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Latham & Watkins LLP
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Boston, MA 02116
(617) 948-6000

Approximate date of commencement of proposed sale to the public:
As soon as practicable after this registration statement becomes effective.

If any of the securities being registered on this Form are to be offered on a delayed or continuous basis pursuant to Rule 415 under the Securities Act of 1933, as amended, check the following box. ☐

If this Form is filed to register additional securities for an offering pursuant to Rule 462(b) under the Securities Act, please check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering. ☐

If this Form is a post-effective amendment filed pursuant to Rule 462(c) under the Securities Act, check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering. ☐

If this Form is a post-effective amendment filed pursuant to Rule 462(d) under the Securities Act, check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering. ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company" and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large Accelerated Filer ☐
Non-Accelerated Filer ☒

Accelerated Filer ☐
Smaller Reporting Company ☐
Emerging Growth Company ☒

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided to Section 7(a)(2)(B) of the Securities Act. ☐

CALCULATION OF REGISTRATION FEE

Title of each Class of Securities to be Registered	Proposed Maximum Aggregate Offering Price ⁽¹⁾⁽²⁾	Amount of Registration Fee ⁽³⁾
Common Stock, par value \$0.001 per share	\$90,357,124	\$10,951.28*

* \$10,453.50 previously paid.

(1) Estimated solely for the purpose of calculating the registration fee pursuant to Rule 457(o) under the Securities Act of 1933, as amended.

(2) Includes the offering price of shares that the underwriters may purchase pursuant to an option to purchase additional shares.

(3) Calculated pursuant to Rule 457(o) based on an estimate of the proposed maximum aggregate offering price.

The registrant hereby amends this registration statement on such date or dates as may be necessary to delay its effective date until the registrant shall file a further amendment that specifically states that this registration statement shall thereafter become effective in accordance with Section 8(a) of the Securities Act of 1933, as amended, or until this registration statement shall become effective on such date as the Commission, acting pursuant to said Section 8(a), may determine.

The information in this preliminary prospectus is not complete and may be changed. These securities may not be sold until the registration statement filed with the Securities and Exchange Commission is effective. This preliminary prospectus is not an offer to sell these securities nor does it seek an offer to buy these securities in any jurisdiction where the offer or sale is not permitted.

SUBJECT TO COMPLETION, DATED APRIL 30, 2019

PRELIMINARY PROSPECTUS

3,571,428 Shares



Axcella Health Inc.

Common Stock

We are offering 3,571,428 shares of our common stock. This is our initial public offering and no public market currently exists for our common stock. We anticipate that the initial public offering price will be between \$20.00 and \$22.00 per share.

Prior to this offering, there has been no public market for our common stock. We have applied to list our common stock on The Nasdaq Global Market under the symbol "AXLA."

Investing in our common stock involves risks. See "Risk Factors" beginning on page 12 of this prospectus.

We are an "emerging growth company" as defined under U.S. federal securities laws and will be subject to reduced public company reporting requirements. See "Prospectus Summary—Implications of being an emerging growth company."

Neither the Securities and Exchange Commission nor any state securities commission has approved or disapproved of these securities, or passed upon the accuracy or adequacy of this prospectus. Any representation to the contrary is a criminal offense.

	Per Share	Total
Initial Public Offering Price	\$	\$
Underwriting Discounts and Commissions ⁽¹⁾	\$	\$
Proceeds, before expenses, to us	\$	\$

⁽¹⁾ See "Underwriting" beginning on page 217 of this prospectus for additional information regarding total underwriter compensation.

We have granted the underwriters an option for a period of up to 30 days to purchase up to 535,714 additional shares of our common stock.

Delivery of the shares of common stock is expected to be made on or about , 2019.

Joint Book-Running Managers

GOLDMAN SACHS & CO. LLC

J.P. MORGAN

SVB LEERINK

Prospectus dated , 2019

TABLE OF CONTENTS

PROSPECTUS SUMMARY	1
RISK FACTORS	12
SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS	86
INDUSTRY AND MARKET DATA	88
USE OF PROCEEDS	89
DIVIDEND POLICY	91
CAPITALIZATION	92
DILUTION	95
SELECTED CONSOLIDATED FINANCIAL DATA	97
MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS	98
BUSINESS	113
MANAGEMENT	178
EXECUTIVE COMPENSATION	186
DIRECTOR COMPENSATION	197
CERTAIN RELATIONSHIPS AND RELATED PARTY TRANSACTIONS	199
PRINCIPAL STOCKHOLDERS	202
DESCRIPTION OF CAPITAL STOCK	205
SHARES ELIGIBLE FOR FUTURE SALE	211
CERTAIN MATERIAL U.S. FEDERAL INCOME AND ESTATE TAX CONSIDERATIONS FOR NON-U.S. HOLDERS	213
UNDERWRITING	217
LEGAL MATTERS	222
EXPERTS	222
WHERE YOU CAN FIND MORE INFORMATION	222
INDEX TO CONSOLIDATED FINANCIAL STATEMENTS	F-1

We and the underwriters have not authorized anyone to provide any information or to make any representations other than those contained in this prospectus or in any free writing prospectuses we have prepared. We and the underwriters take no responsibility for, and can provide no assurance as to the reliability of, any other information that others may provide you. We are offering to sell, and seeking offers to buy, shares of common stock only in jurisdictions where offers and sales are permitted. The information contained in this prospectus is accurate only as of the date of this prospectus, regardless of the time of delivery of this prospectus or of any sale of the common stock.

Until , 2019 (25 days after the date of this prospectus), all dealers that effect transactions in these securities, whether or not participating in this offering, may be required to deliver a prospectus. This is in addition to the dealers' obligation to deliver a prospectus when acting as underwriters and with respect to their unsold allotments or subscriptions.

For investors outside the United States: Neither we nor the underwriters have done anything that would permit this offering or possession or distribution of this prospectus in any jurisdiction where action for that purpose is required, other than in the United States. Persons outside the United States who come into possession of this prospectus must inform themselves about, and observe any restrictions relating to, the offering of the shares of common stock and the distribution of this prospectus outside the United States.

PROSPECTUS SUMMARY

This summary highlights information contained elsewhere in this prospectus. Before investing in our common stock, you should carefully read this entire prospectus, including our consolidated financial statements and the related notes included elsewhere in this prospectus. As used in this prospectus, unless the context otherwise requires, references to the "company," "we," "us" and "our" refer to Axcella Health Inc. together with its consolidated subsidiaries. In this prospectus, we use the following defined terms:

"AXA Candidate" to refer to one of our investigational product candidates.

"AXA Development Platform" to refer to our proprietary human-focused development platform.

"Clinical Trial" to refer to a human clinical study of a drug product candidate subject to the requirements for an effective Investigational New Drug application, or an IND.

"dose" to refer to the exposure amount of an AXA Candidate in Clinical Trials and Non-IND, IRB-Approved Clinical Studies.

"non-drug" to refer to a non-therapeutic use of an AXA Candidate. Such use may be as a food product or dietary supplement.

"Non-IND, IRB-Approved Clinical Study" to refer to Institutional Review Board-approved, or IRB-Approved, clinical studies conducted in humans with our AXA Candidates under U.S. Food and Drug Administration, or the FDA, regulations and guidance supporting research with food outside of an IND (prior to any decision to develop an AXA Candidate as a drug product candidate under an IND or a non-drug product candidate). In these food studies, based on our understanding of FDA regulations and guidance, we evaluate in humans, including individuals with disease, an AXA Candidate for safety, tolerability and effects on the normal structures and functions of the body. These studies are not designed or intended to evaluate an AXA Candidate's ability to diagnose, cure, mitigate, treat or prevent a disease as these would be evaluated in Clinical Trials if we decide to develop an AXA Candidate as a drug or therapeutic.

Overview

We are a biotechnology company pioneering the research and development of novel multifactorial interventions to support health and address dysregulated metabolism across a broad spectrum of consumers and patients who have limited options. Our AXA Candidates are generated from our proprietary, human-focused AXA Development Platform and harness the power of endogenous metabolic modulators, or EMMs, a broad family of molecules that fundamentally impact and regulate human metabolism.

Using our AXA Development Platform, we have rapidly generated a pipeline of AXA Candidates that are novel compositions of EMMs engineered in distinct ratios and designed to target and maximize the fundamental role that EMMs play in regulating multiple metabolic functions. Our AXA Candidates are administered orally and anchored by amino acids, which have a history of safe use as food. As such, we expect our AXA Candidates may also be combinable with other modalities. We believe our current dataset supports the potential of our AXA Candidates to safely modulate the metabolic pathways they target. These features may make them an attractive development opportunity with significant commercial potential.

In 2018, we completed three Non-IND, IRB-Approved Clinical Studies. In all three studies, our AXA Candidates were generally found to be well tolerated, and we generated positive normal structure and function data indicating potential metabolic modulation. We believe generating this rich human dataset at this early stage of development (i) eliminates the translational uncertainty associated with transitioning from animal studies to human studies, (ii) enables us to make

high-insight, capital-efficient development decisions and (iii) potentially increases the probability of success for these AXA Candidates. For AXA Candidates we decide to develop under an IND, we will discuss with the FDA our ability to use data generated from our Non-IND, IRB-Approved Clinical Studies to begin Phase II or potential registrational Clinical Trials.

On March 6, 2019, we had a face-to-face pre-IND meeting with the FDA for AXA1665, our lead AXA Candidate, during which we discussed clinical endpoints, assessment tools and other matters relating to a potential IND-opening Clinical Trial for AXA1665 in hepatic encephalopathy, or HE. After meeting with the FDA, we made a decision to pursue a drug development path for AXA1665. Under the planned IND, the initial indication would be for the treatment of HE, with time to breakthrough episode of overt HE event as the primary endpoint and key secondary muscle-related endpoints. We anticipate interacting with the FDA again prior to a formal IND submission for AXA1665. We anticipate initiating a Clinical Trial in the second half of 2020 for AXA1665 that we believe could potentially serve as a registrational (pivotal) trial to support the submission of a New Drug Application, or NDA.

Our Pipeline

Our wholly-owned pipeline currently comprises five programs focused on the metabolic functions of the liver, muscle and blood. An overview of our AXA Candidates and their status is illustrated below.

POPULATIONS STUDIED		PRE-CLINICAL	NON-IND. IRB-APPROVED CLINICAL STUDIES ¹	PH I	PH II	PH IIb/III	NDA	POTENTIAL INDICATIONS
Liver	Mild-moderate hepatic insufficiency	AXA1665		N/A	N/A	2H 2020 ²		Hepatic Encephalopathy (HE) • Time to breakthrough OHE event • Muscle related (sarcopenia)
	NAFLD (Adult)	AXA1125		IF PURSUED UNDER AN IND				NASH (Adult)
		AXA1957						
	NAFLD (Pediatric)	AXA1957						NASH (Pediatric)
Muscle	Limb immobilization-induced acute atrophy	AXA2678						Hip fracture-related myopenia Hip arthroplasty Total knee arthroplasty
Blood		AXA4010						Sickle cell disease

(1) In the above pipeline chart, "Development Path Decision" reflects the point in a program at which we decide whether to develop an AXA Candidate as a drug product candidate under an IND, develop it as a non-drug product candidate or terminate development. We have made a decision to develop AXA1665 as a drug product candidate and anticipate interacting with the FDA again prior to submitting an IND. We have not made a development path decision for any of our other AXA Candidates.

(2) We believe that this Clinical Trial has the potential to serve as a registrational (pivotal) Clinical Trial, subject to continuing IND discussions and allowance by the FDA.

Definitions: NAFLD = non-alcoholic fatty liver disease; NASH = nonalcoholic steatohepatitis; OHE = overt hepatic encephalopathy.

AXA1665 in Hepatic Encephalopathy

In study AXA1665-001, subjects with mild and moderate hepatic insufficiency (Child-Pugh Class A and B) were divided into two groups: 14.7g/day and 44.1g/day of AXA1665, administered in three divided doses. In subjects receiving the higher dose of AXA1665, we observed a cumulative increase of 40% in the Fischer's ratio, the molar ratio of branched-chain amino acids to aromatic amino acids. These subjects also demonstrated a lower plasma ammonia area under the curve when sampled over five hours (AUC_{0-5h}), and tended to maintain a leaner phenotype (i.e., increase in dry lean mass and decrease in fat mass as assessed by bioimpedance measurements) and muscle function (as assessed using a liver frailty index score) compared to those on a control regimen. Each of these markers are believed to have prognostic significance in assessing liver health, including cirrhosis.

In 2019, prior to making a drug development path decision for AXA1665, we initiated an additional 12-week (with a four-week follow-up), randomized, placebo-controlled, Non-IND, IRB-Approved Clinical Study in approximately 60 mild and moderate hepatic insufficiency (Child-Pugh Class A and B) subjects. We anticipate the data readout from this study in the first half of 2020 and plan to include these data in the IND submission for AXA1665. Under the planned IND, the initial indication would be for the treatment of HE, with time to breakthrough episode of overt HE event as the primary endpoint and key secondary muscle-related endpoints. HE has multiple drivers, namely amino acid imbalance, dysregulated ammonia handling and sarcopenia.

AXA1125 and AXA1957 in Subjects with Non-alcoholic Fatty Liver Disease, or NAFLD

In study AXA1125-002, administration of AXA1125 24g three times a day was associated with a trend of decreased liver fat, improved insulin sensitivity (i.e., lower Homeostatic Model Assessment of Insulin Resistance) and induction of fat oxidation (i.e., increased beta-hydroxybutyrate). In subjects who received AXA1125, mean blood levels of key fibroinflammatory biomarkers tended to decrease compared to the mean pre-administration baseline levels. We believe these data suggest AXA1125 has the potential to impact three critical drivers associated with NAFLD—metabolism, inflammation and fibrosis. Leveraging these findings, we rapidly designed AXA1957 to potentially address additional populations within the liver health and disease spectrum, including pediatrics.

In January 2019, we initiated study AXA1125-003, a 16-week, randomized, single-blind, placebo-controlled, Non-IND, IRB-Approved Clinical Study to assess safety, tolerability and physiological impact on the normal structures and functions of AXA1125 and AXA1957 in approximately 105 adult subjects with NAFLD. We currently anticipate the data readout from this study in the second half of 2020. In the second half of 2019, we also plan to initiate AXA1957-002, a placebo-controlled, single-blind, randomized (2:1), controlled Non-IND, IRB-Approved Clinical Study to assess safety, tolerability and physiological impact on the normal structures and functions of AXA1957 in approximately 30 adolescent subjects with NAFLD.

AXA2678 in Healthy Subjects with Immobilization-Induced Acute Muscle Atrophy

In study AXA2678-001, in subjects receiving AXA2678 24g three times a day, we observed attenuated muscle atrophy during the one-week immobilization period compared to placebo, reflected by a 76% relative difference in average muscle cross sectional area assessed by magnetic resonance imaging. Subjects receiving AXA2678 tended to have muscle fiber architecture preserved during immobilization and also tended to recover muscle strength to pre-immobilization baseline levels as compared to placebo within a short two-week recovery period. We are continuing to evaluate next steps for this program.

We believe that the consistency and nature of the data from our three completed Non-IND, IRB-Approved Clinical Studies indicate that this approach has significant promise. We are focused on actively expanding our pipeline and currently reviewing additional development opportunities in hematology, central nervous system, kidney and pulmonary function. Many diseases are driven by multifactorial dysregulated systemic metabolism, and we have already characterized over 50 diseases for prioritization.

We have attracted a world-class leadership team that has significant experience in the successful development and commercialization of collectively more than 50 drugs across numerous therapeutic areas. We are supported by an industry-leading board of directors and scientific advisory board. Since inception, we have raised approximately \$200 million in capital from leading life sciences investors, including our founder, Flagship Pioneering, Fidelity Management & Research Company, Nestlé Health Science US Holdings and Gurnet Point Capital Limited.

Our Strengths

We believe we are well-positioned to execute on our corporate strategy based on the following competitive strengths:

- **Deep understanding of metabolic dysregulation and the modulatory power of EMMs.** Applying our expertise in EMMs and metabolism, we aim to harness the potential of EMMs to directly and simultaneously support and modulate multiple metabolic pathways implicated both in complex diseases and overall health.
- **Predictive, rapid and scalable human-focused AXA Development Platform.** We have built a first-of-its-kind integrated knowledge platform that has proven capable of rapidly designing our novel and proprietary AXA Candidates. To date, we have progressed three programs from biological hypothesis to readout of initial Non-IND, IRB-Approved Clinical Study data in less than 18 months.
- **Informed and capital-efficient AXA Candidate early-stage development model.** In our Non-IND, IRB-Approved Clinical Studies, we have rapidly generated a rich dataset in healthy subjects and subjects with certain disease conditions. We believe that generating human data at this early stage of development enables us to make high-insight, capital-efficient development decisions and potentially increases the probability of success for these candidates.
- **Pipeline with significant potential across a spectrum of disease and health.** We currently have five AXA Candidate programs across multiple target areas, including in liver and muscle, and have characterized over 50 additional diseases for prioritization.
- **Broad intellectual property portfolio with worldwide rights to our AXA Candidates.** As a first mover in our approach to EMMs, we are building a broad intellectual property portfolio to protect our AXA Candidates and AXA Development Platform.
- **Experienced leadership team and board of directors.** Members of our management team and board of directors have extensive experience in product development and commercialization.

Our Strategy

Our goal is to become the preeminent biotechnology company reprogramming metabolism to address a diverse set of complex diseases and support health. To achieve our goal, we are executing a strategy that includes the following core elements:

- Accelerate paths to market for our lead programs.

- Further enhance and leverage our AXA Development Platform to advance multiple new programs per year in attractive markets.
- Expand patient and consumer access to AXA Candidates, if approved, and opportunistically leverage strategic partnerships.
- Establish ourselves as a global, fully-integrated biotechnology company.

Risks associated with our business

Our business is subject to a number of risks of which you should be aware before making an investment decision. These risks are discussed more fully in the "Risk Factors" section of this prospectus immediately following the prospectus summary. These risks include the following:

- For AXA Candidates we decide to develop under an IND, such as AXA1665, the FDA will require substantial additional preclinical and/or clinical development in target diseased populations before we can seek and receive regulatory approval for and launch these products commercially. For any AXA Candidate under an IND, the FDA may reject data from previously completed Non-IND, IRB-Approved Clinical Studies or may require new, previously untested data points to be studied; the resulting Clinical Trial results may not support or be consistent with our prior data, and analysis or expectations for such AXA Candidate or the AXA Candidate may not meet therapeutic efficacy endpoints in Clinical Trials.
- Regulatory requirements for development of our AXA Candidates as non-drugs or drugs are uncertain and evolving. Changes in these laws, including our ability to conduct Non-IND, IRB-Approved Clinical Studies, or the current interpretation or application of these laws could have a significant adverse impact on our ability to research, develop and commercialize our products. Some of these risks include that the FDA may require that we conduct additional preclinical studies before proceeding to Clinical Trials, determine that our AXA Candidates cannot be marketed as a non-drug product, disagree with our determination that our AXA Candidates may be studied in humans without an effective IND, or subject us to litigation or enforcement actions.
- We have incurred net losses in every year since our inception and anticipate that we will continue to incur net losses in the future.
- Even if we consummate this offering, we will require additional capital to fund our operations and if we fail to obtain necessary financing, we will not be able to complete research or development and commercialization of our AXA Candidates.
- Any negative safety and efficacy data regarding or negative perceptions of EMMs, our novel approach to EMMs or our AXA Candidates could adversely affect our ability to successfully recruit for and complete our human studies. This could adversely affect our ability to conduct our business, obtain regulatory approvals, if required, identify alternate regulatory pathways to market for any AXA Candidates or enter into strategic partnerships, and materially and negatively impact our business and operations.
- Clinical development is a lengthy and expensive process, with an uncertain outcome. We may incur additional costs or experience delays in completing, or ultimately be unable to complete, the development of, obtain positive data for or commercialize any AXA Candidates, which could result in an impaired ability or inability to finance or fund the Company in the future.
- There can be no assurance that we will be able to develop in-house sales, distribution and other capabilities needed to commercialize drug or non-drug products or establish or

maintain relationships with third-party collaborators to successfully commercialize any AXA Candidates that receive regulatory approval in the United States or overseas.

- If we are unable to obtain or protect intellectual property rights related to our technology and current or future AXA Candidates and AXA Development Platform, or if our intellectual property rights are inadequate, we may not be able to compete effectively.
- We may not be able to establish a commercial manufacturing source and secure supply chain capacity sufficient to provide AXA Candidates and materials for preclinical studies, Non-IND, IRB-Approved Clinical Studies, Clinical Trials, if we decide to develop any AXA Candidate as a drug product candidate, and commercial quantities of any AXA Candidates.
- We may be unable to attract and retain key scientific or management personnel to successfully execute our business plans.

For additional information about the risks we face, please see the section of this prospectus captioned "Risk Factors."

Recent Developments

As of March 31, 2019, our cash and cash equivalents were \$66.7 million.

The information above is based on preliminary unaudited information and management estimates for the three months ended March 31, 2019, is not a comprehensive statement of our financial results, and is subject to completion of our financial closing procedures. Our independent registered public accounting firm has not conducted an audit or review of, and does not express an opinion or any other form of assurance with respect to, this preliminary estimate.

Axcella Health Inc. and Flagship Pioneering

We were founded in 2008 by Flagship Labs, the institutional innovation foundry of Flagship Pioneering. A team comprising innovators and entrepreneurs Dr. David Berry, Dr. Geoffrey von Maltzahn and Dr. Noubar Afeyan started exploring the potential medical applications of diverse, orally-consumed proteins. The work of this team led to the understanding that specific amino acid combinations at different ratios have the potential to drive profound biological effects in both health and disease by impacting dysregulated metabolic pathways and multi-compartmental biology. With this transformational new approach, we are harnessing the potential for orally-administered EMM compositions to drive cellular biology in a specific and reproducible manner with the goal of delivering safe interventions for patients or consumers.

Corporate history

We were incorporated in August 2008 under the laws of the state of Delaware under the name Newco LS16, Inc. Our name was changed to Axcella Health Inc. in June 2016. Our principal executive offices are located at 840 Memorial Drive, Cambridge, MA 02139, and our phone number is (857) 320-2200. Our website address is <https://www.axcellahealth.com>. The information contained in or accessible from our website is not incorporated into this prospectus, and you should not consider it part of this prospectus.

We own various U.S. federal trademark applications and unregistered trademarks, including our company name and our logo. All other trademarks or trade names referred to in this prospectus are the property of their respective owners. Solely for convenience, the trademarks and trade names in this prospectus are referred to without the symbols ® and ™, but such references should not be construed as any indicator that their respective owners will not assert, to the fullest extent under applicable law, their rights thereto.

Implications of being an emerging growth company

We are an "emerging growth company," as defined in the Jumpstart Our Business Startups Act, or the JOBS Act, enacted in April 2012. For so long as we remain an emerging growth company, we are permitted and intend to rely on certain exemptions from various public company reporting requirements, including not being required to have our internal control over financial reporting audited by our independent registered public accounting firm pursuant to Section 404(b) of the Sarbanes-Oxley Act of 2002, reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements, exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and any golden parachute payments not previously approved. In particular, in this prospectus, we have provided only two years of audited financial statements and have not included all of the executive compensation related information that would be required if we were not an emerging growth company. Accordingly, the information contained herein may be different than the information you receive from other public companies in which you hold stock.

We will remain an emerging growth company until the earlier to occur of (1) December 31, 2024, (2) the last day of the fiscal year in which we have total annual gross revenues of at least \$1.07 billion, (3) the last day of the fiscal year in which we are deemed to be a "large accelerated filer," under the rules of the U.S. Securities and Exchange Commission, or SEC, which means the market value of our equity securities that is held by non-affiliates exceeds \$700 million as of the prior June 30th and (4) the date on which we have issued more than \$1.0 billion in non-convertible debt during the prior three-year period.

In addition, the JOBS Act provides that an emerging growth company can take advantage of an extended transition period for complying with new or revised accounting standards. This provision allows an emerging growth company to delay the adoption of some accounting standards until those standards would otherwise apply to private companies. We have elected not to "opt out" of such extended transition period, which means that when a standard is issued or revised and it has different application dates for public or private companies, we will adopt the new or revised standard at the time private companies adopt the new or revised standard and will do so until such time that we either (i) irrevocably elect to "opt out" of such extended transition period or (ii) no longer qualify as an emerging growth company.

The Offering

Common stock offered by us	3,571,428 shares
Common stock to be outstanding immediately after this offering	22,988,359 shares (or 23,524,073 shares if the underwriters exercise their option to purchase additional shares in full)
Option to purchase additional shares offered by us	535,714 shares
Use of proceeds	We estimate that we will receive net proceeds from the sale of shares of our common stock in this offering of approximately \$66.6 million, or \$77.1 million if the underwriters exercise their option to purchase additional shares in full, assuming an initial public offering price of \$21.00 per share, the midpoint of the price range set forth on the cover page of this prospectus, and after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us. We intend to use the net proceeds from this offering, together with our existing cash and cash equivalents: (i) to advance our current liver and other programs through additional Non-IND, IRB-Approved Clinical Studies, our planned IND filing for AXA1665 and other potential IND filing(s) and the ensuing Clinical Trials; (ii) to advance our AXA Development Platform and discovery efforts; (iii) to support organizational growth; and (iv) for working capital and other general corporate purposes. For a more complete description of our intended use of the proceeds from this offering, see "Use of Proceeds."
Risk factors	You should carefully read the "Risk Factors" section of this prospectus for a discussion of factors that you should consider before deciding to invest in our common stock.
Proposed Nasdaq Global Market symbol	"AXLA"

The number of shares of our common stock to be outstanding after this offering is based on 4,774,934 shares of our common stock outstanding as of December 31, 2018, and gives effect to the conversion of all outstanding shares of our preferred stock into an aggregate of 14,641,997 shares of our common stock upon the completion of this offering, and excludes:

- 61,235 shares of common stock issuable upon the exercise of warrants to purchase shares of Series A preferred stock that will become warrants to purchase common stock outstanding as of December 31, 2018, with a weighted-average exercise price of \$3.59 per share;
- 4,039,464 shares of common stock issuable upon the exercise of stock options outstanding as of December 31, 2018 under our 2010 Stock Incentive Plan, or our 2010 Plan, with a weighted-average exercise price of \$5.67 per share;

- 41,230 shares of common stock reserved for future issuance as of December 31, 2018 under our 2010 Plan, which will cease to be available for issuance at the time that our 2019 Stock Option and Incentive Plan, or our 2019 Plan, becomes effective;
- 6,671,662 shares of our common stock that will become available for future issuance under our 2019 Plan upon the effectiveness of the registration statement of which this prospectus forms a part; and
- 237,181 shares of our common stock that will become available for future issuance under our 2019 Employee Stock Purchase Plan, or our 2019 ESPP, upon the effectiveness of the registration statement of which this prospectus forms a part.

Unless otherwise indicated, all information in this prospectus reflects or assumes the following:

- the filing of our restated certificate of incorporation and the effectiveness of our amended and restated bylaws in connection with the completion of this offering;
- the conversion of all outstanding shares of preferred stock into an aggregate of 14,641,997 shares of common stock upon the completion of this offering;
- the outstanding warrants to purchase our Series A preferred stock becoming warrants to purchase an aggregate of 61,235 shares of our common stock upon the closing of this offering;
- the payment of a \$1.2 million success fee that is payable to Solar Capital Ltd. upon completion of this offering;
- no exercise of outstanding options after April 20, 2019;
- a one-for-1.842 reverse split of our common stock effected on April 29, 2019; and
- no exercise by the underwriters of their option to purchase up to 535,714 additional shares of common stock in this offering.

Summary Consolidated Financial Data

You should read the following summary consolidated financial data together with our consolidated financial statements and the related notes appearing at the end of this prospectus and the "Selected Consolidated Financial Data" and "Management's Discussion and Analysis of Financial Condition and Results of Operations" sections of this prospectus. We have derived the consolidated statements of operations data for the years ended December 31, 2017 and 2018 from our audited consolidated financial statements appearing at the end of this prospectus. Our historical results are not necessarily indicative of the results that may be expected in the future.

	December 31,	
	2017	2018
	(in thousands, except share and per share data)	
Consolidated Statements of Operations Data:		
Operating expenses:		
Research and development	\$ 22,916	\$ 25,486
General and administrative	6,005	8,410
Total operating expenses	<u>28,921</u>	<u>33,896</u>
Loss from operations	(28,921)	(33,896)
Other income (expense):		
Change in fair value of preferred stock warrant liability	81	(14)
Interest income (expense), net	<u>(2,100)</u>	<u>(2,159)</u>
Total other income (expense), net	<u>(2,019)</u>	<u>(2,173)</u>
Net loss	<u>\$ (30,940)</u>	<u>\$ (36,069)</u>
Net loss per share, basic and diluted ⁽¹⁾	<u>\$ (7.37)</u>	<u>\$ (7.97)</u>
Weighted average common shares outstanding, basic and diluted ⁽¹⁾	<u>4,211,918</u>	<u>4,546,373</u>
Pro forma net loss per share, basic and diluted (unaudited) ⁽¹⁾		<u>\$ (2.19)</u>
Pro forma weighted average common shares outstanding, basic and diluted (unaudited) ⁽¹⁾		<u>16,528,448</u>

⁽¹⁾ See Note 11 to our consolidated financial statements appearing at the end of this prospectus for details on the calculation of basic and diluted net loss per share and the calculation of basic and diluted pro forma net loss per share.

	As of December 31, 2018		
	Actual	Pro Forma ⁽¹⁾	Pro Forma As Adjusted ⁽²⁾
	(in thousands)		
Consolidated Balance Sheet Data:			
Cash and cash equivalents	\$ 79,466	\$ 79,466	\$ 146,106
Working capital ⁽³⁾	73,390	73,390	140,030
Total assets	81,844	81,844	148,484
Long term debt, net of discount	24,521	24,521	24,521
Preferred stock warrant liability	425	—	—
Other liabilities ⁽⁴⁾	1,898	1,898	698
Redeemable convertible preferred stock	197,842	—	—
Total stockholders' equity (deficit)	(149,753)	48,514	116,354

- (1) The pro forma consolidated balance sheet data gives effect to (i) the conversion of all outstanding shares of our preferred stock into an aggregate of 14,641,997 shares of common stock upon the closing of this offering and (ii) all outstanding warrants to purchase shares of Series A preferred stock becoming warrants to purchase shares of common stock upon the closing of this offering.
- (2) The pro forma as adjusted balance sheet data give further effect to our issuance and sale of shares of our common stock in this offering at the initial public offering price of \$21.00 per share, after deducting underwriting discounts and commissions and estimated offering expenses payable by us.
- (3) We define working capital as current assets less current liabilities.
- (4) Includes a \$1.2 million success fee related to our loan and security agreement with Solar Capital Ltd., which is payable upon the consummation of this offering.

The pro forma as adjusted information discussed above is illustrative only and will change based on the actual initial public offering price and other terms of this offering determined at pricing. A \$1.00 increase (decrease) in the assumed initial public offering price of \$21.00 per share, the midpoint of the price range set forth on the cover of this prospectus, would increase (decrease) the pro forma as adjusted amount of each of cash and cash equivalents, working capital, total assets and total stockholders' equity by approximately \$3.3 million, assuming that the number of shares offered by us, as set forth on the cover page of this prospectus, remains the same and after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us. An increase (decrease) of 1,000,000 shares in the number of shares offered by us, as set forth on the cover page of this prospectus, would increase (decrease) each of cash and cash equivalents, working capital, total assets and stockholders' equity by approximately \$19.5 million, assuming the assumed initial public offering price of \$21.00 per share, the midpoint of the price range set forth on the cover page of this prospectus, remains the same, and after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us.

RISK FACTORS

Investing in our common stock involves a high degree of risk. You should carefully consider the risks described below, as well as the other information in this prospectus, including our consolidated financial statements and the related notes and "Management's Discussion and Analysis of Financial Condition and Results of Operations," before deciding whether to invest in our common stock. The occurrence of any of the events or developments described below could harm our business, financial condition, results of operations and growth prospects. In such an event, the market price of our common stock could decline and you may lose all or part of your investment. Additional risks and uncertainties not presently known to us or that we currently deem immaterial also may impair our business operations.

Risks related to our business, technology and industry

We have incurred net losses in every year since our inception and anticipate that we will continue to incur net losses in the future.

We are a biotechnology company with a limited operating history. Investment in product development in the healthcare industry, including of biotechnology products, is highly speculative because it entails substantial upfront capital expenditures and significant risk that any potential product candidate will fail to demonstrate adequate effect or an acceptable safety profile, gain regulatory approval and/or become commercially viable. Our AXA Candidates are currently being studied in Non-IND, IRB-Approved Clinical Studies as food products. We have no products approved for commercial sale, have not generated any revenue from product sales to date and continue to incur significant research and development and other expenses related to our ongoing operations. As a result, we are not profitable and have incurred losses in each period since our inception in 2008. For the years ended December 31, 2017 and 2018, we reported net losses of \$30.9 million and \$36.1 million, respectively. As of December 31, 2018, we had an accumulated deficit of \$157.0 million. We expect to continue to incur significant losses for the foreseeable future, and we expect these losses to increase as we continue our research and development of, and if we choose to develop our AXA Candidates under an Investigational New Drug application, or IND, seek regulatory approvals for, our AXA Candidates. We anticipate that our expenses will increase substantially if, and as, we:

- conduct preclinical studies and additional Non-IND, IRB-Approved Clinical Studies and, for any AXA Candidate we elect to develop as a drug product candidate, initiate Clinical Trials to develop an AXA Candidate under an IND or its equivalent in non-U.S. jurisdictions;
- further develop our proprietary human-focused product development platform, our AXA Development Platform;
- continue to discover and develop our current AXA Candidates as well as additional AXA Candidates;
- maintain, expand and protect our intellectual property portfolio;
- hire or contract additional clinical, scientific, manufacturing and commercial personnel to support our product research, development and commercialization efforts;
- continue to develop, scale and validate a manufacturing process and specifications for our AXA Candidates;
- continue to establish in-house manufacturing capabilities for our research and product development efforts;

- establish a commercial manufacturing source and secure supply chain capacity sufficient to provide preclinical study material, Non-IND, IRB-Approved Clinical Study material, Clinical Trial material for any AXA Candidate we elect to develop as a drug product candidate under an IND, and commercial quantities of any AXA Candidates that we may commercialize as a drug or non-drug product candidate, following receipt of any necessary approvals or authorizations;
- acquire or in-license other candidates and technologies;
- seek various non-drug product marketing pathways and, if applicable, drug regulatory authorizations;
- establish a sales, marketing and distribution infrastructure to commercialize any AXA Candidates for which we may obtain regulatory approval or identify an alternate regulatory pathway to market; and
- add operational, compliance, financial and management information systems and personnel to support our transition to a public company.

To become and remain profitable, we or any potential future collaborator must develop and eventually commercialize products with significant market potential at an adequate profit margin after cost of goods sold and other expenses. This will require us to be successful in a range of challenging activities, including: completing preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials for any AXA Candidate we elect to develop as a drug product candidate under an IND; obtaining marketing approval or identifying alternate regulatory pathways for AXA Candidates; manufacturing, marketing and selling products for which we may obtain marketing approval; or successfully identifying alternate regulatory pathways and satisfying any post-marketing requirements. We may never succeed in any or all of these activities and, even if we do, we may never generate revenue that is significant enough to achieve profitability. If we do achieve profitability, we may not be able to sustain or increase profitability on a quarterly or annual basis. Our failure to become and remain profitable would decrease the value of our company, which could impair our ability to raise capital, maintain our research and development efforts, expand our business or continue our operations. A decline in the value of our company also could cause you to lose all or part of your investment.

Even if we succeed in commercializing one or more of our AXA Candidates, we will continue to incur substantial research and development and other expenditures to develop and market additional AXA Candidates. We may encounter unforeseen expenses, difficulties, complications, delays and other unknown factors that may adversely affect our business, which may be significant. The size of our future net losses will depend, in part, on the rate of future growth of our expenses and our ability to generate revenue. Our prior losses and expected future losses have had and will continue to have an adverse effect on our stockholders' equity and working capital.

Even if we consummate this offering, we will require additional capital to fund our operations and if we fail to obtain necessary financing, we will not be able to complete development and commercialization of our AXA Candidates.

Our operations have consumed substantial amounts of cash since inception. We expect to continue to spend substantial amounts for our current and future programs: to conduct further research and development, preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials for any AXA Candidate we elect to develop as a drug product candidate under an IND, as we plan to do for our AXA1665 product candidate; to validate the manufacturing process and specifications for our AXA Candidates; to seek regulatory approvals for or identify alternate regulatory pathways to market for our AXA Candidates; and to launch and commercialize any

products for which we receive regulatory approval or identify an alternate regulatory pathway to market, including potentially building our own commercial organization. As of December 31, 2018, we had \$79.5 million of cash and cash equivalents on hand. Based on our current operating plan, we believe that the net proceeds from this offering, together with our existing cash and cash equivalents, will enable us to fund our operating expenses, capital expenditure requirements and debt service obligations through the second quarter of 2021. However, our future capital requirements and the period for which our existing resources will support our operations may vary significantly from our expectations, and we will in any event require additional capital in order to complete clinical development of any of our current AXA Candidates. Our monthly spending levels will vary based on new and ongoing development and corporate activities. Because the length of time and activities associated with development of our AXA Candidates is highly uncertain, we are unable to estimate the actual funds we will require for development and any approved marketing and commercialization activities. Our future funding requirements, both near and long-term, will depend on many factors, including, but not limited to:

- our decisions regarding the development path under which we will develop our AXA Candidates (i.e., either continuing to develop our AXA Candidates as non-drug products, or initiating development as drug product candidates under an IND);
- the initiation, progress, timing, costs and results of preclinical studies, Non-IND, IRB-Approved Clinical Studies and, depending on our development path decision, Clinical Trials for our AXA Candidates and any need to conduct additional such studies as may be required by a regulator, including additional studies that may be required by a regulator in order to allow the initiation of Clinical Trials under an IND or the non-U.S. equivalent for any of our AXA Candidates;
- the clinical development plans we establish for these AXA Candidates;
- further development of our AXA Development Platform and supporting infrastructure;
- the number and characteristics of AXA Candidates that we develop or may in-license;
- the terms of any collaboration agreements we may choose to initiate or conclude;
- the outcome, timing and cost of meeting regulatory requirements established by the U.S. Food and Drug Administration, or the FDA, any other regulatory authorities in the United States, and, when applicable, comparable foreign regulatory authorities, such as the European Medicines Agency, or the EMA;
- the effect of changes in regulations or policy relating to the development and commercialization of our AXA Candidates by the FDA, any other regulatory authorities in the United States and, when applicable, other comparable foreign regulatory authorities such as the EMA;
- the costs of establishing, maintaining and overseeing a quality system compliant with current Good Manufacturing Practices, or cGMPs, and a supply chain for the development and manufacture of our AXA Candidates;
- the cost of defending intellectual property disputes, including patent infringement actions brought by third parties against us, our AXA Candidates or our AXA Development Platform;
- the effect of competing technological and market developments;
- the cost and timing of establishing, expanding and scaling manufacturing capabilities; and

- the cost of establishing sales, marketing and distribution capabilities for any AXA Candidates for which we may receive regulatory approval or identify alternate regulatory pathways in regions where we choose to commercialize our products on our own.

We do not have any committed external source of funds or other support for our development efforts and we cannot be certain that additional funding will be available on acceptable terms, or at all. Until we can generate sufficient product or royalty revenue to finance our cash requirements, which we may never do, we expect to finance our future cash needs through a combination of public or private equity offerings, debt financings, collaborations, strategic alliances, licensing arrangements and other marketing or distribution arrangements. If we raise additional funds through public or private equity offerings, the terms of these securities may include liquidation or other preferences that adversely affect our stockholders' rights. Further, to the extent that we raise additional capital through the sale of common stock or securities convertible into or exchangeable for common stock, your ownership interest will be diluted. If we raise additional capital through debt financing, we would be subject to fixed payment obligations and may be subject to covenants limiting or restricting our ability to take specific actions, such as incurring additional debt, making capital expenditures, declaring dividends or acquiring or licensing intellectual property rights. If we raise additional capital through marketing and distribution arrangements or other collaborations, strategic alliances or licensing arrangements with third parties, we may have to relinquish certain valuable rights to our AXA Candidates, technologies, future revenue streams or research programs or grant licenses on terms that may not be favorable to us. We also could be required to seek collaborators for one or more of our current or future AXA Candidates at an earlier stage than otherwise would be desirable or relinquish our rights to AXA Candidates or technologies that we otherwise would seek to develop or commercialize ourselves. If we are unable to raise additional capital in sufficient amounts or on terms acceptable to us, we may have to significantly delay, scale back or discontinue the development or commercialization of one or more of our products or AXA Candidates or one or more of our other research and development initiatives. Any of the above events could significantly harm our business, prospects, financial condition and results of operations and cause the price of our common stock to decline, causing you to lose all or part of your investment.

We have a limited operating history, which may make it difficult to evaluate our technology and product development capabilities and predict our future performance.

We are early in our development efforts and we have not initiated Clinical Trials for any of our AXA Candidates to allow for development of such candidates as drug product candidates. With the exception of AXA1665 for which we plan to file an IND, we are currently developing our AXA Candidates as non-drug products under food regulations, although the ultimate pathway under which we will develop our other AXA Candidates is subject to change depending on a number of factors. We were formed in 2008, have no products approved for commercial sale as drugs or marketed via other regulatory pathways (e.g., non-drug products) and have not generated any revenue from product sales. Our ability to generate product revenue or profits, which we do not expect will occur for many years, if ever, will depend on the successful development and eventual commercialization of our AXA Candidates, which may never occur.

Our limited operating history may make it difficult to evaluate our technology and industry and predict our future performance. Specifically, to date we have conducted Non-IND, IRB-Approved Clinical Studies for our AXA Candidates to evaluate safety and tolerability only in healthy subjects or subjects with certain disease conditions. If we decide to develop an AXA Candidate under an IND with patient populations reflecting the desired indication for such AXA Candidate, the physiological structure and function data we observed in our Non-IND, IRB-Approved Clinical Studies for such

AXA Candidate may not be replicated in or consistent with results from Clinical Trials and such AXA Candidate may not meet therapeutic efficacy endpoints in Clinical Trials.

Our short history as an operating company makes any assessment of our future success or viability subject to significant uncertainty. We will encounter risks and difficulties frequently experienced by early-stage companies in evolving fields. If we do not address these risks successfully, our business will suffer. Similarly, we expect that our financial condition, expenditures and operating results will fluctuate significantly from quarter to quarter and year to year due to a variety of factors, many of which are beyond our control. As a result, our stockholders should not rely upon the results of any quarterly or annual period as an indicator of future operating performance.

In addition, as an early-stage company, we may encounter unforeseen expenses, difficulties, complications, delays and other known and unknown circumstances, which may be significant. As we advance our AXA Candidates, we will need to transition from a company with a research focus to a company capable of supporting clinical development and, if successful, commercial activities. We may not be successful in such transitions.

Any use of our AXA Candidates to support and maintain homeostasis, which helps support normal structures and functions of the body, or to modulate dysregulated metabolism is a novel approach and negative perception of any AXA Candidates that we develop could adversely affect our ability to conduct our business, obtain regulatory approvals or identify alternate regulatory pathways, to the extent required by applicable laws, to market such AXA Candidates.

Using endogenous metabolic modulators, or EMMs, in the compositions, ratios and formulations we use in our AXA Candidates and the potential drug and non-drug applications of our AXA Candidates represents a novel approach. Our AXA Candidates in general may not be successfully developed or commercialized or gain the acceptance of the public or the medical community. For any AXA Candidate that we choose to develop as a drug product candidate, our success will depend upon physicians who specialize in the treatment of diseases targeted by our AXA Candidates, prescribing potential treatments that involve the use of our AXA Candidates in lieu of, or in addition to, existing treatments with which they are more familiar and for which greater clinical data may be available. For any AXA Candidate that we choose to develop as a non-drug product candidate, our success will depend on finding partners in a non-drug market who can help successfully commercialize AXA Candidates. In addition, our success will also depend on consumer acceptance and adoption of our products that we, or a future partner, commercialize. Adverse events in Non-IND, IRB-Approved Clinical Studies and Clinical Trials of our AXA Candidates or in studies or Clinical Trials of others developing similar products and the resulting publicity, as well as any other adverse events in the field of EMMs and metabolic pathways, could result in a decrease in demand for any product that we may develop. In addition, responses by the U.S. federal, state or foreign governments to negative public perception or ethical concerns may result in new legislation or regulations that could limit our ability to develop or commercialize any AXA Candidates, obtain or maintain regulatory approval, if applicable, identify alternate regulatory pathways to market or otherwise achieve profitability. More restrictive statutory regimes, government regulations or negative public opinion would have an adverse effect on our business, financial condition, results of operations and prospects, and may delay or impair the development and commercialization of our AXA Candidates or demand for any products we may commercialize.

All of our AXA Candidates for which we make a drug development path decision, including any targeting the metabolic pathways of the liver and muscle that if dysregulated could result in loss of health or disease, will require significant additional preclinical and clinical development before we can seek regulatory approval for and launch a drug product commercially.

For any AXA Candidate that we choose to develop as a drug product candidate, such as our AXA1665 drug product candidate for which we plan to submit an IND, our business and future success will depend on our ability to obtain regulatory approval of and then successfully launch and commercialize such AXA Candidate as a drug targeting a disease involving dysregulated metabolism, such as cirrhosis, non-alcoholic steatohepatitis or muscle atrophy. Any future Clinical Trials of AXA1665 and any other AXA Candidates that we decide to develop as drug product candidates may experience preliminary complications in trial execution, such as complexities surrounding regulatory clearance to initiate Clinical Trials, the need for additional preclinical data to support authorization to proceed with Clinical Trials, modifications in trial design and trial protocols, bioanalytical assay method development, dose level and regimen selection, patient recruitment and enrollment, quality and supply of clinical doses or safety issues. Additionally, even if additional preclinical studies, Non-IND, IRB-Approved Clinical Studies or Clinical Trials are successfully executed, there is no guarantee that the results produced by such additional studies will confirm or be consistent with the results obtained in our Non-IND, IRB-Approved Clinical Studies to date for our AXA Candidates.

Any AXA Candidates that we decide to develop as drug product candidates will require significant additional development, including preclinical and clinical development, regulatory review or approval in the jurisdictions that we target for commercialization, identification of appropriate non-drug regulatory pathways to commercialization, substantial investment, access to sufficient validated and cGMP-compliant commercial manufacturing capacity and significant marketing efforts before we can generate any revenue from product sales. In addition, if we choose to develop AXA1665, our lead candidate, as a drug product candidate and AXA1665 encounters safety, efficacy, supply or manufacturing problems, developmental delays, regulatory or commercialization issues or other problems, our development plans, including for our other AXA Candidates, and business would be significantly harmed.

The successful development of our AXA Candidates is highly uncertain.

Successful development of our AXA Candidates is highly uncertain and is dependent on numerous factors, many of which are beyond our control. AXA Candidates that appear promising in the early phases of development may fail to reach the market for several reasons, including:

- results from preclinical or Non-IND, IRB-Approved Clinical Studies may demonstrate that our AXA Candidates are not safe, not tolerable or have unanticipated impacts on the normal structure and function of the body and could result in data showing one or more AXA Candidates to have harmful or problematic side effects or toxicities;
- Clinical Trial results may show any AXA Candidate we decide to develop as a drug product candidate to be less effective than expected (e.g., a Clinical Trial could fail to meet its primary endpoint(s)) or to have unacceptable side effects or toxicities;
- failure to execute the Non-IND, IRB-Approved Clinical Studies or Clinical Trials caused by slow enrollment in Non-IND, IRB-Approved Clinical Studies or Clinical Trials, as applicable, study subjects dropping out of Clinical Trials or volunteers or study subjects dropping out of Non-IND, IRB-Approved Clinical Studies, length of time to achieve clinical endpoints, additional time requirements for data analysis, inability to validate the manufacturing process or to achieve cGMP compliance for our AXA Candidates;

- failure to receive the necessary regulatory approvals or authorizations, where applicable, or a delay in receiving such approvals or authorizations for, including, but not limited to, a new drug application, or NDA, or delays in NDA preparation, the need to submit a new dietary ingredient, or NDI, notification or other filings with the FDA, discussions with the FDA and other regulatory authorities in jurisdictions we target or pursue, responding to an FDA request or other regulatory authority for additional preclinical or clinical data or unexpected safety or manufacturing issues;
- manufacturing costs, formulation issues, manufacturing deficiencies or other factors that make our AXA Candidates uneconomical;
- proprietary rights of others and their competing products and technologies that may prevent our product candidates from being commercialized; and
- the length of time necessary to complete Clinical Trials and, for those AXA Candidates that we may decide to develop as drug product candidates, to submit an application for marketing approval of a drug product candidate, where applicable, for a final decision by a regulatory authority may be difficult to predict for any such AXA Candidates, in large part because of their limited regulatory history.

Even if we are successful in obtaining market approval for those AXA Candidates that we decide to develop as drug product candidates, commercial success of any approved drugs will also depend in large part on marketing acceptance, the availability of insurance coverage and adequate reimbursement from third-party payors, including government payors, such as the Medicare and Medicaid programs, and managed care organizations, which may be affected by existing and future healthcare reform measures designed to reduce the cost of healthcare. Third-party payors could require us to conduct additional studies, including post-marketing studies related to the cost-effectiveness of a product, to qualify for reimbursement, which could be costly and divert our resources. If government and other healthcare payors were not to provide adequate insurance coverage and reimbursement levels for one or any of our drug products once approved, market acceptance and commercial success would be reduced.

In addition, if any AXA Candidate we decide to develop as a drug product candidate is approved for marketing, we will be subject to significant regulatory obligations regarding the submission of safety and other post-marketing information and reports and registration. If approved, our drug products may be subject to restrictions on our products' labels and other conditions of regulatory approval that may limit our ability to market our products for therapeutic indications. We will also need to comply (and ensure that our third-party contractors comply) with cGMPs and Good Clinical Practice, or GCP, as we (and our third-party contractors) will be required to comply with cGMPs for products used in Clinical Trials and for any Clinical Trials that we conduct post-approval with cGMPs for either drug or non-drug candidates. In addition, we will need to comply with full GCPs in development efforts for any therapeutic indications we develop for approval and for any additional therapeutic indications we develop after approval of our first drug candidate. In addition, there is always the risk that we or a regulatory authority might identify previously unknown problems with a drug product post-approval or with non-drug products after commercialization, such as adverse events of unanticipated severity or frequency. Compliance with regulatory requirements to address such issues could be costly and any failure to comply or other issues with our drug products post-approval or non-drug products post-commercialization could have a material adverse effect on our business, financial condition and results of operations.

Clinical development is a lengthy and expensive process, with an uncertain outcome. We may incur additional costs or experience delays in completing, or ultimately be unable to complete, the development and commercialization of any AXA Candidates, which could impair our ability to fund our operations or obtain financing on acceptable terms, or at all.

To obtain the requisite regulatory approvals to commercialize any AXA Candidate that we decide to develop as a drug product candidate, we must demonstrate through extensive preclinical studies and Clinical Trials that our AXA Candidates are safe and effective in humans for their intended use. Non-IND, IRB-Approved Clinical Studies to commercialize non-drug products also require a significant financial investment to generate data that supports the claims we would make for such products and the safety of the product. Clinical testing is expensive, difficult to design and implement and can take many years to complete, and its outcome is inherently uncertain. We may be unable to establish, where applicable, endpoints, dose levels and regimens or bioanalytical assay methods that applicable regulatory authorities would consider clinically meaningful, and a Clinical Trial can fail at any stage of testing. Additionally, our Non-IND, IRB-Approved Clinical Studies or other studies may not result in data that supports intended claims for non-drug products. The outcome of preclinical studies, Non-IND, IRB-Approved Clinical Studies and early Clinical Trials may not be predictive of the success of later preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials, and interim results of these studies or trials do not necessarily predict final results. Differences in trial design between early-stage Clinical Trials and later-stage Clinical Trials make it difficult to extrapolate the results of earlier Clinical Trials to later Clinical Trials. Moreover, preclinical and clinical data are often susceptible to varying interpretations and analyses, and many companies that have believed their product candidates performed satisfactorily in preclinical studies and Clinical Trials have nonetheless failed to obtain marketing approval of their product candidates, or have data that supports desirable marketing claims even where marketing approval is not required.

Successful completion of Clinical Trials is a prerequisite to submitting an NDA to the FDA, or its equivalent in other foreign regulatory authorities such as a marketing authorization application to the EMA, for each product candidate for therapeutic indications and, consequently, the ultimate approval and commercial marketing of any product candidates for therapeutic indications. We do not know whether we will be able to initiate or complete Clinical Trials for AXA Candidates we decide to develop as drug product candidates on schedule, if at all.

We may experience delays in completing our preclinical studies and initiating or completing Non-IND, IRB-Approved Clinical Studies and, for those AXA Candidates that we decide to develop as drug product candidates, Clinical Trials. We also may experience numerous unforeseen events during, or as a result of, any future Non-IND, IRB-Approved Clinical Studies or Clinical Trials that we may conduct that could delay or prevent our ability to receive marketing approval or commercialize our AXA Candidates, including:

- we may be unable to generate sufficient preclinical, toxicology or other *in vivo* or *in vitro* data to support the initiation of Clinical Trials for therapeutic indications or the marketing of our products as non-drug products;
- the FDA may not allow us to use data from any Non-IND, IRB-Approved Clinical Studies to support an IND for AXA1665 or any other AXA Candidate we decide to develop as a drug product candidate instead of a non-drug product candidate;
- the FDA or other regulatory authorities may disagree with the design, implementation or results of our Non-IND, IRB-Approved Clinical Studies or Clinical Trials, or require us to submit additional data such as long-term toxicology studies or impose other requirements before permitting us to initiate or complete a Clinical Trial. For example, the FDA could require that we stop a Non-IND, IRB-Approved Clinical Study for an AXA Candidate and

continue such study only under an IND, and we may not be able to obtain such an IND, if at all, without additional study or we may be subject to an enforcement action for conducting a Non-IND, IRB-Approved Clinical Study not under an IND;

- regulators, IRBs or ethics committees may not authorize us or our investigators to commence or conduct a Non-IND, IRB-Approved Clinical Study or Clinical Trial at a prospective study or trial site;
- we may experience delays in reaching, or fail to reach, agreement on acceptable terms with prospective study or trial sites and prospective contract research organizations, or CROs, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and study or trial sites;
- Non-IND, IRB-Approved Clinical Studies or Clinical Trials of any AXA Candidates may fail to show safety or effectiveness, or produce negative or inconclusive results and we may decide or be required to conduct additional preclinical studies, Non-IND, IRB-Approved Clinical Studies, Clinical Trials or any other studies, or we may decide to abandon product development programs;
- the number of subjects or patients required for Non-IND, IRB-Approved Clinical Studies or Clinical Trials of any AXA Candidates may be larger than we anticipate, enrollment in these clinical studies or trials may be slower than we anticipate or participants may drop out of these clinical studies or trials or fail to return for required follow-up post study or trial completion at a higher rate than we anticipate;
- we may need to add new or additional Non-IND, IRB-Approved Clinical Study or Clinical Trial sites;
- our third-party contractors may fail to comply with regulatory requirements or meet their contractual obligations to us in a timely manner, or at all, or may deviate from the Non-IND, IRB-Approved Clinical Study or Clinical Trial protocol or drop out of the study or trial, which may require that we add new clinical study or trial sites or investigators;
- the cost of preclinical studies, Non-IND, IRB-Approved Clinical Studies, Clinical Trials or any other studies of any AXA Candidates may be more than we anticipate or more than our available financial resources;
- the supply or quality of our AXA Candidates or other materials necessary to conduct Non-IND, IRB-Approved Clinical Studies and Clinical Trials may be insufficient or inadequate and may not achieve compliance with applicable cGMPs;
- our AXA Candidates may have undesirable side effects or other unexpected characteristics, causing us or our investigators, regulators, IRBs or ethics committees to suspend or terminate Non-IND, IRB-Approved Clinical Studies and Clinical Trials, or reports may arise from preclinical or clinical testing of our AXA Candidates that raise safety or other concerns about one or more of our AXA Candidates; and
- preclinical studies, Non-IND, IRB-Approved Clinical Studies or Clinical Trials of our AXA Candidates may produce negative or inconclusive results, which may result in our deciding, or being required, to conduct additional clinical studies or trials or abandon product development programs.

We could also encounter delays if a preclinical study, Non-IND, IRB-Approved Clinical Study or Clinical Trial is suspended or terminated for any reason. A suspension or termination may be imposed due to a number of factors, including failure to conduct the Non-IND, IRB-Approved Clinical Study or Clinical Trial in accordance with regulatory requirements or our clinical protocols,

inspection of the clinical trial operations or trial site by the FDA, other regulatory authorities or IRB resulting in the imposition of a clinical hold, unforeseen safety issues or adverse side effects, failure to demonstrate a benefit from using a product or treatment, failure to establish or achieve clinically meaningful endpoints, changes in governmental regulations or administrative actions or lack of adequate funding to continue the Non-IND, IRB-Approved Clinical Study or Clinical Trial. Many of the factors that cause, or lead to, a delay in the commencement or completion of Non-IND, IRB-Approved Clinical Studies or Clinical Trials may also ultimately lead to the denial of regulatory approval of our AXA Candidates for therapeutic indications, where applicable, or the failure to meet applicable regulatory requirements to support and commercialize non-drug products. Further, the FDA or other regulatory authorities may disagree with our Non-IND, IRB-Approved Clinical Study or Clinical Trial design and our interpretation of data from these clinical studies or trials, or may change the requirements for regulatory approval of a drug even after they have reviewed and commented on the design for our preclinical studies, Non-IND, IRB-Approved Clinical Studies or Clinical Trials.

Our product development costs will increase if we experience delays in clinical testing and marketing approvals, if applicable, or otherwise meeting regulatory requirements to commercialize our AXA Candidates. We do not know whether any of our preclinical studies, Non-IND, IRB-Approved Clinical Studies or Clinical Trials, if applicable, will begin as planned, will need to be restructured or will be completed on schedule, or at all. Significant delays in our preclinical studies, Non-IND, IRB-Approved Clinical Studies or Clinical Trial also could shorten any periods during which we may have the exclusive right to commercialize our AXA Candidates and may allow our competitors to bring products to market before we do, potentially impairing our ability to successfully commercialize our AXA Candidates and harming our business and results of operations. Any delays in our preclinical or future clinical development programs may harm our business, financial condition and prospects significantly, and could impair our ability to fund our operations or obtain financing on acceptable terms, or at all.

Our planned Non-IND, IRB-Approved Clinical Studies or any future Clinical Trials, if applicable, or those of our future collaborators may reveal significant adverse events not seen in our preclinical studies, Non-IND, IRB-Approved Clinical Studies or other Clinical Trials and may result in a safety profile that could inhibit regulatory approval or market acceptance of any of our AXA Candidates.

Before obtaining regulatory approvals for the commercial sale of any products for therapeutic indications, we must demonstrate through lengthy, complex and expensive preclinical studies and Clinical Trials that our AXA Candidates are both safe and effective for use in each target indication. Preclinical and clinical studies and testing are expensive and can take many years to complete, and their outcome is inherently uncertain. Failure can occur at any time during the preclinical or clinical study or trial process. The results of preclinical studies, Non-IND, IRB-Approved Clinical Studies as well as early Clinical Trials of our AXA Candidates may not be predictive of the results of later-stage clinical studies or trials. In addition, initial results in Non-IND, IRB-Approved Clinical Studies and Clinical Trials, in particular as shown by any interim data, may not be indicative of results obtained when such Non-IND, IRB-Approved Clinical Studies and Clinical Trials are completed. There is typically an extremely high rate of attrition from the failure of product candidates proceeding through clinical studies and trials. Our AXA Candidates have been generally well tolerated in our Non-IND, IRB-Approved Clinical Studies, but we are not certain that we will be able to dose participants at a high enough dose in any future Clinical Trials so as to demonstrate efficacy without unacceptable safety risk.

AXA Candidates in later stages of Non-IND, IRB-Approved Clinical Studies may fail to show the desired safety profile despite having progressed through successful preclinical studies and earlier

Non-IND, IRB-Approved Clinical Studies. AXA Candidates that we decide to develop as drug product candidates and that progress to Clinical Trials may fail to show the desired safety and efficacy profile despite having progressed successfully through preclinical studies, Non-IND, IRB-Approved Clinical Studies and, if applicable, initial Clinical Trials. A number of companies in the healthcare industry have suffered significant setbacks in later development, notwithstanding promising results in earlier trials. Most product candidates that commence Clinical Trials are never approved as products for therapeutic indications and there can be no assurance that any of our current or future Non-IND, IRB-Approved Clinical Studies or Clinical Trials will ultimately be successful or support further clinical development of any of our AXA Candidates.

If significant adverse events or other side effects are observed in any of our current or future Non-IND, IRB-Approved Clinical Studies or Clinical Trials, we may have difficulty recruiting subjects or patients for our Non-IND, IRB-Approved Clinical Studies or Clinical Trials, subjects or patients may drop out of our Non-IND, IRB-Approved Clinical Studies or Clinical Trials or we may be required to significantly redesign or abandon Non-IND, IRB-Approved Clinical Studies or Clinical Trials or our development efforts of one or more AXA Candidates altogether. We, the FDA or other applicable regulatory authorities or an IRB may suspend Non-IND, IRB-Approved Clinical Studies or Clinical Trials of an AXA Candidate at any time for various reasons, including a belief that subjects or patients in such Non-IND, IRB-Approved Clinical Studies or Clinical Trials are being exposed to unacceptable health risks or adverse side effects or that our Non-IND, IRB-Approved Clinical Studies are designed to evaluate our AXA Candidates as drug product candidates. Some potential non-drug products and drug product candidates that initially showed promise for further development in early-stage testing, including in Non-IND, IRB-Approved Clinical Studies or Clinical Trials, have later been found to cause side effects that prevented their further development. Even if the side effects do not preclude an AXA Candidate from obtaining or maintaining marketing approval, if applicable, or being commercialized, undesirable side effects may inhibit market acceptance of the commercialized product due to its tolerability versus other non-drug products or drugs. Any of these developments could materially harm our business, financial condition and prospects.

If we encounter difficulties enrolling study subjects or patients in our Non-IND, IRB-Approved Clinical Studies or any future Clinical Trials, our development activities could be delayed or otherwise adversely affected.

We may experience difficulties in subject and patient enrollment in our Non-IND, IRB-Approved Clinical Studies and Clinical Trials for a variety of reasons. The timely completion of Non-IND, IRB-Approved Clinical Studies or Clinical Trials in accordance with their protocols depends, among other things, on our ability to enroll a sufficient number of subjects or patients who remain in the Non-IND, IRB-Approved Clinical Study or Clinical Trial until its conclusion. The enrollment of subjects or patients depends on many factors, including:

- the severity of the disease or condition under investigation in the case of a Clinical Trial conducted under an IND for an AXA Candidate that we decide to develop as a drug product candidate;
- the subject or patient eligibility and exclusion criteria defined in the protocol;
- the size of the study subject or patient population required for analysis of the primary endpoint(s) of the Non-IND, IRB-Approved Clinical Study or Clinical Trial;
- the proximity of subjects or patients to study and trial sites;
- the design of the clinical study or trial;
- our ability to recruit investigators with the appropriate competencies and experience;

- clinicians', subjects' or patients' perceptions as to the potential advantages and risks of the AXA Candidate being studied in relation to other available drugs or non-drug products, as applicable;
- the efforts to facilitate timely enrollment in clinical studies or trials;
- the subject or patient referral practices of physicians;
- the ability to monitor subjects or patients adequately during and after study product administration;
- our ability to obtain and maintain subject and patient consents; and
- the risk that subjects or patients enrolled in Non-IND, IRB-Approved Clinical Studies or Clinical Trials will drop out of the Non-IND, IRB-Approved Clinical Studies or Clinical Trials before completion.

In addition, our Non-IND, IRB-Approved Clinical Studies and Clinical Trials will compete with other clinical studies or trials for product candidates that are in the same target markets as our AXA Candidates, and this competition will reduce the number and types of subjects or patients available to us, because some individuals who might have opted to enroll in our clinical studies or trials may instead opt to enroll in a study or trial being conducted by one of our competitors. Because the number of qualified clinical investigators is limited, we expect to conduct some of our Non-IND, IRB-Approved Clinical Studies or Clinical Trials at the same sites that some of our competitors use, which will reduce the number of subjects or patients who are available for our Non-IND, IRB-Approved Clinical Studies and Clinical Trials in such sites. Moreover, because our AXA Candidates represent a departure from more commonly used methods in the non-drug and drug areas we may pursue, potential subjects or patients and their doctors may be inclined to use conventional products or therapies, rather than enroll subjects or patients in any future clinical study or trial.

Delays in subject or patient enrollment may result in increased costs or may affect the timing or outcome of our planned Non-IND, IRB-Approved Clinical Studies or future Clinical Trials, which could prevent completion of these clinical studies or trials and adversely affect our ability to advance the development of our AXA Candidates.

Interim and preliminary data from our Non-IND, IRB-Approved Clinical Studies or future Clinical Trials that we announce or publish from time to time may change as more subject or patient data become available and are subject to audit and verification procedures that could result in material changes in the final data.

To date, our Non-IND, IRB-Approved Clinical Studies have been exploratory in nature and in small numbers of subjects. Data from larger subsequent studies may not support or may be inconsistent with our observations in our completed Non-IND, IRB-Approved Clinical Studies. From time to time, we may conduct Non-IND, IRB-Approved Clinical Studies and Clinical Trials that result in interim or preliminary data. These data are subject to the risk that one or more of the outcomes may materially change as preclinical studies complete, subject enrollment continues and more subject data become available. Preliminary or top-line data also remain subject to audit and verification procedures that may result in the final data being materially different from the preliminary data we previously published. As a result, interim and preliminary data should be viewed with caution until the final data are available. Material inconsistencies between preliminary or interim data and final data could significantly harm our business prospects.

If we fail to comply with environmental, health and safety laws and regulations, we could become subject to fines or penalties or incur costs that could have a material adverse effect on the success of our business.

We are subject to numerous environmental, health and safety laws and regulations, including those governing laboratory procedures and the handling, use, storage, treatment and disposal of hazardous materials and wastes. Our research and development activities may involve the use of biological and hazardous materials and may produce hazardous waste products. We generally contract with third parties for the disposal of these materials and wastes. We cannot eliminate the risk of contamination or injury from these materials, which could cause an interruption of our commercialization efforts, research and development efforts and business operations, environmental damage resulting in costly clean-up and liabilities under applicable laws and regulations governing the use, storage, handling and disposal of these materials and specified waste products. Although we believe that the safety procedures utilized by our third-party manufacturers for handling and disposing of these materials generally comply with the standards prescribed by these laws and regulations, we cannot guarantee that this is the case or eliminate the risk of accidental contamination or injury from these materials. In such an event, we may be held liable for any resulting damages and such liability could exceed our resources and state or federal or other applicable authorities may curtail our use of certain materials or interrupt our business operations. Furthermore, environmental laws and regulations are complex, change frequently and have tended to become more stringent. We cannot predict the impact of such changes and cannot be certain of our future compliance. In addition, we may incur substantial costs in order to comply with current or future environmental, health and safety laws and regulations. These current or future laws and regulations may negatively impact our research, development or production efforts. Failure to comply with these laws and regulations also may result in substantial fines, penalties or other sanctions.

Although we maintain workers' compensation insurance to cover us for costs and expenses we may incur due to injuries to our employees resulting from the use of biological waste or hazardous materials or other work-related injuries, this insurance may not provide adequate coverage against potential liabilities. We do not carry specific biological waste or hazardous waste insurance coverage, workers compensation or property and casualty and general liability insurance policies that include coverage for damages and fines arising from biological or hazardous waste exposure or contamination.

If product liability claims or lawsuits are brought against us, we may incur substantial liabilities and may be required to limit commercialization of our AXA Candidates.

We face an inherent risk of product liability as a result of testing our AXA Candidates in Non-IND, IRB-Approved Clinical Studies and Clinical Trials, if we decide to develop any AXA Candidate as a drug product candidate, and will face an even greater risk if we commercialize any products. For example, we may be sued, or claims may be made against us, if our informed consents for subjects or patients in any preclinical, Non-IND, IRB-Approved Clinical Studies or Clinical Trials are or are alleged to be inadequate or inaccurate in any way or fail to fully inform subjects or patients of any potential risks involved with their participation or other material or required information. We may also be sued, or claims may be made against us, if our AXA Candidates cause or are perceived to cause injury or are found to be otherwise unsuitable during Non-IND, IRB-Approved Clinical Studies, Clinical Trials, manufacturing, marketing or after sale. Any such product liability claims may include, without limitation, allegations of defects in manufacturing, defects in design, a failure to warn of dangers inherent in the product, negligence, strict liability, marketing or promotional claims or a breach of warranties. Claims could also be asserted under state consumer protection or other statutes or regulations. If we cannot successfully defend ourselves against product liability claims or any other claims related to our products, we may incur

substantial liabilities or be required to limit commercialization of our product candidates. Even successful defense would require significant financial and management resources. Regardless of the merits or eventual outcome, liability claims could have a material adverse effect on our business and operations, and may result in, among other things:

- inability to bring an AXA Candidate to the market;
- decreased demand for our products;
- damage to our reputation;
- withdrawal of Non-IND, IRB-Approved Clinical Study or Clinical Trial participants and inability to enroll future participants or continue Non-IND, IRB-Approved Clinical Studies or Clinical Trials;
- initiation of investigations by regulators;
- costs to defend the related litigation;
- diversion of management's time and our resources;
- substantial monetary awards to participants or patients;
- product recalls, withdrawals or labeling, packaging, marketing or promotional modifications or restrictions;
- loss of revenue;
- exhaustion of any available insurance and our capital resources;
- the inability to commercialize any AXA Candidates via any regulatory pathway; and
- decline in our share price.

We maintain clinical trial insurance. We review our clinical trial insurance policy annually and we believe that our coverage is currently adequate to cover any claims that may arise in connection with our Non-IND, IRB-Approved Clinical Studies or Clinical Trials. There is no guarantee that we will be able to obtain additional clinical trial insurance at an acceptable cost in the future, which could prevent or inhibit the ongoing development of our products.

Since we have not yet commenced marketing of any products we do not yet hold product liability insurance for commercialization of our products. Our inability to obtain sufficient product liability insurance at an acceptable cost to protect against potential product liability claims could prevent or inhibit the commercialization of products we develop, alone or with collaborators. If and when coverage is secured, our insurance policies may also have various exclusions, and we may be subject to a product liability claim for which we have no or inadequate coverage. We may have to pay any amounts awarded by a court or negotiated in a settlement that exceed our coverage limitations or that are not covered by our insurance, and we may not have, or be able to obtain, sufficient capital to pay such amounts. Even if our agreements with any future corporate collaborators entitle us to indemnification against losses, such indemnification may not be available or adequate should any claim arise.

The market opportunities for our AXA Candidates may be limited and our estimates of the incidence and prevalence of our target patient populations may be inaccurate.

Our projections of both the non-drug and drug market sizes we may target and the number of people who have the diseases or conditions we may target, as well as the subset of people with these diseases or conditions in a position to receive any drug or non-drug we develop, if approved, are based on our beliefs and estimates. These estimates have been derived from a variety of

sources, including scientific literature, input from key opinion leaders, patient foundations or secondary market research databases, and may prove to be incorrect. Further, new studies may change the estimated market sizes or the incidence or prevalence of target diseases we may target with AXA Candidates that we decide to develop as drug product candidates. For those AXA Candidates we develop under an IND, regulatory approvals may include limitations for use or contraindications that decrease the addressable patient population. The number of subject individuals may turn out to be lower than expected. Additionally, the potentially addressable patient population for our AXA Candidates that we decide to develop as drugs may be limited or may not be amenable to treatment with our AXA Candidates. For instance, we estimate that there are approximately 633,000 patients currently diagnosed with cirrhosis in the United States and upwards of 518,000 patients undergoing or recovering from procedures that are associated with limb immobilization-induced acute atrophy. Even if we obtain significant market share for our AXA Candidates, because certain potential target populations are small, we may never achieve profitability without obtaining regulatory approval for additional indications for drugs or expanding the target market size for non-drug products.

We are early in our development efforts and may not be successful in our efforts to use our AXA Development Platform to build a pipeline of AXA Candidates and develop marketable products.

We are developing our AXA Candidates and AXA Development Platform to reprogram metabolism and maintain and restore metabolic health. However, our AXA Development Platform has not yet led, and may never lead, to marketable drug or non-drug products. We are developing our initial AXA Candidates and have additional AXA Candidates that we intend to investigate, including in liver, muscle, central nervous system and blood, and in the future, we may decide to develop any AXA Candidate as a drug product candidate. We may have problems applying our technologies to these and other future target areas, and our AXA Candidates may not demonstrate a comparable ability in supporting or maintaining health or treating disease, where applicable. Even if we are successful in identifying additional AXA Candidates, they may not be suitable for clinical development as a result of limited efficacy, unacceptable safety profiles or other characteristics that indicate that they are unlikely to be products that will receive marketing approval or achieve market acceptance. The success of our AXA Candidates will depend on several factors, including the following:

- completion of preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials with positive results;
- receipt of marketing approvals from applicable regulatory authorities, if necessary;
- obtaining and maintaining patent and trade secret protection and regulatory exclusivity for our AXA Candidates;
- making arrangements with third-party manufacturers for, or establishing our own, commercial manufacturing capabilities;
- launching commercial sales of our products, if and when approved, whether alone or in collaboration with others;
- entering into new collaborations throughout the development process as appropriate, from preclinical studies through to commercialization;
- acceptance of our products, if and when approved or launched for commercialization under applicable regulations, by patients, consumers, the medical community and third-party payors;

- effectively competing with other drugs and non-drug products, depending on the development pathway that we choose for an AXA Candidate;
- obtaining and maintaining coverage and adequate reimbursement by third-party payors, including government payors, for our AXA Candidates developed as drug products, if approved by the FDA;
- protecting our rights in our intellectual property portfolio;
- operating without infringing or violating the valid and enforceable patents or other intellectual property of third parties;
- remaining in compliance with applicable laws and regulations that apply to the research, development and commercialization of our AXA Candidates and having productive interactions and positive regulatory decisions that lead to successful product commercialization;
- maintaining a continued acceptable safety profile of the products following approval or commercialization; and
- maintaining and growing an organization of scientists and business people who can develop and commercialize our products and technology.

If we do not successfully develop and commercialize AXA Candidates using our AXA Development Platform, we will not be able to obtain product revenue in future periods, which could result in significant harm to our financial position and adversely affect our stock price.

We face significant competition from other healthcare companies, and our operating results will suffer if we fail to compete effectively.

The healthcare industry is characterized by intense competition and rapid innovation. Our competitors may be able to develop other drug or non-drug products that are able to achieve similar or better results. Our potential competitors include major multinational pharmaceutical, nutritional foods companies, established biotechnology companies, specialty pharmaceutical companies and universities and other research institutions. Many of our competitors have substantially greater financial, technical and other resources, such as larger research and development staff, experienced marketing and manufacturing organizations and well-established sales forces. Smaller or early-stage companies may also prove to be significant competitors, particularly through collaborative arrangements with large, established companies. Established pharmaceutical companies may also invest heavily to accelerate discovery and development of novel drugs or to in-license novel drugs that could make any AXA Candidate that we develop as a drug product candidate obsolete. Mergers and acquisitions in the healthcare industry may result in even more resources being concentrated amongst our competitors. Competition may increase further as a result of advances in the commercial applicability of technologies and greater availability of capital for investment in these industries. Our competitors, either alone or with collaborative partners, may succeed in developing, acquiring or licensing on exclusive basis non-drug products that are more effective, safer, more easily commercialized or less costly than our AXA Candidates or may develop proprietary technologies or secure patent protection that we may need for the development of our technologies and products. We believe the key competitive factors that will affect the development and commercial success of our AXA Candidates are efficacy, safety, tolerability, reliability, convenience of use, price and reimbursement, if applicable depending on the development path we choose. We also anticipate that we will face increased competition in the future as additional companies enter our market and scientific developments surrounding other non-drug products and drugs targeted at metabolic pathways continue to accelerate.

In addition, there are additional companies that are working on modulating specific metabolic pathways involved in various health and disease conditions, although we are not aware of any company creating AXA Candidate-like products with multifactorial activity. Companies with clinical programs that could compete with our AXA Candidates include Madrigal Pharmaceuticals, Inc., Intercept Pharmaceuticals, Inc., Gilead Sciences, Inc., Novartis AG, Bristol-Myers Squibb Co., Esperion Therapeutics, Inc., Viking Therapeutics, Inc., Scholar Rock Holding Corporation, NGM Biopharmaceuticals Inc., Genfit SA and Kaleido Biosciences, Inc., among others.

We also anticipate competing with the largest consumer health companies and nutritional and amino acid companies in the world, such as Nestlé Health Science S.A., Abbott Laboratories, Johnson & Johnson, The Procter & Gamble Company and Ajinomoto Co., Inc., all of which are currently conducting research in competitive indications or may be interested in using amino acids and other EMMs as therapeutics as well as nutritional supplements.

Even if we obtain regulatory approval to market our AXA Candidates as drugs or are successful in identifying alternate regulatory pathways to market our AXA Candidates under regulations that would apply to non-drug products, the availability and price of our competitors' products could limit the demand and the price we are able to charge for our AXA Candidates. We may not be able to implement our business plan if the acceptance of our AXA Candidates is inhibited by price competition or the reluctance of consumers to accept of our AXA Candidates and choose them over other competitive products on the market or, for AXA Candidates we develop as drugs, of physicians to switch from existing methods of treatment to our AXA Candidates, or if physicians switch to other new drug or biologic products or choose to reserve our AXA Candidates for use in limited circumstances. For additional information regarding our competition, see "Business—Competition."

Even if an AXA Candidate we develop as a drug product candidate receives marketing approval, or otherwise is commercialized as a non-drug product, such products may fail to achieve the degree of market acceptance by physicians, patients, third-party payors, consumers and others in the medical or healthcare community or other target markets necessary for commercial success.

If any AXA Candidate we decide to develop as a drug product candidate receives marketing approval or otherwise is commercialized under applicable regulations as a non-drug product, it may nonetheless fail to gain sufficient market acceptance by physicians, patients, third-party payors, consumers and others in the medical or health community or other target markets. If the AXA Candidates we develop do not achieve an adequate level of acceptance, we may not generate significant product revenues and we may not become profitable. The degree of market acceptance of any AXA Candidate, if approved for commercial sale, will depend on a number of factors, including:

- efficacy (for any AXA Candidate developed as a drug product candidate), safety and potential advantages compared to alternative products;
- the labeled uses or limitations for use, including age limitations or contraindications, for our AXA Candidates compared to alternative products;
- convenience and ease of administration compared to alternative products;
- the willingness of the target patient or consumer population to try new drugs or non-drug products, respectively, and, with respect to any AXA Candidates developed as drug product candidates, of physicians to prescribe these therapies or, in the case of non-drug products, the willingness of target consumers in the market of health products to try and healthcare professionals to recommend consumers purchase our products;

- public perception of new drugs and non-drug products, including our AXA Candidates;
- the strength of marketing and distribution support;
- the ability for us to partner in the manufacture and distribution of these products;
- the ability to offer our products, if approved, as applicable, for sale at competitive prices;
- the ability to obtain sufficient third-party insurance coverage and adequate reimbursement, as applicable depending on the development path we pursue; and
- the prevalence and severity of any side effects.

We will need to grow the size of our organization and we may experience difficulties in managing this growth.

As of December 31, 2018, we had 49 full-time employees. As our research, development, manufacturing and commercialization plans and strategies develop, and as we transition into operating as a public company, we expect to need additional managerial, operational, sales, marketing, financial and other personnel. Future growth would impose significant added responsibilities on members of management, including:

- identifying, recruiting, compensating, integrating, maintaining and motivating additional employees;
- managing our internal research and development efforts effectively, including identification of clinical candidates, scaling our manufacturing process and navigating the clinical and the FDA review process for our AXA Candidates; and
- improving our operational, financial and management controls, reporting systems and procedures.

Our future financial performance and our ability to commercialize our AXA Candidates will depend, in part, on our ability to effectively manage any future growth, and our management may also have to divert a disproportionate amount of its attention away from day-to-day activities in order to devote a substantial amount of time to managing these growth activities.

We currently rely, and for the foreseeable future will continue to rely, in substantial part on certain organizations, advisors and consultants to provide certain services, including many aspects of regulatory affairs, clinical management and manufacturing. There can be no assurance that the services of these organizations, advisors and consultants will continue to be available to us on a timely basis when needed or that we can find qualified replacements. In addition, if we are unable to effectively manage our outsourced activities or if the quality or accuracy of the services provided by consultants is compromised for any reason, our clinical development may be extended, delayed or terminated, and we may not be able to obtain regulatory approval of our AXA Candidates, if required, or otherwise advance our business. There can be no assurance that we will be able to manage our existing consultants or find other competent outside contractors and consultants on economically reasonable terms, or at all.

If we are not able to effectively expand our organization by hiring new employees and expanding our groups of consultants and contractors, we may not be able to successfully implement the tasks necessary to further develop and commercialize our AXA Candidates and, accordingly, may not achieve our research, development and commercialization goals.

Our current operations are located in Massachusetts; and we or the third parties upon whom we depend may be adversely affected by natural disasters and our business continuity and disaster recovery plans may not adequately protect us from a serious disaster.

Our current operations are located in Massachusetts. Any unplanned event, such as flood, fire, explosion, earthquake, extreme weather condition, medical epidemics, power shortage, telecommunication failure or other natural or manmade accidents or incidents that result in us being unable to fully utilize our facilities, or the manufacturing facilities of our third-party contract manufacturers, may have a material and adverse effect on our ability to operate our business, particularly on a daily basis, and have significant negative consequences on our financial and operating conditions. Loss of access to these facilities may result in increased costs, delays in the development of our AXA Candidates or interruption of our business operations. Natural disasters could further disrupt our operations, and have a material and adverse effect on our business, financial condition, results of operations and prospects. If a natural disaster, power outage or other event occurred that prevented us from using all or a significant portion of our headquarters, that damaged critical infrastructure, such as our research facilities or the manufacturing facilities of our third-party contract manufacturers, or that otherwise disrupted operations, it may be difficult or, in certain cases, impossible, for us to continue our business for a substantial period of time. The disaster recovery and business continuity plans we have in place may prove inadequate in the event of a serious disaster or similar event. We may incur substantial expenses as a result of the limited nature of our disaster recovery and business continuity plans, which could have a material adverse effect on our business. As part of our risk management policy, we maintain insurance coverage at levels that we believe are appropriate for our business. However, in the event of an accident or incident at these facilities, we cannot assure our investors that the amounts of insurance will be sufficient to satisfy any damages and losses. If our facilities or the manufacturing facilities of our third-party contract manufacturers are unable to operate because of an accident or incident or for any other reason, even for a short period of time, any or all of our research and development programs may be harmed. Any business interruption may have a material and adverse effect on our business, financial condition, results of operations and prospects.

If we lose key management personnel, or if we are unable to recruit additional highly skilled personnel, our ability to identify and develop new or next generation AXA Candidates will be impaired, could result in loss of markets or market share and could make us less competitive.

Our ability to compete in the highly competitive biotechnology industry depends upon our ability to attract and retain highly qualified managerial, scientific and medical personnel. We are highly dependent on our management, scientific and medical personnel, including David Epstein, our Chairman of the Board, William Hinshaw, our Chief Executive Officer and President, Thomas Leggett, our Chief Financial Officer and Senior Vice President of Finance, Manu Chakravarthy, M.D., Ph.D., our Chief Medical Officer and Senior Vice President of Clinical Development, Tony Tramontin, Ph.D., our Chief Scientific Officer and Senior Vice President of Research and Development, Stephen Mitchener, PharmD, our Chief Business Officer and Senior Vice President and Paul Fehlner, J.D., Ph.D., our Chief Intellectual Property Officer and Senior Vice President. The loss of the services of any of our executive officers, other key employees and other scientific and medical advisors, and our inability to find suitable replacements could result in delays in product development and harm our business.

We conduct our operations in Massachusetts. Competition for skilled personnel in our market is intense and may limit our ability to hire and retain highly qualified personnel on acceptable terms or at all.

To induce valuable employees to remain at our company, in addition to salary and cash incentives, we have provided stock options that vest over time. The value to employees of stock

options that vest over time may be significantly affected by movements in our stock price that are beyond our control, and may at any time be insufficient to counteract more lucrative offers from other companies. Despite our efforts to retain valuable employees, members of our management, scientific and development teams may terminate their employment with us on short notice. Employment of our key employees is at-will, which means that any of our employees could leave our employment at any time, with or without notice. We do not maintain "key man" insurance policies on the lives of these individuals or the lives of any of our other employees. Our success also depends on our ability to continue to attract, retain and motivate highly skilled junior, mid-level and senior managers as well as junior, mid-level and senior scientific and medical personnel.

Business disruptions could seriously harm our future revenue and financial condition and increase our costs and expenses.

Our operations, and those of our CROs, contract manufacturing organizations, or CMOs, manufacturers of the raw materials used in our AXA Candidates and other contractors and consultants, could be subject to earthquakes, power shortages, telecommunications failures, water shortages, floods, hurricanes, typhoons, fires, extreme weather conditions, medical epidemics and other natural or man-made disasters or business interruptions, for which we are predominantly self-insured. The occurrence of any of these business disruptions could seriously harm our operations and financial condition and increase our costs and expenses. For our Non-IND, IRB-Approved Clinical Studies, we rely on third-party manufacturers to produce our AXA Candidates, on CROs for conducting various portions of such studies and on various consultants throughout the study process. For materials to be used in any future Clinical Trials for AXA Candidates that we decide to develop as drug product candidates, we plan to rely on an external CMO for the entire manufacturing supply chain and plan to continue using CROs and consultants in connection with conducting such trials. Our ability to obtain supplies of our AXA Candidates and services from CROs and consultants could be disrupted if the operations of these suppliers are affected by a man-made or natural disaster or other business interruption.

Our internal computer systems, or those used by our CROs, CMOs or other contractors or consultants, may fail or suffer security breaches.

Despite the implementation of security measures, our internal computer systems and those of our CROs, CMOs and other contractors and consultants are vulnerable to damage from computer viruses and unauthorized access. While we have not experienced any such material system failure or security breach to date, if such an event were to occur and cause interruptions in our operations, it could result in a material disruption of our development programs and our business operations. For example, the loss of data from any future Clinical Trials could result in delays in our regulatory approval efforts and significantly increase our costs to recover or reproduce the data. Likewise, we currently rely on third parties for the manufacture of our AXA Candidates and to conduct Non-IND, IRB-Approved Clinical Studies, and similar events relating to their computer systems could also have a material adverse effect on our business. To the extent that any disruption or security breach were to result in a loss of, or damage to, our data or applications, or inappropriate disclosure of confidential or proprietary information, we could incur liability and the further development and commercialization of our AXA Candidates could be delayed.

Regulators globally are also imposing greater monetary fines for privacy violations. For example, in 2016, the European Union adopted a new regulation governing data practices and privacy called the General Data Protection Regulation, or GDPR, which became effective on May 25, 2018. The GDPR applies to any company that collects and uses personal data in connection with offering goods or services to individuals in the European Union or the monitoring of their behavior. Non-compliance with the GDPR may result in monetary penalties of up to €20 million or 4% of worldwide revenue, whichever is higher. The GDPR and other changes in laws or regulations associated with the enhanced protection of certain types of personal data, such as healthcare data or other sensitive information, could greatly increase the cost of providing our AXA Candidates, if approved, or even prevent us from offering our AXA Candidates, if approved, in certain jurisdictions.

Our employees, independent contractors, consultants, commercial partners and vendors may engage in misconduct or other improper activities, including noncompliance with regulatory standards and requirements.

We are exposed to the risk of employee fraud or other illegal activity by our employees, independent contractors, consultants, commercial partners and vendors. Misconduct by these parties could include intentional, reckless or negligent conduct that fails to comply with the laws of the FDA and other similar foreign regulatory bodies, provide true, complete and accurate information to the FDA and other similar foreign regulatory bodies, comply with manufacturing standards we have established, comply with healthcare fraud and abuse laws in the United States and similar foreign fraudulent misconduct laws or report financial information or data accurately or to disclose unauthorized activities to us. If we obtain FDA approval of any of our AXA Candidates and begin commercializing those products in the United States, our potential exposure under such laws will increase significantly, and our costs associated with compliance with such laws are also likely to increase. These laws may impact, among other things, our current activities with principal investigators and research subjects, as well as proposed and future sales, marketing and education programs.

A variety of risks associated with testing and developing our AXA Candidates internationally could materially adversely affect our business.

In addition to researching, developing and commercializing our AXA Candidates in the United States, we also intend to engage in these activities outside of the United States and, accordingly, we expect that we will be subject to additional risks related to operating in foreign countries, if our AXA Candidates are approved, including:

- differing regulatory requirements in foreign countries;
- unexpected changes in tariffs, trade barriers, price and exchange controls and other regulatory requirements;
- economic weakness, including inflation, or political instability in particular foreign economies and markets;
- compliance with tax, employment, immigration and labor laws for employees living or traveling abroad;
- foreign taxes, including withholding of payroll taxes;
- foreign currency fluctuations, which could result in increased operating expenses and reduced revenue, and other obligations incident to doing business in another country;
- difficulties staffing and managing foreign operations;
- workforce uncertainty in countries where labor unrest is more common than in the United States;
- potential liability under the Foreign Corrupt Practices Act, or FCPA, or comparable foreign regulations;
- challenges enforcing our contractual and intellectual property rights, especially in those foreign countries that do not respect and protect intellectual property rights to the same extent as the United States;
- production shortages resulting from any events affecting raw material supply or manufacturing capabilities abroad; and
- business interruptions resulting from geo-political actions, including war and terrorism.

Additionally, we intend to contract with third parties to conduct some of our Clinical Trials outside the United States, which will subject us to additional risks and regulations. These and other risks associated with our international operations may materially adversely affect our ability to attain or maintain profitable operations.

We currently have no marketing and sales organization and have no experience in marketing products for therapeutic or non-drug uses. If we are unable to establish marketing and sales capabilities or enter into agreements with third parties to market and sell our AXA Candidates, we may not be able to generate product revenue.

We currently have no sales, marketing or distribution capabilities and have no experience in marketing products for therapeutic uses or other non-drug uses. We intend to develop an in-house marketing organization and sales force, which will require significant capital expenditures, management resources and time. We will have to compete with other healthcare companies to recruit, hire, train and retain marketing and sales personnel.

In addition to establishing internal sales, marketing and distribution capabilities, we intend to optimistically pursue collaborative arrangements regarding the sales and marketing of our products, in particular for products we develop as non-drug products; however, there can be no assurance that we will be able to establish or maintain such collaborative arrangements, or if we are able to do so, that they will have effective sales forces. Any revenue we receive will depend upon the efforts of such third parties, which may not be successful. We may have little or no control over the marketing and sales efforts of such third parties and our revenue from product sales may be lower than if we had commercialized our AXA Candidates ourselves. We also face competition in our search for third parties to assist us with the sales and marketing efforts of our AXA Candidates.

There can be no assurance that we will be able to develop in-house sales and distribution capabilities or establish or maintain relationships with third-party collaborators to commercialize any product in the United States or overseas.

Comprehensive tax reform legislation could adversely affect our business and financial condition.

The Tax Cuts and Jobs Act, or the TCJA, that significantly reforms the Internal Revenue Code of 1986, as amended, or the Code. The TCJA, among other things, contains significant changes to corporate taxation, including reduction of the corporate tax rate from a top marginal tax rate of 35% to a flat rate of 21%, limitation of the tax deduction for interest expense to 30% of adjusted earnings (except for certain small businesses), limitation of the deduction for net operating losses, or NOLs, to 80% of current year taxable income and elimination of NOL carrybacks, in each case, for losses generated after December 31, 2017 (though any such NOLs may be carried forward indefinitely), and modifying or repealing many business deductions and credits, including reducing the business tax credit for certain clinical testing expenses incurred in the testing of certain drugs for rare diseases or conditions generally referred to as "orphan drug." We continue to examine the impact this tax reform legislation may have on our business. We urge investors to consult with their legal and tax advisers regarding the implications of the TCJA on an investment in our common stock.

Our ability to use NOLs and research and development credits to offset future taxable income may be subject to certain limitations.

As of December 31, 2018, we had U.S. federal and state NOL carryforwards of \$140.6 million and \$139.4 million, respectively, both of which expire at various dates beginning in 2030. As of December 31, 2018, we also had U.S. federal and state research and development tax credit carryforwards of \$4.2 million and \$1.6 million respectively, both of which expire at various dates

through 2038. These NOL and tax credit carryforwards could expire unused and be unavailable to offset future taxable income or tax liabilities, respectively. In addition, in general, under Sections 382 and 383 of the Code, and corresponding provisions of state law, a corporation that undergoes an "ownership change" is subject to limitations on its ability to utilize its pre-change NOL carryforwards or tax credits, or Credits, to offset future taxable income or taxes. For these purposes, an ownership change generally occurs where the aggregate stock ownership of one or more stockholders or groups of stockholders who owns at least 5% of a corporation's stock increases its ownership by more than 50 percentage points over its lowest ownership percentage within a specified testing period. Our existing NOLs or Credits may be subject to limitations arising from previous ownership changes, and if we undergo an ownership change in connection with or after this offering, our ability to utilize NOLs or Credits could be further limited by Sections 382 and 383 of the Code. In addition, future changes in our stock ownership, many of which are outside of our control, could result in an ownership change under Sections 382 and 383 of the Code. Our NOLs or Credits may also be impaired under state law. Accordingly, we may not be able to utilize a material portion of our NOLs or Credits. Furthermore, our ability to utilize our NOLs or Credits is conditioned upon our attaining profitability and generating U. S. federal and state taxable income. We have incurred significant net losses since our inception and anticipate that we will continue to incur significant losses for the foreseeable future; and therefore, we do not know whether or when we will generate the U.S. federal or state taxable income necessary to utilize our NOLs or Credits that are subject to limitation by Sections 382 and 383 of the Code. The reduction of the corporate tax rate under the TCJA caused a reduction in the economic benefit of our NOL carryforwards and other deferred tax assets available to us. Under the TCJA, NOLs generated after December 31, 2018 will not be subject to expiration; however, any NOLs generated after December 31, 2018 may only offset 80% of our annual taxable income.

Unstable market and economic conditions may have serious adverse consequences on our business, financial condition and stock price.

As widely reported, global credit and financial markets have experienced extreme volatility and disruptions in the past, including severely diminished liquidity and credit availability, declines in consumer confidence, declines in economic growth, increases in unemployment rates and uncertainty about economic stability. There can be no assurance that future volatility, disruption or deterioration in credit and financial markets and confidence in economic conditions will not occur. Our general business strategy may be adversely affected by any such economic downturn, volatile business environment or continued unpredictable and unstable market conditions. If the current equity and credit markets continue to be volatile or are disrupted or deteriorate, it may make any necessary debt or equity financing more difficult, more costly and more dilutive. Failure to secure any necessary financing in a timely manner and on favorable terms could have a material adverse effect on our growth strategy, financial performance and stock price and could require us to delay or abandon clinical development plans. In addition, there is a risk that one or more of our current service providers, manufacturers and other partners may not survive these difficult economic times, which could directly affect our ability to attain our operating goals on schedule and on budget.

As of December 31, 2018, we had cash and cash equivalents of approximately \$79.5 million. While we are not aware of any downgrades, material losses or other significant deterioration in the fair value of our cash equivalents since December 31, 2018, no assurance can be given that further deterioration of the global credit and financial markets would not negatively impact our current portfolio of cash equivalents or our ability to meet our financing objectives. Furthermore, our stock price may decline due in part to the volatility of the stock market and the general economic downturn.

Our loan agreement subjects us to operating restrictions and financial covenants and may restrict our business and financing activities.

On January 9, 2018, we entered into a loan and security agreement with Solar Capital Ltd., or Solar, for term loans in an aggregate principal amount of \$26 million, which we amended on October 5, 2018 and November 30, 2018. Our obligations under the loan agreement are secured by a first priority security interest in our assets, excluding intellectual property and certain other exceptions. We are subject to a negative pledge covenant with respect to our intellectual property. The loan agreement contains customary representations, as well as customary affirmative and negative covenants. Among other restrictions, the negative covenants, subject to exceptions, prohibit or limit our ability to: declare dividends or redeem or purchase equity interests; incur additional liens; make investments; incur additional indebtedness; engage in mergers, acquisitions and asset sales; transact with affiliates; undergo a change in control; add or change business locations; and engage in businesses that are not related to its existing business. These covenants may restrict our ability to finance our operations and to pursue our business activities and strategies. Our ability to comply with these covenants may be affected by events beyond our control.

Risks related to government regulation

We are very early in our development efforts. AXA Candidates we decide to develop as drug product candidates will require significant additional preclinical and clinical development before we seek regulatory approval. AXA Candidates that we decide to bring to market as non-drug products may also require additional development, and all AXA Candidates may require significant interactions with regulators and investments before their respective commercial launches. If we are unable to advance our AXA Candidates to final development, meet regulatory requirements, including obtaining regulatory approval, where applicable, or ultimately commercialize our AXA Candidates or experience significant delays in doing so, our business will be materially harmed.

We are very early in our development efforts and have invested substantially all of our efforts and financial resources in the identification and early clinical development of AXA Candidates. To date, we have not marketed or commercialized products and, although we have made a development path decision to develop AXA1665 as a drug product candidate under a planned IND submission, we have not done so for any of our other AXA Candidates, including whether to continue their development under food or dietary supplement regulations or to pursue their development as drugs. Our ability to generate product revenues, which we do not expect will occur for many years, if ever, will depend on the successful development and eventual commercialization of our AXA Candidates, which may never occur. We currently generate no revenue from sales of any products, and we may never be able to develop or commercialize a marketable product. The success of our AXA Candidates will depend on several factors, including the following:

- successful completion of preclinical studies, Non-IND, IRB-Approved Clinical Studies and, if applicable, Clinical Trials;
- clearance of INDs for future Clinical Trials for AXA Candidates that we decide to develop as drug product candidates;
- successful enrollment in, and completion of, Non-IND, IRB-Approved Clinical Studies and Clinical Trials, if applicable;
- receipt of regulatory approvals from applicable regulatory authorities for drug product candidates or, alternatively, compliance with regulatory requirements applicable to non-drug products;

- establishing cGMP-compliant supply and commercial manufacturing operations or making arrangements with cGMP-compliant third-party manufacturers for supply and commercial manufacturing;
- obtaining and maintaining patent and trade secret protection or regulatory exclusivity for our AXA Candidates;
- launching commercial sales of our AXA Candidates, if and when approved or allowed for marketing, whether alone or in collaboration with others;
- acceptance of our drug product candidates, if and when approved, by patients, the medical community and third-party payors, if we decide to develop any of our AXA Candidates as drug product candidates, or acceptance of our non-drug products we may market by consumers;
- effectively competing with other drugs for any AXA Candidate developed and approved as a drug or competing with other non-drug products for any AXA Candidate developed and marketed as such;
- obtaining and maintaining third-party insurance coverage and adequate reimbursement, as applicable;
- enforcing and defending intellectual property rights and claims;
- the marketing of our products; and
- maintaining a continued acceptable safety profile of the AXA Candidates following approval or commercialization.

If we do not achieve one or more of these factors in a timely manner or at all, we could experience significant delays or an inability to successfully commercialize our AXA Candidates, which would materially harm our business. If we do not receive regulatory approvals or identify and execute on alternate regulatory pathways to market for our AXA Candidates, we may not be able to continue our operations.

Regulatory requirements for development of our AXA Candidates as drugs or as non-drug products are uncertain and evolving. Changes in these laws, including our ability to conduct Non-IND, IRB-Approved Clinical Studies, or the current interpretation or application of these laws, or conflicts between us and the FDA on the applicability or interpretation of applicable laws, would have a significant adverse impact on our ability to develop and commercialize our products.

In the United States, under sections 201(s) and 409 of the Federal Food, Drug, and Cosmetic Act, or the FD&C Act, any substance that is reasonably expected to become a component of food is considered to be a food additive, and therefore subject to FDA premarket review and approval, unless the substance is generally recognized, among qualified experts, as having been adequately shown to be safe under the conditions of its intended use. Moreover, under federal law, dietary supplement products must only contain certain permissible dietary ingredients, and any ingredients considered to be an NDI under the FD&C Act will require pre-market notification to the FDA.

Based on the large body of studies and scientific literature on the human exposure to and safety profiles of certain amino acids, the FDA's promulgation of regulations governing the use of certain amino acids under certain conditions as safe and permissible food additives when used as nutrients, our own data on amino acids used in AXA Candidates and the fact that we use amino acids in our AXA Candidates within amounts previously studied safely in humans, we believe we have designed our AXA Candidates to have favorable safety profiles, and we further have evaluated

or will evaluate the safety and tolerability of these AXA Candidates in Non-IND, IRB-Approved Clinical Studies. Under the FDA's framework governing studies of non-drug products, we believe that use of our AXA Candidates containing amino acids may be studied for safety and tolerability without an IND. However, the FDA or comparable regulators may disagree with this approach and determine that our studies should be conducted under an IND, which may result in negative consequences. To date, we have only had a pre-IND meeting with the FDA regarding the potential development of AXA1665 as drug under IND but have not met with FDA in connection with our other programs or at all with other comparable foreign regulatory authorities to discuss our approach or plans for further development.

In prior or future studies or trials of our AXA Candidates, we may have or will expressly or implicitly characterize or classify such candidates as encompassed within a specific regulatory scheme (e.g., as foods or dietary supplements). Regulators may not agree with the regulatory classification of the AXA Candidates used in our Non-IND, IRB-Approved Clinical Studies or any subsequent classification of such candidates prior to commercialization. To date, we have had one pre-IND meeting with FDA regarding our AXA1665 program and have not discussed the development of our other AXA Candidates evaluated in Non-IND, IRB-Approved Clinical Studies or our utilization of specific regulatory pathways for our other AXA Candidates with the FDA or comparable foreign regulatory authorities and any such regulator may not agree with our current activities or future approach or plans. The FDA may determine that our AXA Candidates are not safe or appropriate for use in Non-IND, IRB-Approved Clinical Studies or are not governed by food regulations and therefore may classify any of our AXA Candidates as being ineligible for investigation in clinical studies without an IND. The FDA or other regulatory authorities may also take enforcement action, or otherwise delay or prevent further development or commercialization of our AXA Candidates.

The FDA may determine that our AXA Candidates cannot be marketed as or do not meet the regulatory requirements for marketing or testing as non-drug products. The FDA may take the position that we failed to satisfy the premarket requirements for ingredient compositions, including that the particular product is not generally recognized as safe, or GRAS, is an unapproved food additive, is a NDI requiring premarket review or that our products contain otherwise impermissible ingredients, in which case some or all of our products may be deemed adulterated or misbranded in violation of the FD&C Act. Moreover, if we choose to study a product under an IND before the product candidate has been marketed as a non-drug product, the FD&C Act could prevent us from marketing the product as a non-drug product if we are unable to secure FDA approval as a new drug. Any delay in the regulatory consultation process, or a warning, finding or determination that any of our operations or product candidates do not meet the regulatory requirements of the FDA, including but not limited to any applicable GRAS, food additive or NDI requirements, could subject the company to regulatory enforcement action, and/or cause a delay in or prevent the commercialization of one or more of our product candidates, which may lead to reduced acceptance by the public or others for any products we are able to commercialize and could materially adversely affect our business.

The FDA may determine that the only pathway for conducting studies of our AXA Candidates is under an IND or that our Non-IND, IRB-Approved Clinical Studies already conducted should have been conducted under an IND. Any such determination could prevent our reliance on existing regulatory frameworks to conduct Non-IND, IRB-Approved Clinical Studies for other AXA Candidates or prevent us from relying on or including data from our Non-IND, IRB-Approved Clinical Studies in any regulatory submissions to support further clinical development or marketing approval, and could significantly increase the cost of and delay the development or commercialization of AXA Candidates. If the FDA disagrees with our determination that we may conduct Non-IND, IRB-Approved Clinical Studies without filing an IND, they could require that we halt any Non-IND,

IRB-Approved Clinical Studies or Clinical Trials we have commenced, or we may be subject to enforcement action. Should we choose to commercialize our AXA Candidates as non-drug products and if the FDA determines our AXA Candidates fall outside the food regulations, we may be subject to regulatory enforcement action and we could be required to stop selling, withdraw, recall, re-label or re-package any products we have commercialized as non-drug products on the market. In addition, if new safety issues are raised by Non-IND, IRB-Approved Clinical Studies in advance of deciding whether to file an IND that suggest safety concerns for all of our AXA Candidates, then the FDA could ask us to modify approved labeling for or withdraw from the market any previously approved products for therapeutic uses or products being commercialized for other non-drug uses. A decision by the FDA that we cannot conduct Non-IND, IRB-Approved Clinical Studies without filing an IND would significantly impact our current business model and we may incur significant expense and operational difficulties.

Changes in the legal and regulatory environment could limit our future business activities, increase our operating or regulatory costs, reduce demand for our AXA Candidates or result in litigation.

The conduct of our business, including, but not limited to, the development, testing, production, storage, distribution, sale, display, advertising, marketing, labeling, packaging, health and safety practices and regulatory classification and approval (where necessary) use of many of our AXA Candidates, is subject to various laws and regulations administered by federal, state and local governmental agencies in the United States, as well as to laws and regulations administered by government entities and agencies outside the United States in markets in which we conduct clinical studies or trials under foreign food or drug regulations or in which our AXA Candidates and components thereof (such as packaging) may be manufactured or sold.

These laws and regulations and interpretations thereof may change, sometimes dramatically, as a result of a variety of factors, including political, economic or social events. Such changes may include changes in:

- food and drug laws, including FDA regulations;
- laws related to product labeling;
- advertising and marketing laws and practices;
- laws and programs restricting the sale and advertising of certain of product candidates;
- laws and programs aimed at regulating, restricting or eliminating ingredients present in certain of our AXA Candidates;
- increased regulatory scrutiny of, and increased litigation involving, product claims and concerns regarding the actual or possible effects or side effects of ingredients in, or attributes of, certain of our AXA Candidates;
- state and federal consumer protection and disclosure laws; and
- increased sponsor or company obligations under privacy laws such as the federal Health Insurance Portability and Accountability Act of 1996, or HIPAA, and GDPR.

New laws, regulations or governmental policy and their related interpretations, or changes in any of the foregoing, may alter the environment in which we do business and, therefore, may impact our operating results or increase our costs or liabilities.

We may rely on academic and private non-academic institutions to conduct investigator-sponsored Non-IND, IRB-Approved Clinical Studies or Clinical Trials of our AXA Candidates. Any failure by the investigator-sponsor to meet its obligations with respect to the clinical development of our AXA Candidates may delay or impair our ability to obtain regulatory approval or otherwise commercialize the applicable AXA Candidates.

We may rely on academic and private non-academic institutions to conduct and sponsor clinical studies or trials relating to our AXA Candidates. We will not control the design or conduct of the investigator-sponsored trials, and it is possible that the FDA or ex-U.S. regulatory authorities will not view these investigator-sponsored studies or trials as providing adequate support to allow for the initiation of future Clinical Trials for those AXA Candidates that we choose to develop as drug product candidates, whether controlled by us or independent investigators, for any one or more reasons, including elements of the design or execution of the trials or safety concerns or other trial results.

Such arrangements will likely provide us certain information rights with respect to the investigator-sponsored studies or trials, including access to and the ability to use and reference the data, including for our own regulatory filings, resulting from the investigator-sponsored studies or trials. However, we would not have control over the timing and reporting of the data from investigator-sponsored trials, nor would we own the data from the investigator-sponsored studies or trials. If we are unable to confirm or replicate the results from the investigator-sponsored studies or trials or if negative results are obtained, we would likely be further delayed or prevented from advancing further clinical development of our AXA Candidates. Further, if investigators or institutions breach their obligations with respect to the clinical development of our AXA Candidates or if the data proves to be inadequate compared to the first-hand knowledge we might have gained had the investigator-sponsored studies or trials been sponsored and conducted by us, then our ability to design and conduct any future Clinical Trials ourselves may be adversely affected.

Additionally, the FDA or ex-U.S. regulatory authorities may disagree with the sufficiency of our right of reference to the preclinical, manufacturing or clinical data generated by these investigator-sponsored studies or trials or our interpretation of preclinical, manufacturing or clinical data from these investigator-sponsored studies or trials. If so, the FDA or other ex-U.S. regulatory authorities may require us to obtain and submit additional preclinical, manufacturing or clinical data before we may initiate our planned Clinical Trials or may not accept such additional data as adequate to initiate our planned Clinical Trials. In addition, it could limit or prevent our ability to commercialize AXA Candidates for non-drug uses.

Obtaining and maintaining regulatory approval of our AXA Candidates that we decide to develop as drug product candidates for therapeutic indications or the ability to commercialize our AXA Candidates through a non-drug regulatory pathway in one jurisdiction does not mean that we will be successful in obtaining regulatory approval or identifying a similar alternate regulatory pathway for our AXA Candidates in other jurisdictions.

Obtaining and maintaining regulatory approval for AXA Candidates that we decide to develop as drug product candidates or identifying or commercializing our AXA Candidates through non-drug pathways in one jurisdiction does not guarantee that we will be able to obtain or maintain regulatory approval or identify and maintain an alternate regulatory pathway in any other jurisdiction, while a failure or delay in obtaining regulatory approval or an alternate regulatory pathway in one jurisdiction may have a negative effect on the regulatory approval process or path to market in others. For example, even if the FDA grants marketing approval of an AXA Candidate for therapeutic indications, comparable regulatory authorities in foreign jurisdictions could take opposing positions and decline to approve the manufacturing, marketing and promotion of such AXA Candidate in those countries. Approval procedures vary among jurisdictions and can involve

requirements and administrative review periods different from, and greater than, those in the United States, including additional preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials conducted in one jurisdiction may not be accepted by regulatory authorities in other jurisdictions. In many jurisdictions outside the United States, a product candidate must be approved for reimbursement before it can be approved for sale in that jurisdiction. In some cases, the price that we intend to charge for our products is also subject to approval and the approved price may not lead to profitability or acceptable margins.

We may also submit marketing applications in other countries. Regulatory authorities in jurisdictions outside of the United States may have requirements for approval of product candidates with which we must comply prior to marketing in those jurisdictions. Obtaining foreign regulatory approvals and compliance with foreign regulatory requirements could result in significant delays, difficulties and costs for us and could delay or prevent the introduction of our products in certain countries. If we fail to comply with the regulatory requirements in international markets or receive applicable marketing approvals, our target market will be reduced and our ability to realize the full market potential of our AXA Candidates will be harmed.

Preclinical and clinical development is uncertain. Our preclinical programs, Non-IND, IRB-Approved Clinical Studies and Clinical Trials may experience delays or may never advance to the next stage of development, which would adversely affect our ability to obtain regulatory approvals, where necessary, or identify and execute on alternate regulatory pathways to commercialize these programs on a timely basis or at all, which would have an adverse effect on our business.

Our AXA Candidates are in both preclinical and clinical (non-IND) stages of development, and their risk of failure is high. To proceed with our development plans and ultimately commercialization, we may need to conduct and meet regulatory requirements for preclinical, Non-IND, IRB-Approved Clinical Studies or, for AXA Candidates that we decide to develop as drug product candidates, Clinical Trials. For therapeutic applications, the FDA may require additional extensive preclinical and other studies. We cannot be certain of the timely completion or outcome of our preclinical testing and studies and cannot predict if the FDA or other regulatory authorities will accept our proposed clinical programs, including our Non-IND, IRB-Approved Clinical Studies and future Clinical Trials, if any, including their design, dose level, and dose regimen, or if the outcome of our preclinical testing, Non-IND, IRB-Approved Clinical Studies or Clinical Trials, if any, will ultimately support the subsequent development of our clinical programs for therapeutic indications or non-drug applications. As a result, we cannot be sure that we will be able to submit INDs or similar applications in the case of AXA Candidates for which we pursue a drug pathway or comply with any other regulatory requirements where necessary for commercialization and marketing of drugs or non-drug products on the timelines we expect, if at all. We cannot be sure that submission of INDs or similar applications, where necessary, or other regulatory required submissions for our AXA Candidates will result in the FDA or other regulatory authorities allowing our studies or Clinical Trials to begin, be completed or have their data used to support commercialization and required regulatory approvals. We also cannot be certain if our testing and studies will provide support for the further development of AXA Candidates as non-drug products or support for any associated product claims made, and, as a result, we cannot be sure that we will be able to successfully pursue alternative regulatory pathways to commercialization as non-drug product for some or all of our AXA Candidates.

If we are not able to meet certain regulatory requirements for our AXA Candidates or to obtain, or timely obtain, required regulatory approvals for our AXA Candidates that we choose to develop as drugs, we will not be able to commercialize or will be delayed in commercializing, our AXA Candidates, and our ability to generate revenue will be materially impaired.

Our AXA Candidates and the activities associated with their development and commercialization as a drug or non-drug products, including but not limited to their design, testing, manufacture, safety, efficacy, recordkeeping, packaging, labeling, storage, holding, approval, advertising, promotion, sale, distribution, import and export are subject to comprehensive regulation by the FDA and other regulatory agencies in the United States and by comparable authorities in other countries. Before we can commercialize any of our AXA Candidates as a drug, we must obtain marketing approval. Before we can commercialize any of our AXA Candidates as a non-drug product, we may be required to follow pre- or post-market notification and other applicable regulatory requirements for ingredients and claims. We have not received approval to market any of our AXA Candidates as drugs from regulatory authorities in any jurisdiction nor executed on requirements for commercialization of non-drug products under applicable regulations, and it is possible that none of our current AXA Candidates, or any AXA Candidates we may seek to develop in the future, will ever obtain regulatory approval, where applicable, or meet other applicable regulatory requirements to reach the market. We, as a company, have no experience in filing and supporting the applications necessary to gain regulatory approvals for drugs or in the submission of other petitions, notifications or registrations in the case of non-drug products, where applicable, and expect to work with or rely on third-party CROs or regulatory consultants to assist us in this process. For example, the FDA and Federal Trade Commission, or FTC, require substantiating data or evidence for marketing claims and may require other regulatory submissions, including, for example, NDI submissions for certain product ingredients in certain non-drug products before they can be sold. With respect to AXA Candidates that we decide to develop as drug product candidates, securing regulatory approval requires the submission of extensive preclinical and clinical data and supporting information to the various regulatory authorities for each therapeutic indication to establish the drug candidate's safety and efficacy. If we fail to execute competently on these requirements, as applicable, our AXA Candidates may not make it to market.

Securing regulatory approval for therapeutic indications also requires the submission of information about the drug manufacturing process to, and inspection of manufacturing facilities by, the relevant regulatory authority. Our AXA Candidates that we decide to develop as drug product candidates may not be effective, may be only moderately effective or may prove to have undesirable or unintended side effects, toxicities or other characteristics that may preclude our obtaining marketing approval or prevent or limit commercial use.

The process of obtaining regulatory approvals for therapeutic indications, both in the United States and abroad, is expensive, may take many years if additional Clinical Trials are required, if approval is obtained at all, and can vary substantially based upon a variety of factors, including the type, complexity and novelty of the AXA Candidates involved. Changes in marketing approval policies during the development period, changes in or the enactment of additional statutes or regulations, or changes in regulatory review for each submitted IND, NDA or equivalent application types, may cause delays in the approval or rejection of an application. The FDA and comparable authorities in other countries have substantial discretion in the approval process of our AXA Candidates that we decide to commercialize as drugs and may refuse to accept any application or may decide that our data are insufficient for approval and require additional preclinical, clinical or other studies. Our AXA Candidates that we decide to develop as drug product candidates could be

delayed in receiving, or fail to receive, regulatory approval for many reasons, including the following:

- the FDA or comparable foreign regulatory authorities may disagree with the design, including study population, dose level, dose regimen and bioanalytical assay methods, or implementation of our Clinical Trials;
- we may be unable to demonstrate to the satisfaction of the FDA or comparable foreign regulatory authorities that a drug candidate is safe and effective for its proposed indication or a related companion diagnostic is suitable to identify appropriate patient populations;
- the results of our Non-IND, IRB-Approved Clinical Studies and Clinical Trials may not meet the level of statistical significance required by the FDA or comparable foreign regulatory authorities for approval;
- we may be unable to demonstrate that an AXA Candidate's clinical and other benefits outweigh its safety risks;
- the FDA or comparable foreign regulatory authorities may disagree with our interpretation of data from preclinical studies, Non-IND, IRB-Approved Clinical Studies or Clinical Trials;
- the data collected from our Non-IND, IRB-Approved Clinical Studies and Clinical Trials of our product candidates may not be sufficient to support the submission of an NDA or other submission or to obtain regulatory approval in the United States or elsewhere;
- the FDA or comparable foreign regulatory authorities may fail to approve the manufacturing processes or facilities of third-party manufacturers with which we contract for clinical and commercial supplies; and
- the approval policies or regulations of the FDA or comparable foreign regulatory authorities may significantly change in a manner rendering our clinical data insufficient for approval.

Of the large number of drugs in development, only a small percentage successfully complete the FDA or foreign regulatory approval processes and are commercialized. The lengthy approval process as well as the unpredictability of future Clinical Trial results may result in our failing to obtain regulatory approval to market our AXA Candidates, which would significantly harm our business, results of operations and prospects.

If we decide to develop an AXA Candidate as a drug product candidate and submit an NDA for such AXA Candidate, the FDA may also require a panel of experts, or an Advisory Committee, to deliberate on the adequacy of the safety and efficacy data to support approval for therapeutic indications. The opinion of the Advisory Committee, although not binding, may have a significant impact on our ability to obtain approval of any AXA Candidates that we decide to develop as drugs based on the completed Clinical Trials.

In addition, even if we were to obtain approval for use of our AXA Candidates as drug product candidates, regulatory authorities may approve any of our AXA Candidates for fewer or more limited therapeutic indications than we request, may include limitations for use or contraindications that limit the suitable patient population, may not approve the price we intend to charge for our products, may grant approval contingent on the performance of costly post-marketing Clinical Trials or may approve an AXA Candidate with a label that does not include the labeling claims necessary or desirable for the successful commercialization of that drug product candidate. Similarly, regulatory authorities may limit or prohibit label claims that limit the market, price or other factors that are necessary or desirable for the successful commercialization of candidates developed as non-drug products. Any of the foregoing scenarios could materially harm the commercial prospects for our AXA Candidates.

If we experience delays or failures in obtaining regulatory approvals, where applicable, or otherwise experience delays or failures in complying with regulatory requirements for commercialization of our product candidates, the commercial prospects for our AXA Candidates may be harmed and our ability to generate revenues will be materially impaired.

The FDA and other regulatory authorities such as the EMA may implement additional regulations or restrictions on the development and commercialization of products that act on metabolic pathways, which may be difficult to predict.

The FDA and foreign regulatory authorities such as the EMA have expressed interest in further regulating biotechnology products and product candidates, such as AXA Candidates. Agencies at both the federal and state level in the United States, as well as the U.S. Congressional committees and other governments or governing agencies, have also expressed interest in further regulating the biotechnology industry. Such action may delay or prevent commercialization of some or all of our AXA Candidates. Adverse developments in Non-IND, IRB-Approved Clinical Studies or Clinical Trials of AXA Candidates or similar products conducted by others may cause the FDA or other oversight bodies to change the requirements for approval of any of our AXA Candidates. The FDA or other regulatory authorities may impose unexpected, onerous requirements on our products because they are composed of multiple amino acids, requiring a clinical demonstration of the functionality and contribution of each component of our EMMs. Such requirements may include additional studies or analyses. Similarly, the EMA governs the development of AXA Candidates as drugs in the European Union and member state regulatory bodies govern the development of AXA Candidates under non-drug regulations and may issue new guidelines concerning the development and marketing authorization for AXA Candidates and require that we comply with these new guidelines. These regulatory review agencies and committees and the new requirements or guidelines they promulgate may lengthen the regulatory review process, require us to perform additional studies or trials, increase our development costs, lead to changes in regulatory positions and interpretations, delay or prevent approval and commercialization of our AXA Candidates or lead to significant limitations or restrictions. As we advance our AXA Candidates, we will be required to consult with these regulatory agencies and comply with applicable requirements and guidelines. If we fail to do so, we may be required to delay or discontinue development of such AXA Candidates. These additional processes may, for our AXA Candidates that we decide to develop as drug product candidates, result in a review and approval process that is longer than we otherwise would have expected and delays as a result of an increased or lengthier regulatory approval process or further restrictions on the development of our AXA Candidates can be costly and could negatively impact our ability to complete Clinical Trials and commercialize our current and future AXA Candidates in a timely manner, if at all.

We may fail to obtain and maintain orphan drug designations from the FDA or, if applicable, other foreign regulatory authorities such as the EMA for AXA Candidates that we decide to develop as drug product candidates.

Our strategy includes filing for orphan drug designation where available for our AXA Candidates we decide to develop as drug product candidates. In the United States, under the Orphan Drug Act, the FDA may grant orphan drug designation to a drug or biologic intended to treat a rare disease or condition, which is defined as one occurring in a patient population of fewer than 200,000 in the United States, or a patient population greater than 200,000 in the United States where there is no reasonable expectation that the cost of developing the drug or biologic will be recovered from sales in the United States. In the United States, orphan drug designation entitles a party to financial incentives, such as opportunities for grant funding toward clinical trial costs, tax advantages and user-fee waivers. In addition, if a product that has orphan drug designation subsequently receives the first FDA approval for the disease for which it has such designation, the

product is entitled to orphan drug exclusivity, which means that the FDA may not approve any other applications, including an NDA, to market the same drug or biologic for the same indication for seven years, except in limited circumstances, such as a showing of clinical superiority to the product with orphan drug exclusivity or where the original manufacturer is unable to assure sufficient product quantity.

In addition, exclusive marketing rights in the United States may be limited if we seek approval for an indication broader than the orphan-designated indication or may be lost if the FDA later determines that the request for designation was materially defective or if we are unable to assure sufficient quantities of the product to meet the needs of patients with the orphan-designated disease or condition. Further, even if we obtain orphan drug exclusivity for a product, that exclusivity may not effectively protect the product from competition because different drugs with different active moieties may receive and be approved for the same condition, and only the first applicant to receive approval will receive the benefits of marketing exclusivity. Even after an orphan-designated product is approved, the FDA can subsequently approve a later drug with the same active moiety for the same condition if the FDA concludes that the later drug is clinically superior if it is shown to be safer, more effective or makes a major contribution to patient care. Orphan drug designation neither shortens the development time or regulatory review time of a drug, nor gives the drug any advantage in the regulatory review or approval process. In addition, while we may seek orphan drug designation for our AXA Candidates that we decide to develop as drug product candidates, we may never receive such designations.

In the European Union, the EMA's Committee for Orphan Medicinal Products grants orphan drug designation to the development of products that are intended for the diagnosis, prevention or treatment of a life-threatening or chronically debilitating condition affecting not more than five in 10,000 persons in the European Union. Additionally, designation is granted for products intended for the diagnosis, prevention or treatment of a life-threatening, seriously debilitating or serious and chronic condition when, without incentives, it is unlikely that sales of the drug in the European Union would be sufficient to justify the necessary investment in developing the drug or biological product or where there is no satisfactory method of diagnosis, prevention or treatment, or, if such a method exists, the medicine must be of significant benefit to those affected by the condition.

In the European Union, orphan drug designation entitles a party to financial incentives such as reductions of fees or fee waivers. In addition, ten years of market exclusivity is granted following drug product approval, meaning that another application for marketing authorization of a later similar medicinal product for the same indication will generally not be approved in the European Union. This period may be reduced to six years if the orphan designation criteria are no longer met, including where it is shown that the product is not sufficiently profitable to justify maintenance of market exclusivity.

Even if we receive regulatory approval of any AXA Candidates as drugs, or commercialize our AXA Candidates as non-drug products, we will be subject to ongoing regulatory compliance obligations or continued regulatory review, which may result in significant additional expense. Additionally, any of our AXA Candidates, if approved or commercialized, could be subject to labeling and other restrictions and market withdrawal and we may be subject to penalties if we fail to comply with regulatory requirements or experience unanticipated problems with our AXA Candidates.

If any of our AXA Candidates are developed as drug product candidates and approved for therapeutic indications or are commercialized as non-drug products, they will be subject to ongoing regulatory requirements for manufacturing, labeling, packaging, storage, distribution, quality, safety, sale, marketing, advertising, promotion, sampling, record-keeping, export, import, conduct of post-marketing studies and submission of safety, efficacy or other post-market information. Such

requirements may be imposed as federal and state requirements in the United States or by comparable foreign regulatory authorities. In addition, we will be subject to continued compliance with cGMP requirements as applicable to drugs and non-drug products and GCP requirements for any Clinical Trials that we conduct post-approval, if applicable.

Manufacturers and manufacturers' facilities are required to comply with extensive FDA, and comparable foreign regulatory authority requirements, including ensuring that quality control and manufacturing procedures conform to the respective cGMP regulations. As such, we and our contract manufacturers will be subject to continual review and inspections to assess compliance with cGMP and adherence to commitments made in any NDA, if applicable, or other marketing application or submission, and previous responses to inspection observations. Accordingly, we and others with whom we work must continue to expend time, money and effort in all areas of regulatory compliance, including manufacturing, production and quality control.

The FDA has significant post-marketing authority, including, for example, the authority to require labeling or packaging changes based on the use of improper product claims or new safety or other information and, where applicable, to require post-marketing studies or clinical trials to evaluate serious safety risks related to the use of a drug. With respect to products developed as drugs, any regulatory approvals that we receive for our AXA Candidates may be subject to limitations on the approved indicated uses for which a drug may be marketed or to the conditions of approval, or contain requirements for potentially costly post-marketing testing, including Phase IV clinical trials and surveillance to monitor the safety and efficacy of the AXA Candidate. The FDA may also require a Risk Evaluation and Mitigation Strategy, or REMS, program as a condition of approval of our AXA Candidates that we decide to develop as drugs, which could entail requirements for long-term patient follow-up, a medication guide, physician communication plans or additional elements to ensure safe use, such as restricted distribution methods, patient registries and other risk minimization tools. In addition, if the FDA or a comparable foreign regulatory authority approves our AXA Candidates as a drug for therapeutic uses, we will have to comply with requirements including submissions of safety and other post-marketing information and reports and registration.

The FDA or other regulatory authorities may take regulatory enforcement action or other legal action or, in the case of drugs, impose consent decrees or withdraw approval if compliance with regulatory requirements and standards is not maintained or if problems occur after the product reaches the market. Later discovery of previously unknown problems with our AXA Candidates, including adverse events of unanticipated severity or frequency, or with our third-party manufacturers or manufacturing processes, or failure to comply with regulatory requirements, may result in potential consequences, including, among other things:

- in the case of AXA Candidates that we decide to develop as drugs, revisions to the approved labeling to add new safety information and required regulatory submissions; imposition of post-market studies or clinical trials to assess new safety risks; or imposition of distribution restrictions or other restrictions under a REMS program;
- restrictions on the marketing or manufacturing of our products, withdrawal of the product from the market or voluntary or mandatory product recalls;
- re-labeling or re-packaging;
- fines, warning or untitled enforcement letters or holds on clinical trials;
- in the case of drugs, refusal by the FDA to approve pending applications or supplements to approved applications filed by us or suspension or revocation of license approvals;

- product seizure or detention or refusal to permit the import or export of our AXA Candidates; and
- injunctions or the imposition of civil or criminal penalties.

The FDA and FTC strictly regulate marketing, labeling, advertising and promotion of products that are placed on the market. Drugs may be promoted only for the approved indications and in accordance with the provisions of the approved labeling. The FDA and other agencies actively enforce the laws and regulations prohibiting the promotion of off-label uses for drugs, and a company that is found to have improperly promoted off-label uses may be subject to significant liability. Non-drug products are prohibited from making any claims, whether express or implied, that the product is intended to "diagnose, mitigate, treat, cure or prevent disease," and doing so may subject a non-drug product to classification as a drug product and regulatory enforcement action. If the FDA or other regulatory agency determines that any of our AXA Candidates make impermissible claims, we may be subject to any of the aforementioned consequences or other legal challenges that may have an adverse effect on the company's business and operations.

The policies of the FDA and of other regulatory authorities may change and additional government regulations may be enacted that could prevent, limit or delay regulatory approval, where applicable, and commercialization, and continued commercialization, of our AXA Candidates. If we are slow or unable to adapt to changes in existing requirements or the adoption of new requirements or policies, or if we are not able to maintain regulatory compliance, we may lose any marketing approval that we may have obtained for any drugs, or may no longer be able to market or sell products we develop as non-drug products, which would adversely affect our business, prospects and ability to achieve or sustain profitability.

We also cannot predict the likelihood, nature or extent of government regulation that may arise from future legislation or administrative or executive action, either in the United States or abroad. For example, certain policies of the current administration may impact our business and industry. Namely, the current administration has taken several executive actions, including the issuance of a number of executive orders, that could impose significant burdens on, or otherwise materially delay, the FDA's ability to engage in routine regulatory and oversight activities, such as implementing statutes through rulemaking, issuance of guidance and review and approval of marketing applications. It is difficult to predict how these executive actions, including any executive orders, will be implemented, and the extent to which they will impact the FDA's ability to exercise its regulatory authority. If these executive actions impose constraints on the FDA's ability to engage in oversight and implementation activities in the normal course, our business may be negatively impacted. In addition, if we are slow or unable to adapt to changes in existing requirements or the adoption of new requirements or policies, or if we are not able to maintain regulatory compliance, we may lose any marketing approval that we may have obtained, where applicable, our ability to continue to market and sell our products and we may not achieve or sustain profitability.

Non-compliance by us or any future collaborator with regulatory requirements, including safety monitoring or pharmacovigilance requirements, where applicable, can also result in significant financial penalties.

Healthcare insurance coverage and reimbursement may be limited or unavailable in certain market segments for our AXA Candidates, if developed as a drug and approved, which could make it difficult for us to sell any product profitably.

The success of our AXA Candidates, if approved for therapeutic indications, depends on the availability of adequate coverage and reimbursement from third-party payors, including governmental healthcare programs, such as Medicare and Medicaid, commercial payors and health maintenance organizations. In addition, because our AXA Candidates have the potential to

represent a relatively new approach to the treatment of the diseases, we cannot be sure that coverage and reimbursement will be available for, or accurately estimate the potential revenue from, our AXA Candidates or assure that coverage and reimbursement will be available for any product that we may develop.

Patients who are provided medical treatment for their conditions generally rely on third-party payors to reimburse all or part of the costs associated with their treatment. Adequate coverage and reimbursement from governmental healthcare programs and commercial payors are critical to new product acceptance.

Government authorities and third-party payors, such as private health insurers and health maintenance organizations, decide which drugs and treatments they will cover and the amount of reimbursement. Coverage and reimbursement by a third-party payor may depend upon a number of factors, including the third-party payor's determination that use of a product is:

- a covered benefit under its health plan;
- safe, effective and medically necessary;
- appropriate for the specific patient;
- cost-effective; and
- neither experimental nor investigational.

In the United States, no uniform policy of coverage and reimbursement for products exists among third-party payors. As a result, obtaining coverage and reimbursement approval of a product from a government or other third-party payor is a time-consuming and costly process that could require us to provide to each payor supporting scientific, clinical and cost-effectiveness data for the use of our products on a payor-by-payor basis, with no assurance that coverage and adequate reimbursement will be obtained. Even if we obtain coverage for a given product, the resulting reimbursement payment rates might not be adequate for us to achieve or sustain profitability or may require co-payments that patients find unacceptably high. Additionally, third-party payors may not cover, or provide adequate reimbursement for, long-term follow-up evaluations required following the use of product candidates. Patients are unlikely to use our AXA Candidates unless coverage is provided and reimbursement is adequate to cover a significant portion of the cost of our AXA Candidates. Because our AXA Candidates may have a higher cost of goods than conventional therapies, and may require long-term follow-up evaluations, the risk that coverage and reimbursement rates may be inadequate for us to achieve profitability may be greater. There is significant uncertainty related to insurance coverage and reimbursement of newly approved products. It is difficult to predict at this time what third-party payors will decide with respect to the coverage and reimbursement for our AXA Candidates.

The pricing of prescription pharmaceuticals is also subject to governmental control outside the United States. In these other countries, pricing negotiations with governmental authorities can take considerable time after the receipt of marketing approval for a product. To obtain reimbursement or pricing approval in some countries, we may be required to conduct a clinical trial that compares the cost effectiveness of our product candidates to other available therapies. If reimbursement of our products is unavailable or limited in scope or amount, or if pricing is set at unsatisfactory levels, our ability to generate revenues and become profitable could be impaired.

Healthcare insurance often does not cover non-drug products administered outside of the hospital setting. This may impact our AXA Candidates if we decide to commercialize them as non-drug products.

For those AXA Candidates that we decide to develop as drug product candidates, our relationships with healthcare providers, physicians and third-party payors will be subject to applicable anti-kickback, fraud and abuse and other healthcare laws and regulations, which could expose us to criminal sanctions, civil penalties, contractual damages, reputational harm and diminished profits and future earnings.

Healthcare providers, physicians and third-party payors in the United States and elsewhere play a primary role in the recommendation and prescription of pharmaceutical products. Arrangements with third-party payors and customers can expose pharmaceutical manufacturers to broadly applicable fraud and abuse and other healthcare laws and regulations, including, without limitation, the federal Anti-Kickback Statute and the federal False Claims Act, or FCA, which may constrain the business or financial arrangements and relationships through which such companies sell, market and distribute pharmaceutical products. In particular, the promotion, sales and marketing of healthcare items and services, as well as certain business arrangements in the healthcare industry, are subject to extensive laws designed to prevent fraud, kickbacks, self-dealing and other abusive practices. These laws and regulations may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, structuring and commission(s), certain customer incentive programs and other business arrangements generally. Activities subject to these laws also involve the improper use of information obtained in the course of patient recruitment for Clinical Trials. The applicable federal and state healthcare laws and regulations laws that may affect our ability to operate include, but are not limited to:

- The federal Anti-Kickback Statute, which prohibits, among other things, knowingly and willfully soliciting, receiving, offering or paying any remuneration (including any kickback, bribe or rebate), directly or indirectly, overtly or covertly, in cash or in kind, to induce, or in return for, either the referral of an individual, or the purchase, lease, order or recommendation of any good, facility, item or service for which payment may be made, in whole or in part, under a federal healthcare program, such as the Medicare and Medicaid programs. A person or entity can be found guilty of violating the statute without actual knowledge of the statute or specific intent to violate it. In addition, a claim including items or services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the FCA. The Anti-Kickback Statute has been interpreted to apply to arrangements between pharmaceutical manufacturers on the one hand and prescribers, purchasers and formulary managers on the other. There are a number of statutory exceptions and regulatory safe harbors protecting some common activities from prosecution.
- Federal civil and criminal false claims laws and civil monetary penalty laws, including the FCA, which prohibit, among other things, individuals or entities from knowingly presenting, or causing to be presented, false or fraudulent claims for payment to, or approval by Medicare, Medicaid or other federal healthcare programs, knowingly making, using or causing to be made or used a false record or statement material to a false or fraudulent claim or an obligation to pay or transmit money to the federal government, or knowingly concealing or knowingly and improperly avoiding or decreasing or concealing an obligation to pay money to the federal government. Manufacturers can be held liable under the FCA even when they do not submit claims directly to government payors if they are deemed to "cause" the submission of false or fraudulent claims. The FCA also permits a private individual acting as a "whistleblower" to bring actions on behalf of the federal government alleging violations of the FCA and to share in any monetary recovery.
- HIPAA created new federal criminal statutes that prohibit knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program or obtain, by means of false or fraudulent pretenses, representations or promises, any of the money or

property owned by, or under the custody or control of, any healthcare benefit program, regardless of the payor (e.g., public or private) and knowingly and willfully falsifying, concealing or covering up by any trick or device a material fact or making any materially false statements in connection with the delivery of, or payment for, healthcare benefits, items or services relating to healthcare matters. Similar to the federal Anti-Kickback Statute, a person or entity can be found guilty of violating HIPAA without actual knowledge of the statute or specific intent to violate it.

- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act of 2009, or HITECH, and their respective implementing regulations, which impose, among other things, requirements on certain covered healthcare providers, health plans and healthcare clearinghouses as well as their respective business associates that perform services for them that involve the use, or disclosure of, individually identifiable health information, relating to the privacy, security and transmission of individually identifiable health information without appropriate authorization. HITECH also created new tiers of civil monetary penalties, amended HIPAA to make civil and criminal penalties directly applicable to business associates and gave state attorneys general new authority to file civil actions for damages or injunctions in federal courts to enforce the federal HIPAA laws and seek attorneys' fees and costs associated with pursuing federal civil actions.
- The federal Physician Payment Sunshine Act, created under the Patient Protection and Affordable Care Act, or the ACA, and its implementing regulations, which require manufacturers of drugs, devices, biologicals and medical supplies for which payment is available under Medicare, Medicaid or the Children's Health Insurance Program (with certain exceptions) to report annually to the United States Department of Health and Human Services information related to payments or other transfers of value made to physicians (defined to include doctors, dentists, optometrists, podiatrists and chiropractors) and teaching hospitals, as well as ownership and investment interests held by physicians and their immediate family members.
- Federal consumer protection and unfair competition laws, which broadly regulate marketplace activities and activities that potentially harm consumers.
- Analogous state and foreign laws and regulations, such as state anti-kickback and false claims laws, which may apply to sales or marketing arrangements and claims involving healthcare items or services reimbursed by non-governmental third-party payors, including private insurers, and may be broader in scope than their federal equivalents; state and foreign laws that require pharmaceutical companies to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant compliance guidance promulgated by the federal government or otherwise restrict payments that may be made to healthcare providers; state and foreign laws that require drug manufacturers to report information related to payments and other transfers of value to physicians and other healthcare providers or marketing expenditures; and state and foreign laws governing the privacy and security of health information in certain circumstances, many of which differ from each other in significant ways and often are not preempted by HIPAA, thus complicating compliance efforts.

The distribution of pharmaceutical products is subject to additional requirements and regulations, including extensive record-keeping, licensing, storage and security requirements intended to prevent the unauthorized sale of pharmaceutical products.

The scope and enforcement of each of these laws is uncertain and subject to rapid change in the current environment of healthcare reform, especially in light of the lack of applicable precedent and regulations. Federal and state enforcement bodies have recently increased their scrutiny of

interactions between healthcare companies and healthcare providers, which has led to a number of investigations, prosecutions, convictions and settlements in the healthcare industry. Ensuring business arrangements comply with applicable healthcare laws, as well as responding to possible investigations by government authorities, can be time- and resource-consuming and can divert a company's attention from the business.

The failure to comply with any of these laws or regulatory requirements subjects entities to possible legal or regulatory action. Depending on the circumstances, failure to meet applicable regulatory requirements can result in significant civil, criminal and administrative penalties, damages, fines, disgorgement, individual imprisonment, exclusion from participation in federal and state funded healthcare programs (such as Medicare and Medicaid), contractual damages and the curtailment or restructuring of our operations, as well as additional reporting obligations and oversight if we become subject to a corporate integrity agreement or other agreement to resolve allegations of non-compliance with these laws. Any action for violation of these laws, even if successfully defended, could cause a pharmaceutical manufacturer to incur significant legal expenses and divert management's attention from the operation of the business. If any of the physicians or other healthcare providers or entities with whom we expect to do business is found not to be in compliance with applicable laws, that person or entity may be subject to criminal, civil or administrative sanctions, including exclusions from government funded healthcare programs. Prohibitions or restrictions on sales or withdrawal of future marketed products could materially affect business in an adverse way.

Effective upon the completion of this offering, we will adopt a code of business conduct and ethics, but it is not always possible to identify and deter employee misconduct, and the precautions we take to detect and prevent inappropriate conduct may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations or other actions or lawsuits stemming from a failure to be in compliance with such laws or regulations. Efforts to ensure that our business arrangements will comply with applicable healthcare laws may involve substantial costs. It is possible that governmental and enforcement authorities will conclude that our business practices may not comply with current or future statutes, regulations or case law interpreting applicable fraud and abuse or other healthcare laws and regulations. If any such actions are instituted against us and we are not successful in defending ourselves or asserting our rights, those actions could have a significant impact on our business, including the imposition of civil, criminal and administrative penalties, damages, disgorgement, monetary fines, possible exclusion from participation in Medicare, Medicaid and other federal healthcare programs, contractual damages, reputational harm, diminished profits and future earnings, and curtailment of our operations, any of which could adversely affect our ability to operate our business and our results of operations. In addition, the approval and commercialization of any of our AXA Candidates outside the United States will also likely subject us to foreign equivalents of the healthcare laws mentioned above, among other foreign laws.

Failure to comply with health and data protection laws and regulations could lead to government enforcement actions (which could include civil or criminal penalties), private litigation or adverse publicity and could negatively affect our operating results and business.

We and any potential collaborators may be subject to federal, state and foreign data protection laws and regulations (i.e., laws and regulations that address privacy and data security). In the United States, numerous federal and state laws and regulations, including federal health information privacy laws, state data breach notification laws, state health information privacy laws and federal and state consumer protection laws (e.g., Section 5 of the Federal Trade Commission Act), that govern the collection, use, disclosure and protection of health-related and other personal information could apply to our operations or the operations of our collaborators. In addition, we

may obtain health information from third parties (including research institutions from which we obtain clinical trial data) that are subject to privacy and security requirements under HIPAA, as amended by HITECH. Depending on the facts and circumstances, we could be subject to civil, criminal and administrative penalties if we knowingly obtain, use or disclose individually identifiable health information maintained by a HIPAA-covered entity in a manner that is not authorized or permitted by HIPAA.

Compliance with U.S. and international data protection laws and regulations could require us to take on more onerous obligations in our contracts, restrict our ability to collect, use and disclose data or, in some cases, impact our ability to operate in certain jurisdictions. Failure to comply with these laws and regulations could result in government enforcement actions (which could include civil, criminal and administrative penalties), private litigation or adverse publicity and could negatively affect our operating results and business. Moreover, clinical trial subjects, employees and other individuals about whom we or our potential collaborators obtain personal information, as well as the providers who share this information with us, may limit our ability to collect, use and disclose the information. Claims that we have violated individuals' privacy rights, failed to comply with data protection laws, or breached our contractual obligations, even if we are not found liable, could be expensive and time-consuming to defend and could result in adverse publicity that could harm our business.

European data collection is governed by restrictive regulations governing the use, processing and cross-border transfer of personal information.

In the event we decide to conduct Clinical Trials in the European Union, we may be subject to additional privacy restrictions. The collection and use of personal health data in the European Union is governed by the provisions of the GDPR. This directive imposes several requirements relating to the consent of the individuals to whom the personal data relates, the information provided to the individuals, notification of data processing obligations to the competent national data protection authorities and the security and confidentiality of the personal data. The GDPR also imposes strict rules on the transfer of personal data out of the European Union to the United States. Failure to comply with the requirements of the Data Protection Directive, the GDPR, and the related national data protection laws of the European Union Member States may result in fines and other administrative penalties. The GDPR introduces new data protection requirements in the European Union and substantial fines for breaches of the data protection rules. The GDPR regulations may impose additional responsibility and liability in relation to personal data that we process and we may be required to put in place additional mechanisms ensuring compliance with these or new data protection rules. This may be onerous and adversely affect our business, financial condition, prospects and results of operations.

Ongoing healthcare legislative and regulatory reform measures may have a material adverse effect on our business and results of operations.

The United States and many foreign jurisdictions have enacted or proposed legislative and regulatory changes affecting the healthcare system that could prevent or delay marketing approval of our AXA Candidates or any future AXA Candidates, restrict or regulate post-approval activities and affect our ability to profitably sell any product for which we obtain marketing approval. Changes in regulations, statutes or the interpretation of existing regulations could impact our business in the future by requiring, for example: (i) changes to our manufacturing arrangements; (ii) additions or modifications to product labeling; (iii) the recall or discontinuation of our products; or (iv) additional record-keeping requirements. If any such changes were to be imposed, they could adversely affect the operation of our business.

In the United States, there have been and continue to be a number of legislative initiatives to contain healthcare costs. For example, in March 2010, the ACA was passed, which substantially changes the way healthcare is financed by both governmental and private insurers, and significantly impacts the U.S. pharmaceutical industry. The ACA, among other things, subjects biological products to potential competition by lower-cost biosimilars, addresses a new methodology by which rebates owed by manufacturers under the Medicaid Drug Rebate Program are calculated for drugs that are inhaled, infused, instilled, implanted or injected, increases the minimum Medicaid rebates owed by manufacturers under the Medicaid Drug Rebate Program and extends the rebate program to individuals enrolled in Medicaid managed care organizations, establishes annual fees and taxes on manufacturers of certain branded prescription drugs, and creates a new Medicare Part D coverage gap discount program, in which manufacturers must agree to offer 70% (as of 2019) point-of-sale discounts off negotiated prices of applicable brand drugs to eligible beneficiaries during their coverage gap period, as a condition for the manufacturer's outpatient drugs to be covered under Medicare Part D.

Since January 2017, the Trump administration has signed two Executive Orders designed to delay the implementation of certain provisions of the ACA or otherwise circumvent some of the requirements for health insurance mandated by the ACA. One Executive Order directs federal agencies with authorities and responsibilities under the ACA to waive, defer, grant exemptions from or delay the implementation of any provision of the ACA that would impose a fiscal or regulatory burden on states, individuals, healthcare providers, health insurers or manufacturers of pharmaceuticals or medical devices. The second Executive Order terminates the cost-sharing subsidies that reimburse insurers under the ACA. Several state Attorneys General filed suit to stop the administration from terminating the subsidies, but their request for a restraining order was denied by a federal judge in California on October 25, 2017. Further, on June 14, 2018, U.S. Court of Appeals for the Federal Circuit ruled that the federal government was not required to pay more than \$12 billion in ACA risk corridor payments to third-party payors who argued were owed to them. The effects of this gap in reimbursement on third-party payors, the viability of the ACA marketplace, providers and potentially our business, are not yet known.

Since its enactment, some of the provisions of the ACA have yet to be fully implemented, while certain provisions have been subject to judicial, congressional or executive challenges. As a result, there have been delays in the implementation of, and action taken to repeal or replace, certain aspects of the ACA. The U.S. Supreme Court has upheld certain key aspects of the legislation, including a tax-based shared responsibility payment imposed on certain individuals who fail to maintain qualifying health coverage for all or part of a year or pay a penalty, which is commonly known as the "individual mandate." However, as a result of tax reform legislation passed in December 2017, the individual mandate has been eliminated effective January 1, 2019. On January 22, 2018, President Trump signed a continuing resolution on appropriations for fiscal year 2018 that delayed the implementation of certain ACA-mandated fees, including the so-called "Cadillac" tax on certain high cost employer-sponsored insurance plans, the annual fee imposed on certain health insurance providers based on market share and the medical device excise tax on non-exempt medical devices. The Bipartisan Budget Act of 2018, or the BBA, among other things, amended the ACA to close the coverage gap in most Medicare drug plans, commonly referred to as the "donut hole."

In July 2018, the Centers for Medicare and Medicaid Services, or CMS, published a final rule permitting further collections and payments to and from certain ACA qualified health plans and health insurance issuers under the ACA risk adjustment program in response to the outcome of federal district court litigation regarding the method CMS uses to determine this risk adjustment. In addition, CMS has recently published a final rule that would give states greater flexibility, starting in 2020, in setting benchmarks for insurers in the individual and small group marketplaces, which may

have the effect of relaxing the essential health benefits required under the ACA for plans sold through such marketplaces. On December 14, 2018, a U.S. District Court Judge in the Northern District of Texas, or the Texas District Court Judge, ruled that the individual mandate is a critical and inseparable feature of the ACA, and therefore, because it was repealed as part of the Tax Cuts and Jobs Act of 2017, the remaining provisions of the ACA are invalid as well. While the Trump Administration and CMS have both stated that the ruling will have no immediate effect, and on December 30, 2018 the Texas District Court Judge issued an order staying the judgment pending appeal, it is unclear how this decision, subsequent appeals and other efforts to repeal and replace the ACA Act will impact the ACA and our business.

In addition, other legislative changes have been proposed and adopted since the ACA was enacted. In August 2011, President Obama signed into law the Budget Control Act of 2011, which, among other things, created the Joint Select Committee on Deficit Reduction to recommend to Congress proposals in spending reductions. The Joint Select Committee on Deficit Reduction did not achieve a targeted deficit reduction, which triggered the legislation's automatic reduction to several government programs. This includes aggregate reductions to Medicare payments to providers of, on average, two percent per fiscal year through 2025 unless Congress takes additional action. These reductions were extended through 2027 under the BBA. In January 2013, the American Taxpayer Relief Act of 2012, among other things, further reduced Medicare payments to several providers, including hospitals and cancer treatment centers, and increased the statute of limitations period for the government to recover overpayments to providers from three to five years.

There has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices. Specifically, there have been several recent U.S. Congressional inquiries and proposed federal and state legislation designed to, among other things, bring more transparency to drug pricing, reduce the cost of prescription drugs under Medicare, review the relationship between pricing and manufacturer patient programs, and reform government program reimbursement methodologies for drugs. At the federal level, the Trump administration's budget proposal for fiscal year 2019 contains further drug price control measures that could be enacted during the 2019 budget process or in other future legislation, including, for example, measures to permit Medicare Part D plans to negotiate the price of certain drugs under Medicare Part B, to allow some states to negotiate drug prices under Medicaid, and to eliminate cost sharing for generic drugs for low-income patients. Additionally, the Trump administration released a "Blueprint" to lower drug prices and reduce out of pocket costs of drugs that contains additional proposals to increase manufacturer competition, increase the negotiating power of certain federal healthcare programs, incentivize manufacturers to lower the list price of their products and reduce the out of pocket costs of drug products paid by consumers. The U.S. Department of Health and Human Services has already started the process of soliciting feedback on some of these measures and, at the same time, is immediately implementing others under its existing authority. For example, in September 2018, CMS announced that it will allow Medicare Advantage Plans the option to use step therapy for Part B drugs beginning January 1, 2019, and in October 2018, CMS proposed a new rule that would require direct-to-consumer television advertisements of prescription drugs and biological products, for which payment is available through or under Medicare or Medicaid, to include in the advertisement the Wholesale Acquisition Cost, or list price, of that drug or biological product. Although a number of these and other proposed measures will require authorization through additional legislation to become effective, Congress and the Trump administration have each indicated that it will continue to seek new legislative or administrative measures to control drug costs. At the state level, legislatures have increasingly passed legislation and implemented regulations designed to control pharmaceutical and biological product pricing, including price or patient reimbursement constraints, discounts, restrictions on certain product access and marketing cost disclosure and transparency measures, and, in some cases, designed to encourage importation from other countries and bulk purchasing.

We expect that the healthcare reform measures that have been adopted and may be adopted in the future may result in more rigorous coverage criteria and in additional downward pressure on the price that we receive for any approved product and could seriously harm our future revenues. Any reduction in reimbursement from Medicare or other government programs may result in a similar reduction in payments from private third-party payors.

There have been, and likely will continue to be, legislative and regulatory proposals at the foreign, federal and state levels directed at broadening the availability of healthcare and containing or lowering the cost of healthcare. The implementation of cost containment measures or other healthcare reforms may prevent us from being able to generate revenue, attain profitability or commercialize our product. Such reforms could have an adverse effect on anticipated revenue from product candidates that we may successfully develop and for which we may obtain regulatory approval and may affect our overall financial condition and ability to develop product candidates.

European Union drug marketing and reimbursement regulations may materially affect our ability to market and receive coverage for any AXA Candidate that we decide to develop as a drug candidate in the European member states.

We intend to seek approval to market our AXA Candidates in both the United States and in selected foreign jurisdictions. If we obtain approval in one or more foreign jurisdictions for our AXA Candidates, we will be subject to rules and regulations in those jurisdictions. In some foreign countries, particularly those in the European Union, the pricing of pharmaceutical products is subject to governmental control and other market regulations which could put pressure on the pricing and usage of our AXA Candidates. In these countries, pricing negotiations with governmental authorities can take considerable time after obtaining marketing approval of an AXA Candidate. In addition, market acceptance and sales of our AXA Candidates will depend significantly on the availability of adequate coverage and reimbursement from third-party payors for our AXA Candidates and may be affected by existing and future healthcare reform measures.

Much like the federal Anti-Kickback Statute prohibition in the United States, the provision of benefits or advantages to physicians to induce or encourage the prescription, recommendation, endorsement, purchase, supply, order or use of medicinal products is also prohibited in the European Union. The provision of benefits or advantages to physicians is governed by the national anti-bribery laws of European Union Member States, such as the UK Bribery Act 2010. Infringement of these laws could result in substantial fines and imprisonment.

Payments made to physicians in certain European Union Member States must be publicly disclosed. Moreover, agreements with physicians often must be the subject of prior notification and approval by the physician's employer, his or her competent professional organization or the regulatory authorities of the individual European Union Member States. These requirements are provided in the national laws, industry codes or professional codes of conduct, applicable in the European Union Member States. Failure to comply with these requirements could result in reputational risk, public reprimands, administrative penalties, fines or imprisonment.

In addition, in most foreign countries, including the European Economic Area, the proposed pricing for a drug must be approved before it may be lawfully marketed. The requirements governing drug pricing and reimbursement vary widely from country to country. For example, the European Union provides options for its member states to restrict the range of medicinal products for which their national health insurance systems provide reimbursement and to control the prices of medicinal products for human use. Reference pricing used by various European Union Member States and parallel distribution, or arbitrage between low-priced and high-priced member states, can further reduce prices. A member state may approve a specific price for the medicinal product or it may instead adopt a system of direct or indirect controls on the profitability of the company

placing the medicinal product on the market. In some countries, we may be required to conduct a Clinical Trial or other studies that compare the cost-effectiveness of any of our AXA Candidates to other available therapies in order to obtain or maintain reimbursement or pricing approval. There can be no assurance that any country that has price controls or reimbursement limitations for pharmaceutical products will allow favorable reimbursement and pricing arrangements for any of our products. Historically, products launched in the European Union do not follow price structures of the United States and generally prices tend to be significantly lower. Publication of discounts by third-party payors or authorities may lead to further pressure on the prices or reimbursement levels within the country of publication and other countries. If pricing is set at unsatisfactory levels or if reimbursement of our products is unavailable or limited in scope or amount, our revenues from sales by us or our strategic partners and the potential profitability of any of our product candidates in those countries would be negatively affected.

Laws and regulations governing any international operations we may have in the future may preclude us from developing, manufacturing and selling certain products outside of the United States and require us to develop and implement costly compliance programs.

If we expand our operations outside of the United States, we must dedicate additional resources to comply with numerous laws and regulations in each jurisdiction in which we plan to operate. The FCPA prohibits any U.S. individual or business from paying, offering, authorizing payment or offering of anything of value, directly or indirectly, to any foreign official, political party or candidate for the purpose of influencing any act or decision of the foreign entity in order to assist the individual or business in obtaining or retaining business. The FCPA also obligates companies whose securities are listed in the United States to comply with certain accounting provisions requiring the company to maintain books and records that accurately and fairly reflect all transactions of the corporation, including international subsidiaries, and to devise and maintain an adequate system of internal accounting controls for international operations.

Compliance with the FCPA is expensive and difficult, particularly in countries in which corruption is a recognized problem. In addition, the FCPA presents particular challenges in the pharmaceutical industry, because, in many countries, hospitals are operated by the government, and doctors and other hospital employees are considered foreign officials. Certain payments to hospitals in connection clinical trials and other work have been deemed to be improper payments to government officials and have led to FCPA enforcement actions.

Various laws, regulations and executive orders also restrict the use and dissemination outside of the United States, or the sharing with certain ex-U.S. nationals, of information classified for national security purposes, as well as certain products and technical data relating to those products. If we expand our presence outside of the United States, it will require us to dedicate additional resources to comply with these laws, and these laws may preclude us from developing, manufacturing, or selling certain products and product candidates outside of the United States, which could limit our growth potential and increase our development costs.

The failure to comply with laws governing international business practices may result in substantial civil and criminal penalties and suspension or debarment from government contracting. The Securities and Exchange Commission, or SEC, also may suspend or bar issuers from trading securities on U.S. exchanges for violations of the FCPA's accounting provisions.

We are subject to certain U.S. and foreign anti-corruption, anti-money laundering, export control, sanctions and other trade laws and regulations. We can face serious consequences for violations.

Among other matters, U.S. and foreign anti-corruption, anti-money laundering, export control, sanctions and other trade laws and regulations, which are collectively referred to as Trade Laws, prohibit companies and their employees, agents, clinical research organizations, legal counsel, accountants, consultants, contractors and other partners from authorizing, promising, offering, providing, soliciting or receiving directly or indirectly, corrupt or improper payments or anything else of value to or from recipients in the public or private sector. Violations of Trade Laws can result in substantial criminal fines and civil penalties, imprisonment, the loss of trade privileges, debarment, tax reassessments, breach of contract and fraud litigation, reputational harm and other consequences. We have direct or indirect interactions with officials and employees of government agencies or government-affiliated hospitals, universities and other organizations. We also expect our ex-U.S. activities to increase in time. We plan to engage third parties for Clinical Trials or to obtain necessary permits, licenses, patent registrations and other regulatory approvals and we can be held liable for the corrupt or other illegal activities of our personnel, agents or partners, even if we do not explicitly authorize or have prior knowledge of such activities.

Changes in funding for the FDA, the SEC and other government agencies could hinder their ability to hire and retain key leadership and other personnel, prevent new products and services from being developed or commercialized in a timely manner or otherwise prevent those agencies from performing normal functions on which the operation of our business may rely, which could negatively impact our business.

The ability of the FDA to review and approve new products or take action with respect to other regulatory matters can be affected by a variety of factors, including government budget and funding levels, ability to hire and retain key personnel and accept payment of user fees and statutory, regulatory and policy changes. Average review times at the agency have fluctuated in recent years as a result. In addition, government funding of the SEC and other government agencies on which our operations may rely, including those that fund research and development activities is subject to the political process, which is inherently fluid and unpredictable.

Disruptions at the FDA and other agencies may also slow the time necessary for new drugs to be reviewed or approved, or for other actions to be taken, by relevant government agencies, which would adversely affect our business. For example, over the last several years, including beginning on December 22, 2018, the U.S. government has shut down several times and certain regulatory agencies, such as the FDA and the SEC, have had to furlough critical FDA, SEC and other government employees and stop critical activities. If a prolonged government shutdown occurs, it could significantly impact the ability of the FDA to timely review and process our regulatory submissions, which could have a material adverse effect on our business. Similarly, a prolonged government shutdown could prevent the timely review of our patent applications by the United States Patent and Trademark Office, or USPTO, which could delay the issuance of any U.S. patents to which we might otherwise be entitled. Further, upon completion of this offering and in our operations as a public company, future government shutdowns could impact our ability to access the public markets and obtain necessary capital in order to properly

Risks related to our intellectual property

If we are unable to obtain and maintain patent protection for any AXA Candidates we develop or for our AXA Development Platform, our competitors could develop and commercialize products or technology similar or identical to ours, and our ability to successfully commercialize any AXA Candidates we may develop, and our technology may be adversely affected.

Our success depends in large part on our ability to obtain and maintain patent protection in the United States and other countries with respect to our AXA Candidates, AXA Development Platform and other technologies we may develop. We seek to protect our proprietary position by filing patent applications in the United States and abroad relating to our AXA Candidates and AXA Development Platform, as well as other technologies that are important to our business. Given that the development of our technology and AXA Candidates is at an early stage, our intellectual property portfolio with respect to certain aspects of our technology and AXA Candidates is also at an early stage. We have filed or intend to file patent applications on these aspects of our technology and our AXA Candidates; however, there can be no assurance that any such patent applications will issue as granted patents. Furthermore, in some cases, we have only filed provisional patent applications on certain aspects of our technology and AXA Candidates and each of these provisional patent applications is not eligible to become an issued patent until, among other things, we file a non-provisional patent application within 12 months of the filing date of the applicable provisional patent application. Any failure to file a non-provisional patent application within this timeline could cause us to lose the ability to obtain patent protection for the inventions disclosed in the associated provisional patent applications.

Composition of matter patents for biological and pharmaceutical products are generally considered to be the strongest form of intellectual property protection for those types of products, as such patents provide protection without regard to any method of use. We cannot be certain, however, that the claims in our pending patent applications covering the composition of matter of our AXA Candidates will be considered patentable by the USPTO or by patent offices in foreign countries, or that the claims in any of our issued patents will be considered valid and enforceable by courts in the United States or foreign countries. Furthermore, in some cases, we may not be able to obtain issued claims covering compositions of matter relating to our AXA Candidates and proprietary product platform, as well as other technologies that are important to our business, and instead may need to rely on filing patent applications with claims covering a method of use or method of manufacture. Method of use patents protect the use of a product for the specified method. This type of patent does not prevent a competitor from making and marketing a product that is identical to our product for an indication that is outside the scope of the patented method. Moreover, even if competitors do not actively promote their products for our targeted indications, physicians may prescribe these products "off-label" for those uses that are covered by our method of use patents. Although off-label prescriptions may infringe or contribute to the infringement of method of use patents, the practice is common and such infringement is difficult to prevent or prosecute. There can be no assurance that any such patent applications will issue as granted patents, and even if they do issue, such patent claims may be insufficient to prevent third parties, such as our competitors, from utilizing our technology. Any failure to obtain or maintain patent protection with respect to our AXA Candidates and AXA Development Platform could have a material adverse effect on our business, financial condition, results of operations and prospects.

If any of our owned patent applications do not issue as patents in any jurisdiction, we may not be able to compete effectively.

Changes in either the patent laws or their interpretation in the United States and other countries may diminish our ability to protect our inventions, obtain, maintain and enforce our

intellectual property rights and, more generally, could affect the value of our intellectual property or narrow the scope of our owned patents. With respect to our patent portfolio, as of April 1, 2019, our AXA Candidate-related patent portfolio consists of 18 patent families, including two granted U.S. patents, 22 U.S. pending patent applications (including provisional applications) and 13 owned pending patent applications in jurisdictions outside of the United States (including Patent Cooperation Treaty applications) that, in many cases, are counterparts to the foregoing U.S. patents and patent applications, which include claims directed to compositions, methods of use, treatment of indications, dosing, formulations and methods of manufacturing. With respect to owned intellectual property, we cannot predict whether the patent applications we are currently pursuing will issue as patents in any particular jurisdiction or whether the claims of any issued patents will provide sufficient protection from competitors or other third parties.

The patent prosecution process is expensive, time-consuming and complex, and we may not be able to file, prosecute, maintain, enforce or license all necessary or desirable patents and patent applications at a reasonable cost or in a timely manner. Disruptions at the USPTO or other government agencies may also slow the time necessary for patent applications to be reviewed by the USPTO, which could adversely affect our patent portfolio. It is also possible that we will fail to identify patentable aspects of our research and development output in time to obtain patent protection. Although we enter into non-disclosure and confidentiality agreements with parties who have access to confidential or patentable aspects of our research and development output, such as our employees, corporate collaborators, outside scientific collaborators, CROs, contract manufacturers, consultants, advisors and other third parties, any of these parties may breach such agreements and disclose such output before a patent application is filed, thereby jeopardizing our ability to seek patent protection. In addition, our ability to obtain and maintain valid and enforceable patents depends on whether the differences between our inventions and the prior art allow our inventions to be patentable over the prior art. Furthermore, publications of discoveries in the scientific literature often lag behind the actual discoveries, and patent applications in the United States and other jurisdictions are typically not published until 18 months after filing, or in some cases not at all. Therefore, we cannot be certain that we were the first to make the inventions claimed in any of our owned or pending patent applications, or that we were the first to file for patent protection of such inventions.

If the scope of any patent protection we obtain is not sufficiently broad, or if we lose any of our patent protection, our ability to prevent our competitors from commercializing similar or identical technology and AXA Candidates would be adversely affected.

The patent position of healthcare companies generally is highly uncertain, involves complex legal and factual questions and has been the subject of much litigation in recent years. As a result, the issuance, scope, validity, enforceability and commercial value of our patent rights are highly uncertain. Our pending and future patent applications may not result in patents being issued which protect our AXA Candidates, AXA Development Platform or other technologies or which effectively prevent others from commercializing competitive technologies and AXA Candidates.

No consistent policy regarding the scope of claims allowable in patents in the biotechnology field has emerged in the United States. The patent situation outside of the United States is similarly uncertain. Changes in either the patent laws or their interpretation in the United States and other countries may diminish our ability to protect our inventions and enforce our intellectual property rights, and more generally could affect the value of our intellectual property. In particular, our ability to stop third parties from making, using, selling, offering to sell or importing products that infringe our intellectual property will depend in part on our success in obtaining and enforcing patent claims that cover our technology, inventions and improvements. With respect to intellectual property that we own, we cannot be sure that patents will be granted with respect to any of our pending patent

applications or with respect to any patent applications filed by us in the future, nor can we be sure that any of our existing patents or any patents that may be granted to us in the future will be commercially useful in protecting our products and the methods used to manufacture those products. Moreover, even our issued patents do not guarantee us the right to practice our technology in relation to the commercialization of our products. The area of patent and other intellectual property rights in biotechnology is an evolving one with many risks and uncertainties, and third parties may have blocking patents that could be used to prevent us from commercializing our patented AXA Candidates and practicing our proprietary technology. Our issued patents and those that may issue in the future may be challenged, invalidated or circumvented, which could limit our ability to stop competitors from marketing related products or limit the length of the term of patent protection that we may have for our AXA Candidates. In addition, the rights granted under any issued patents may not provide us with protection or competitive advantages against competitors with similar technology. Furthermore, our competitors may independently develop similar technologies. For these reasons, we may have competition for our AXA Candidates. Moreover, because of the extensive time required for development, testing and regulatory review of a potential product, it is possible that, before any particular AXA Candidate can be commercialized, any related patent may expire or remain in force for only a short period following commercialization, thereby reducing any advantage of the patent.

Moreover, the coverage claimed in a patent application can be significantly reduced before the patent is issued, and its scope can be reinterpreted after issuance. Even if patent applications we own issue as patents, they may not issue in a form that will provide us with any meaningful protection, prevent competitors or other third parties from competing with us, or otherwise provide us with any competitive advantage. Any patents that we own may be challenged, narrowed, circumvented or invalidated by third parties. Consequently, we do not know whether our AXA Candidates or other technologies will be protectable or remain protected by valid and enforceable patents. Our competitors or other third parties may be able to circumvent our patents by developing similar or alternative technologies or products in a non-infringing manner which could materially adversely affect our business, financial condition, results of operations and prospects.

The issuance of a patent is not conclusive as to its inventorship, scope, validity or enforceability, and patents that we own may be challenged in the courts or patent offices in the United States and abroad. We may be subject to a third party preissuance submission of prior art to the USPTO or to foreign patent authorities or become involved in opposition, derivation, revocation, reexamination, post-grant and *inter partes* review or interference proceedings or other similar proceedings challenging our owned patent rights. An adverse determination in any such submission, proceeding or litigation could reduce the scope of, or invalidate or render unenforceable, our owned patent rights, allow third parties to commercialize our AXA Candidates, AXA Development Platform or other technologies and compete directly with us, without payment to us, or result in our inability to manufacture or commercialize products without infringing third-party patent rights. Moreover, we may have to participate in interference proceedings declared by the USPTO to determine priority of invention or in post-grant challenge proceedings, such as *inter partes* reviews, post-grant reviews or derivation proceedings at the USPTO or oppositions in a foreign patent office, that challenge our priority of invention or other features of patentability with respect to our owned patents and patent applications. Such challenges may result in loss of patent rights, loss of exclusivity or in patent claims being narrowed, invalidated or held unenforceable, which could limit our ability to stop others from using or commercializing similar or identical technology and products, or limit the duration of the patent protection of our AXA Candidates, AXA Development Platform and other technologies. Such proceedings also may result in substantial cost and require significant time from our scientists and management, even if the eventual outcome is favorable to us.

In addition, given the amount of time required for the development, testing and regulatory review of new AXA Candidates, patents protecting such AXA Candidates might expire before or shortly after such AXA Candidates are commercialized. As a result, our intellectual property may not provide us with sufficient rights to exclude others from commercializing products similar or identical to ours.

We may in the future co-own patent rights relating to future AXA Candidates and our AXA Development Platform with third parties. We may need the cooperation of any such co-owners of our patent rights in order to enforce such patent rights against third parties, and such cooperation may not be provided to us. Any of the foregoing could have a material adverse effect on our competitive position, business, financial conditions, results of operations and prospects.

Our rights to develop and commercialize our AXA Candidates and AXA Development Platform may be subject, in part, to the terms and conditions of future licenses granted to us by others.

We may rely upon licenses to certain patent rights and proprietary technology from third parties that are important or necessary to the development of our AXA Candidates and AXA Development Platform. Patent rights that we in-license in the future may be subject to a reservation of rights by one or more third parties. As a result, any such third parties may have certain rights to such intellectual property.

In addition, subject to the terms of any such license agreements, we may not have the right to control the preparation, filing, prosecution and maintenance, and we may not have the right to control the enforcement, and defense of patents and patent applications covering the technology that we license from third parties. We cannot be certain that any in-licensed patent applications (and any patents issuing therefrom) that are controlled by any potential licensors will be prepared, filed, prosecuted, maintained, enforced and defended in a manner consistent with the best interests of our business. If our licensors fail to prosecute, maintain, enforce and defend such patent rights, or lose rights to those patent applications (or any patents issuing therefrom), the rights we have licensed may be reduced or eliminated, our right to develop and commercialize any of our AXA Candidates and AXA Development Platform technologies that are subject of such licensed rights could be adversely affected and we may not be able to prevent competitors from making, using and selling competing products. Moreover, we cannot be certain that such activities by our potential future licensors will be conducted in compliance with applicable laws and regulations or will result in valid and enforceable patents or other intellectual property rights. In addition, even where we may have the right to control patent prosecution of patents and patent applications that we may license to and from third parties, we may still be adversely affected or prejudiced by actions or inactions of our potential future licensees, licensors and their counsel that took place prior to the date of assumption of control over patent prosecution.

We may not be able to protect our intellectual property and proprietary rights throughout the world.

Filing, prosecuting and defending patents on our AXA Candidates, AXA Development Platform technologies and other technologies in all countries throughout the world would be prohibitively expensive, and the laws of foreign countries may not protect our rights to the same extent as the laws of the United States. Consequently, we may not be able to prevent third parties from practicing our inventions in all countries outside the United States, or from selling or importing products made using our inventions in and into the United States or other jurisdictions. Competitors may use our technologies in jurisdictions where we have not obtained patent protection to develop their own products and may export otherwise infringing products to territories where we have patent protection but enforcement is not as strong as that in the United States. These products may compete with our products, and our patents or other intellectual property rights may not be

effective or sufficient to prevent them from competing. Furthermore, the amino acids that we expect to incorporate into our products are available for purchase separately from a variety of retail outlets, and our intellectual property rights will not prevent these sales from continuing in the future.

Many companies have encountered significant problems in protecting and defending intellectual property rights in foreign jurisdictions. The legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents, trade secrets and other intellectual property protection, particularly those relating to biotechnology products, which could make it difficult for us to stop the infringement of our patents or marketing of competing products in violation of our intellectual property and proprietary rights generally. Proceedings to enforce our intellectual property and proprietary rights in foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business, could put our patents at risk of being invalidated or interpreted narrowly, could put our patent applications at risk of not issuing, and could provoke third parties to assert claims against us. We may not prevail in any lawsuits that we initiate, and the damages or other remedies awarded, if any, may not be commercially meaningful. Accordingly, our efforts to enforce our intellectual property and proprietary rights around the world may be inadequate to obtain a significant commercial advantage from the intellectual property that we develop or license.

Many countries have compulsory licensing laws under which a patent owner may be compelled to grant licenses to third parties. In addition, many countries limit the enforceability of patents against government agencies or government contractors. In these countries, the patent owner may have limited remedies, which could materially diminish the value of such patent. If we are forced to grant a license to third parties with respect to any patents relevant to our business, our competitive position may be impaired, and our business, financial condition, results of operations and prospects may be adversely affected.

Obtaining and maintaining our patent protection depends on compliance with various procedural requirements, document submission, fee payment and other requirements imposed by government patent agencies and our patent protection could be reduced or eliminated for non-compliance with these requirements.

Periodic maintenance fees, renewal fees, annuity fees and various other government fees on patents and applications will be due to be paid to the USPTO and various government patent agencies outside of the United States over the lifetime of our owned patents and applications. The USPTO and various ex-U.S. government agencies require compliance with several procedural, documentary, fee payment and other similar provisions during the patent application process. In some cases, an inadvertent lapse can be cured by payment of a late fee or by other means in accordance with the applicable rules. There are situations, however, in which non-compliance can result in abandonment or lapse of the patent or patent application, resulting in a partial or complete loss of patent rights in the relevant jurisdiction. In such an event, potential competitors might be able to enter the market with similar or identical products or technology, which could have a material adverse effect on our business, financial condition, results of operations and prospects.

Changes in U.S. patent law could diminish the value of patents in general, thereby impairing our ability to protect our products.

Changes in either the patent laws or interpretation of the patent laws in the United States could increase the uncertainties and costs surrounding the prosecution of patent applications and the enforcement or defense of issued patents. Assuming that other requirements for patentability are met, prior to March 2013, in the United States, the first to invent the claimed invention was entitled to the patent, while outside the United States, the first to file a patent application was entitled to the patent. After March 2013, under the Leahy-Smith America Invents Act, or the America

Invents Act, enacted in September 2011, the United States transitioned to a first-inventor-to-file system in which, assuming that other requirements for patentability are met, the first inventor to file a patent application will be entitled to the patent on an invention regardless of whether a third party was the first to invent the claimed invention. A third party that files a patent application in the USPTO after March 2013, but before we do could therefore be awarded a patent covering an invention of ours even if we had made the invention before it was made by such third party. This will require us to be cognizant going forward of the time from invention to filing of a patent application. Since patent applications in the United States and most other countries are confidential for a period of time after filing or until issuance, we cannot be certain that we were the first to file any patent application related to our AXA Candidates, AXA Development Platform or other technologies.

The America Invents Act also includes a number of significant changes that affect the way patent applications will be prosecuted and also may affect patent litigation. These include allowing third party submission of prior art to the USPTO during patent prosecution and additional procedures to attack the validity of a patent by USPTO administered post-grant proceedings, including post-grant review, *inter partes* review and derivation proceedings. Because of a lower evidentiary standard in USPTO proceedings compared to the evidentiary standard in United States federal courts necessary to invalidate a patent claim, a third party could potentially provide evidence in a USPTO proceeding sufficient for the USPTO to hold a claim invalid even though the same evidence would be insufficient to invalidate the claim if first presented in a district court action. Accordingly, a third party may attempt to use the USPTO procedures to invalidate our patent claims that would not have been invalidated if first challenged by the third party as a defendant in a district court action. Therefore, the America Invents Act and its implementation could increase the uncertainties and costs surrounding the prosecution of our owned patent applications and the enforcement or defense of our owned issued patents, all of which could have a material adverse effect on our business, financial condition, results of operations and prospects.

In addition, the patent positions of companies in the development and commercialization of biologics and pharmaceuticals are particularly uncertain. Recent U.S. Supreme Court rulings have narrowed the scope of patent protection available in certain circumstances and weakened the rights of patent owners in certain situations. This combination of events has created uncertainty with respect to the validity and enforceability of patents, once obtained. Depending on future actions by the U.S. Congress, the federal courts and the USPTO, the laws and regulations governing patents could change in unpredictable ways that could have a material adverse effect on our existing patent portfolio and our ability to protect and enforce our intellectual property in the future.

From time-to-time the U.S. Supreme Court, other federal courts, the U.S. Congress or the USPTO, may change the standards of patentability and any such changes could have a negative impact on our business. For instance, on June 13, 2013, in *Association for Molecular Pathology v. Myriad Genetics*, the Supreme Court held that a naturally occurring DNA segment is a product of nature and not patent eligible merely because it has been isolated. The Supreme Court did not address the patentability of any innovative method claims involving the manipulation of isolated genes. On January 7, 2019, the USPTO released guidance entitled "2019 Revised Subject Matter Eligibility Guidance." This memorandum provides guidelines for the USPTO's new examination procedure for subject matter eligibility under 35 U.S.C. §101 for claims embracing natural products or natural principles. Although the guidelines do not have the force of law, patent examiners have been instructed to follow them. Some aspects of our technology involve processes or molecules that may be subject to this evolving standard and we cannot guarantee that any of our pending process claims will be patent eligible, or issued claims will remain patent eligible, as a result of such evolving standards. Changes in either the patent laws or in interpretations of patent laws in the United States or other countries could weaken our ability to obtain new patents or to enforce

our existing patents and patents that we might obtain in the future. We cannot predict the breadth of claims that may be allowed or enforced in our patents or in third-party patents. We may not develop additional proprietary products, methods and technologies that are patentable.

Issued patents covering our AXA Candidates and any patents that may issue covering our AXA Development Platform and other technologies, could be found invalid or unenforceable if challenged in court or before administrative bodies in the United States or abroad.

If we initiated legal proceedings against a third party to enforce a patent covering our AXA Candidates, AXA Development Platform or other technologies, the defendant could counterclaim that such patent is invalid or unenforceable. In patent litigation in the United States, defendant counterclaims alleging invalidity or unenforceability are commonplace. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, including lack of novelty, obviousness or non-enablement. Grounds for an unenforceability assertion could be an allegation that someone connected with prosecution of the patent withheld relevant information from the USPTO, or made a misleading statement, during prosecution. Third parties may raise claims challenging the validity or enforceability of our owned patents before administrative bodies in the United States or abroad, even outside the context of litigation. Such mechanisms include re-examination, post-grant review, *inter partes* review, interference proceedings, derivation proceedings and equivalent proceedings in foreign jurisdictions (e.g., opposition proceedings). Such proceedings could result in the revocation of, cancellation of, or amendment to our patents in such a way that they no longer cover our AXA Candidates, AXA Development Platform or other technologies. The outcome following legal assertions of invalidity and unenforceability is unpredictable. With respect to the validity question, for example, we cannot be certain that there is no invalidating prior art, of which we and the patent examiner were unaware during prosecution. If a third party were to prevail on a legal assertion of invalidity or unenforceability, we would lose at least part, and perhaps all, of the patent protection on our AXA Candidates, AXA Development Platform or other technologies. Such a loss of patent protection would have a material adverse impact on our business, financial condition, results of operations and prospects.

If we do not obtain patent term extension and/or data exclusivity for any AXA Candidates we decide to develop as drug product candidates, our business may be materially harmed.

Depending upon the timing, duration and specifics of any FDA marketing approval of any AXA Candidates we decide to develop as drug product candidates, one or more of our owned U.S. patents may be eligible for limited patent term extension under the Drug Price Competition and Patent Term Restoration Act, also known as the Hatch-Waxman Act. The Hatch-Waxman Act permits a patent term extension of up to five years as compensation for patent term lost during the FDA regulatory review process. A patent term extension cannot extend the remaining term of a patent beyond a total of 14 years from the date of product approval, only one patent may be extended and only those claims covering the approved drug, a method for using it, or a method for manufacturing it may be extended. Similar extensions as compensation for patent term lost during regulatory review processes are also available in certain foreign countries and territories, such as in Europe under a Supplementary Protection Certificate. However, we may not be granted an extension in the United States and/or foreign countries and territories because of, for example, failing to exercise due diligence during the testing phase or regulatory review process, failing to apply within applicable deadlines, failing to apply prior to expiration of relevant patents or otherwise failing to satisfy applicable requirements. Moreover, the applicable time period or the scope of patent protection afforded could be less than we request. If we are unable to obtain patent term extension or the term of any such extension is shorter than what we request, our competitors may obtain approval of competing products following our patent expiration, and our business, financial condition, results of operations and prospects could be materially harmed.

We may be subject to claims challenging the inventorship or ownership of our patents and other intellectual property.

We may be subject to claims that former employees, collaborators or other third parties have an interest in our owned patent rights, trade secrets or other intellectual property as an inventor or co-inventor. For example, we may have disputes arise from conflicting obligations of employees, consultants or others who are involved in developing our AXA Candidates, AXA Development Platform or other technologies. Litigation may be necessary to defend against these and other claims challenging inventorship or our ownership of our owned patent rights, trade secrets or other intellectual property. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights, such as exclusive ownership of, or right to use, intellectual property that is important to our AXA Candidates, AXA Development Platform and other technologies. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management and other employees. Any of the foregoing could have a material adverse effect on our business, financial condition, results of operations and prospects.

If we are unable to protect the confidentiality of our trade secrets, our business and competitive position would be harmed.

In addition to seeking patents for our AXA Candidates, AXA Development Platform and other technologies, we also rely on trade secrets and confidentiality agreements to protect our unpatented know-how, technology and other proprietary information and to maintain our competitive position. Trade secrets and know-how can be difficult to protect. We expect our trade secrets and know-how to over time be disseminated within the industry through independent development, the publication of journal articles describing the methodology and the movement of personnel from academic to industry scientific positions.

We currently, and may in the future continue to, rely on third parties to assist us in developing and manufacturing our AXA Candidates. Accordingly, we must, at times, share know-how and trade secrets, including those related to our AXA Development Platform, with them. We may in the future also enter into research and development collaborations with third parties that may require us to share know-how and trade secrets under the terms of our research and development partnerships or similar agreements. We seek to protect our know-how, trade secrets and other proprietary technology, in part, by entering into non-disclosure and confidentiality agreements, and including in our vendor and service agreements terms protecting our confidential information, know-how and trade secrets, with parties who have access to such information, such as our employees, scientific collaborators, CROs, contract manufacturers, consultants, advisors and other third parties. We also enter into confidentiality and invention or patent assignment agreements with our employees and consultants as well as train our employees not to bring or use proprietary information or technology from former employers to us or in their work, and we remind former employees when they leave their employment of their confidentiality obligations. However, we cannot guarantee that we have entered into such agreements with each party that may have or have had access to our trade secrets or proprietary technology and processes. We also seek to preserve the integrity and confidentiality of our data and other confidential information by maintaining physical security of our premises and physical and electronic security of our information technology systems.

Despite our efforts, any of the aforementioned parties may breach the agreements and disclose our proprietary information, including our trade secrets, or there may be lapses or failures in our physical and electronic security systems that lead to our proprietary information being disclosed, and we may not be able to obtain adequate remedies in the event of any such breaches. Monitoring unauthorized uses and disclosures is difficult, and we do not know whether the steps we have taken to protect our proprietary technologies will be effective. If any of our scientific advisors,

employees, contractors and consultants who are parties to these agreements breaches or violates the terms of any of these agreements, we may not have adequate remedies for any such breach or violation, and we could lose our trade secrets as a result. Moreover, if confidential information that is licensed or disclosed to us by our partners, collaborators or others is inadvertently disclosed or subject to a breach or violation, we may be exposed to liability to the owner of that confidential information. Enforcing a claim that a party illegally disclosed or misappropriated a trade secret is difficult, expensive and time-consuming and the outcome is unpredictable. In addition, some courts inside and outside the United States are less willing or unwilling to protect trade secrets. If any of our trade secrets were to be lawfully obtained or independently developed by a competitor or other third party, we would have no right to prevent them from using that technology or information to compete with us. If any of our trade secrets were to be disclosed to or independently developed by a competitor or other third party, our competitive position would be materially and adversely harmed.

We rely on our AXA Development Platform to identify AXA Candidates. Our competitive position could be materially harmed if our competitors develop a similar platform and develop rival product candidates.

We rely on know-how, inventions and other proprietary information to strengthen our competitive position. We consider know-how to be our primary intellectual property with respect to our AXA Development Platform. Our Non-IND, IRB-Approved Clinical Studies allow us to collect clinical data, which we use in a feedback loop to make improvements to our AXA Development Platform. In particular, we anticipate that, with respect to this platform, this data may over time be disseminated within the industry through independent development, the publication of journal articles describing the method and the movement of skilled personnel.

We cannot rule out that our competitors may have or will obtain the knowledge necessary to analyze and characterize similar data to our known data for the purpose of identifying and developing products that could compete with any of our AXA Candidates. Our competitors may also have significantly greater financial, product development, technical and human resources and access to data. Further, our competitors may have significantly greater experience in using translational science methods to identify and develop product candidates.

We may not be able to prohibit our competitors from using technology or methods that are the same as or similar to our AXA Development Platform to develop their own product candidates. If our competitors develop associated therapies, our ability to develop and market a promising product or product candidate may diminish substantially, which could have a material adverse effect on our business, financial condition, prospects and results of operations.

We may not be successful in obtaining, through acquisitions, in-licenses or otherwise, necessary rights to our AXA Candidates, AXA Development Platform technologies or other technologies.

We may need to, or want to for strategic purposes, acquire rights to certain intellectual property, through licenses from third parties, to create new products or advancements to our AXA Development Platform or further develop our AXA Candidates and AXA Development Platform technologies. Some healthcare companies and academic institutions are competing with us in the field of EMMs and metabolic pathways and may have patents and have filed and are likely filing patent applications potentially relevant to our business. In order to avoid infringing these third-party patents, we may find it necessary or prudent to obtain licenses to such patents from such third party intellectual property holders. We may also require licenses from third parties for certain technologies that we may evaluate for use with our current or future AXA Candidates. However, we may be unable to secure such licenses or otherwise acquire or in-license any compositions,

methods of use, processes or other intellectual property rights from third parties that we identify as necessary for our current or future AXA Candidates and our AXA Development Platform at a reasonable cost or on reasonable terms, if at all. The licensing or acquisition of third party intellectual property rights is a competitive area, and several more established companies may pursue strategies to license or acquire third party intellectual property rights that we may consider attractive or necessary. These established companies may have a competitive advantage over us due to their size, capital resources and greater clinical development and commercialization capabilities. In addition, companies that perceive us to be a competitor may be unwilling to assign or license rights to us. We also may be unable to license or acquire third party intellectual property rights on terms that would allow us to make an appropriate return on our investment or at all.

In the event that we try to obtain rights to required third party intellectual property rights, and are ultimately unsuccessful, we may be required to expend significant time and resources to redesign our technology, AXA Candidates or the methods for manufacturing them or to develop or license replacement technology, all of which may not be feasible on a technical or commercial basis. If we are unable to do so, we may be unable to develop or commercialize the affected AXA Candidates or continue to utilize our existing AXA Development Platform technology, which could harm our business, financial condition, results of operations and prospects significantly.

We may be subject to claims that our employees, consultants or advisors have wrongfully used or disclosed alleged trade secrets of their current or former employers or claims asserting ownership of what we regard as our own intellectual property.

Many of our employees, consultants and advisors are currently or were previously employed at universities or other healthcare companies, including our competitors and potential competitors. Although we try to ensure that our employees, consultants and advisors do not use the proprietary information or know-how of others in their work for us, we may be subject to claims that we or these individuals have used or disclosed intellectual property, including trade secrets or other proprietary information, of any such individual's current or former employer. Litigation may be necessary to defend against these claims. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights or personnel. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management.

In addition, while it is our policy to require our employees and contractors who may be involved in the conception or development of intellectual property to execute agreements assigning such intellectual property to us, we may be unsuccessful in executing such an agreement with each party who, in fact, conceives or develops intellectual property that we regard as our own. The assignment of intellectual property rights may not be self-executing, or the assignment agreements may be breached, and we may be forced to bring claims against third parties, or defend claims that they may bring against us, to determine the ownership of what we regard as our intellectual property. Such claims could have a material adverse effect on our business, financial condition, results of operations and prospects.

Third-party claims of intellectual property infringement, misappropriation or other violation against us or our collaborators may prevent or delay the development and commercialization of our AXA Candidates, AXA Development Platform and other technologies.

The field of developing drug or non-drug products that target metabolic pathways is competitive and dynamic. Due to the focused research and development that is taking place by several companies, including us and our competitors, in this field, the intellectual property landscape is in flux, and it may remain uncertain in the future. As such, there may be significant intellectual property related litigation and proceedings relating to our owned, and other third party, intellectual property and proprietary rights in the future.

Our commercial success depends in part on our and our collaborators' ability to avoid infringing, misappropriating and otherwise violating the patents and other intellectual property rights of third parties. There is a substantial amount of complex litigation involving patents and other intellectual property rights in the biotechnology and pharmaceutical industries, as well as administrative proceedings for challenging patents, including interference, derivation and reexamination proceedings before the USPTO or oppositions and other comparable proceedings in foreign jurisdictions. As discussed above, recently, due to changes in U.S. law referred to as patent reform, new procedures including *inter partes* review and post-grant review have been implemented. As stated above, this reform adds uncertainty to the possibility of challenge to our patents in the future.

Numerous U.S. and foreign issued patents and pending patent applications owned by third parties exist relating to technologies and fields in which we are developing our AXA Candidates. As the biotechnology and pharmaceutical industries expand and more patents are issued, the risk increases that our AXA Candidates, AXA Development Platform and other technologies may give rise to claims of infringement of the patent rights of others. We cannot assure you that our AXA Candidates, proprietary product platform technologies and other technologies that we have developed, are developing or may develop in the future will not infringe existing or future patents owned by third parties. We may not be aware of patents that have already been issued and that a third party, for example, a competitor in the fields in which we are developing our AXA Candidates, AXA Development Platform and other technologies might assert are infringed by our current or future AXA Candidates, AXA Development Platform or other technologies, including claims to compositions, formulations, methods of manufacture or methods of use or treatment that cover our AXA Candidates, AXA Development Platform or other technologies. It is also possible that patents owned by third parties of which we are aware, but which we do not believe are relevant to our AXA Candidates, AXA Development Platform or other technologies, could be found to be infringed by our AXA Candidates, AXA Development Platform or other technologies. In addition, because patent applications can take many years to issue, there may be currently pending patent applications that may later result in issued patents that our AXA Candidates, AXA Development Platform or other technologies may infringe. We cannot provide any assurances that third-party patents do not exist which might be enforced against our current technology, including our AXA Development Platform technologies, manufacturing methods, AXA Candidates or future methods or products resulting in either an injunction prohibiting our manufacture or future sales, or, with respect to our future sales, an obligation on our part to pay royalties and/or other forms of compensation to third parties, which could be significant.

Third parties may have patents or obtain patents in the future and claim that the manufacture, use or sale of our AXA Candidates, AXA Development Platform or other technologies infringes upon these patents. In the event that any third party claims that we infringe their patents or that we are otherwise employing their proprietary technology without authorization and initiates litigation against us, even if we believe such claims are without merit, a court of competent jurisdiction could hold that such patents are valid, enforceable and infringed by our AXA Candidates, AXA Development Platform or other technologies. In this case, the holders of such patents may be able to block our ability to commercialize the applicable AXA Candidate or technology unless we obtain a license under the applicable patents, or until such patents expire or are finally determined to be held invalid or unenforceable. Such a license may not be available on commercially reasonable terms or at all. Even if we are able to obtain a license, the license would likely obligate us to pay license fees or royalties or both, and the rights granted to us might be non-exclusive, which could result in our competitors gaining access to the same intellectual property. If we are unable to obtain a necessary license to a third-party patent on commercially reasonable terms, we may be unable to commercialize our AXA Candidates, AXA Development Platform or other technologies, or such

commercialization efforts may be significantly delayed, which could in turn significantly harm our business.

Defense of infringement claims, regardless of their merit, would involve substantial litigation expense and would be a substantial diversion of management and other employee resources from our business, and may impact our reputation. In the event of a successful claim of infringement against us, we may be enjoined from further developing or commercializing our infringing AXA Candidates, AXA Development Platform or other technologies. In addition, we may have to pay substantial damages, including treble damages and attorneys' fees for willful infringement, obtain one or more licenses from third parties, pay royalties and/or redesign our infringing AXA Candidates or technologies, which may be impossible or require substantial time and monetary expenditure. In that event, we would be unable to further develop and commercialize our AXA Candidates, AXA Development Platform or other technologies, which could harm our business significantly.

Engaging in litigation to defend against third parties alleging that we have infringed, misappropriated or otherwise violated their patents or other intellectual property rights is very expensive, particularly for a company of our size, and time-consuming. Some of our competitors may be able to sustain the costs of litigation or administrative proceedings more effectively than we can because of greater financial resources. Patent litigation and other proceedings may also absorb significant management time. Uncertainties resulting from the initiation and continuation of patent litigation or other proceedings against us could impair our ability to compete in the marketplace. The occurrence of any of the foregoing could have a material adverse effect on our business, financial condition or results of operations.

We may become involved in lawsuits to protect or enforce our patents and other intellectual property rights, which could be expensive, time-consuming and unsuccessful.

Competitors may infringe our patents, or we may be required to defend against claims of infringement. In addition, our patents also may become involved in inventorship, priority or validity disputes. To counter or defend against such claims can be expensive and time-consuming. In an infringement proceeding, a court may decide that a patent owned by us is invalid or unenforceable, the other party's use of our patented technology falls under the safe harbor to patent infringement under 35 U.S.C. §27(l)(1) or may refuse to stop the other party from using the technology at issue on the grounds that our owned patents do not cover the technology in question. An adverse result in any litigation proceeding could put one or more of our owned patents at risk of being invalidated or interpreted narrowly. Even if we establish infringement, the court may decide not to grant an injunction against further infringing activity and instead award only monetary damages, which may or may not be an adequate remedy. Furthermore, because of the substantial amount of discovery required in connection with intellectual property litigation, there is a risk that some of our confidential information could be compromised by disclosure during this type of litigation.

Even if resolved in our favor, litigation or other legal proceedings relating to intellectual property claims may cause us to incur significant expenses and could distract our personnel from their normal responsibilities. In addition, there could be public announcements of the results of hearings, motions or other interim proceedings or developments, and if securities analysts or investors perceive these results to be negative, it could have a substantial adverse effect on the price of our common stock. Such litigation or proceedings could substantially increase our operating losses and reduce the resources available for development activities or any future sales, marketing or distribution activities. We may not have sufficient financial or other resources to conduct such litigation or proceedings adequately. Some of our competitors may be able to sustain the costs of such litigation or proceedings more effectively than we can because of their greater financial resources and more mature and developed intellectual property portfolios. Uncertainties

resulting from the initiation and continuation of patent litigation or other proceedings could have a material adverse effect on our ability to compete in the marketplace.

If our trademarks and trade names are not adequately protected, then we may not be able to build name recognition in our markets of interest and our business may be adversely affected.

Our registered or unregistered trademarks or trade names may be challenged, infringed, circumvented or declared generic or determined to be infringing on other marks. We may not be able to protect our rights to these trademarks and trade names, which we need to build name recognition among potential partners or customers in our markets of interest. At times, competitors or other third parties may adopt trade names or trademarks similar to ours, thereby impeding our ability to build brand identity and possibly leading to market confusion. If we assert trademark infringement claims, a court may determine that the marks we have asserted are invalid or unenforceable, or that the party against whom we have asserted trademark infringement has superior rights to the marks in question. In this case, we could ultimately be forced to cease use of such trademarks. In addition, there could be potential trade name or trademark infringement claims brought by owners of other registered trademarks or trademarks that incorporate variations of our registered or unregistered trademarks or trade names. Over the long term, if we are unable to establish name recognition based on our trademarks and trade names, then we may not be able to compete effectively and our business may be adversely affected. Our efforts to enforce or protect our proprietary rights related to trademarks, trade secrets, domain names, copyrights or other intellectual property may be ineffective and could result in substantial costs and diversion of resources and could adversely affect our business, financial condition, results of operations and prospects.

Intellectual property rights do not necessarily address all potential threats.

The degree of future protection afforded by our intellectual property rights is uncertain because intellectual property rights have limitations and may not adequately protect our business or permit us to maintain our competitive advantage. For example:

- others may be able to make products that are similar to our AXA Candidates or utilize similar technology but that are not covered by the claims of the patents that we may own;
- we, or our future licensors or collaborators, might not have been the first to make the inventions covered by the issued patent or pending patent application that we own now or in the future;
- we, or our future licensors or collaborators, might not have been the first to file patent applications covering certain of our or their inventions;
- others may independently develop similar or alternative technologies or duplicate any of our technologies without infringing our owned intellectual property rights;
- it is possible that our current or future pending owned patent applications will not lead to issued patents;
- issued patents that we hold rights to may be held invalid or unenforceable, including as a result of legal challenges by our competitors or other third parties;
- our competitors or other third parties might conduct research and development activities in countries where we do not have patent rights and then use the information learned from such activities to develop competitive products for sale in our major commercial markets;
- we may not develop additional proprietary technologies that are patentable;

- the patents of others may harm our business; and
- we may choose not to file a patent in order to maintain certain trade secrets or know-how, and a third party may subsequently file a patent covering such intellectual property.

Should any of these events occur, they could have a material adverse effect on our business, financial condition, results of operations and prospects.

Risks related to our reliance on third parties

Third-party relationships are important to our business. If we are unable to enter into and maintain strategic collaborations or if these relationships are not successful, our business could be adversely affected.

We have limited capabilities for product development and do not yet have any capability for sales, marketing or distribution. Accordingly, we may need to enter into relationships with other companies to provide us with important technologies, and we may receive additional technologies and funding under these and other collaborations in the future. Relationships we enter into may pose a number of risks, including the following:

- third parties have, and future third-party collaborators may have, significant discretion in determining the efforts and resources that they will apply;
- third parties may not perform their obligations as expected;
- third parties may not pursue development and commercialization of any AXA Candidates that we decide to develop as drugs and that achieve regulatory approval or may elect not to continue or renew development or commercialization programs based on clinical study or trial results, changes in the third parties' strategic focus or available funding, or external factors, such as a strategic transaction that may divert resources or create competing priorities;
- third parties may delay Non-IND, IRB-Approved Clinical Studies or Clinical Trials, provide insufficient funding for a Non-IND, IRB-Approved Clinical Study or Clinical Trial program, stop a Non-IND, IRB-Approved Clinical Study or Clinical Trial or abandon an AXA Candidate, repeat or conduct Non-IND, IRB-Approved Clinical Studies or new Clinical Trials or require a new formulation of an AXA Candidate for clinical testing;
- third parties could independently develop, or develop with other third parties, products that compete directly or indirectly with our products and AXA Candidates if the third parties believe that the competitive products are more likely to be successfully developed or can be commercialized under terms that are more economically attractive than ours;
- AXA Candidates discovered in collaboration with us may be viewed by our current or future third parties as competitive with their own product candidates or products, which may cause such third parties to cease to devote resources to the commercialization of our AXA Candidates;
- third parties may fail to comply with applicable regulatory requirements regarding the development, manufacture, packaging, labeling, holding, distribution and/or marketing of an AXA Candidate or product;
- third parties with marketing and distribution rights to one or more of our AXA Candidates that achieve regulatory approval may not commit sufficient resources to the marketing and distribution of such product or products;

- disagreements with third parties, including disagreements over proprietary rights, contract interpretation or the preferred course of development, might cause delays or terminations of the research, development or commercialization of AXA Candidates, might lead to additional responsibilities for us with respect to AXA Candidates, or might result in litigation or arbitration, any of which would be time-consuming and expensive;
- third parties may not properly maintain or defend our intellectual property rights or may use our proprietary information in such a way as to invite litigation that could jeopardize or invalidate our intellectual property or proprietary information or expose us to potential litigation;
- third parties may infringe the intellectual property rights of third parties, which may expose us to litigation and potential liability;
- if one of our third parties is involved in a business combination, the collaborator might deemphasize or terminate the development or commercialization of any AXA Candidate licensed to it by us; and
- relationships may be terminated by the collaborator, and, if terminated, we could be required to raise additional capital to pursue further development or commercialization of the applicable AXA Candidates.

If our relationships do not result in the successful discovery, development and commercialization of products or if a third party terminates its agreement with us, we may not receive any future research funding or milestone or royalty payments under the collaboration. If we do not receive the funding we expect under any third party agreements we enter into, our development of our technology and AXA Candidates could be delayed and we may need additional resources to develop AXA Candidates and our technology. All of the risks relating to product development, regulatory compliance and/or approval and commercialization described in this prospectus also apply to the activities of any drug and non-drug collaborators we enter into relationships or agreements with in the future. Additionally, if any third party terminates its agreement with us, we may find it more difficult to attract new collaborators and our perception in the business and financial communities could be adversely affected.

Relationships are complex and time-consuming to negotiate and document. In addition, there have been a significant number of recent business combinations among large pharmaceutical companies that have resulted in a reduced number of potential future collaborators. We face significant competition in seeking appropriate collaborators. Our ability to reach a definitive agreement for a collaboration will depend, among other things, upon our assessment of the collaborator's resources and expertise, the terms and conditions of the proposed collaboration and the proposed collaborator's evaluation of a number of factors. If we are unable to reach agreements with suitable third parties on a timely basis, on acceptable terms, or at all, we may have to curtail the development of an AXA Candidate, reduce or delay its development program or one or more of our other development programs, delay its potential commercialization or reduce the scope of any sales or marketing activities, or increase our expenditures and undertake development or commercialization activities at our own expense. If we elect to increase our expenditures to fund development or commercialization activities on our own, we may need to obtain additional expertise and additional capital, which may not be available to us on acceptable terms, or at all. If we fail to enter into relationships or do not have sufficient funds or expertise to undertake the necessary development and commercialization activities, we may not be able to further develop our AXA Candidates, bring them to market and generate revenue from sales of drugs or continue to develop our technology, and our business may be materially and adversely affected.

We will rely on third parties to conduct our clinical trials for any AXA Candidate that we decide to develop as a drug product candidate and to assist us in meeting the regulatory requirements applicable to development and marketing of non-drug products. If these third parties do not successfully carry out their contractual duties or meet expected deadlines or comply with regulatory requirements, we may not be able to obtain regulatory approval of or commercialize any potential AXA Candidates.

We will depend upon third parties, including independent investigators, to conduct preclinical studies, Non-IND, IRB-Approved Clinical Studies and/or Clinical Trials under agreements with universities, medical institutions, CROs, strategic partners and others. We expect to have to negotiate budgets and contracts with CROs and study or trial sites, which may result in delays to our development timelines and increased costs.

We have, and will have to, rely heavily on third parties over the course of our Non-IND, IRB-Approved Clinical Studies and Clinical Trials and, as a result, will have limited control over the clinical investigators and limited visibility into their day-to-day activities, including with respect to their compliance with the approved clinical protocol. Nevertheless, we are responsible for ensuring that each of our Non-IND, IRB-Approved Clinical Studies and Clinical Trials is conducted in accordance with the applicable protocol, legal and regulatory requirements and scientific standards, and our reliance on third parties does not relieve us of our regulatory responsibilities. We and these third parties are required to comply with GCP requirements, which are regulations and guidelines enforced by the FDA and comparable foreign regulatory authorities for product candidates in clinical development. Regulatory authorities enforce these GCP requirements through periodic inspections of study or trial sponsors, clinical investigators and trial sites. If we or any of these third parties fail to comply with applicable GCP requirements, the clinical data generated in our Non-IND, IRB-Approved Clinical Studies or Clinical Trials may be deemed unreliable and the FDA or comparable foreign regulatory authorities may require us to suspend or terminate these Non-IND, IRB-Approved Clinical Studies or Clinical Trials or perform additional Non-IND, IRB-Approved Clinical Studies or Clinical Trials before approving our marketing applications. We cannot be certain that, upon inspection, such regulatory authorities will determine that any of our Non-IND, IRB-Approved Clinical Studies or Clinical Trials comply with the GCP or other applicable requirements. In addition, our Clinical Trials for therapeutic indications must be conducted with drug product produced under cGMP requirements and may require a large number of patients.

Our failure or any failure by these third parties to comply with these regulations or to recruit a sufficient number of subjects or patients may require us to repeat Non-IND, IRB-Approved Clinical Studies or Clinical Trials, which would delay the regulatory approval or commercialization process. Moreover, our business may be implicated if any of these third parties violates federal or state laws or regulations including fraud and abuse or false claims laws and regulations or healthcare privacy and security laws.

Any parties conducting our future Non-IND, IRB-Approved Clinical Studies or Clinical Trials, if any, generally will not be our employees and, except for remedies that may be available to us under our agreements with the third parties conducting such Non-IND, IRB-Approved Clinical Studies or Clinical Trials, if any, we cannot control whether or not they devote sufficient time and resources to our ongoing preclinical and clinical programs. These third parties may also have relationships with other commercial entities, including our competitors, for whom they may also be conducting Non-IND, IRB-Approved Clinical Studies or Clinical Trials or other product development activities, which could affect their performance on our behalf. If these third parties do not successfully carry out their contractual duties or obligations or meet expected deadlines, if they need to be replaced or if the quality or accuracy of the clinical data they obtain is compromised due to the failure to adhere to our clinical protocols or regulatory requirements or for other reasons, our Non-IND, IRB-Approved Clinical Studies and Clinical Trials may be extended, delayed or

terminated and we may not be able to complete development of, obtain regulatory approval of or successfully commercialize our AXA Candidates. As a result, our financial results and the commercial prospects for our AXA Candidates would be harmed, our costs could increase and our ability to generate revenue could be delayed.

If any of our relationships with these third-party CROs or others terminate, we may not be able to enter into contractual and other arrangements with alternative CROs or other third parties in a timely manner to meet projected clinical development deadlines or to do so on commercially reasonable terms. Switching or adding additional CROs involves additional cost and requires management time and focus. In addition, there is a natural transition period when a new CRO begins work. As a result, delays may occur, which can materially impact our ability to meet our desired clinical development timelines. Though we carefully manage our relationships with our CROs, there can be no assurance that we will not encounter similar challenges or delays in the future or that these delays or challenges will not have a material adverse impact on our business, financial condition and prospects.

Further, we expect to work with and/or rely upon third-party CROs and/or regulatory consultants to assist us with meeting regulatory requirements applicable to non-drug products. If we experience delays in meeting or fail to meet the regulatory requirements for commercialization of our AXA Candidates, the commercial prospects for our AXA Candidates may be harmed and our ability to generate revenues will be materially impaired.

We expect to rely on third parties to manufacture our supply of AXA Candidates, and we intend to rely on third parties to produce and process our products, if approved or commercialized.

We currently rely on outside vendors to supply raw materials and other important components, such as the amino acids and excipients that make up our AXA Candidates. We have not yet caused any AXA Candidates to be manufactured or processed on a large clinical or commercial scale and may not be able to do so for any of our AXA Candidates. We will make changes as we work to optimize the manufacturing process for our AXA Candidates, and we cannot be sure that even minor changes in the process will result in products that are safe and, where applicable, effective.

The facilities used to manufacture our AXA Candidates that we develop as drug product candidates must be approved by the FDA or other foreign regulatory agencies pursuant to inspections that will be conducted after we submit a marketing application to the FDA or other foreign regulatory agencies. Additionally, any facilities used for the manufacture of AXA Candidates commercialized for non-drug uses will be subject to registration and inspection by the FDA and foreign regulatory authorities. We do not currently control all aspects of the manufacturing process of, and are currently largely dependent on, our contract manufacturing partners for compliance with regulatory requirements, known as cGMP requirements, for manufacture of our AXA Candidates. If we ever decide to open a manufacturing facility, we will be responsible for compliance with cGMP requirements. If we or our contract manufacturers cannot successfully manufacture in conformance with our specifications and the strict regulatory requirements of the FDA or other regulatory authorities, we and they will not be able to secure and/or maintain regulatory approval for their manufacturing facilities with respect to the manufacture of our AXA Candidates. In addition, we have no control over the ability of our contract manufacturers to maintain adequate quality control, quality assurance and qualified personnel. If the FDA or a comparable foreign regulatory authority does not approve these facilities for the manufacture of our AXA Candidates, where applicable, or if it withdraws any such approval in the future, or if it otherwise finds that a manufacturing facility is out of regulatory compliance, we may need to find alternative manufacturing facilities, which would significantly impact our ability to research, develop, obtain regulatory approval, where necessary, for and/or market our AXA Candidates.

For more information, see "Risk Factors — Risks related to manufacturing and supply" below.

Risks related to manufacturing and supply

Our AXA Candidates rely on the availability of specialty raw materials, including significant quantities of amino acids, which may not be available to us on acceptable terms or at all.

Our AXA Candidates require certain specialty raw materials, including significant quantities of amino acids, some of which we may obtain from small companies with limited resources and experience to support a commercial product. The suppliers may be ill-equipped to support our needs, especially in non-routine circumstances like an FDA or foreign regulatory inspection or medical crisis, such as widespread contamination. Additionally, our suppliers may fail inspections or have other compliance issues with regulatory authorities that, even if unrelated to our supply chain and materials, may impact or cause delays in their ability to deliver agreed upon supplies in a timely manner which can have negative impacts on our business plans, including delays in initiating or continuing Non-IND, IRB-Approved Clinical Studies or Clinical Trials. We do not currently have supply contracts in place with all of the suppliers that we may need at any point in time in the future, and if needed, may not be able to contract with them on acceptable terms or at all, in particular for large quantities of pharmaceutical grade raw materials, including amino acids. Accordingly, we may experience delays in receiving key raw materials to support clinical or commercial manufacturing.

Our AXA Candidates require precise, high-quality manufacturing capabilities. If any of our third-party manufacturers encounter difficulties in manufacturing our AXA Candidates, our ability to provide supply of our AXA Candidates for Non-IND, IRB-Approved Clinical Studies or Clinical Trials or future commercial supply of products we bring to market under applicable regulatory requirements and approvals, could be delayed or stopped, or we may be unable to maintain a commercially viable cost structure.

We do not currently operate manufacturing facilities and rely on third parties under our existing contracts to produce our AXA Candidates. The manufacturing process used to produce our AXA Candidates has not been validated for clinical and commercial production. We combine multiple EMMs in novel combinations and ratios in our manufacturing process for AXA Candidates. These combinations may result in unanticipated manufacturing and product quality issues that we may not be able to resolve without incurring significant expense or delays in our Non-IND Clinical Studies or Clinical Trials, or at all. Furthermore, our cGMP manufacturing process development and scale-up is at an early stage. The actual cost to manufacture and process our AXA Candidates could be greater than we expect and could materially and adversely affect the commercial viability of our AXA Candidates.

Our manufacturing process may be susceptible to manufacturing issues associated with interruptions in the manufacturing process, contamination, equipment or reagent failure, improper installation or operation of equipment, vendor or operator error and variability in product characteristics. Even minor deviations from normal manufacturing processes could result in reduced production yields, lot failures, product defects, product recalls, product liability claims and other supply disruptions. If microbial, viral or other contaminations are discovered in our AXA Candidates or in the manufacturing facilities in which our AXA Candidates are made, production at such manufacturing facilities may be interrupted for an extended period of time to investigate and remedy the contamination. Further, as AXA Candidates are developed through preclinical, Non-IND, IRB-Approved Clinical Studies and, if we decide to develop any AXA Candidates as a drug product candidate, like we have done with AXA1665, Clinical Trials toward approval and commercialization, it is common that various aspects of the development program, such as manufacturing methods, are altered along the way in an effort to scale-up and optimize processes and results. Such changes carry the risk that they will not achieve these intended objectives, and any of these changes could cause our AXA Candidates to perform differently and affect the results of planned Clinical Trials or other future Clinical Trials.

Although we continue to optimize our manufacturing process for our AXA Candidates, doing so is a difficult and uncertain task, and there are risks associated with scaling to the level required for advanced Non-IND, IRB-Approved Clinical Studies and Clinical Trials or commercialization, including, among others, cost overruns, potential problems with process scale-up, process reproducibility, stability issues, lot consistency, supplier manufacturing capacity and timely availability of reagents and/or raw materials. We ultimately may not be successful in transferring our production system from our contract manufacturers to any manufacturing facilities we may establish ourselves or other contract manufacturers who can provide cost and process efficiencies, or our contract manufacturer may not have the necessary capabilities to complete the implementation and development process. If we are unable to adequately validate or scale-up the manufacturing process for our AXA Candidates with each of our current manufacturers, we will need to transfer to other manufacturers and complete the manufacturing validation and scale-up processes, which can be lengthy. If we are able to adequately validate and scale-up the manufacturing process for our AXA Candidates with a contract manufacturer, we will still need to negotiate with such contract manufacturer an agreement for commercial supply and it is not certain we will be able to come to agreement on terms acceptable to us. As a result, we may ultimately be unable to reduce the cost of goods for our AXA Candidates to levels that will allow for an attractive return on investment if and when those AXA Candidates are commercialized.

The manufacturing process for any AXA Candidates that we decide to develop as drug product candidates is subject to the FDA and foreign regulatory authority approval process, and extensive oversight of manufacturing facilities and changes to manufacturing processes. Non-drug products that we may develop will also be subject to extensive legal and regulatory requirements, including those with respect to the manufacturing, packaging, labeling, holding, processing and distribution of such products under appropriate cGMPs, as indicated in other risk factor sections herein. As such, we will need to contract with manufacturers who can meet all applicable FDA, foreign or other regulatory authority requirements on an ongoing basis, including with respect to quality systems and standards. If we or our CMOs are unable to reliably produce products under conditions and to specifications acceptable to the company and/or the FDA or other regulatory authorities, we may not obtain or maintain the ability or, in the case of drugs, the requisite approvals to commercialize such products. There is no assurance that our CMOs will be able to manufacture the approved product to specifications acceptable to us, the FDA, foreign or other regulatory authorities, even if we obtain regulatory approval for any of our AXA Candidates for therapeutic indications, to produce product in sufficient quantities to meet the requirements for the potential launch of the product or to meet potential future demand. In the case of AXA Candidates for which a therapeutic pathway is pursued, any of these challenges could delay completion of Clinical Trials, require bridging Clinical Trials or the repetition of one or more Clinical Trials, increase Clinical Trial costs and delay approval of our AXA Candidates. In the case of all AXA Candidates that we choose to commercialize, any of these challenges could delay and/or impair commercialization efforts, increase our cost of goods, and have an adverse effect on our business, financial condition, results of operations and growth prospects. Our future success depends on our ability to manufacture our AXA Candidates on a timely basis with acceptable manufacturing costs, while at the same time maintaining good quality control and complying with applicable regulatory requirements, and an inability to do so could have a material adverse effect on our business, financial condition and results of operations. In addition, we could incur higher manufacturing costs if manufacturing processes or standards change, and we could need to replace, modify, design or build and install equipment, all of which would require additional capital expenditures. Specifically, because our AXA Candidates may have a higher cost of goods than other drugs and/or non-drug products, the risk that coverage and reimbursement rates may be inadequate for us to achieve profitability may be greater.

In addition to raw materials and CMOs, we depend on third parties for clinical product supplies (e.g., clinical labeling and secondary packaging materials) and will likely need to do the same for any future commercial supply, including, in some instances, a single supplier.

In addition to raw materials and CMOs, we depend on third-party suppliers for labeling secondary packaging and other materials needed to produce Non-IND, IRB-Approved Clinical Study ready supplies of our AXA Candidates and will likely need to do the same for any future supplies for Clinical Trials or commercial supplies. These supplies may not always be available to us at the standards we require or on terms acceptable to us, or at all, and we may not be able to locate alternative suppliers in a timely manner, or at all. If we are unable to obtain necessary clinical or commercial supplies, our manufacturing operations and Non-IND, IRB-Approved Clinical Studies and Clinical Trials and the clinical studies and trials of our collaborators may be delayed or disrupted and our business and prospects may be materially and adversely affected as a result.

We may rely on a sole supplier for certain of our supplies. If this sole suppliers is unable to supply to us in the quantities we require, or at all, or otherwise defaults on its supply obligations to us, we may not be able to obtain alternative supplies from other suppliers on acceptable terms, in a timely manner, or at all.

We have limited experience manufacturing our AXA Candidates for purposes of Non-IND, IRB-Approved Clinical Studies, and have no experience manufacturing our AXA Candidates for the purposes of Clinical Trials, or at commercial scale, and if we decide to establish our own manufacturing facility for our AXA Candidates, we cannot assure you that we can manufacture our AXA Candidates in compliance with regulations at a cost or in quantities necessary to make them commercially viable.

We may establish a manufacturing facility for our AXA Candidates for use in Non-IND, IRB-Approved Clinical Studies, Clinical Trials, if any, or commercial sale. We have limited experience in cGMP compliant manufacturing of our AXA Candidates for purposes of Non-IND, IRB-Approved Clinical Studies and no experience manufacturing for Clinical Trials. We similarly have limited experience with the manufacturing requirements for non-drug products at a commercial scale. In the future, we may develop internal manufacturing capacity in part by expanding our own facilities or building additional facilities. This activity will require substantial additional funds and we would need to invest such funds in creating the proper manufacturing infrastructure and to hire and train a significant number of qualified employees to staff these facilities. We may not be able to develop cGMP-compliant manufacturing facilities that are adequate to produce materials for additional later-stage Non-IND, IRB-Approved Clinical Studies, Clinical Trials or commercialization.

The equipment and facilities employed in the manufacture of pharmaceuticals and non-drug products are subject to stringent qualification requirements by regulatory agencies, including validation of facility, equipment, systems, processes and analytics. We may be subject to lengthy delays and expense in conducting validation studies, if we can meet the requirements at all.

Risks related to our common stock and this offering

We do not know whether an active, liquid and orderly trading market will develop for our common stock or what the market price of our common stock will be and, as a result, it may be difficult for you to sell your shares of our common stock.

Prior to this offering there has been no public market for shares of our common stock. Although we have applied to list our common stock on The Nasdaq Global Market, an active trading market for our shares may never develop or be sustained following this offering. You may not be able to sell your shares quickly or at the market price if trading in shares of our common stock is not active. The initial public offering price for our common stock will be determined through negotiations with the underwriters, and the negotiated price may not be indicative of the market

price of the common stock after the offering. As a result of these and other factors, you may be unable to resell your shares of our common stock at or above the initial public offering price. Further, an inactive market may also impair our ability to raise capital by selling shares of our common stock and may impair our ability to enter into strategic partnerships or acquire companies or products by using our shares of common stock as consideration.

The price of our stock may be volatile, and you could lose all or part of your investment.

The trading price of our common stock following this offering is likely to be highly volatile and could be subject to wide fluctuations in response to various factors, some of which are beyond our control, including limited trading volume. In addition to the factors discussed in this "Risk Factors" section and elsewhere in this prospectus, these factors include:

- the commencement, enrollment or results of our ongoing and planned Non-IND, IRB-Approved Clinical Studies, or any future Non-IND, IRB-Approved Clinical Studies or Clinical Trials we may conduct, or changes in the development status of our AXA Candidates;
- any delay in our regulatory filings for our AXA Candidates and any adverse development or perceived adverse development with respect to the applicable regulatory authority's review of such filings;
- adverse results from or delays in Non-IND, IRB-Approved Clinical Studies or Clinical Trials of our AXA Candidates, including as a result of clinical holds, safety events, enrollment or study or trial protocol amendments;
- our decision to initiate a Non-IND, IRB-Approved Clinical Studies or Clinical Trial, not to initiate a Non-IND, IRB-Approved Clinical Study or Clinical Trial or to terminate an existing Non-IND, IRB-Approved Clinical Study or Clinical Trial;
- adverse regulatory decisions, including the FDA's disagreeing with our interpretation and application of applicable rules and regulations and any government actions that may arise from such disagreement and our failure to receive regulatory approval of our AXA Candidates for therapeutic indications or to proceed on alternate regulatory pathways to market for our AXA Candidates;
- changes in laws or regulations applicable to our products, including, but not limited to, clinical trial requirements for approvals of drugs or marketing of non-drug products;
- adverse developments concerning our manufacturers;
- our inability to obtain adequate product supply for any approved product or inability to do so at acceptable prices;
- our inability to establish collaborations, if needed;
- our failure to commercialize our AXA Candidates;
- additions or departures of key scientific or management personnel;
- unanticipated serious safety concerns related to the use of our AXA Candidates;
- introduction of new products or services by our competitors;
- announcements of significant acquisitions, strategic partnerships, joint ventures or capital commitments by us or our competitors;
- our ability to effectively manage our growth;
- the size and growth of our initial target markets;
- actual or anticipated variations in quarterly or annual operating results;
- our cash position;

- our failure to meet the estimates and projections of the investment community or that we may otherwise provide to the public;
- publication of research reports about us or our industry or positive or negative recommendations or withdrawal of research coverage by securities analysts;
- changes in the market valuations of similar companies;
- overall performance of the equity markets;
- sales of our common stock by us or our stockholders in the future;
- trading volume of our common stock;
- adoption of new accounting standards;
- ineffectiveness of our internal controls;
- disputes or other developments relating to proprietary rights, including patents, litigation matters and our ability to obtain patent protection for our technologies;
- significant lawsuits, including patent or stockholder litigation;
- general political and economic conditions; and
- other events or factors, many of which are beyond our control.

In addition, the stock market in general, and the market for healthcare companies in particular, has experienced extreme price and volume fluctuations that have often been unrelated or disproportionate to the operating performance of these companies. Broad market and industry factors may negatively affect the market price of our common stock, regardless of our actual operating performance. If the market price of our common stock after this offering does not exceed the initial public offering price, you may not realize any return on your investment in us and may lose some or all of your investment. In the past, securities class action litigation has often been instituted against companies following periods of volatility in the market price of a company's securities. This type of litigation, if instituted, could result in substantial costs and a diversion of management's attention and resources, which would harm our business, operating results or financial condition.

We do not intend to pay dividends on our common stock so any returns will be limited to the value of our stock.

We currently anticipate that we will retain future earnings for the development, operation and expansion of our business and do not anticipate declaring or paying any cash dividends for the foreseeable future. In addition, our ability to pay cash dividends is currently restricted by the terms of our loan and security agreement with Solar, and future debt or other financing arrangements may contain terms prohibiting or limiting the amount of dividends that may be declared or paid on our common stock. Any return to stockholders will therefore be limited in the foreseeable future to the appreciation of their stock.

Our principal stockholders and management own a significant percentage of our stock and will be able to exert significant control over matters subject to stockholder approval.

Immediately following the completion of this offering, based on shares of common stock outstanding as of December 31, 2018 on a pro forma basis, our current executive officers, directors and their affiliates and 5% stockholders will hold, in the aggregate, approximately 64.7% of our outstanding voting stock (assuming no exercise of the underwriters' option to purchase additional shares). Therefore, even after this offering, these stockholders will have the ability to influence us through this ownership position. These stockholders may be able to determine all matters requiring stockholder approval. For example, these stockholders may be able to control elections of directors, amendments of our organizational documents or approval of any merger, sale of assets

or other major corporate transaction. This may prevent or discourage unsolicited acquisition proposals or offers for our common stock that stockholders may feel are otherwise in their best interests.

If you purchase our common stock in this offering, you will incur immediate and substantial dilution in the net tangible book value of your shares.

The initial public offering price will be substantially higher than the pro forma as adjusted net tangible book value per share of our common stock after this offering. Investors purchasing common stock in this offering will pay a price per share that substantially exceeds the pro forma as adjusted net tangible book value per share after this offering. As a result, investors purchasing common stock in this offering will incur immediate dilution of \$15.94 per share, based on an assumed initial public offering price of \$21.00 per share, which is the midpoint of the price range set forth on the cover page of this prospectus, representing the difference between our pro forma as adjusted net tangible book value per share after giving effect to this offering and the assumed initial public offering price. Further, investors purchasing common stock in this offering will contribute approximately 27.5% of the total amount invested by stockholders since our inception, but will own only approximately 15.5% of the shares of common stock outstanding after this offering.

This dilution is due to our investors who purchased shares prior to this offering having paid substantially less when they purchased their shares than the price offered to the public in this offering. To the extent outstanding stock options or warrants are exercised, new stock options or warrants are issued or we issue additional shares of common stock in the future, there will be further dilution to new investors. As a result of the dilution to investors purchasing common stock in this offering, investors may receive significantly less than the purchase price paid in this offering, if anything, in the event of our liquidation. For a further description of the dilution that you will experience immediately after this offering, see "Dilution."

We are an emerging growth company, and we cannot be certain if the reduced reporting requirements applicable to emerging growth companies will make our common stock less attractive to investors.

We are an emerging growth company, as defined in the JOBS Act, enacted in April 2012. For as long as we continue to be an emerging growth company, we may take advantage of exemptions from various reporting requirements that are applicable to other public companies that are not emerging growth companies, including not being required to comply with the auditor attestation requirements of Section 404 of the Sarbanes-Oxley Act of 2002, as amended, or the Sarbanes-Oxley Act, reduced disclosure obligations regarding executive compensation in this prospectus and our periodic reports and proxy statements and exemptions from the requirements of holding nonbinding advisory votes on executive compensation and stockholder approval of any golden parachute payments not previously approved. We could be an emerging growth company for up to five years following the year in which we complete this offering, although circumstances could cause us to lose that status earlier. We will remain an emerging growth company until the earlier of (1) the last day of the fiscal year (a) following the fifth anniversary of the completion of this offering; (b) in which we have total annual gross revenue of at least \$1.07 billion; or (c) in which we are deemed to be a large accelerated filer, which requires the market value of our common stock that is held by non-affiliates to exceed \$700 million as of the prior June 30th; and (2) the date on which we have issued more than \$1.0 billion in non-convertible debt during the prior three-year period. We cannot predict if investors will find our common stock less attractive because we may rely on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock and our stock price may be more volatile.

Under the JOBS Act, emerging growth companies can also delay adopting new or revised accounting standards until such time as those standards apply to private companies. We have elected not to "opt out" of such extended transition period, which means that when a standard is issued or revised and it has different application dates for public or private companies, we may adopt the new or revised standard at the time private companies adopt the new or revised standard and may do so until such time that we either (i) irrevocably elect to "opt out" of such extended transition period or (ii) no longer qualify as an emerging growth company. This may make comparison of our financial statements with the financial statements of another public company that is not an emerging growth company, or an emerging growth company that has opted out of using the extended transition period, difficult or impossible because of the potential differences in accounting standards used.

We will incur significant increased costs as a result of operating as a public company, and our management will be required to devote substantial time to new compliance initiatives.

As a public company, we will incur significant legal, accounting and other expenses that we did not incur as a private company. We will be subject to the reporting requirements of the Securities Exchange Act of 1934, as amended, which will require, among other things, that we file with the SEC, annual, quarterly and current reports with respect to our business and financial condition. In addition, the Sarbanes-Oxley Act, as well as rules subsequently adopted by the SEC and The Nasdaq Global Market to implement provisions of the Sarbanes-Oxley Act, impose significant requirements on public companies, including requiring establishment and maintenance of effective disclosure and financial controls and changes in corporate governance practices. Further, in July 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act, or the Dodd-Frank Act, was enacted. There are significant corporate governance and executive compensation related provisions in the Dodd-Frank Act that require the SEC to adopt additional rules and regulations in these areas, such as "say on pay" and proxy access. Recent legislation permits emerging growth companies to implement many of these requirements over a longer period and up to five years from the pricing of this offering. We intend to take advantage of this new legislation but cannot guarantee that we will not be required to implement these requirements sooner than budgeted or planned and thereby incur unexpected expenses. Stockholder activism, the current political environment and the current high level of government intervention and regulatory reform may lead to substantial new regulations and disclosure obligations, which may lead to additional compliance costs and impact the manner in which we operate our business in ways we cannot currently anticipate.

We expect the rules and regulations applicable to public companies to substantially increase our legal and financial compliance costs and to make some activities more time-consuming and costly. If these requirements divert the attention of our management and personnel from other business concerns, they could have a material adverse effect on our business, financial condition and results of operations. The increased costs will decrease our net income or increase our net loss, and may require us to reduce costs in other areas of our business or increase the prices of our products or services. For example, we expect these rules and regulations to make it more difficult and more expensive for us to obtain director and officer liability insurance and we may be required to incur substantial costs to maintain the same or similar coverage. We cannot predict or estimate the amount or timing of additional costs we may incur to respond to these requirements. The impact of these requirements could also make it more difficult for us to attract and retain qualified persons to serve on our board of directors, our board committees or as executive officers.

Sales of a substantial number of shares of our common stock by our existing stockholders in the public market could cause our stock price to fall.

If our existing stockholders sell, or indicate an intention to sell, substantial amounts of our common stock in the public market after the lock-up and other legal restrictions on resale discussed in this prospectus lapse, the trading price of our common stock could decline. Based on shares of common stock outstanding as of April 20, 2019, upon the closing of this offering we will have outstanding a total of 22,998,513 shares of common stock. Of these shares, only the shares of common stock sold in this offering by us, plus any shares sold upon exercise of the underwriters' option to purchase additional shares, will be freely tradable without restriction in the public market immediately following this offering.

The lock-up agreements pertaining to this offering will expire 180 days from the date of this prospectus, subject to earlier release of all or a portion of the shares subject to such agreements by the representatives of the underwriters in their sole discretion. After the lock-up agreements expire, based upon the number of shares of common stock, on an as-converted basis, outstanding as of April 20, 2019, up to an additional 19,416,931 shares of common stock will be eligible for sale in the public market. Approximately 59.5% of these additional shares are held by directors, current executive officers and other affiliates and will be subject to certain limitations of Rule 144 under the Securities Act of 1933, as amended, or the Securities Act. If these additional shares of common stock are sold upon the expiration of the lockup and market stand-off agreements, or if it is perceived that they will be sold, or the early release therefrom, the trading price of our common stock could decline and it may be more difficult for you to sell your common stock at a time and price that you deem appropriate.

In addition, shares of common stock that are either subject to outstanding options or reserved for future issuance under our existing equity compensation plans will become eligible for sale in the public market to the extent permitted by the provisions of various vesting schedules, the lock-up agreements and Rule 144 and Rule 701 under the Securities Act. If these additional shares of common stock are sold, or if it is perceived that they will be sold, in the public market, the trading price of our common stock could decline. Additionally, the number of shares of our common stock reserved for issuance under our 2019 Stock Option and Incentive Plan will automatically increase on January 1, 2020 and each January 1 thereafter by 4% of the number of shares of common stock outstanding on the immediately preceding December 31 or such lesser number of shares determined by our compensation committee. Unless our board of directors elects not to increase the number of shares available for future grant each year, our stockholders may experience additional dilution.

After this offering, the holders of 17,356,437 shares of our common stock as of April 20, 2019 will be entitled to rights with respect to the registration of their shares under the Securities Act, subject to the 180-day lock-up agreements described above. See "Description of capital stock — Registration rights." Registration of these shares under the Securities Act would result in the shares becoming freely tradable without restriction under the Securities Act, except for shares held by affiliates, as defined in Rule 144 under the Securities Act, where offers and sales by affiliates are not registered. Any sales of securities by these stockholders could have a material adverse effect on the trading price of our common stock.

We have broad discretion in the use of our existing cash, cash equivalents and the net proceeds from this offering and may not use them effectively.

Our management will have broad discretion in the application of our existing cash, cash equivalents and the net proceeds from this offering, including for any of the purposes described in the section entitled "Use of Proceeds," and you will not have the right or opportunity as part of your investment decision to assess whether such proceeds are being used appropriately. Because

of the number and variability of factors that will determine our use of our existing cash, cash equivalents and the net proceeds from this offering, their ultimate use may vary substantially from their currently intended use. Our management might not apply our existing cash, cash equivalents and the net proceeds from this offering in ways that ultimately increase the value of your investment. The failure by our management to apply these funds effectively could harm our business. Pending their use, we may invest the net proceeds from this offering in short-term, investment-grade, interest-bearing securities. These investments may not yield a favorable return to our stockholders. If we do not invest or apply the net proceeds from this offering in ways that enhance stockholder value, we may fail to achieve expected financial results, which could cause our stock price to decline.

Our operating results may fluctuate significantly, which makes our future operating results difficult to predict and could cause our operating results to fall below expectations or our guidance.

Our quarterly and annual operating results may fluctuate significantly in the future, which makes it difficult for us to predict our future operating results. From time to time, we may enter into license or collaboration agreements with other companies that include development funding and significant upfront and milestone payments and/or royalties, which may become an important source of our revenue. Accordingly, our revenue may depend on development funding and the achievement of development and clinical milestones under current and any potential future license and collaboration agreements and sales of our products, if approved. These upfront and milestone payments may vary significantly from period to period and any such variance could cause a significant fluctuation in our operating results from one period to the next.

In addition, we measure compensation cost for stock-based awards made to employees, directors and non-employee consultants based on the fair value of the award on either the grant date or service completion date, and we recognize the cost as an expense over the recipient's service period. Because the variables that we use as a basis for valuing stock-based awards change over time, including our underlying stock price and stock price volatility, the magnitude of the expense that we must recognize may vary significantly.

Furthermore, our operating results may fluctuate due to a variety of other factors, many of which are outside of our control and may be difficult to predict, including the following:

- the timing and cost of, and level of investment in, research and development activities relating to our current and any future AXA Candidates, which will change from time to time;
- our ability to enroll subjects in Non-IND, IRB-Approved Clinical Studies or Clinical Trials and the timing of enrollment;
- the cost of manufacturing our current and any future AXA Candidates, which may vary depending on FDA guidelines and requirements, the quantity of production and the terms of our agreements with manufacturers;
- expenditures that we may incur to acquire or develop additional AXA Candidates and technologies;
- the timing and outcomes of Clinical Trials for our current AXA Candidates and any other future AXA Candidates or competing product candidates;
- competition from existing and potential future products that compete with our current AXA Candidates and any other future AXA Candidates, and changes in the competitive landscape of our industry, including consolidation among our competitors or partners;
- any delays in regulatory review or approval or commercialization of our current AXA Candidates or any other future AXA Candidates;

- the level of demand for our current AXA Candidates and any other future AXA Candidates, if approved, which may fluctuate significantly and be difficult to predict;
- the risk/benefit profile, cost and reimbursement policies with respect to our products, if approved, and existing and potential future products that compete with our current AXA Candidates and any other future AXA Candidates;
- our ability to commercialize our current AXA Candidates and any other future AXA Candidates inside and outside of the United States, either independently or working with third parties;
- our ability to adequately support future growth;
- potential unforeseen business disruptions that increase our costs or expenses;
- future accounting pronouncements or changes in our accounting policies; and
- the changing and volatile global economic environment.

The cumulative effect of these factors could result in large fluctuations and unpredictability in our quarterly and annual operating results. As a result, comparing our operating results on a period-to-period basis may not be meaningful. Investors should not rely on our past results as an indication of our future performance. This variability and unpredictability could also result in our failing to meet the expectations of industry or financial analysts or investors for any period. If our revenue or operating results fall below the expectations of analysts or investors or below any forecasts we may provide to the market, or if the forecasts we provide to the market are below the expectations of analysts or investors, the price of our common stock could decline substantially. Such a stock price decline could occur even when we have met any previously publicly stated revenue and/or earnings guidance we may provide.

Anti-takeover provisions under our charter documents and Delaware law could delay or prevent a change of control, which could limit the market price of our common stock and may prevent or frustrate attempts by our stockholders to replace or remove our current management.

Our restated certificate of incorporation and amended and restated bylaws, which are to become effective at or prior to the closing of this offering, contain provisions that could delay or prevent a change of control of our company or changes in our board of directors that our stockholders might consider favorable. Some of these provisions include:

- a board of directors divided into three classes serving staggered three-year terms, such that not all members of the board will be elected at one time;
- a prohibition on stockholder action through written consent, which requires that all stockholder actions be taken at a meeting of our stockholders;
- a requirement that special meetings of stockholders be called only by a majority of the total number of authorized directors;
- advance notice requirements for stockholder proposals and nominations for election to our board of directors;
- a requirement that no member of our board of directors may be removed from office by our stockholders except for cause and, in addition to any other vote required by law, upon the approval of not less than two-thirds of all outstanding shares of our voting stock then entitled to vote in the election of directors;
- a requirement of approval of not less than two-thirds of all outstanding shares of our voting stock to amend any bylaws by stockholder action or to amend specific provisions of our certificate of incorporation; and

- the authority of the board of directors to issue preferred stock on terms determined by the board of directors without stockholder approval and which preferred stock may include rights superior to the rights of the holders of common stock.

In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, which may prohibit certain business combinations with stockholders owning 15% or more of our outstanding voting stock. These anti-takeover provisions and other provisions in our restated certificate of incorporation and amended and restated bylaws could make it more difficult for stockholders or potential acquirers to obtain control of our board of directors or initiate actions that are opposed by the then-current board of directors and could also delay or impede a merger, tender offer or proxy contest involving our company. These provisions could also discourage proxy contests and make it more difficult for you and other stockholders to elect directors of your choosing or cause us to take other corporate actions you desire. Any delay or prevention of a change of control transaction or changes in our board of directors could cause the market price of our common stock to decline.

If securities or industry analysts do not publish research or publish inaccurate or unfavorable research about our business, our stock price and trading volume could decline.

The trading market for our common stock, if it ever develops, will depend in part on the research and reports that securities or industry analysts publish about us or our business. Securities and industry analysts do not currently, and may never, publish research on our company. If no securities or industry analysts commence coverage of our company, the trading price for our stock would likely be negatively impacted. In the event securities or industry analysts initiate coverage, if one or more of the analysts who cover us downgrades our stock or publishes inaccurate or unfavorable research about our business, our stock price may decline. If one or more of these analysts ceases coverage of our company or fails to publish reports on us regularly, demand for our stock could decrease, which might cause our stock price and trading volume to decline.

If we fail to maintain proper and effective internal control over financial reporting, our ability to produce accurate and timely financial statements could be impaired, investors may lose confidence in our financial reporting and the trading price of our common stock may decline.

Pursuant to Section 404 of Sarbanes-Oxley, our management will be required to report upon the effectiveness of our internal control over financial reporting beginning with the annual report for our fiscal year ending December 31, 2020. When we lose our status as an "emerging growth company," our independent registered public accounting firm will be required to attest to the effectiveness of our internal control over financial reporting. The rules governing the standards that must be met for management to assess our internal control over financial reporting are complex and require significant documentation, testing and possible remediation. To comply with the requirements of being a reporting company under the Exchange Act, we may need to implement additional financial and management controls, reporting systems and procedures and may need to hire additional accounting and finance staff.

We cannot assure you that there will not be material weaknesses or significant deficiencies in our internal control over financial reporting in the future. Any failure to maintain internal control over financial reporting could severely inhibit our ability to accurately report our financial condition, results of operations or cash flows. If we are unable to conclude that our internal control over financial reporting is effective, or if our independent registered public accounting firm determines we have a material weakness or significant deficiency in our internal control over financial reporting, investors may lose confidence in the accuracy and completeness of our financial reports, the market price of our common stock could decline, and we could be subject to sanctions or investigations by The Nasdaq Global Market, the SEC or other regulatory authorities. Failure to

remedy any material weakness in our internal control over financial reporting, or to implement or maintain other effective control systems required of public companies, could also restrict our future access to the capital markets.

If we engage in future acquisitions or strategic partnerships, this may increase our capital requirements, dilute our stockholders, cause us to incur debt or assume contingent liabilities and subject us to other risks.

We may evaluate various acquisition opportunities and strategic partnerships, including licensing or acquiring complementary products, intellectual property rights, technologies or businesses. Any potential acquisition or strategic partnership may entail numerous risks, including:

- increased operating expenses and cash requirements;
- the assumption of additional indebtedness or contingent liabilities;
- the issuance of our equity securities;
- assimilation of operations, intellectual property and products of an acquired company, including difficulties associated with integrating new personnel;
- the diversion of our management's attention from our existing product programs and initiatives in pursuing such a strategic merger or acquisition;
- retention of key employees, the loss of key personnel and uncertainties in our ability to maintain key business relationships;
- risks and uncertainties associated with the other party to such a transaction, including the prospects of that party and their existing products or product candidates and marketing approvals; and
- our inability to generate revenue from acquired technology and/or products sufficient to meet our objectives in undertaking the acquisition or even to offset the associated acquisition and maintenance costs.

In addition, if we undertake acquisitions, we may issue dilutive securities, assume or incur debt obligations, incur large one-time expenses and acquire intangible assets that could result in significant future amortization expense. Moreover, we may not be able to locate suitable acquisition opportunities, and this inability could impair our ability to grow or obtain access to technology or products that may be important to the development of our business.

Our amended and restated bylaws will designate specific courts as the exclusive forum for certain litigation that may be initiated by our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us.

Pursuant to our amended and restated bylaws, as will be in effect upon the completion of this offering, unless we consent in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware (or, if the Chancery Court does not have jurisdiction, the federal district court for the District of Delaware or other state courts of the State of Delaware) will be the sole and exclusive forum for state law claims for (i) any derivative action or proceeding brought on our behalf; (ii) any action asserting a claim of breach of a fiduciary duty or other wrongdoing by any of our directors, officers, employees or agents to us or our stockholders; (iii) any action asserting a claim against us arising pursuant to any provision of the Delaware General Corporation Law or our certificate of incorporation or bylaws; (iv) any action to interpret, apply, enforce or determine the validity of our certificate of incorporation or bylaws; or (v) any action asserting a claim governed by the internal affairs doctrine. This exclusive forum provision will not apply to any cases of action arising under the Securities Act or the Exchange Act. The forum selection clauses in our amended and restated bylaws may limit our stockholders' ability to obtain a favorable judicial forum for disputes with us.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This prospectus contains forward-looking statements that are based on management's beliefs and assumptions and on information currently available to management. Some of the statements in the section captioned "Prospectus summary," "Risk factors," "Management's discussion and analysis of financial condition and results of operations," "Business" and elsewhere in this prospectus contain forward-looking statements. In some cases, you can identify forward-looking statements by the following words: "may," "will," "could," "would," "should," "expect," "intend," "plan," "anticipate," "believe," "estimate," "predict," "project," "potential," "continue," "ongoing" or the negative of these terms or other comparable terminology, although not all forward-looking statements contain these words.

These statements involve risks, uncertainties and other factors that may cause actual results, levels of activity, performance or achievements to be materially different from the information expressed or implied by these forward-looking statements. Although we believe that we have a reasonable basis for each forward-looking statement contained in this prospectus, we caution you that these statements are based on a combination of facts and factors currently known by us and our projections of the future, about which we cannot be certain. Forward-looking statements in this prospectus include, but are not limited to, statements about:

- the success, cost and timing of our product development activities, preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials, including statements regarding the timing of initiation and completion of preclinical studies, Non-IND, IRB-Approved Clinical Studies or Clinical Trials and related preparatory work, and the timing of the availability of the results of these preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials;
- our ability to obtain funding for our operations, including funding necessary to complete further development of our initial AXA Candidates, and if successful, commercialization of these candidates as drug or non-drug products;
- the potential for our identified research priorities to advance our AXA Development Platform, development programs or AXA Candidates;
- our ability to obtain and maintain regulatory approval or find alternate regulatory commercialization pathways from the FDA, EMA and other regulatory authorities for our AXA Candidates, and any related restrictions, limitations or warnings in the label of an approved AXA Candidate;
- our expectations regarding our ability to obtain and maintain intellectual property protection for our AXA Candidates, AXA Development Platform and the direction of such protection;
- our ability and the potential to successfully manufacture our AXA Candidates for preclinical studies, Non-IND, IRB-Approved Clinical Studies and Clinical Trials and for commercial use, if approved;
- the size and growth potential of the markets for our AXA Candidates and our ability to serve those markets, either alone or in combination with others;
- the rate and degree of market acceptance of our AXA Candidates, if approved;
- regulatory developments in the United States and foreign countries;
- our ability to enter into a partnership or other agreement with a third party on reasonable terms or at all to commercialize any of our AXA Candidates, if approved;
- our ability to secure sufficient manufacturing and supply chain capacity;

- the success of competing products or therapies that are or may become available;
- our ability to attract and retain key scientific or management personnel;
- our estimates regarding expenses, future revenue, capital requirements and needs for additional financing; and
- our use of the proceeds from this offering.

In addition, you should refer to the "Risk Factors" section of this prospectus for a discussion of other important factors that may cause actual results to differ materially from those expressed or implied by the forward-looking statements. As a result of these factors, we cannot assure you that the forward-looking statements in this prospectus will prove to be accurate. Furthermore, if the forward-looking statements prove to be inaccurate, the inaccuracy may be material. In light of the significant uncertainties in these forward-looking statements, you should not regard these statements as a representation or warranty by us or any other person that we will achieve our objectives and plans in any specified time frame, or at all. The forward-looking statements in this prospectus represent our views as of the date of this prospectus. We anticipate that subsequent events and developments will cause our views to change. However, while we may elect to update these forward-looking statements at some point in the future, we have no current intention of doing so except to the extent required by applicable law. You should, therefore, not rely on these forward-looking statements as representing our views as of any date subsequent to the date of this prospectus.

INDUSTRY AND MARKET DATA

The market data and certain other statistical information used throughout this prospectus are based on independent industry publications, governmental publications, reports by market research firms or other independent sources that we believe to be reliable sources. Industry publications and third-party research, surveys and studies generally indicate that their information has been obtained from sources believed to be reliable, although they do not guarantee the accuracy or completeness of such information. We are responsible for all of the disclosure contained in this prospectus, and we believe these industry publications and third-party research, surveys and studies are reliable. While we are not aware of any misstatements regarding any third-party information presented in this prospectus, their estimates, in particular, as they relate to projections, involve numerous assumptions, are subject to risks and uncertainties and are subject to change based on various factors, including those discussed under the section entitled "Risk Factors" and elsewhere in this prospectus. Some data are also based on our good faith estimates.

USE OF PROCEEDS

We estimate that the net proceeds to us from the sale of the shares of our common stock in this offering will be approximately \$66.6 million, or approximately \$77.1 million if the underwriters exercise their option to purchase additional shares in full, based upon an assumed initial public offering price of \$21.00 per share, the midpoint of the price range set forth on the cover page of this prospectus, after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us.

A \$1.00 increase (decrease) in the assumed initial public offering price of \$21.00 per share, the midpoint of the price range set forth on the cover page of this prospectus, would increase (decrease) the net proceeds to us from this offering by approximately \$3.3 million, assuming the number of shares offered by us, as set forth on the cover page of this prospectus, remains the same. Similarly, an increase (decrease) of 1,000,000 shares in the number of shares offered by us would increase (decrease) the net proceeds to us from this offering by approximately \$19.5 million, assuming that the assumed initial public offering price remains the same. We do not expect that a change in the initial public offering price or the number of shares by these amounts would have a material effect on our uses of the proceeds from this offering, although it may accelerate the time at which we will need to seek additional capital.

We currently expect to use the net proceeds from this offering, together with our cash and cash equivalents as of March 31, 2019, as follows:

- approximately \$90.0 million to advance our current liver (AXA1665, AXA1125 and AXA1957) and other programs, including through additional Non-IND, IRB-Approved Clinical Studies, potential IND filing(s) and the ensuing Clinical Trials, including our planned IND filing and Clinical Trial for AXA1665, and infrastructure to support our pipeline;
- approximately \$30.0 million to advance our AXA Development Platform discovery efforts, intellectual property and associated infrastructure; and
- the remainder, if any, for working capital and other general corporate purposes.

As of March 31, 2019, we had \$66.7 million of cash and cash equivalents on hand, based on preliminary unaudited information and management estimates for the three months ended March 31, 2019. Based on our current plans, we believe our cash and cash equivalents as of March 31, 2019, together with the net proceeds from this offering, will be sufficient to fund our operating expenses and capital expenditure requirements through the second quarter of 2021. With our cash and cash equivalents as of March 31, 2019 and the net proceeds of this offering, we expect to be able to complete ongoing and planned Non-IND IRB-Approved Clinical Studies numbered AXA1665-002, AXA1125-003, AXA1957-002 and AXA4010-001; and file an IND for a Phase IIb/III AXA1665 Clinical Trial in HE, including if it is a registrational study. We have based these estimates on assumptions that may prove to be incorrect, and we could use our available capital resources sooner than we currently expect. In any event, we will require additional funding to be able to complete any Clinical Trial in HE, and we do not yet have any committed source of funding for this Clinical Trial. We may satisfy our future cash needs through the sale of equity securities, debt financings, working capital lines of credit, corporate collaborations or license agreements, grant funding, interest income earned on invested cash balances, or a combination of one or more of these sources.

We cannot specify with certainty all of the particular uses for the net proceeds to be received upon the completion of this offering. Due to uncertainties inherent in the development process, it is difficult to estimate the exact amounts of the net proceeds that will be used for any particular purpose. We may use our existing cash, cash equivalents and the future payments, if any, generated from any future collaboration agreements to fund our operations, either of which may

alter the amount of net proceeds used for a particular purpose. In addition, the amount, allocation and timing of our actual expenditures will depend upon numerous factors, including the results of our research and development efforts, the timing and success of our Non-IND, IRB-Approved Clinical Studies and Clinical Trials and the timing of regulatory submissions. Accordingly, we will have broad discretion in using these proceeds.

Pending their uses, we plan to invest the net proceeds of this offering in short-term, interest-bearing, investment-grade instruments, certificates of deposit or direct or guaranteed obligations of the U.S. government.

DIVIDEND POLICY

We have never declared or paid any cash dividends on our common stock or any other securities. We anticipate that we will retain all available funds and any future earnings, if any, for use in the operation of our business and do not anticipate paying cash dividends in the foreseeable future. In addition, our ability to pay cash dividends is currently restricted by the terms of our loan and security agreement with Solar, and future debt or other financing arrangements may contain terms prohibiting or limiting the amount of dividends that may be declared or paid on our common stock.

CAPITALIZATION

The following table sets forth our cash and cash equivalents and our capitalization as of December 31, 2018:

- on an actual basis;
- on a pro forma basis to give effect to (i) the conversion of all outstanding shares of our preferred stock into an aggregate of 14,641,997 shares of common stock upon the closing of this offering, (ii) all outstanding warrants to purchase shares of Series A preferred stock becoming warrants to purchase shares of common stock upon the closing of this offering and (iii) the filing and effectiveness of our restated certificate of incorporation in connection with this offering; and
- on a pro forma as adjusted basis to give further effect to our issuance and sale of 3,571,428 shares of common stock in this offering at an assumed initial public offering price of \$21.00 per share, which is the midpoint of the price range set forth on the cover page of this prospectus, after deducting estimated underwriting discounts, commissions and estimated offering expenses payable by us and the payment of the \$1.2 million success fee that is payable to Solar in connection with our loan and security agreement upon completion of this offering.

You should read the information in this table together with our consolidated financial statements and the related notes appearing at the end of this prospectus and the "Selected

Consolidated Financial Data" and "Management's Discussion and Analysis of Financial Condition and Results of Operations" sections of this prospectus.

	As of December 31, 2018		
	Actual	Pro Forma	Pro Forma As Adjusted
	(in thousands, except share and per share data)		
Cash and cash equivalents	\$ 79,466	\$ 79,466	\$ 146,106
Long term debt, net of discount	24,521	24,521	24,521
Other liabilities ⁽¹⁾	1,898	1,898	698
Warrant liability	425	—	—
Redeemable convertible preferred stock (Series A, B, B-1, C, D and E), \$0.001 par value; 27,928,825 shares authorized, 26,831,246 issued and outstanding, actual; no shares authorized, no issued or outstanding, pro forma and pro forma as adjusted	197,842	—	—
Stockholders' equity (deficit):			
Preferred stock, \$0.001 par value; no shares authorized, issued or outstanding, actual; 10,000,000 shares authorized; no shares issued or outstanding, pro forma and pro forma as adjusted	—	—	—
Common stock, \$0.001 par value; 47,000,000 shares authorized, 5,193,915 shares issued and 4,774,934 shares outstanding, actual; 47,000,000 shares authorized, 19,835,912 shares issued and 19,416,931 shares outstanding, pro forma; 150,000,000 shares authorized, 23,407,340 shares issued and 22,988,359 shares outstanding, pro forma as adjusted	6	19	23
Additional paid-in capital	7,290	205,544	273,380
Treasury stock, 418,981 shares at cost	—	—	—
Accumulated deficit	(157,049)	(157,049)	(157,049)
Total stockholders' equity (deficit)	(149,753)	48,514	116,354
Total capitalization	\$ 74,933	\$ 74,933	\$ 141,573

(1) Includes a \$1.2 million success fee relating to our loan and security agreement with Solar, which is payable upon the consummation of this offering.

A \$1.00 increase (decrease) in the assumed initial public offering price of \$21.00 per share, which is the midpoint of the price range set forth on the cover page of this prospectus, would increase (decrease) the pro forma as adjusted amount of each of cash and cash equivalents, additional paid-in capital, total stockholders' equity and total capitalization by \$3.3 million, assuming that the number of shares offered by us, as set forth on the cover page of this prospectus, remains the same and after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us. An increase (decrease) of 1,000,000 shares in the number of shares offered by us, as set forth on the cover page of this prospectus, would increase (decrease) the pro forma as adjusted amount of each of cash, cash equivalents, additional paid-in capital, total stockholders' equity and total capitalization by \$19.5 million, assuming no change in the assumed initial public offering price per share and after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us.

The table above does not include:

- 4,039,464 shares of common stock issuable upon the exercise of stock options outstanding as of December 31, 2018, at a weighted average exercise price of \$5.67 per share;
- 61,235 shares of common stock issuable upon the exercise of warrants outstanding as of December 31, 2018 to purchase shares of Series A preferred stock that will become warrants to purchase shares of common stock, at a weighted average exercise price of \$3.59 per share, in connection with this offering;
- 41,230 shares of common stock available for future issuance as of December 31, 2018 under our 2010 Plan, which will cease to be available for issuance at the time that our 2019 Plan becomes effective;
- 6,671,662 shares of common stock that will become available for future issuance under our 2019 Plan in connection with the effectiveness of the registration statement of which this prospectus is a part; and
- 237,181 shares of common stock that will become available for future issuance under our 2019 Employee Stock Purchase Plan in connection with the effectiveness of the registration statement of which this prospectus is a part.

DILUTION

If you invest in our common stock in this offering, your ownership interest will be diluted immediately to the extent of the difference between the initial public offering price per share of our common stock and the pro forma as adjusted net tangible book value per share of our common stock immediately after this offering.

Our historical net tangible book value (deficit) as of December 31, 2018 was \$(149.8) million, or \$(31.36) per share of our common stock. Our historical net tangible book value (deficit) is the amount of our total tangible assets less our total liabilities and the carrying values of our preferred stock, which is not included within stockholders' equity (deficit). Historical net tangible book value (deficit) per share represents historical net tangible book value (deficit) divided by the 4,774,934 shares of our common stock outstanding as December 31, 2018.

Our pro forma net tangible book value as of December 31, 2018 was \$48.5 million, or \$2.50 per share of our common stock. Pro forma net tangible book value (deficit) represents the amount of our total tangible assets less our total liabilities, after giving effect to (i) the conversion of all outstanding shares of our preferred stock into an aggregate of 14,641,997 shares of common stock upon the closing of this offering and (ii) all outstanding warrants to purchase shares of Series A preferred stock becoming warrants to purchase shares of common stock upon the closing of this offering. Pro forma net tangible book value per share represents pro forma net tangible book value divided by the total number of shares outstanding as of December 31, 2018, after giving effect to the pro forma adjustments described above.

After giving further effect to our issuance and sale of 3,571,428 shares of our common stock in this offering at the initial public offering price of \$21.00 per share and after deducting underwriting discounts and commissions and estimated offering expenses payable by us, our pro forma as adjusted net tangible book value as of December 31, 2018 would have been \$116.4 million, or \$5.06 per share. This represents an immediate increase in pro forma as adjusted net tangible book value per share of \$2.56 to existing stockholders and immediate dilution of \$15.94 in pro forma as adjusted net tangible book value per share to new investors purchasing common stock in this offering. Dilution per share to new investors is determined by subtracting pro forma as adjusted net tangible book value per share after this offering from the initial public offering price per share paid by new investors. The following table illustrates this dilution on a per share basis:

Assumed initial public offering price per share	\$ 21.00
Historical net tangible book value (deficit) per share as of December 31, 2018	\$ (31.36)
Increase per share attributable to the pro forma adjustments described above	33.86
Pro forma net tangible book value per share as of December 31, 2018	2.50
Increase in pro forma as adjusted net tangible book value per share attributable to new investors purchasing common stock in this offering	2.56
Pro forma as adjusted net tangible book value per share after this offering	5.06
Dilution per share to new investors purchasing common stock in this offering	<u>\$ 15.94</u>

If the underwriters exercise their option to purchase additional shares in full, our pro forma as adjusted net tangible book value per share after this offering would be \$5.39, representing an immediate increase in pro forma as adjusted net tangible book value per share of \$2.89 to existing stockholders and immediate dilution in pro forma as adjusted net tangible book value per share of \$15.61 to new investors purchasing common stock in this offering, based on the initial public offering price of \$21.00 per share and after deducting underwriting discounts and commissions and estimated offering expenses payable by us.

The following table summarizes, as of December 31, 2018, on the pro forma as adjusted basis described above, the total number of shares of common stock purchased from us on an as converted to common stock basis, the total consideration paid or to be paid, and the average price per share paid or to be paid by existing stockholders and by new investors in this offering at an assumed initial public offering price of \$21.00 per share, before deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us. As the table shows, new investors purchasing common stock in this offering will pay an average price per share substantially higher than our existing stockholders paid.

	Shares Purchased		Total Consideration		Average Price Per Share
	Number	Percentage	Amount	Percentage	
Existing shareholders	19,416,931	84.5%	\$ 198,012,594	72.5%	\$ 10.20
New investors	3,571,428	15.5	75,000,000	27.5	\$ 21.00
Total	22,988,359	100.0%	\$ 273,012,594	100.0%	

The table above assumes no exercise of the underwriters' option to purchase additional shares in this offering. If the underwriters' option to purchase additional shares is exercised in full, the number of shares of our common stock held by existing stockholders would be reduced to 82.5% of the total number of shares of our common stock outstanding after this offering, and the number of shares of common stock held by new investors purchasing common stock in this offering would be increased to 17.5% of the total number of shares of our common stock outstanding after this offering.

The tables and discussion above are based on the number of shares of our common stock outstanding as of December 31, 2018, and exclude:

- 4,039,464 shares of common stock issuable upon the exercise of stock options outstanding as of December 31, 2018, at a weighted average exercise price of \$5.67 per share;
- 61,235 shares of common stock issuable upon the exercise of warrants outstanding as of December 31, 2018 to purchase shares of Series A preferred stock that will become warrants to purchase shares of common stock, at a weighted average exercise price of \$3.59 per share, in connection with this offering;
- 41,230 shares of common stock available for future issuance as of December 31, 2018 under our 2010 Plan, which will cease to be available for issuance at the time that our 2019 Plan becomes effective;
- 6,671,662 shares of common stock that will become available for future issuance under our 2019 Plan in connection with the effectiveness of the registration statement of which this prospectus is a part; and
- 237,181 shares of common stock that will become available for future issuance under our 2019 Employee Stock Purchase Plan in connection with the effectiveness of the registration statement of which this prospectus is a part.

To the extent that outstanding stock options or warrants are exercised, new stock options or warrants are issued or we issue additional shares of common stock in the future, there will be further dilution to new investors. In addition, we may choose to raise additional capital because of market conditions or strategic considerations, even if we believe that we have sufficient funds for our current or future operating plans. If we raise additional capital through the sale of equity or convertible debt securities, the issuance of these securities could result in further dilution to our stockholders.

SELECTED CONSOLIDATED FINANCIAL DATA

You should read the following selected consolidated financial data together with our consolidated financial statements and the related notes appearing at the end of this prospectus and the "Management's Discussion and Analysis of Financial Condition and Results of Operations" section of this prospectus. We have derived the consolidated statements of operations data for the years ended December 31, 2017 and 2018 and the consolidated balance sheet data as of December 31, 2018 from our audited consolidated financial statements appearing at the end of this prospectus. Our historical results are not necessarily indicative of the results that may be expected in the future.

	December 31,	
	2017	2018
	(in thousands, except share and per share data)	
Consolidated Statements of Operations Data:		
Operating expenses:		
Research and development	\$ 22,916	\$ 25,486
General and administrative	6,005	8,410
Total operating expenses	28,921	33,896
Loss from operations	(28,921)	(33,896)
Other income (expense):		
Change in fair value of preferred stock warrant liability	81	(14)
Interest income (expense), net	(2,100)	(2,159)
Total other income (expense), net	(2,019)	(2,173)
Net loss	\$ (30,940)	\$ (36,069)
Net loss per share, basic and diluted ⁽¹⁾	\$ (7.37)	\$ (7.97)
Weighted average common shares outstanding, basic and diluted ⁽¹⁾	4,211,918	4,546,373
Pro forma net loss per share, basic and diluted (unaudited) ⁽¹⁾		\$ (2.19)
Pro forma weighted average common shares outstanding, basic and diluted (unaudited) ⁽¹⁾		16,528,448

⁽¹⁾ See Note 11 to our consolidated financial statements appearing at the end of this prospectus for details on the calculation of basic and diluted net loss per share and the calculation of basic and diluted pro forma net loss per share.

	December 31,	
	2017	2018
	(in thousands)	
Consolidated Balance Sheet Data:		
Cash and cash equivalents	\$ 46,817	\$ 79,466
Working capital ⁽¹⁾	41,977	73,390
Total assets	48,813	81,844
Long term debt, net of discount	19,557	24,521
Other liabilities ⁽²⁾	1,276	1,898
Preferred stock warrant liability	411	425
Redeemable convertible preferred stock	138,828	197,842
Total stockholders' equity (deficit)	(116,354)	(149,753)

⁽¹⁾ We define working capital as current assets less current liabilities.

⁽²⁾ Includes a \$1.2 million success fee relating to our loan and security agreement with Solar, which is payable upon the consummation of this offering.

MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

You should read the following discussion and analysis of our financial condition and results of operations together with the "Selected Consolidated Financial Data" section of this prospectus and our consolidated financial statements and related notes appearing elsewhere in this prospectus. Some of the information contained in this discussion and analysis or set forth elsewhere in this prospectus, including information with respect to our plans and strategy for our business and related financing, includes forward-looking statements that involve risks and uncertainties. As a result of many factors, including those factors set forth in the "Risk Factors" section of this prospectus, our actual results could differ materially from the results described in or implied by the forward-looking statements contained in the following discussion and analysis.

Overview

We are a biotechnology company pioneering the research and development of novel multifactorial interventions to support health and address dysregulated metabolism across a broad spectrum of consumers and patients who have limited options. Our AXA Candidates are generated from our proprietary, human-focused AXA Development Platform and harness the power of EMMs, a broad family of molecules that fundamentally impact and regulate human metabolism.

Using our AXA Development Platform, we have rapidly generated a pipeline of AXA Candidates that are novel compositions of EMMs engineered in distinct ratios and designed to target and maximize the fundamental role that EMMs play in regulating multiple metabolic functions. Our AXA Candidates are administered orally and anchored by amino acids, which have a history of safe use as food. As such, we expect our AXA Candidates may also be combinable with other modalities. We believe our current dataset supports the potential of our AXA Candidates to support and modulate the metabolic pathways they target with favorable safety profiles. These features may make them an attractive development opportunity with significant commercial potential.

To date, we have funded our operations with proceeds from the sale of preferred stock and borrowing of debt. Through December 31, 2018, we had received gross proceeds of \$197.8 million from sales of our preferred stock and \$26.0 million from borrowings under a loan and security agreement. Since our inception, we have incurred significant operating losses. Our ability to generate product revenue sufficient to achieve profitability or even any product revenue will depend on the successful development and eventual commercialization of one or more of our AXA Candidates. We reported net losses of \$30.9 million and \$36.1 million for the years ended December 31, 2017 and 2018, respectively. We expect to continue to incur significant expenses and increasing operating losses and capital requirements for at least the next several years in connection with our ongoing activities, particularly if and as we conduct clinical trials for our AXA Candidates as we:

- further develop our AXA Development Platform;
- continue to discover and develop additional AXA Candidates;
- maintain, expand and protect our intellectual property portfolio;
- hire additional clinical, scientific manufacturing and commercial personnel;
- establish a commercial manufacturing source and secure supply chain capacity sufficient to provide commercial quantities of any AXA Candidates for which we may obtain regulatory approval;

- seek regulatory approvals for any AXA Candidates for which we make a drug development path decision, as we have done with AXA1665, and that successfully complete Clinical Trials;
- establish a sales, marketing and distribution infrastructure to commercialize any products for which we may obtain regulatory approval;
- potentially acquire or in-license other product candidates and technologies; and
- add operational, financial and management information systems and personnel, including personnel to support our product development and planned future commercialization efforts, as well as to support our transition to being a public company.

Regulatory agencies, including the FDA, regulate many aspects of a product candidate's life cycle, including research and development and clinical testing. We will not generate revenue from product sales unless and until we successfully complete clinical development and obtain regulatory approval for our AXA Candidates or choose to market an AXA Candidate as a non-drug product. If we obtain regulatory approval for any of our AXA Candidates, we expect to incur significant expenses related to developing our commercialization capabilities to support product sales, marketing and distribution. Further, following the closing of this offering, we expect to incur additional costs associated with operating as a public company.

As a result, we will need substantial additional funding to support our continuing operations and pursue our growth strategy. Until such time as we can generate significant revenue from product sales, if ever, we expect to finance our operations through a combination of equity offerings, debt financings, strategic alliances and marketing, distribution or licensing arrangements. We may be unable to raise additional funds or enter into such other agreements or arrangements when needed on favorable terms, or at all. If we fail to raise capital or enter into such agreements as, and when, needed, we may have to significantly delay, scale back or discontinue the development and commercialization of one or more of our AXA Candidates.

Because of the numerous risks and uncertainties associated with pharmaceutical product development, we are unable to accurately predict the timing or amount of increased expenses or when, or if, we will be able to achieve or maintain profitability. Even if we are able to generate product sales, we may not become profitable. If we fail to become profitable or are unable to sustain profitability on a continuing basis, then we may be unable to continue our operations at planned levels and be forced to reduce or terminate our operations.

We believe that the net proceeds from this offering, together with our existing cash and cash equivalents, will enable us to fund our operating expenses, capital expenditure requirements, and debt service payments through the second quarter of 2021. See "—Liquidity and capital resources."

Components of our results of operations

Revenue

To date, we have not generated any revenue from product sales and do not expect to generate any revenue from the sale of products in the near future. If our development efforts for our AXA Candidates are successful and result in regulatory approval or we execute license or collaboration agreements with third parties, we may generate revenue in the future from product sales, payments from collaborations or license agreements that we may enter into with third parties, or any combination thereof.

Operating expenses

Research and development expenses

Our research and development expenses consist primarily of costs incurred in connection with our research activities, including our drug discovery efforts, and the development of our AXA Candidates, which include:

- employee-related expenses, including salaries, related benefits and stock-based compensation expense for employees engaged in research and development functions;
- expenses incurred in connection with the preclinical and clinical development of our AXA Candidates, including any Non-IND, IRB-Approved Clinical Studies and research programs, including under agreements with third parties, such as consultants, contractors and contract research organizations, or CROs;
- the cost of developing and scaling our manufacturing process and manufacturing products for use in our preclinical studies and Non-IND, IRB-Approved Clinical Studies, including under agreements with third parties, such as consultants, contractors and contract manufacturing organizations, or CMOs;
- laboratory supplies and research materials;
- facilities, depreciation and other expenses, which include direct and allocated expenses for rent and maintenance of facilities and insurance; and
- costs related to compliance with regulatory requirements as well as costs to protect our intellectual property.

We expense research and development expenses as incurred. Advance payments that we make for goods or services to be received in the future for use in research and development activities are recorded as prepaid expenses. The prepaid amounts are expensed as the related goods are delivered or the services are performed.

Our direct external research and development expenses are tracked on a program-by-program basis and consist of costs that include fees, reimbursed materials and other costs paid to consultants, contractors, CMOs and CROs in connection with our preclinical and clinical development and manufacturing activities. We do not allocate employee costs, costs associated with our discovery efforts, laboratory supplies and facilities expenses, including depreciation or other indirect costs, to specific product development programs because these costs are deployed across multiple programs, as well as our platform technology and, as such, are not separately classified.

AXA Candidates in later stages of clinical development generally have higher development costs than those in earlier stages of clinical development, primarily due to the increased size, scope and duration of later-stage Clinical Trials. We expect that our research and development expenses will increase substantially in connection with our planned preclinical and clinical development activities both in the near-term and beyond. At this time, we cannot accurately estimate or know the nature, timing and costs of the efforts that will be necessary to complete the preclinical and clinical development of any of our AXA Candidates, as the successful development and commercialization of our AXA Candidates is highly uncertain. This is due to the numerous risks and uncertainties associated with product development and commercialization, including the following:

- the timing and progress of preclinical and clinical development activities;
- the number and scope of preclinical and clinical programs we decide to pursue;

- the progress of the development efforts of parties with whom we may enter into collaboration arrangements;
- our ability to maintain our current research and development programs and to establish new ones;
- our ability to establish new licensing or collaboration arrangements for both drug and non-drug products;
- FDA clinical and other requirements for the receipt and related terms of regulatory approval;
- the successful initiation and completion of Non-IND, IRB-Approved Clinical Studies or Clinical Trials, with safety, tolerability and efficacy profiles that are satisfactory to the FDA or any comparable foreign regulatory authority;
- the receipt and related terms of regulatory approvals from applicable regulatory authorities;
- the availability of specialty raw materials for use in production of our AXA Candidates;
- our ability to consistently manufacture our AXA Candidates for use in Non-IND, IRB-Approved Clinical Studies or Clinical Trials;
- our ability to establish and secure manufacturing supply through relationships with third parties;
- our ability to protect our rights in our intellectual property portfolio and maintain trade secret protection and regulatory exclusivity, both in the United States and internationally;
- the commercialization of our AXA Candidates, if and when approved;
- obtaining and maintaining third-party insurance coverage and adequate reimbursement;
- the acceptance of our AXA Candidates, if approved, by patients, the medical community, third-party payors or other parties, such as consumers;
- our ability to raise additional funds necessary to complete preclinical and clinical development of and commercialize our AXA Candidates;
- competition with other products; and
- a continued acceptable safety profile of our therapies following approval.

A change in the outcome of any of these variables with respect to the development of any of our AXA Candidates could significantly change the costs and timing associated with the development of that AXA Candidate. We may never succeed in obtaining regulatory approval for any of our AXA Candidates.

General and administrative expenses

General and administrative expenses consist primarily of salaries and related costs, including stock-based compensation, for personnel in executive, finance and administrative functions. General and administrative expenses also include direct and allocated facility-related costs including information technology, as well as professional fees for legal, consulting, investor and public relations, accounting and audit services. We anticipate that our general and administrative expenses will increase in the future as we expand our organization to support the continued research and development activities of our AXA Candidates. We also anticipate that we will incur increased accounting, audit, legal, regulatory, compliance and director and officer insurance costs as well as investor and public relations expenses associated with operating as a public company.

Other income (expense)

Interest expense, net

Interest expense consists of interest expense on outstanding borrowings under our loan and security agreement as well as amortization of debt discount and debt issuance costs. Interest income has historically been insignificant and consists of interest earned on our invested cash balances. We expect our interest income to increase compared to the year ended December 31, 2018 as we invest the cash received from the sale of Series E Preferred Stock in November 2018 and the net proceeds from this offering.

Change in fair value of preferred stock warrant liability

In connection with the issuance of debt in 2012, we issued warrants to purchase Series A preferred stock. We classify these warrants as a liability on our consolidated balance sheet that we remeasure to fair value as of each reporting date, and we recognize changes in the fair value of the warrant liability as a component of other income (expense) in our consolidated statements of operations. We will continue to recognize changes in the fair value of the warrant liability until the warrants are exercised, expire or qualify for equity classification.

Upon the closing of this offering, the preferred stock warrants will become exercisable for common stock instead of preferred stock, and the fair value of the warrant liability at that time will be reclassified to additional paid-in capital. As a result, subsequent to the closing of this offering, we will no longer remeasure the fair value of the warrant liability at each reporting date.

Income taxes

Since our inception, we have not recorded any income tax benefits for the net losses we have incurred in each year or for our research and development tax credits, as we believe, based upon the weight of available evidence, that it is more likely than not that all of our net operating loss carryforwards and tax credits will not be realized. As of December 31, 2018, we had U.S. federal and state net operating loss carryforwards of \$140.6 million and \$139.4 million, respectively, which may be available to offset future taxable income and begin to expire in 2030. As of December 31, 2018, we also had U.S. federal and state research and development tax credit carryforwards of \$4.2 million and \$1.6 million, respectively, which may be available to offset future tax liabilities and will expire at various dates through 2038. We have recorded a full valuation allowance against our net deferred tax assets at each balance sheet date.

On December 22, 2017, the Tax Cuts and Jobs Act, or the TCJA, was signed into United States law. The TCJA includes a number of changes to existing tax law, including, among other things, a permanent reduction in the federal corporate income tax rate from a top marginal tax rate of 35% to a flat rate of 21%, effective as of January 1, 2018, as well as limitation of the deduction for net operating losses to 80% of annual taxable income and elimination of net operating loss carrybacks, in each case, for losses arising in taxable years beginning after December 31, 2017, although any such net operating losses may be carried forward indefinitely.

Results of operations

Comparison of the years ended December 31, 2017 and 2018

The following table summarizes our results of operations for the years ended December 31, 2017 and 2018:

	2017	2018	Change
	(in thousands)		
Revenue	\$ —	\$ —	\$ —
Operating expenses:			
Research and development	22,916	25,486	2,570
General and administrative	6,005	8,410	2,405
Total operating expenses	28,921	33,896	4,975
Loss from operations	(28,921)	(33,896)	(4,975)
Other income (expense):			
Change in fair value of preferred stock warrant liability	81	(14)	(95)
Interest income (expense), net	(2,100)	(2,159)	(59)
Total other expense, net	(2,019)	(2,173)	(154)
Net loss	\$ (30,940)	\$ (36,069)	\$ (5,129)

Research and development expenses

	Year ended December 31,		Change
	2017	2018	
	(in thousands)		
Direct research and development expenses by program:			
AXA1665	\$ —	\$ 2,012	\$ 2,012
AXA1125/1957	1,747	3,689	1,942
AXA2678	657	356	(301)
Platform development, early-stage research and unallocated expenses:			
Personnel related	9,375	9,265	(110)
Stock-based compensation expense	604	1,091	487
External manufacturing and research	4,919	3,018	(1,901)
Laboratory supplies and research materials	825	1,031	206
Facility related and other	4,789	5,024	235
Total research and development expenses	\$ 22,916	\$ 25,486	\$ 2,570

Research and development expenses were \$22.9 million for the year ended December 31, 2017, compared to \$25.5 million for the year ended December 31, 2018. The increase in direct costs related to our AXA1665 program of \$2.0 million was primarily due to costs incurred with external CROs and CMOs for the Non-IND, IRB-Approved Clinical Studies conducted in 2018. The increase in direct costs related to our AXA1125 and AXA1957 program was due to the Non-IND, IRB-Approved Clinical Study achieving full enrollment and completing during 2018. The increase in stock-based compensation expense of \$0.5 million was primarily due to an increase in the number of awards granted and the per share fair value of such awards. The decrease in external manufacturing and research costs of \$1.9 million was a result of lower use of material to support our Non-IND, IRB-Approved Clinical Studies. The increase in laboratory supplies and research materials of \$0.2 million was primarily due to expansion of our *in vitro* capabilities. The increase in

facility-related and other expenses of \$0.2 million was primarily due to increased rent and expanded operations.

General and administrative expenses

	Year ended December 31,		
	2017	2018	Change
	(in thousands)		
Personnel related	\$ 3,792	\$ 4,462	\$ 670
Stock-based compensation expense	642	1,690	1,048
Professional and consultant fees	1,105	1,848	743
Facility related and other	466	410	(56)
Total general and administrative expenses	<u>\$ 6,005</u>	<u>\$ 8,410</u>	<u>\$ 2,405</u>

General and administrative expenses for the year ended December 31, 2017 were \$6.0 million, compared to \$8.4 million for the year ended December 31, 2018. The increase in general and administrative expenses of \$2.4 million was primarily due to growth of operations and clinical programs and required personnel and professional services to support that growth. The increase in stock-based compensation expense of \$1.0 million was primarily due to an increase in the number of awards granted and the per share fair value of such awards. Personnel-related costs increased by \$0.7 million primarily due to the hiring of key executives in 2018, including our Chief Executive Officer and Chief Business Officer, as well as additional personnel in our general and administrative functions as we continued to expand our operations to support the organization. Professional and consultant fees increased by \$0.7 million primarily due to expanded operations.

Liquidity and capital resources

Since our inception, we have incurred significant operating losses. We have not yet commercialized any of our AXA Candidates, and we do not expect to generate revenue from sales of any AXA Candidates for several years, if at all. To date, we have funded our operations with proceeds from the sales of preferred stock and borrowings under our loan and security agreement. Through December 31, 2018, we had received gross proceeds of \$197.8 million from sales of our preferred stock and \$26.0 million from borrowings under a loan and security agreement. As of December 31, 2018, we had cash and cash equivalents of \$79.5 million.

Cash flows

The following table summarizes our sources and uses of cash for each of the periods presented:

	Year ended December 31,	
	2017	2018
Cash used in operating activities	\$ (26,861)	\$ (30,712)
Cash used in investing activities	(915)	(586)
Cash provided by financing activities	25,697	63,947
Net increase (decrease) in cash and cash equivalents	<u>\$ (2,079)</u>	<u>\$ 32,649</u>

Operating activities

During the year ended December 31, 2018, operating activities used \$30.7 million of cash, primarily resulting from our net loss of \$36.9 million, partially offset by net non-cash charges of \$4.4 million, primarily consisting of stock-based compensation expense, and net cash provided by

changes in our operating assets and liabilities of \$1.0 million. Net cash provided by changes in our operating assets and liabilities for the year ended December 31, 2018 consisted primarily of a \$1.6 million increase in accounts payable and accrued expenses, partially offset by a \$0.6 million increase in prepaid expenses and other current assets.

During the year ended December 31, 2017, operating activities used \$26.9 million of cash, primarily resulting from our net loss of \$30.9 million, partially offset by net non-cash charges of \$2.9 million and net cash provided by changes in our operating assets and liabilities of \$1.2 million. Net cash provided by changes in our operating assets and liabilities for the year ended December 31, 2017 consisted primarily of a \$1.1 million increase in accounts payable and accrued expenses.

Investing activities

During the years ended December 31, 2017 and 2018, net cash used in investing activities was \$0.9 million and \$0.6 million, respectively, due to purchases of property and equipment. The purchases of property and equipment during the year ended December 31, 2018 related to equipment purchases associated with the expansion of our AXA Development Platform and other research and development capabilities.

Financing activities

During the year ended December 31, 2018, net cash provided by financing activities was \$63.9 million, consisting primarily of proceeds from the issuance of preferred stock of \$58.9 million and borrowings of \$6.0 million under our current loan and security agreement.

During the year ended December 31, 2017, net cash provided by financing activities was \$25.7 million, consisting primarily of proceeds from the issuance of Series C Preferred Stock.

Loan and security agreement

At December 31, 2018, we had \$26.0 million in outstanding long term debt. In October 2018, we amended the 2018 Facility, or the Amended 2018 Facility, to extend the interest only period through July 2020 or January 2021 and the Maturity Date to July 2022 or January 2023 if certain conditions are met. The Amended 2018 Facility provides additional funding in the amounts of \$5.0 million, in the Term B Loan, and \$4.0 million, in the Term C Loan, if certain conditions are met. The Term B Loan of \$5.0 million was drawn in December 2018. Monthly principal payments of \$1.1 million will commence August 2020 for 24 months. The terminal interest fee was amended to 5.35% (\$1.4 million) and is due with the final principal payment of the loan. We granted the lender a first security interest in all of our assets, excluding intellectual property and granted a negative pledge on such intellectual property. The interest rate and success fee were not changed through the amendment.

Funding requirements

We expect our expenses to increase substantially in connection with our ongoing activities, particularly as we advance the preclinical activities, Non-IND, IRB-Approved Clinical Studies and Clinical Trials for our AXA Candidates in development. In addition, upon the closing of this offering, we expect to incur additional costs associated with becoming and operating as a public company. The timing and amount of our operating and capital expenditures will depend largely on:

- the timing and progress of preclinical and clinical development activities;
- the commencement, enrollment or results of the planned Non-IND, IRB-Approved Clinical Studies of our AXA Candidates or any future or additional Non-IND, IRB-Approved Clinical Studies or Clinical Trials we may conduct or may be required to conduct, or changes in the development status of our AXA Candidates;

- the timing and outcome of regulatory review of our AXA Candidates;
- our decision to initiate a Non-IND, IRB-Approved Clinical Study or Clinical Trial, not to initiate a Non-IND, IRB-Approved Clinical Study or Clinical Trial or to terminate an existing Non-IND, IRB-Approved Clinical Study or Clinical Trial;
- changes in laws or regulations applicable to our AXA Candidates, including but not limited to Clinical Trial requirements for approvals;
- developments concerning our CMOs;
- our ability to obtain materials to produce adequate product supply for any approved product or inability to do so at acceptable prices;
- our ability to establish a manufacturing and a supply chain for supply of AXA Candidates for Non-IND, IRB-Approved Clinical Studies and Clinical Trials and for commercial supply;
- our ability to establish collaborations if needed;
- the costs and timing of future commercialization activities, including product manufacturing, marketing, sales and distribution, for any of our AXA Candidates for which we obtain marketing approval as a drug or market as a non-drug product;
- the legal patent costs involved in prosecuting patent applications and enforcing patent claims and other intellectual property claims;
- additions or departures of key scientific or management personnel;
- unanticipated serious safety concerns related to the use of our AXA Candidates; and
- the terms and timing of any collaboration, license or other arrangement, including the terms and timing of any milestone payments thereunder.

We believe that the net proceeds from this offering, together with our existing cash and cash equivalents, will enable us to fund our operating expenses, capital expenditure requirements, and debt service payments through the second quarter of 2021. We have based this estimate on assumptions that may prove to be wrong, and we could utilize our available capital resources sooner than we expect.

Until such time, if ever, as we can generate substantial product revenue, we expect to finance our operations through a combination of equity offerings, debt financings, collaborations, strategic alliances and marketing, distribution or licensing arrangements. To the extent that we raise additional capital through the sale of equity or convertible debt securities, your ownership interest will be diluted, and the terms of these securities may include liquidation or other preferences that adversely affect your rights as a common stockholder. Debt financing and preferred equity financing, if available, may involve agreements that include covenants limiting or restricting our ability to take specific actions, such as incurring additional debt, making acquisitions or capital expenditures or declaring dividends. If we raise additional funds through collaborations, strategic alliances or marketing, distribution or licensing arrangements with third parties, we may have to relinquish valuable rights to our technologies, future revenue streams, research programs or drug candidates, or grant licenses on terms that may not be favorable to us. If we are unable to raise additional funds through equity or debt financings or other arrangements when needed, we may be required to delay, limit, reduce or terminate our research, product development or future commercialization efforts, or grant rights to develop and market product candidates that we would otherwise prefer to develop and market ourselves.

Contractual obligations and commitments

The following table summarizes our contractual obligations as of December 31, 2018 and the effects that such obligations are expected to have on our liquidity and cash flows in future periods:

	Payments due by period				
	Total	Less than 1 year	1 to 3 years	4 to 5 years	More than 5 years
	(in thousands)				
Operating lease commitments ⁽¹⁾	\$ 2,828	\$ 1,187	\$ 1,641	\$ —	\$ —
Debt obligations ⁽²⁾	31,594	2,740	21,005	7,849	—
Total	\$ 34,422	\$ 3,927	\$ 22,646	\$ 7,849	\$ —

(1) Amounts in table reflect payments due for our leases of office and laboratory space in Cambridge, Massachusetts under one operating lease agreement that expires in April 2021.

(2) Amounts in table reflect the contractually required principal and interest payments payable under our credit facility. For purposes of this table, the interest due under the 2018 Credit Facility was calculated using an assumed interest rate of 10.54% (LIBOR plus 8.50%) per annum, which was the interest rate in effect as of December 31, 2018.

We enter into contracts in the normal course of business with CROs, CMOs and other third parties for preclinical research studies, Non-IND, IRB-Approved Clinical Studies, Clinical Trials and testing and manufacturing services. These contracts do not contain minimum purchase commitments and are cancelable by us upon prior written notice. Payments due upon cancellation consist only of payments for services provided or expenses incurred, including noncancelable obligations of our service providers, up to the date of cancellation. These payments are not included in the table above as the amount and timing of such payments are not known.

Critical accounting policies and significant judgments and estimates

Our consolidated financial statements are prepared in accordance with generally accepted accounting principles in the United States, or GAAP. The preparation of our consolidated financial statements and related disclosures requires us to make estimates and judgments that affect the reported amounts of assets, liabilities, revenue, costs and expenses and the disclosure of contingent assets and liabilities in our financial statements. We base our estimates on historical experience, known trends and events and various other factors that we believe are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. We evaluate our estimates and assumptions on an ongoing basis. Our actual results may differ from these estimates under different assumptions or conditions.

While our significant accounting policies are described in more detail in Note 2 to our consolidated financial statements appearing at the end of this prospectus, we believe that the following accounting policies are those most critical to the judgments and estimates used in the preparation of our financial statements.

Research and development costs

As part of the process of preparing our consolidated financial statements, we are required to estimate our accrued research and development expenses. This process involves reviewing open contracts and purchase orders, communicating with our applicable personnel to identify services that have been performed on our behalf and estimating the level of service performed and the associated cost incurred for the service when we have not yet been invoiced or otherwise notified of actual costs. The majority of our service providers invoice us in arrears for services performed,

on a pre-determined schedule or when contractual milestones are met; however, some service providers require advance payments. Examples of estimated accrued research and development expenses include fees paid to:

- CROs in connection with Non-IND, IRB-Approved Clinical Studies;
- investigative sites in connection with Non-IND, IRB-Approved Clinical Studies;
- CMOs in connection with the process development and scale-up activities and the production of preclinical Non-IND, IRB-Approved Clinical Study and Clinical Trial materials; and
- vendors in connection with preclinical and clinical development activities (e.g., data analytics).

We base our expenses related to Non-IND, IRB-Approved Clinical Studies on our estimates of the services received and efforts expended pursuant to contracts with CROs that conduct and manage Non-IND, IRB-Approved Clinical Studies on our behalf. The financial terms of these agreements are subject to negotiation, vary from contract to contract and may result in uneven payment flows. There may be instances in which payments made to our vendors will exceed the level of services provided and result in a prepayment of the clinical expense. Payments under some of these contracts depend on factors such as the successful enrollment of subjects and the completion of clinical study milestones. In accruing service fees, we estimate the time period over which services will be performed and the level of effort to be expended in each period and adjust accordingly.

We make estimates of our research and development accrued expenses as of each balance sheet date in our financial statements based on facts and circumstances known to us at that time. We recognize costs for certain development activities based on an evaluation of the progress to completion of specific tasks using information and data provided to us by our vendors and our clinical sites, such as number of sites activated, number of patient enrollments and visits and patient duration. We determine accrual estimates through financial models that take into account discussion with applicable personnel and service providers as to the progress or state of completion of trials. We periodically confirm the accuracy of these estimates with the service providers and make adjustments, if necessary. Upon settlement, these costs may differ materially from the amounts accrued in our consolidated financial statements. Our historical accrual estimates have not been materially different from our actual costs. However, due to the nature of estimates, we cannot provide assurance that we will not make changes to our estimates in the future as we become aware of additional information about the status or conduct of our Non-IND, IRB-Approved Clinical Studies and other research activities.

Stock-based compensation

We issue stock-based awards to employees and non-employees, generally in the form of stock options and unvested stock. We measure and recognize compensation expense for our stock-based awards granted to our employees and non-employee directors based on the estimated grant date fair value in accordance with FASB ASC Topic 718, *Compensation — Stock Compensation*, or ASC 718. We account for stock-based awards to non-employees in accordance with FASB ASC Topic 505-50, *Equity-Based Payments to Non-Employees*, which requires the fair value of the unvested portion of the equity awards granted to non-employees to be re-measured as of each reporting date.

Our stock-based awards are subject to either service or performance-based vesting conditions. We recognize compensation expense related to awards to employees and directors with service-based vesting on a straight-line basis based on the grant date fair value over the requisite service

period, which is generally the vesting period. Compensation expense related to awards to employees with performance-based vesting conditions is recognized based on the grant date fair value over the requisite service period using an accelerated attribution method to the extent the achievement of the performance condition is probable. Compensation expense related to awards to non-employees with service-based vesting conditions is recognized on the then-current fair value at each reporting date prior to the measurement date over the requisite service period, which is generally the vesting period. We recognize forfeitures as they occur.

We classify stock-based compensation expense in our consolidated statements of operations in the same manner in which the award recipient's salary and related costs are classified or in which the award recipient's service payments are classified. In future periods, we expect stock-based compensation expense to increase, due in part to our existing unrecognized stock-based compensation expense and as we grant additional stock-based awards to continue to attract and retain our employees.

Fair value of stock-based awards

We estimate the fair value of our stock options using the Black-Scholes option pricing model, which requires inputs of subjective assumptions, including: (i) the expected volatility of our stock; (ii) the expected term of the award; (iii) the risk-free interest rate; (iv) expected dividends; and (v) the fair value of common stock. Due to the lack of company specific historical and implied volatility data, we based our estimate of expected volatility on the estimate and expected volatilities of a guideline group of publicly traded companies. For these analyses, we select companies with comparable characteristics to ours including enterprise value, risk profiles, and with historical share price information sufficient to meet the expected life of the stock-based awards. We compute the historical volatility data using the daily closing prices for the selected companies' shares during the equivalent period of the calculated expected term of our stock-based awards. We will continue to apply this process until a sufficient amount of historical information regarding the volatility of our own stock price becomes available. We estimate the expected term of our stock options granted to employees and non-employee directors using the simplified method, whereby, the expected term equals the midpoint of the vesting term and the original contractual term of the option. We utilize this method as we do not have sufficient historical exercise data to provide a reasonable basis upon which to estimate the expected term. For the determination of the risk-free interest rates we utilize the U.S. Treasury yield curve for instruments in effect at the time of measurement with a term commensurate with the expected term assumption. The expected dividend yield is assumed to be zero as we have never paid dividends and do not have current plans to pay any dividends on our common stock. Historically, for periods prior to this initial public offering, the fair value of our common stock underlying our stock-based awards were determined on each grant date by our board of directors based on valuation estimates from management considering our most recently available independent third-party valuation of our equity instruments.

We determine the fair value of unvested stock based on the fair value of our common stock. In addition, for unvested stock awards under which unvested common stock is purchased by the holder with a promissory note treated as a nonrecourse note for accounting purposes, we measure the fair value of the award using the Black-Scholes option-pricing model.

Determination of fair value of common stock

As there has been no public market for our common stock to date, the estimated fair value of our common stock has been determined by our board of directors as of the date of each option grant, with input from management, considering our most recently available third-party valuations of common stock, and our board of directors' assessment of additional objective and subjective factors that it believed were relevant and which may have changed from the date of the most recent

valuation through the date of the grant. These third-party valuations were performed in accordance with the guidance outlined in the American Institute of Certified Public Accountants' Accounting and Valuation Guide, *Valuation of Privately-Held-Company Equity Securities Issued as Compensation*. Our common stock valuations were prepared using either an option pricing method, or OPM, or a hybrid method, both of which used market approaches to estimate our enterprise value. The OPM treats common stock and preferred stock as call options on the total equity value of a company, with exercise prices based on the value thresholds at which the allocation among the various holders of a company's securities changes. Under this method, the common stock has value only if the funds available for distribution to stockholders exceeded the value of the preferred stock liquidation preferences at the time of the liquidity event, such as a strategic sale or a merger. A discount for lack of marketability of the common stock is then applied to arrive at an indication of value for the common stock. The hybrid method is a probability-weighted expected return method, PWERM, where the equity value in one or more scenarios is calculated using an OPM. The PWERM is a scenario-based methodology that estimates the fair value of common stock based upon an analysis of future values for the company, assuming various outcomes. The common stock value is based on the probability-weighted present value of expected future investment returns considering each of the possible outcomes available as well as the rights of each class of stock. The future value of the common stock under each outcome is discounted back to the valuation date at an appropriate risk-adjusted discount rate and probability weighted to arrive at an indication of value for the common stock. These third-party valuations were performed at various dates, which resulted in valuations of our common stock of \$3.54 per share as of February 10, 2017, \$3.37 per share as of February 10, 2018, \$4.64 per share as of November 30, 2018, and \$7.51 per share as of January 31, 2019. In addition to considering the results of these third-party valuations, our board of directors considered various objective and subjective factors to determine the fair value of our common stock as of each grant date, including:

- the prices at which we sold shares of preferred stock and the superior rights and preferences of the preferred stock relative to our common stock at the time of each grant;
- the progress of our research and development programs, including the status and results of preclinical studies for our AXA Candidates and progress of our development of manufacturing processes;
- our stage of development and commercialization and our business strategy;
- external market conditions affecting the biopharmaceutical industry and trends within the biopharmaceutical industry;
- our financial position, including cash on hand, and our historical and forecasted performance and operating results;
- the lack of an active public market for our common stock and our preferred stock;
- the likelihood of achieving a liquidity event, such as an initial public offering, or IPO, or sale of our company in light of prevailing market conditions; and
- the analysis of IPOs and the market performance of similar companies in the biopharmaceutical industry.

The assumptions underlying these valuations represented management's best estimate, which involved inherent uncertainties and the application of management's judgment. As a result, if we had used significantly different assumptions or estimates, the fair value of our common stock and our stock-based compensation expense could have been materially different.

Once a public trading market for our common stock has been established in connection with the closing of this offering, it will no longer be necessary for our board of directors to estimate the

fair value of our common stock in connection with our accounting for granted stock options and other such awards we may grant, as the fair value of our common stock will be determined based on the quoted market price of our common stock.

The following table summarizes by grant date the number of shares subject to option awards granted between January 1, 2017 and March 22, 2019, the per share exercise price of the options, the fair value of common stock on each grant date, and the per share estimated fair value of the awards:

Grant date	Number of shares subject to award	Per share exercise price of options (\$)	Per share fair value of common stock on grant date (\$) ⁽¹⁾	Per share estimated fair value of award on grant date (\$)
June 13, 2017	799,932	6.52	6.52	4.46
August 10, 2017	262,277	6.52	6.52	4.46
October 13, 2017	11,128	6.52	6.52	4.47
December 19, 2017	5,428	6.52	6.52	4.46
December 21, 2017	782,646	6.52	6.52	3.74
February 7, 2018	67,316	6.52	6.52	3.76
April 26, 2018	267,258	6.20	6.20	3.84
June 21, 2018	69,488	6.20	6.20	3.84
June 22, 2018	1,053,573	6.20	6.20	3.84
August 29, 2018	125,681	6.20	6.20	3.84
October 2, 2018	224,498	6.20	6.20	3.85
March 11, 2019	482,166	13.83	13.83	9.24
March 22, 2019	60,803	13.83	13.83	9.21

⁽¹⁾ Independent third-party valuations of our equity instruments were performed annually in February or when material changes in the business occurred and these were considered by the board of directors in determining the exercise price for stock-based awards. We granted options with an exercise price equal to or above the fair value of the common stock based on the most recent independent third-party valuation, at discretion of the board of directors.

Off-balance sheet arrangements

We did not have during the periods presented, and we do not currently have, any off-balance sheet arrangements, as defined in the rules and regulations of the SEC.

Recently adopted and issued accounting pronouncements

A description of recently adopted and issued accounting pronouncements that may potentially impact our financial position, results of operations or cash flows is disclosed in Note 2 to our consolidated financial statements appearing at the end of this prospectus.

Quantitative and qualitative disclosures about market risks

As of December 31, 2018, we had cash, cash equivalents of \$79.5 million, which consisted of cash, and money market funds. Interest income is sensitive to changes in the general level of interest rates; however, due to the nature of these investments, an immediate 10% change in interest rates would not have a material effect on the fair market value of our investment portfolio.

As of December 31, 2018 we had \$26.0 million of borrowings outstanding under the Amended 2018 Debt Facility. An immediate 10% change in the LIBOR rate would not have had a material impact on our debt-related obligations, financial position or results of operations.

We are not currently exposed to significant market risk related to changes in foreign currency exchange rates; however, we have contracted with and may continue to contract with foreign vendors that are located in Europe and Australia. Our operations may be subject to fluctuations in foreign currency exchange rates in the future.

Inflation generally affects us by increasing our cost of labor. We do not believe that inflation had a material effect on our business, financial condition or results of operations during the years ended December 31, 2017 and 2018.

Emerging growth company status

The Jumpstart Our Business Startups Act of 2012 permits an "emerging growth company" such as us to take advantage of an extended transition period to comply with new or revised accounting standards applicable to public companies until those standards would otherwise apply to private companies. We have elected not to "opt out" of such extended transition period, which means that when a standard is issued or revised and it has different application dates for public or private companies, we will adopt the new or revised standard at the time private companies adopt the new or revised standard and will do so until such time that we either (i) irrevocably elect to "opt out" of such extended transition period or (ii) no longer qualify as an emerging growth company.

BUSINESS

Overview

We are a biotechnology company pioneering the research and development of novel multifactorial interventions to support health and address dysregulated metabolism across a broad spectrum of consumers and patients who have limited options. Our AXA Candidates are generated from our proprietary, human-focused AXA Development Platform and harness the power of endogenous metabolic modulators, or EMMs, a broad family of molecules that fundamentally impact and regulate human metabolism.

Using our AXA Development Platform, we have rapidly generated a pipeline of AXA Candidates that are novel compositions of EMMs engineered in distinct ratios and designed to target and maximize the fundamental role that EMMs play in regulating multiple metabolic functions. Our AXA Candidates are administered orally and anchored by amino acids, which have a history of safe use as food. As such, we expect our AXA Candidates may also be combinable with other modalities. We believe our current dataset supports the potential of our AXA Candidates to support and modulate the metabolic pathways they target with favorable safety profiles. These features may make them an attractive development opportunity with significant commercial potential.

In 2018, we completed three Non-IND, IRB-Approved Clinical Studies. In all three studies, our AXA Candidates were generally found to be well tolerated, and we generated positive normal structure and function data indicating potential metabolic modulation. We believe generating this rich human dataset at this early stage of development (i) eliminates the translational uncertainty associated with transitioning from animal studies to human studies (ii) enables us to make high-insight, capital-efficient development decisions and (iii) potentially increases the probability of success for these AXA Candidates. For AXA Candidates we decide to develop under an Investigational New Drug application, or IND, we will discuss with the U.S. Food and Drug Administration, or FDA our ability to use data generated from our Non-IND, IRB-Approved Clinical Studies to begin Phase II or potential registrational (pivotal) Clinical Trials.

On March 6, 2019, we had a face-to-face pre-IND meeting with the FDA for AXA1665, our lead AXA Candidate, during which we discussed clinical endpoints, assessment tools and other matters relating to a potential IND-opening Clinical Trial for AXA1665 in hepatic encephalopathy, or HE. After meeting with the FDA, we made a decision to pursue a drug development path for AXA1665. Under the planned IND, the initial indication would be for the treatment of HE, with time to breakthrough episode of overt HE event as the primary endpoint and key secondary muscle-related endpoints. We anticipate interacting with the FDA again prior to a formal IND submission for AXA1665. We anticipate initiating a Clinical Trial in the second half of 2020 for AXA1665 that we believe could potentially serve as a registrational (pivotal) trial to support the submission of a New Drug Application, or NDA.

Our wholly-owned pipeline currently comprises five programs focused on the metabolic functions of the liver, muscle and blood. An overview of our AXA Candidate and their status is illustrated below.

POPULATIONS STUDIED		PRE-CLINICAL	NON-IND, IRB-APPROVED CLINICAL STUDIES ¹	PH I	PH II	PH IIb/III	NDA	POTENTIAL INDICATIONS
Liver	Mild-moderate hepatic insufficiency	AXA1665		N/A	N/A	2H 2020 ²		Hepatic Encephalopathy (HE) • Time to breakthrough OHE event • Muscle related (sarcopenia)
	NAFLD (Adult)	AXA1125		DEVELOPMENT PATH DECISION				NASH (Adult)
		AXA1957						
	NAFLD (Pediatric)	AXA1957						NASH (Pediatric)
Muscle	Limb immobilization-induced acute atrophy	AXA2678						Hip fracture-related myopenia Hip arthroplasty Total knee arthroplasty
Blood		AXA4010						Sickle cell disease

(1) In the above pipeline chart, "Development Path Decision" reflects the point in a program at which we decide whether to develop an AXA Candidate as a drug product candidate under an IND, develop it as a non-drug product candidate or terminate development. We have made a decision to develop AXA1665 as a drug product candidate and anticipate interacting with the FDA again prior to submitting an IND. We have not made a development path decision for any of our other AXA Candidates.

(2) We believe that this Clinical Trial has the potential to serve as a registrational (pivotal) Clinical Trial, subject to continuing IND discussions and allowance by the FDA.

Definitions: NAFLD = non-alcoholic fatty liver disease; NASH = nonalcoholic steatohepatitis; OHE = overt hepatic encephalopathy.

AXA1665 in Hepatic Encephalopathy

In study AXA1665-001, in subjects with mild and moderate hepatic insufficiency (Child-Pugh Class A and B), receiving the higher dose of AXA1665, we observed a cumulative increase of 40% in the Fischer's ratio, or FR, the molar ratio of branched-chain amino acids, or BCAAs, to aromatic amino acids, or AAAs. These subjects also demonstrated a lower plasma ammonia area under the curve when sampled over five hours (AUC_{0-5h}), and tended to maintain a leaner phenotype (i.e., increase in dry lean mass and decrease in fat mass as assessed by bioimpedance measurements) and muscle function (as assessed using a liver frailty index score) compared to those on a control regimen. Each of these markers appear to have prognostic significance in assessing liver health, including in cirrhosis.

AXA1125 in Subjects with Non-alcoholic Fatty Liver Disease, or NAFLD

In study AXA1125-002, administration of AXA1125 24g three times a day was associated with a trend of decreased liver fat, improved insulin sensitivity (i.e., lower Homeostatic Model Assessment of Insulin Resistance, or HOMA-IR) and induction of fat oxidation (i.e., increased beta-hydroxybutyrate, or BHB). In subjects who received AXA1125, mean blood levels of key

fibroinflammatory biomarkers reflective of normal function tended to decrease compared to the mean pre-administration baseline levels. We believe these data suggest AXA1125 has the potential to impact three critical drivers associated with NAFLD-metabolism, inflammation and fibrosis.

AXA2678 in Healthy Subjects with Immobilization-Induced Acute Muscle Atrophy

In study AXA2678-001, in subjects receiving AXA2678 24g three times a day, we observed attenuated muscle atrophy during the one week immobilization period compared to placebo, reflected by a 76% relative difference in average muscle cross sectional area, or CSA, assessed by magnetic resonance imaging, or MRI. Subjects receiving AXA2678 tended to have muscle fiber architecture preserved during immobilization and also tended to recover muscle strength to pre-immobilization baseline levels as compared to placebo within a short two-week recovery period.

Once we have generated sufficient data for an AXA Candidate, we will decide whether to develop such candidate as a drug or non-drug product candidate. This development path decision will be based on the (i) strength of data from our Non-IND, IRB-Approved Clinical Studies, (ii) the unmet need, (iii) market opportunity and (iv) availability of accelerated paths to market under applicable regulations. To date, we have not submitted any INDs to conduct Clinical Trials with our AXA Candidates to evaluate their therapeutic potential, and while we plan to pursue the development of AXA1665 as a drug product candidate under IND, we have not yet filed such IND nor made decisions to pursue future development of any of our other AXA Candidates as drug product candidates. For AXA Candidates developed under an IND, we will discuss with the FDA our ability to use data generated from our Non-IND, IRB-Approved Clinical Studies to begin Phase II or potential registrational Clinical Trials.

We believe that the consistency and nature of the data from our three completed Non-IND, IRB-Approved Clinical Studies indicate that this approach has significant promise. We are focused on actively expanding our pipeline and currently reviewing additional development opportunities in hematology, central nervous system, or CNS, kidney and pulmonary function. Many diseases are driven by multifactorial dysregulated systemic metabolism, and we have already characterized over 50 diseases for prioritization.

We have attracted a world-class leadership team that has significant experience in the successful development and commercialization of collectively more than 50 drugs across numerous therapeutic areas. We are supported by an industry-leading board of directors and scientific advisory board. Since inception, we have raised approximately \$200 million in capital from leading life sciences investors, including Flagship Pioneering, our founder, Fidelity Management & Research Company, Nestlé Health Science US Holdings and Gurnet Point Capital Limited.

Our Strengths

We believe we are well-positioned to execute on our corporate strategy based on the following competitive strengths:

- **Deep understanding of metabolic dysregulation and the modulatory power of EMMs.** We are pioneers of a novel approach that we believe can address metabolic health and dysregulation. Applying our expertise in EMMs and metabolism, we aim to harness the potential of EMMs to directly and simultaneously support and modulate multiple metabolic pathways implicated both in complex diseases and overall health.
- **Predictive, rapid and scalable human-focused AXA Development Platform.** We have built a first-of-its-kind integrated knowledge platform that has proven capable of rapidly designing our novel and proprietary AXA Candidates. Our AXA1665, AXA1125 and AXA2678 programs progressed from biological hypothesis to readout of initial Non-IND, IRB-Approved

Clinical Study data in less than 18 months. We believe that the data derived from testing these three AXA Candidates in a total of more than 160 normal structure and function assessments support the potential that our AXA Candidates may have the ability to modulate the metabolic pathways they target with favorable safety profiles.

- **Informed and capital-efficient AXA Candidate early-stage development model.** In our Non-IND, IRB-Approved Clinical Studies, we have rapidly generated a rich dataset in healthy subjects and subjects with certain disease conditions. We believe that generating human data at this early stage of development enables us to make high-insight, capital-efficient development decisions and potentially increases the probability of success for these candidates.
- **Pipeline with significant potential across a spectrum of disease and health.** We currently have five AXA Candidate programs across multiple target areas, including in liver and muscle. Our three lead programs are in large, growing and commercially attractive areas with notable unmet needs. We have already characterized over 50 additional diseases for prioritization.
- **Broad intellectual property portfolio with worldwide rights to our AXA Candidates.** As a first mover in our approach to EMMs, we are building a broad intellectual property portfolio to protect our AXA Candidates and AXA Development Platform. We believe our patents, trademarks and trade secrets will help to maintain our competitive advantage. We have full commercial rights to all of our AXA Candidates.
- **Experienced leadership team and board of directors.** We have attracted a world-class leadership team that has significant experience in the successful development and commercialization of collectively more than 50 drugs across numerous therapeutic areas. We are supported by an industry-leading board of directors and scientific advisory board. Since inception, we have raised approximately \$200 million in capital from leading life sciences investors, including Flagship Pioneering, our founder, Fidelity Management & Research Company, Nestlé Health Science US Holdings and Gurnet Point Capital Limited.

Our Strategy

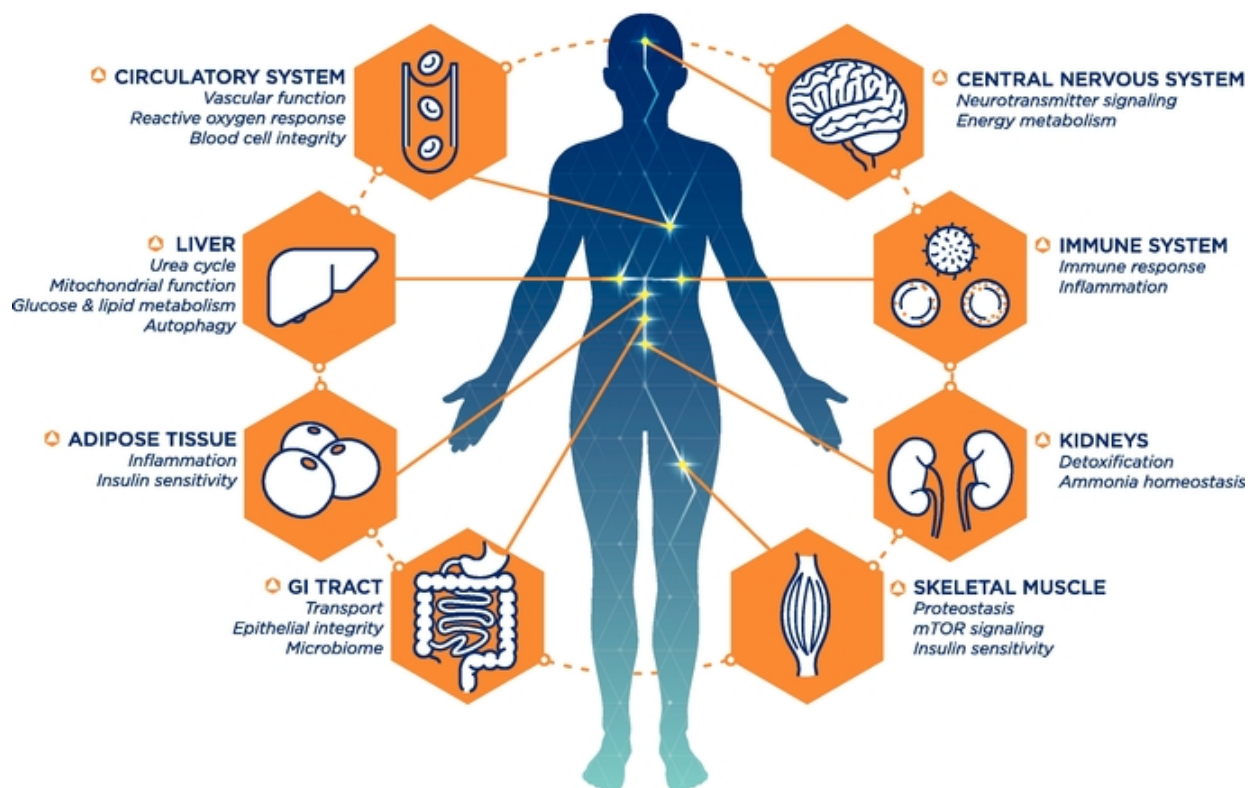
Our goal is to become the preeminent biotechnology company reprogramming metabolism to address a diverse set of complex diseases and support health. To achieve our goal, we are executing a strategy that includes the following core elements:

- **Accelerate paths to market for our lead programs.** For AXA Candidates we decide to develop under an IND, we will discuss with the FDA our ability to use data generated from our Non-IND, IRB-Approved Clinical Studies to begin Phase II or potential registrational Clinical Trials.
- **Further enhance and leverage our AXA Development Platform to advance multiple new programs per year in attractive markets.** We intend to continue to enhance the predictive capability of our AXA Development Platform, which is underpinned by a continuous feedback loop between our AXA Candidate design process and the data generated from our Non-IND, IRB-Approved Clinical Studies and Clinical Trials. We will prioritize attractive markets with high unmet need where our AXA Candidates have the potential to address the underlying metabolic dysregulation.
- **Expand patient and consumer access to AXA Candidates, if approved, and opportunistically leverage strategic partnerships.** Our AXA Candidates are administered orally and anchored by amino acids, which have a history of safe use as food. As such, we expect our AXA Candidates may also be combinable with other modalities. We believe such

characteristics may make them an attractive development opportunity with significant commercial potential. We will opportunistically evaluate strategic partnerships to optimally commercialize our products in large markets.

- **Establish ourselves as a global, fully-integrated biotechnology company.** We believe that building a fully-integrated company will allow us to more rapidly and efficiently develop our AXA Candidates. We will continue to bring together world-class scientific talent with experienced, innovative leaders who are focused on building an independent research, development, clinical and potentially commercial organization to realize the value of our AXA Development Platform.

Our Approach to the Development of AXA Candidates



Schematic representation of the numerous organs and systems effected by EMMs.

Our approach to the development of our AXA Candidates is based on the fundamental thesis of translating complex human biology into potential drug and non-drug product candidates that modulate metabolism. Metabolic dysregulation results from a disruption in human homeostasis that is core to optimal functioning and consequently, health. Maintenance of this dynamic state of equilibrium requires an orchestration of multiple metabolic pathways and inter-organ signaling, evolved over billions of years, and is carried out by signaling intermediates and endogenous mediators. EMMs are a critical subset of such endogenous elements that regulate metabolic function.

EMMs encompass a broad set of molecular families, including amino acids, bile acids other intermediary substrates and hormones. Together, these molecules drive a myriad of biological pathways to elicit multifactorial effects that integrate basic cellular functioning to impact fundamental biologies. Such biologies include cellular bioenergetics (e.g., tricarboxylic acid cycle and electron transport chain), nutrient handling (e.g., *de novo* lipogenesis, or metabolic formation of fat,

gluconeogenesis, or the generation of glucose from certain non-carbohydrate carbon substrates, and proteogenesis, or protein formation), nutrient sensing via master regulators (e.g., mammalian target of rapamycin, or mTOR, 5' AMP-activated protein kinase, or AMPK, fibroblast growth factor 21, or FGF21, and peroxisome proliferator-activated receptors, or PPARs), immune response and inflammation, reactive oxygen response, vascular function, neurotransmitter signaling, tissue repair, autophagy, or recycling of damaged and defective parts into basic elements thereby allowing the cells to remodel itself, and detoxification.

Dysregulation in the endogenous modulators, their signaling pathways or the metabolic processes they control can all lead to the loss of homeostasis, which can be manifested within specific organs and their sequelae, such as Type 2 diabetes, or T2D, NAFLD and muscle atrophy. As an example, dysregulation in the metabolic processes and pathways controlled by the liver such as *de novo* lipogenesis or gluconeogenesis can lead to an inability to adequately handle fuel substrates such as fats or carbohydrates. This ultimately results in fatty liver, insulin resistance and buildup of toxic waste products, such as ammonia, as the liver loses its detoxification capabilities. Similarly, a complex cascade of fuel dysregulation within skeletal muscles, a key organ involved in glucose disposal and utilization of amino acids as substrates for protein synthesis, can result in insulin resistance, intramuscular fat infiltration and muscle mass loss, thus decreasing muscle function. Muscle mass loss, or sarcopenia, is being increasingly recognized as a critical determinant of end organ function, and is linked to clinical outcomes and overall survival, such as in end-stage liver disease (cirrhotic sarcopenia) or in end-stage renal disease (uremic sarcopenia).

Complex diseases impact multiple biological pathways. Loss of health can be the direct result of metabolic pathways and functions that are not being maintained or supported. Consequently, restoring homeostasis and maintaining health requires multifactorial approaches. We believe that EMMs, anchored by amino acids, have the potential to serve as interventional candidates to address the systems-wide impact of dysregulated metabolism to support and maintain homeostasis, which helps support normal structures and functions of the body. Amino acids have decades of data supporting their role as fundamental building blocks of life. More recently, their roles in cellular signaling have become elucidated not only with individual amino acids, such as a leucine sensor on mTOR, but also in combinations, with a long history of general safe use in foods and other dietary supplements. We believe our approach with the use of EMMs has the potential to bring about a transformation in health and medicine by harnessing the body's own molecules and intrinsic chemistry to maintain or restore health.

Our Human-Focused AXA Development Platform

Our AXA Development Platform allows us to efficiently design and test AXA Candidates that simultaneously target multiple biologies and metabolic pathways by integrating advanced analytics of metabolism regulation and dysregulation with correlative-reasoning algorithms to interrogate data in our proprietary databases, which we refer to as AxcellaDB and AxcellaKB. Our proprietary human primary cell systems then directly test the multiple biologies that drive particular disease-related or metabolic dysregulation. We leverage predictive combinatorial drug metabolism and pharmacokinetics, or DMPK, analytics to inform dose-exposure relationships. All of this is supported by what we believe to be the world's leading EMM safety database. The data and learnings generated from our AXA Candidate design process further inform the design pathway, increasing the AXA Development Platform's efficiency.

Dysregulated Metabolism Data and Analytics: AxcellaDB and AxcellaKB

AxcellaDB, our proprietary database, synthesizes a combination of data from published literature and data from our proprietary models and human studies. AxcellaDB also includes key

data and analytics that are integral to our AXA Candidate design and development process, including:

- Metabolic profiles derived from a range of human plasma and specific tissue compartments, such as muscle biopsies.
- Characterization of over 50 diseases driven by multifactorial dysregulated systemic metabolism, including liver, renal, metabolic, CNS, muscle, inborn errors of metabolism and immune disorders.
- Clinical precedent using EMMs published across various public clinical trial databases and literature.
- Our proprietary EMM Safety Database, which synthesizes our own and third-party data on safety information for dose ranges for each EMM or combinations of EMM previously studied in humans.

We leverage AxcellaDB to apply internal modeling of EMM and metabolic pathways to generate hypotheses around the biological drivers of regulation and dysregulation in the human body. In the AXA Candidate design process, we use AxcellaDB's EMM safety database to determine the ranges within which individual or combinations of EMMs have been found to be tolerable with no significant safety concerns. We synthesize this information to determine the specific EMM components and proprietary composition ratios for an AXA Candidate and then test them in our studies, including in proprietary *in vitro* models and in Non-IND, IRB-Approved Clinical Studies.

We are currently building our internal machine learning capabilities, which we refer to as Axcella Knowledge Base, or AxcellaKB, to further probe novel, causal connections contained within the information and data contained in AxcellaDB. This will allow us to take a systems biology approach to AXA Candidate discovery and development. We plan to use a number of advanced approaches for network and pathway analysis of big data. Ultimately, AxcellaKB uses could include identifying AXA Candidate combinations, predicting effects of our AXA Candidates, use of causal reasoning to identify new target areas for our technology and novel biology.

Human Primary Cell Systems

We test hypothesized EMM mechanisms, synergies and dis-synergies in normal and disease-specific human primary cell models. We conduct our model systems in environments that aim to simulate physiological levels of biofluids and nutrients. These models include multiple cell types that we use to deconstruct dysregulated metabolism or disease conditions to isolate effects of AXA Candidates and EMMs on subsets of metabolic pathways. The high throughput of these models enables us to test AXA Candidates as well as combinations of the individual constituents to identify, better understand and incorporate their synergistic and dis-synergistic interactions.

Predictive Combinatorial DMPK

The designed AXA Candidate components, amounts and ratios are subsequently refined using pharmacokinetic, or PK, and pharmacodynamic modeling that evaluates EMM plasma exposure, supra-physiological exposures, windows of exposure administration amounts, the characterization of critical PK behaviors across molecule classes and the implications of physiological compartmental distribution. We believe these data allow us to highly refine AXA Candidates based on the variability among each AXA Candidate's individual constituents.

Axcella Health and Flagship Pioneering

We were founded in 2008 by Flagship Labs, the institutional innovation foundry of Flagship Pioneering. A team comprising innovators and entrepreneurs Dr. David Berry, Dr. Geoffrey von Maltzahn and Dr. Noubar Afeyan started exploring the potential medical applications of diverse, orally-consumed proteins. The work of this team led to the understanding that specific amino acid combinations at different ratios have the potential to drive profound biological effects in both health and disease by impacting dysregulated metabolic pathways and multi-compartmental biology. With this transformational new approach, we are harnessing the potential for orally-administered EMM compositions to drive cellular biology in a specific and reproducible manner, with the goal of delivering safe interventions for patients or consumers.

Regulatory Landscape and Our AXA Candidate Development Framework

Regulatory Status of Our AXA Candidates

Under the FDA's September 2013 Guidance for Clinical Investigators, Sponsors, and IRBs entitled "*Investigational New Drug Applications (INDs) — Determining Whether Human Research Studies Can Be Conducted Without an IND*," we believe Non-IND, IRB-Approved Clinical Studies of food products may be conducted to study the safety, tolerability, effect on normal structure or function in humans. We believe such Non-IND, IRB-Approved Clinical Studies may also be conducted to characterize the mechanism by which such product acts to maintain such structure or function, including in individuals with disease conditions, as long as the assessment is not intended to evaluate the non-drug product candidate's ability to diagnose, cure, mitigate, treat or prevent a disease. Studies specifically intended to assess the potential therapeutic use of a product candidate, such as its ability to diagnose, cure, mitigate, treat or prevent disease, including effects on an abnormal and uncommon or serious condition, must be done under an IND. Initially, we are generally studying our AXA Candidates as non-drug product candidates, and in particular, as food for humans in Non-IND, IRB-Approved Clinical Studies. The EMM constituents of our AXA Candidates generally fall under the food category. They are based on combinations of amino acids and their natural derivatives, which are all naturally occurring in the body and generally in the foods we eat. Based on our large database of studies and scientific literature on human exposure to and safety profiles of amino acids, the FDA's food additive regulations authorizing the use of specific amino acids under certain conditions as safe and permissible food additives when used as nutrients, our own data on amino acids used in AXA Candidates, and the fact that we use amino acids in our AXA Candidates within amounts previously studied in humans in doses found to be tolerable with no significant safety concerns, we believe we can and have studied our AXA Candidates in Non-IND, IRB-Approved Clinical Studies as foods and not as drug product candidates under an IND.

Our Non-IND, IRB-Approved Clinical Studies for AXA Candidates

In our Non-IND, IRB-Approved Clinical Studies for our AXA Candidates, we evaluate their safety and tolerability, effect on the normal structures or functions of the human body, and characterize the mechanism by which AXA Candidates act to maintain such structure or function. Such a study may be performed in individuals with disease for purposes of evaluating safety and tolerability. For example, in AXA1125-002, in addition to the primary endpoint of safety and tolerability, we included as secondary assessments normal liver structure assessments (e.g., liver fat) and normal liver functional assessments (e.g., alanine aminotransferase, or ALT, monocyte chemoattractant protein-1, or MCP-1 and N-terminal type III collagen propeptide, or Pro-C3, which are markers of changes in inflammation and fibrosis). The protocols for Non-IND, IRB-Approved Clinical Studies, which include detailed rationale and descriptions of the composition of amino acids in our AXA Candidates, are approved by IRBs at the various sites and conducted consistent

with Good Clinical Practices, or GCP. To date, our Non-IND, IRB-Approved Clinical Studies have been exploratory in nature and conducted in small numbers of subjects. We conduct Non-IND, IRB-Approved Clinical Studies for our AXA Candidates in both healthy subjects and subjects with specific disease conditions to maximize interpretability and accuracy of data on safety, tolerability and physiological impact on normal structures and functions of the body given that some of these changes may not be in healthy populations. The learnings from these studies inform the evolution of the AXA Candidate design and our AXA Development Platform. Armed with the deep scientific knowledge and understandings from all of our studies for each AXA Candidate, we believe that we will be able to make a highly informed development path decision for each AXA Candidate. For example, we made our first drug development path decision for AXA1665 after assessing AXA1665 Non-IND, IRB-Approved Clinical Study data and having a pre-IND meeting with the FDA on March 6, 2019 on a potential IND development path for AXA1665.

Development Path Decisions for AXA Candidates

The development path decision for an AXA Candidate, based on data from our Non-IND, IRB-Approved Clinical Studies and other data and market analyses, includes (i) exploring the AXA Candidate's therapeutic potential for a disease or disorder in Clinical Trials, (ii) developing the AXA Candidate as a non-drug product or (iii) terminating development efforts for such AXA Candidate. The development path decision we make for an AXA Candidate will also determine the appropriate market channel. For AXA Candidates we decide to develop under an IND, as we have done with AXA1665, we will discuss with the FDA our ability to use data generated from our Non-IND, IRB-Approved Clinical Studies to begin Phase II or potential registrational Clinical Trials.

In the context of further developing an AXA Candidate as a non-drug product, we anticipate that we would look to partner with third parties. Once a formulation for commercialization is finalized, we would expect that either we or our partner would comply with all applicable regulatory requirements applicable to the chosen commercialization path and market (e.g., submitting a notification to the FDA that the product is generally recognized as safe and effective, or GRAS, or, in the case of a dietary supplement, confirmation that it contains permissible dietary ingredients or file a new dietary ingredient filing, if necessary).

Our AXA Candidates

Key Characteristics of Our AXA Candidates

Our AXA Candidates are novel compositions of EMMs engineered in distinct ratios, with the objective of maximizing the fundamental role that EMMs play in regulating metabolic function. Our AXA Candidates have the following characteristics:

- **Multifactorial:** Our AXA Candidates are designed to simultaneously target multiple pathways that if not maintained, or dysregulated, can lead to disease or loss of health.
- **Safety Precedent:** Our AXA Candidates are anchored by amino acids, which have a history of use as foods without significant safety concerns.
- **Combinable:** We believe the EMM constituents in our AXA Candidates, due to their favorable safety profiles based on our own and third-party data to date, may enable us to combine them with other modalities. This could potentially further expand our market opportunity.
- **Oral Administration:** Our AXA Candidates are supplied in a dry powder form for oral consumption after being mixed with water, which we believe increases convenience of administration.

- **Rapidly Designed and Scalable:** We have produced human study-ready product in less than three months from initial biological hypothesis generation. Our AXA Candidates are produced using third-party manufacturers that employ readily and widely available clinical-grade materials. We believe that manufacturing will be both scalable and cost-effective.
- **Novel and Proprietary:** We own full commercial rights to our AXA Candidates, which are protected by our expanding patent estate, trade secrets and know-how.

AXA Candidates that Target Liver Metabolism

The liver has many critical functions relating to metabolism, including detoxification of a variety of substances, synthesis of key proteins and other intermediary substrates impacting nutrient homeostasis to coagulation, lipid metabolism and amino acid regulation. Hepatic insufficiency can lead to the loss of health and consequently to disease. We are investigating our AXA Candidates for safety, tolerability and physiological effects across a spectrum of normal liver structures and functions in our Non-IND, IRB-Approved Clinical Studies. Our AXA Candidates may have potential for development under an IND as drug product candidates with applications in conditions from non-alcoholic steatohepatitis, or NASH, to certain complications of cirrhosis. While the pathologies of NAFLD, NASH and cirrhosis may manifest primarily in the liver, these are heterogeneous and systemic diseases that affect multiple biological pathways impacting nearly every important organ system within the body, namely skeletal muscle, the heart, kidney, brain and gut.

AXA1665 Program in Hepatic Encephalopathy

Overview

On March 6, 2019, we had a face-to-face pre-IND meeting with the FDA for AXA1665, our lead AXA Candidate, during which we discussed clinical endpoints, assessment tools and other matters relating to a potential IND-opening Clinical Trial for AXA1665. Among other feedback received, the FDA indicated that (i) our proposal to proceed with the proposed IND-opening Clinical Trial without conducting additional toxicology studies appears to be acceptable, (ii) our drug product development approach with respect to chemistry, manufacturing and controls, or CMC, including analytical methods, microbial tests and specification to control the quality of AXA1665 appear reasonable for this stage of the product development, and (iii) the FDA requested we provide the relevant CMC and other information with the initial IND submission package in a Drug Master File, or DMF. After meeting with the FDA, we made a decision to pursue a drug development path for AXA1665 for HE. Under the planned IND, the initial indication would be for the treatment of HE, with time to breakthrough episode of overt HE event as the primary endpoint and key secondary muscle-related endpoints. We anticipate interacting with the FDA again prior to a formal IND submission for AXA1665. We anticipate initiating a Clinical Trial in the second half of 2020 for AXA1665 that we believe could potentially serve as a registrational (pivotal) trial to support the submission of a New Drug Application, or NDA.

To date, we have completed one Non-IND, IRB-Approved Clinical Study, AXA1665-001, in subjects with mild and moderate hepatic insufficiency to assess AXA1665's safety, tolerability and physiological effects on normal structures and functions. We did not observe any significant safety issues with AXA1665, and it was generally well-tolerated in this population over 15 days across two periods. Secondary assessments suggest that subjects administered AXA1665 tended to maintain a leaner phenotype as observed by changes in body composition and clinically relevant functional parameters.

In 2019, prior to making a drug development path decision for AXA1665, we initiated a 12-week (with a four-week follow-up), randomized, placebo-controlled, Non-IND, IRB-Approved Clinical Study, AXA1665-002, in approximately 60 mild and moderate hepatic insufficiency (Child-Pugh Class A and B) subjects to extend the initial observations from AXA1665-001 and further characterize the safety, tolerability and physiological effects on normal structure and function over this longer duration.

AXA1665 Design Rationale

AXA1665 has been designed to target multiple metabolic pathways intersecting key organ systems (liver, muscle and gut) to maintain liver health.

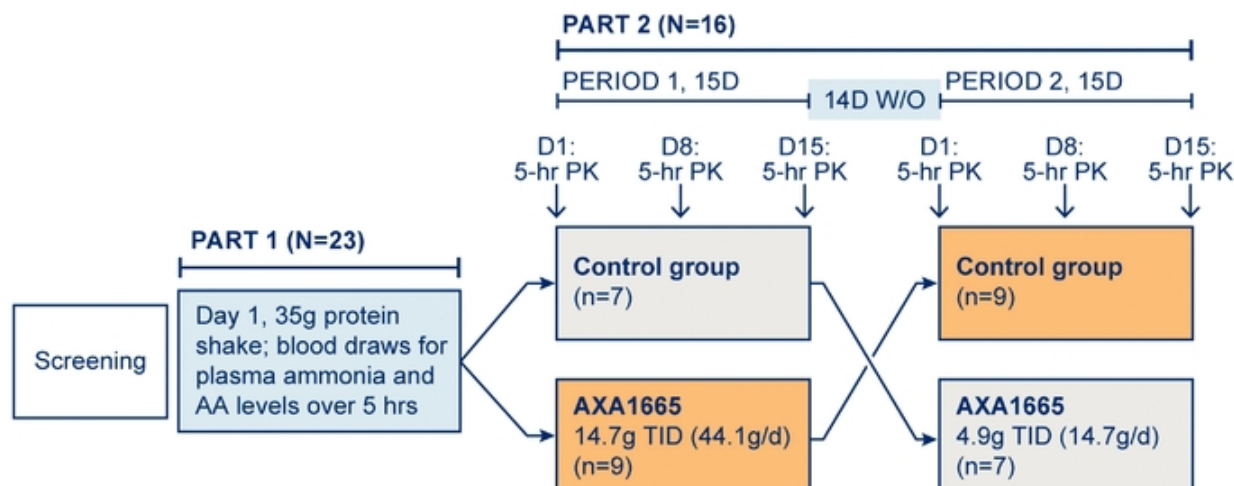
Underlying Biology	Design Objectives
Plasma amino acid imbalance	Maximize proteogenesis and reduce systemic AAAs
Ammonia handling	Stimulate urea cycle function, intestinal and renal nitrogen metabolism, and induce intramuscular ammonia detoxification
Muscle wasting	Increase muscle protein synthesis by addressing metabolic demand and stimulating mTORC1

Completed AXA1665-001 Non-IND, IRB-Approved Clinical Study

Study Design

AXA1665-001 was a two-part, 15-day controlled crossover Non-IND, IRB-Approved Clinical Study to assess the safety, tolerability and physiological impact on the normal structures and functions of the liver in subjects with mild and moderate hepatic insufficiency. The purpose of Part 1 was to evaluate the response (i.e., tolerability, changes in endogenous amino acid levels and plasma ammonia) to a standard 35-gram protein shake. A total of 23 subjects participated in Part 1. Part 2 utilized a crossover design comprising two 15-day periods separated by a 14-day washout. Subjects were domiciled in the Clinical Research Unit during each period, but not during the washout. Sixteen subjects participated in Part 2. All subjects in Part 2 were provided with well-balanced protein rich meals, a daily exercise regimen of 30 minutes of walking at their usual pace per day (other than on Days 1, 8, and 15), and a daily mandatory late-evening snack, or LES. LES alone has been shown in previous studies to reverse anabolic resistance and sarcopenia of cirrhosis with improved quality of life parameters in cirrhotic patients. The 16 subjects in Part 2 were split into two groups: Group 1 (n=7) received only LES in Period 1 and, after a 14-day washout, received AXA1665 4.9g three times a day, or TID (14.7g/day) and LES in Period 2; Group 2

(n=9) received AXA1665 14.7g TID (44.1g/day) and LES in Period 1 and, after a 14-day washout, received only LES in Period 2.



Study design for AXA1665-001, a two-part, 15-day controlled crossover Non-IND, IRB-Approved Clinical Study to assess the safety, tolerability and physiological impact of AXA1665 on the normal structures and functions of the liver in subjects with mild and moderate hepatic insufficiency (Child-Pugh Class A and B). AA=amino acid; D=day; W/O=washout.

Study Assessments in AXA1665-001

Primary Safety & tolerability	Clinical adverse events, or AEs, vital signs, electrocardiograms, or ECGs, clinical laboratory parameters, including standard chemistry and hematology panels, plasma ammonia, albumin, total protein and other liver function tests
Secondary PK of AXA1665 constituents and endogenous amino acid levels Physiological assessments	FR* Valine-to-phenylalanine ratio, or VPR* Normal Structure <ul style="list-style-type: none"> Body composition via bioimpedance to assess lean and fat mass compartments Normal Function <ul style="list-style-type: none"> Handgrip strength, timed chair stands and balance to derive a composite score called the liver frailty index, or the LFI*

* FR, VPR and LFI are believed to have prognostic significance in subjects with cirrhosis and end-stage liver disease based on emerging scientific literature.

Study Results

Primary

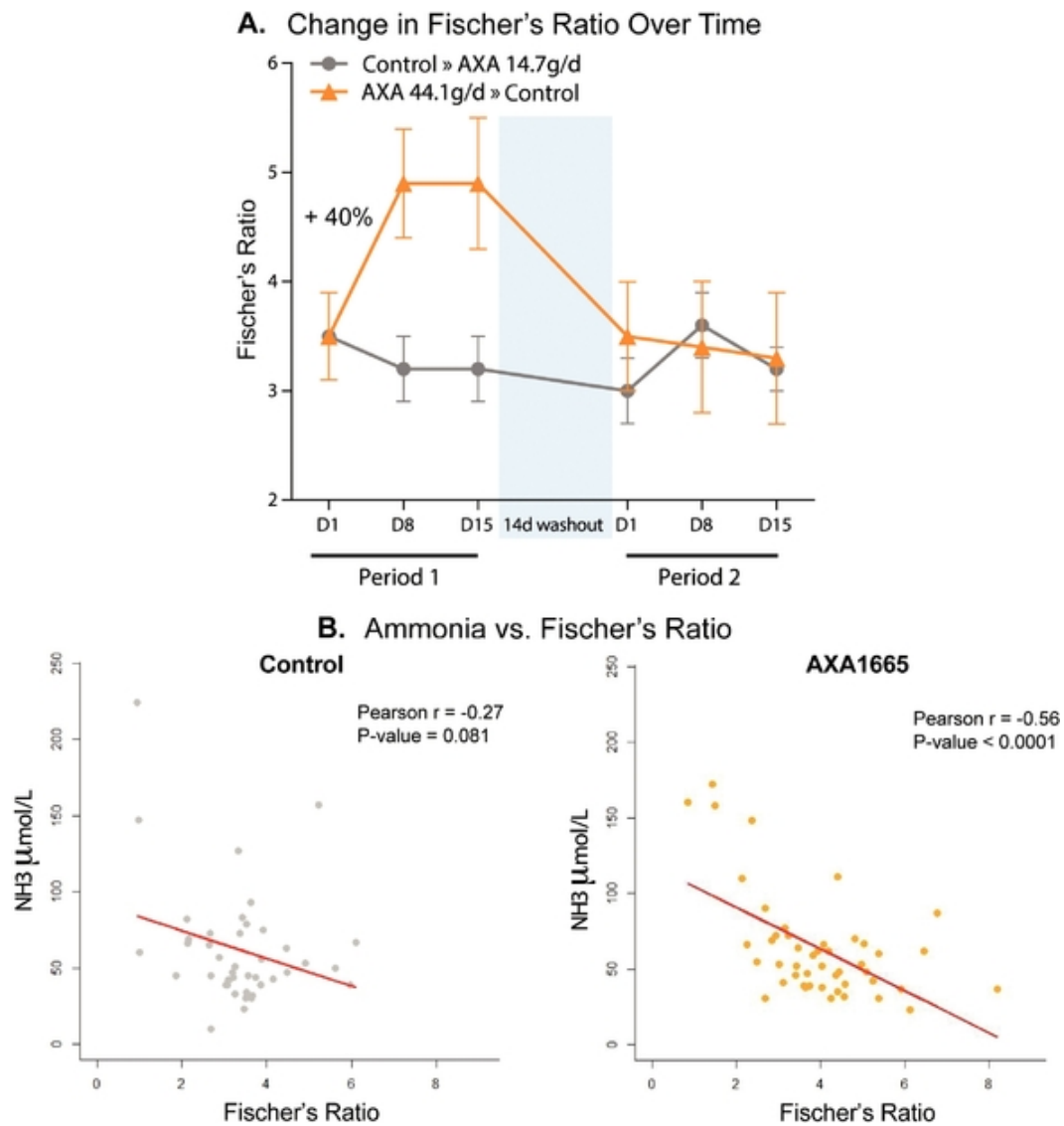
Daily consumption of AXA1665 at both the 14.7g/day and 44.1g/day amounts for 15 days was well-tolerated. There were no study product-related AEs observed in Part 1. There were five AEs, specifically neck pain, posterior shoulder pain, gastroesophageal reflux disease, or GERD, rib pain and headache, observed in four subjects in Part 2, all of which were considered unlikely to be related to the study food product. Three of these AEs were observed while subjects were consuming the LES and two, GERD and headache, were observed when subjects were consuming AXA1665. Four of the AEs were mild, and GERD was of moderate intensity. None were serious or led to discontinuation from the study. All the AEs resolved spontaneously, including GERD, which self-resolved within a day. There were no clinically significant changes in vital signs, ECGs or standard clinical laboratory parameters, including plasma ammonia, albumin, total protein, creatinine or blood urea nitrogen.

Secondary

Consumption of AXA1665 resulted in supra-physiological plasma concentrations of the constituent amino acids within AXA1665. These changes in amino acids resulted in a 40% increase in the basal (fasted) FR as early as Day 8 and maintained to Day 15, as compared to Day 1 baseline. These changes were markedly diminished once the 44.1g/day amount of AXA1665 in Period 1 was washed out over 14 days. The same subjects were then re-baselined and placed on the control regimen for 15 additional days in Period 2. A similar pattern of change was also seen in VPR.

We observed a statistically significant inverse correlation between basal (fasted) plasma ammonia and basal (fasted) FR with AXA1665 administration, but not in the control group, suggesting a potential ammonia dampening effect of AXA1665. Despite the provision of additional nitrogen via amino acids within AXA1665, the mean plasma ammonia area under the curve (AUC_{0-5h}) decreased by an average of approximately 10-25% on Day 15 compared to Day 1 in both

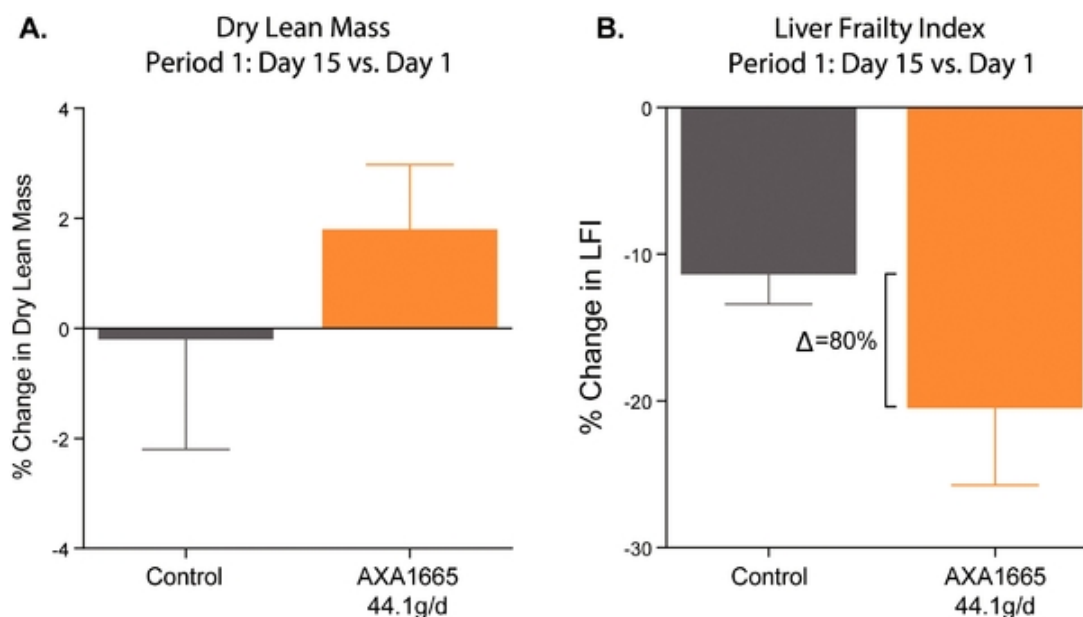
the 44.1g/day and 14.7g/day AXA1665 groups. We believe these findings are notable given that prior studies showed protein meals or BCAA mixtures by themselves increased plasma ammonia.



(A) Change in the basal (fasted) FR over time in both Periods 1 and 2 of Part 2 of the Non-IND, IRB-Approved Clinical Study of AXA1665. Data represent mean \pm standard error of the mean, or SEM; control, or CTRL à AXA 14.7g/d (n=7); AXA 44.1g/d à CTRL (n=9); (B) Inverse correlation between basal plasma ammonia and corresponding FR; p-value determined using Pearson correlation of basal plasma ammonia and basal plasma FR values from the D1, D8 and D15 fasted samples from the control and AXA1665 treated groups. In these figures g/day means grams per day and D means study Day. p-value is a statistical calculation that relates to the probability that the difference between groups happened by chance, with a p-value of less than 0.05 (i.e., less than 5% probability that the difference happened by chance) generally being used as the threshold to indicate statistical significance.

Clinical observations indicated that subjects consuming the higher amounts of AXA1665 (44.1g/day), but not the lower amount (14.7g/day), generally tended to maintain or increase their lean body compartments (dry lean mass, lean body mass and skeletal muscle mass), with a concomitant decrease in fat mass from baseline levels, with no overall change in body

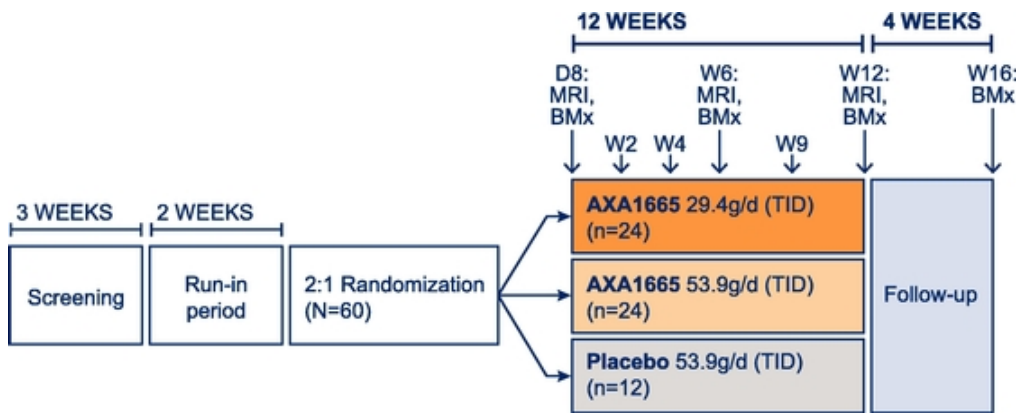
weight. These structure-related findings suggest alteration of the body composition toward a leaner phenotype, a key indicator of potential healthy muscle gain. Functional assessments included measurements of handgrip strength, timed chair stands and balance, from which the LFI composite score was derived. The average LFI score directionally moved toward less frailty in those consuming AXA1665 44.1g/day, but not in those consuming 14.7g/day AXA1665, nor in LES alone. A relative difference of 80% between the control and 44.1g/day AXA1665 groups was observed at the end of the 15-day administration period. We believe this finding is notable because LES alone appears to favorably impact sarcopenia in subjects with cirrhosis. Therefore, we believe an observed relative difference of this magnitude, even within this relatively short duration, warrants continued investigation of these effects in a longer duration study. Both the structural and functional changes were diminished once the 44.1g/day amount of AXA1665 in Period 1 was washed out over 14 days. The same subjects were then re-baselined and placed on the control regimen for 15 additional days in Period 2.



Percentage change in Day 15 compared to Day 1 values of (A) Dry lean mass and (B) LFI from Period 1 of Part 2 of the Non-IND, IRB-Approved Clinical Study of AXA1665. Values represent mean \pm SEM; Control (n=7) and AXA1665 44.1g/day (n=9). In these figures g/d means grams per day.

On-Going AXA1665-002 Non-IND, IRB-Approved Clinical Study

In 2019, prior to making a drug development path decision for AXA1665 we initiated AXA1665-002, a 12-week (with a four week follow-up), randomized placebo-controlled, Non-IND, IRB-Approved Clinical Study to assess AXA1665's safety, tolerability and physiological impact on normal liver and muscle structures and functions in approximately 60 subjects with mild and moderate hepatic insufficiency (Child-Pugh Class A and B) to further extend the findings from AXA1665-001. We anticipate the data readout from this study in the first half of 2020.



Study design of AXA1665-002, a 12-week (with a four-week follow-up), randomized placebo-controlled, Non-IND, IRB-Approved Clinical Study to assess the safety, tolerability and physiological impact on normal liver and muscle structures and functions of AXA1665 in subjects with mild and moderate hepatic insufficiency (Child-Pugh Class A and B).
W=week; g/d=grams per day; BMx=biomarkers.

Study Assessments in AXA1665-002

Primary Safety & tolerability	Clinical AEs, vital signs, ECGs, clinical laboratory parameters, including standard chemistry and hematology panels, plasma ammonia, albumin, total protein and other liver function tests
Secondary PK of AXA1665 constituents and endogenous amino acid levels Physiological assessments	FR* and VPR* Normal Structure <ul style="list-style-type: none">Body composition via MRI to assess lean and fat mass compartments, including thigh muscle volumes, intramuscular fat Normal Function <ul style="list-style-type: none">Physical (LFI*; gait speed)Cognitive (Stroop test; PHES; CFF)Health-related questionnaires

* FR, VPR and LFI are believed to have prognostic significance in subjects with cirrhosis and end-stage liver disease based on emerging scientific literature. PHES = psychometric hepatic encephalopathy score; CFF = critical flicker frequency.

Overview of HE

Under our planned IND for AXA1665, the initial indication would be for the treatment of HE, with time to breakthrough episode of overt HE as the primary endpoint and key secondary muscle-related endpoints. HE has multiple precipitating factors, such as amino acid imbalance, ammonia handling, muscle wasting, infections and constipation. Emerging data suggest that muscle mass and function are key independent factors associated with progression to and severity of HE.

Long-term damage to the liver from various causes, such as alcohol, hepatitis B or C viral infections, NASH or autoimmune hepatitis, can lead to permanent scarring, a condition called cirrhosis. Prevalence of cirrhosis in the United States is approximately 0.27%, corresponding to approximately 633,000 adults, of which 69% reported that they were unaware of having liver disease. Transition from compensated cirrhosis to decompensated cirrhosis occurs at a rate of approximately 5% to 7% per year.

Decompensated cirrhosis is a serious systemic disease with multi-organ dysfunction, resulting in a variety of significant complications, including HE, bacterial infections, gastrointestinal bleeding, renal impairment and ascites, which is the build-up of excess fluid in the abdomen. Presence of sarcopenia, which affects approximately 40% of patients with cirrhosis being evaluated for liver transplant, independently worsens many of these complications, results in more hospital stays and is becoming increasingly recognized as a complication of cirrhosis. The presence of complications decreases median survival to approximately two years versus approximately 12 years without complications.

HE is a common complication of cirrhosis, with an estimated prevalence of overt HE of 10% to 14% in the general cirrhotic population and 16% to 21% in those with decompensated cirrhosis. Overt HE refers to the evidence of neurological abnormalities without specialized psychometric testing. By contrast, minimal or covert HE requires specialized testing for its diagnosis, including psychometric tests. HE is a type of metabolic encephalopathy with a multifactorial etiopathogenesis, and including dysregulated amino acid metabolism and neurotransmitter signaling, inability of the failing liver to clear toxins such as ammonia and microbiome changes, all of which ultimately result in diminished brain function. Consequently, HE is well-established as a significant cause of morbidity and mortality in the cirrhotic population and represents a significant unmet medical need.

Muscle depletion and muscle fat infiltration independently increase the risk of both overt and minimal HE with increased mortality. Decline in muscle mass can also hamper the alternative pathway of ammonia detoxification, and hyperammonemia may further worsen sarcopenia, generating a vicious cycle. The highly interdependent complications of cirrhosis, sarcopenia and HE, constitute a significant disease burden and can have an impact on irreversible morbidity and mortality in cirrhotic patients. We estimate that approximately 63,000 to 130,000 individuals may be affected at any given time with both cirrhotic sarcopenia and overt HE in the United States.

We believe that therapeutic strategies that simultaneously address both sarcopenia and ammonia detoxification will clinically improve outcomes, such as maintaining remission of HE in those with prior overt HE and/or reduce rates of other cirrhosis complications, and ultimately mortality. Thus, under an IND, we propose to develop AXA1665 to treat either or both complications of cirrhosis, specifically HE and sarcopenia.

Limitations of Current Therapies for HE

There are currently no treatment options that directly address the multifactorial drivers of HE in an integrated manner. There is a significant unmet need for approved medications to reverse and

resolve the hepatic as well as systemic effects (e.g., muscle and gut) of HE. There are currently three main approved therapies for the treatment of HE: lactulose, rifaximin and HepatAmine.

- Lactulose is a non-absorbed disaccharide that has been used for several decades to reduce hyperammonemia in cirrhotic patients. For maximum clinical effect, lactulose must be titrated to cause two to four loose stools per day. The resulting diarrhea and fecal urgency, as well as other adverse gastrointestinal events, significantly limits patient compliance. Because of the variability in individual response, patients are often instructed to self-regulate dosing, which may lead to noncompliance and, in some cases, additional complications, including aspiration, dehydration, hyponatremia, and severe perianal skin irritation.
- Rifaximin is an antibiotic derived from rifamycin that impacts gut microbiota and likely indirectly influences ammonia generation by the gut flora. It is prescribed for the secondary prophylaxis of HE as a tablet twice per day, although caution is advised for patients with very advanced liver disease due to increased systemic absorption.
- HepatAmine is an intravenous administered amino acid composition, which is used in patients who are malnourished and unable to consume normal proteins or diets orally. In a Phase II/III Clinical Trial, HepatAmine reversed the abnormal plasma amino acid pattern characterized by decreased levels of BCAAs and elevated levels of AAAs, as compared to neomycin, which was used as an active control. The trend towards normalization of these amino acids was generally associated with an improvement in mental status and electroencephalogram, or EEG, patterns in a majority of patients, including a reduction in mortality.

Despite these treatment options for HE, none are adequate to directly address the multifactorial etiology, complexity, severity and sequelae of HE. This is either because the existing treatment options do not sufficiently and comprehensively address the underlying pathophysiologic drivers such as amino acid dysregulation, ammonia detoxification and sarcopenia, or they fail to pre-empt the cascading series of events leading to HE, such as altered metabolic signaling, or combinations thereof. Based on the evidence to date, sarcopenia is not only an effect-modifier of HE but also an independent complication of cirrhosis itself, impacting overall morbidity and mortality of cirrhotic patients. Consequently, new approaches are warranted that can adequately and directly address sarcopenia, a critical driver of the multifactorial pathogenesis of HE and other complications in cirrhotic patients. Based on our data to date, we believe that AXA1665 may have the potential to address the aforementioned multiple drivers of HE.

AXA1125 Program

Overview

AXA1125 is an AXA Candidate that is also being evaluated in liver health. To date, we have conducted Non-IND, IRB-Approved Clinical Studies of AXA1125 in healthy subjects in AXA1125-001 and in T2D subjects with NAFLD in AXA1125-002. In both studies, the safety, tolerability and physiological effects on normal structures and functions were assessed. We did not observe any significant safety issues with AXA1125, and it was generally well tolerated in these studies. In AXA1125-002, we observed that administration of AXA1125 tended to impact normal liver structure (as measured by average fat content) and function (e.g., plasma ALT, other markers of inflammation and fibrosis and mediators of glucose and lipid homeostasis). In 2019, we initiated a 16-week Non-IND, IRB-Approved Clinical Study, AXA1125-003, to extend the initial observations from AXA1125-002 and further characterize the safety, tolerability and physiological effects on normal structure and function over this longer period and in approximately 105 adult NAFLD subjects.

AXA1125 Design Rationale

AXA1125 has been designed to target multiple pathways (metabolism, inflammation and fibrosis) intersecting key organ systems (liver, muscle, adipose and gut) to maintain liver health.

Underlying Biology	Design Objectives
Metabolism	Lower lipotoxicity, improve insulin sensitivity and maximize mitochondrial function by enhancing fatty acid beta-oxidation
Inflammation	Modulate macrophage function, reduce hepatic inflammatory mediators and improve gut epithelial integrity
Fibrosis	Reduce hepatic stellate cell activation and proliferation to decrease hepatic fibrogenesis

Completed AXA1125-001 Non-IND, IRB-Approved Clinical Study

AXA1125-001 was a two-part study in normal healthy subjects. Part 1 included ten subjects administered a single 24g amount of AXA1125 either 30 minutes before meal (fasted), 30 minutes after meal (fed) or two hours after meal (fed) to assess the effect of meal timing on plasma concentration and exposure of AXA1125 amino acid constituents. Part 2 included ten subjects administered 24g TID (72g/day) for six weeks to assess the safety and tolerability at these amounts over this duration in healthy subjects.

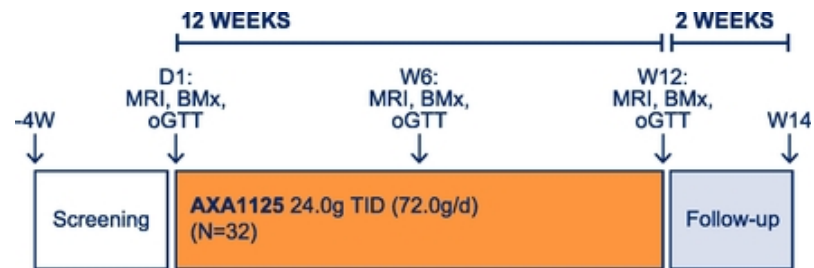
In Part 1, the PK data suggested well-behaved PK of the complex amino acid mixture with all of the constituents achieving supra-physiologic concentrations as well as no meaningful impact of meal timing on the amino acid profiles. Average peak amino acid plasma concentrations, or C_{max}, and total exposure, or AUC, values were generally similar (within 20% to 30%) and sequentially increased with each AXA1125 consumption regardless of meal timing, with the exception of glutamine. Consumption of AXA1125 in the fed state, either 30 minutes or two hours after a meal, resulted in a 1.1 to 2.5-fold increased AUC of glutamine relative to when AXA1125 was consumed in the fasted state.

In both Parts 1 and 2, we did not observe any significant safety issues with AXA1125 and it was generally well tolerated with no clinically significant changes in clinical laboratory values, vital signs or ECGs. There were no product-related AEs in Part 1. In Part 2, mild gastrointestinal symptoms of abdominal pain, distention and diarrhea were noted in three of ten subjects, considered by the study investigator to be study product-related. All AEs were transient, self-limited and resolved with no intervention, and none were serious or led to discontinuation.

Completed AXA1125-002 Non-IND, IRB-Approved Clinical Study

Study Design

AXA1125-002 was a pilot, single-arm, open-label, 12-week (with a two-week follow-up) multicenter, Non-IND, IRB-Approved Clinical Study to assess the safety, tolerability and physiological impact of AXA1125 24g TID (72g/day) on the normal liver structures and functions in subjects with T2D and NAFLD.



Study design of AXA1125-002, a single-arm, pilot, open-label, 12-week (with a two-week follow-up), multicenter, Non-IND, IRB-Approved Clinical Study of AXA1125 in subjects with T2D and NAFLD. W=week; D=day; BMx=biomarkers; oGTT=oral glucose tolerance test.

Study Subject Baseline Demographics and Disposition

A total of 32 subjects were enrolled, of which 50% were males and 50% were females. Subjects were an average age of 51 years, weight of 105.3 kg, body mass index of 38.6 kg/m² and hemoglobin A1c, or HbA1c, of 8%. Subjects with stable chronic disease (i.e., T2D, hypertension and hyperlipidemia) were maintained on their usual standard of care therapies on a stable regimen for the duration of treatment. Of these 32 subjects, 23 received AXA1125 24g TID and had baseline MRI proton density fat fraction, or PDFF, greater than 10%, five received AXA1125 24g TID with baseline MRI PDFF less than 10% (i.e., a total of 28 subjects received AXA1125 24g TID) and four received AXA1125 6g TID (an error in study product administration at one study site). In the subgroup that received AXA1125 24g TID with baseline MRI PDFF greater than 10% (n=23), there were a total of nine early terminations: four between Day 1 and Week 6, and five between Week 6 and Week 12. Discontinuations were due to a combination of withdrawal of consent (n=2), lost to follow up (n=1) and AEs (n=6). Of the six AE-related reasons for early termination, only one AE (diarrhea, prior to Week 6 visit) was considered as possibly related to study product. One subject was removed from the analysis of the physiological assessments because the subject missed several study product administrations and was noncompliant during the study. In addition, one subject had no Week 6 MRI due to poor image quality. Consequently, sample sizes vary at the indicated time points due to subject attrition, discontinuation and availability of the corresponding data at those time points.

Primary Safety & tolerability	Clinical AEs, vital signs, ECGs, clinical laboratory parameters, including standard chemistry and hematology panels, other liver function tests (e.g., ALT, AST)
Secondary Basal levels of endogenous amino acids and amino acids within AXA1125 Physiological assessments	Amino acid levels Normal Structure <ul style="list-style-type: none"> • MRI-PDFF assessment of liver fat Normal Function <ul style="list-style-type: none"> • Metabolism — glucose (FPG, HbA1c, oGTT, insulin and HOMA-IR) and lipid (BHB, FAO markers, lipid panel) homeostasis assessments • Inflammation — apoptosis (e.g., CK-18) and macrophage (e.g., MCP-1) markers • Fibrosis — fibrogenic (e.g., Pro-C3) markers

FPG: fasting plasma glucose; oGTT: oral glucose tolerance test; FAO: fatty acid oxidation; HOMA-IR: Homeostatic Model Assessment of Insulin Resistance; BHB: beta-hydroxybutyrate; CK: cytokeratin; MCP: monocyte chemoattractant protein; Pro-C3: N-terminal type III collagen propeptide.

Study Results

Primary

We did not observe any significant safety issues with AXA1125 and it was generally well tolerated. The rates and patterns of the observed AEs in this study appear to be consistent with the typical rates and patterns observed generally in clinical studies with T2D and NAFLD subjects. The most common AEs were diarrhea (in seven subjects) and headache (in six subjects). There were two serious AEs reported, acute cholecystitis and right toe infection, which were deemed not reasonably associated with the study product, and more likely due to subject's preexisting conditions as these complications are quite common with underlying obesity and T2D. A total of six subjects discontinued from the study due to an AE. These were diarrhea (n=2), cholecystitis (n=1), stomach flu (n=1), hyperglycemia (n=1) and right toe infection (n=1). Of these six AEs leading to discontinuation, only one (diarrhea, prior to the Week 6 study visit) was considered as possibly related to the study product. All AEs, except the two serious AEs, generally resolved without intervention. There were no clinically significant abnormalities in physical examination, body weight, vital signs, ECG and standard clinical safety laboratory (chemistry and hematology) parameters over the 12-week duration.

Secondary

Pharmacokinetic changes

Only basal (fasted) levels of amino acids were measured in this study. The average plasma concentration of the individual amino acid constituents within AXA1125 in all subjects receiving 24g

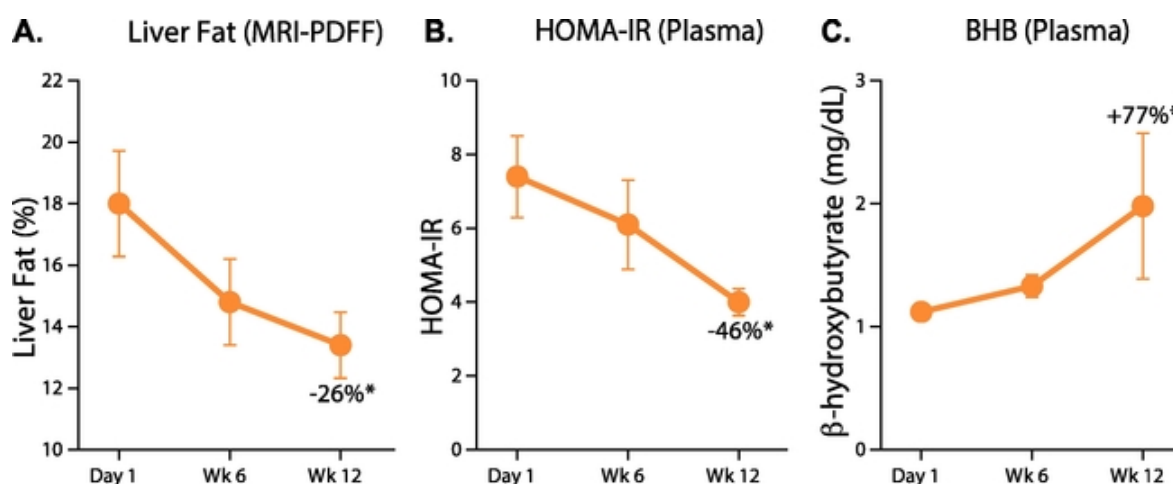
TID AXA1125 in the basal state (i.e., before ingestion of AXA1125) were not meaningfully changed over the course of the 12-week study, as compared to baseline (Day 1) levels.

Physiologic Assessments

Metabolism

Lipotoxicity and insulin resistance are generally regarded as metabolic drivers of NAFLD. AXA1125 24g TID administration for 12 weeks tended to decrease the mean liver fat content, and the average directional change over this period tended to be 26% lower compared to subjects' corresponding Day 1 baseline values in those with a baseline PDFF greater than 10%. Measures of glucose homeostasis revealed no changes in FPG, HbA1c or in glucose AUC during oGTT with AXA1125 administration. However, after 12 weeks of AXA1125 24g TID administration, HOMA-IR (−46%) and plasma insulin in both the fasted (−38%) and prandial states (i.e., after a glucose bolus in the setting of an oGTT, −19%), tended to decrease as compared to the corresponding mean pre-administration baseline levels in those with a baseline PDFF greater than 10%. We believe these results suggest a potential insulin sensitizing effect of AXA1125 as lower amounts of insulin are needed to maintain the same glucose level and/or an enhanced insulin clearance effect.

Effects on both liver fat and HOMA-IR were observed without any accompanying body weight changes despite the provision of approximately 496 kcal/day via AXA1125 daily administrations. Subjects did not drastically alter their usual dietary or physical activity patterns during the 12-week study period. Thus, the observation of body weight neutrality under these circumstances suggests a likely change in nutrient utilization, implicating increased fat oxidation. Assessment of the fasting lipid profile revealed no changes in mean serum levels of total cholesterol, HDL-C, and nonesterified fatty acids, with trends toward slight decreases in LDL-C and triglyceride, or TG, levels. However, beta hydroxybutyrate, or BHB, tended to directionally increase by 77% as compared to the corresponding mean pre-administration baseline levels in those with a baseline PDFF greater than 10% suggestive of a mild-to-moderate ketotic state. A systematic plasma lipidomic profiling indicated a tendency to upregulate acylcarnitines, a marker of mitochondrial fatty acid oxidation, and downregulate toxic lipid species such as ceramides, sphingomyelins and long-chain TGs. Taken together, we believe these results suggest that AXA1125 over 12 weeks tended to impact lipid handling (lowered liver fat and raised BHB), and insulin sensitivity (lowered HOMA-IR and plasma insulin).



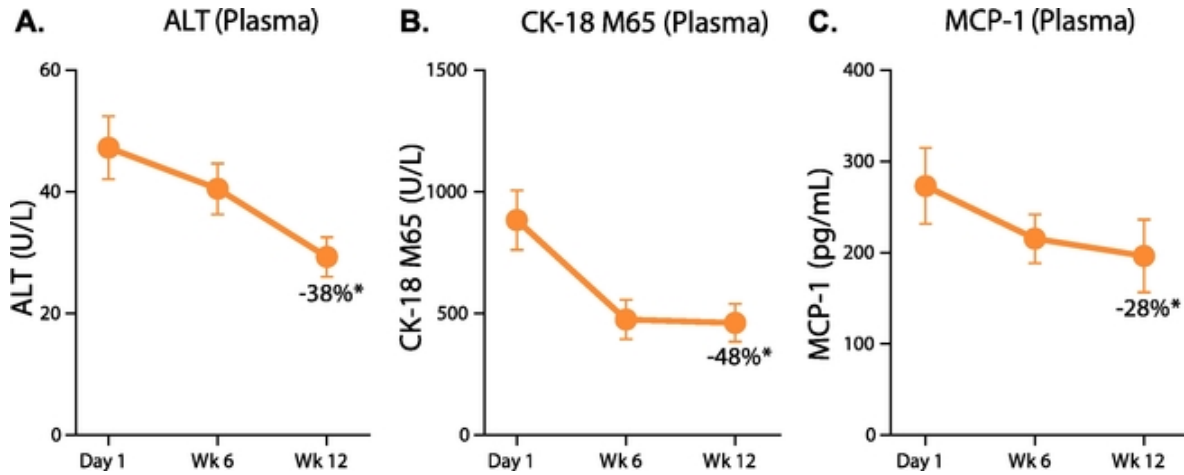
(A) Liver fat content (n=22, day 1; n=17, week 6; n=13, week 12); (B) Plasma HOMA-IR (n=22, day 1; n=19, week 6; n=13, week 12); (C) Plasma beta-hydroxybutyrate (n=22, day 1; n=20, week 6; n=13, week 12) levels at baseline (day 1), week 6, and week 12 in the Non-IND, IRB-Approved Clinical Study of AXA1125. * denotes the relative directional percentage change trend over the 12-week administration period. Values represent mean ± SEM from subjects administered AXA1125 24g TID with Day 1 PDFF greater than 10%. Wk=week.

The clinical observations of a decreasing trend in liver fat in subjects with T2D and NAFLD were followed up with cell-based experiments in primary human hepatocytes. In these *in vitro* experiments, AXA1125 attenuated the saturated fatty acid and tumor necrosis factor alpha mediated increase in lipid droplet accumulation, as well as induced a microsteatotic phenotype.

Inflammation

After 12 weeks of AXA1125 24g TID administration, mean blood levels of key inflammation biomarkers (ALT, CK-18 M65 and MCP-1) were directionally decreased by –38%, –48%, and –28%, respectively, as compared to their corresponding mean pre-administration baseline levels in those with a baseline PDFF greater than 10%. Changes in AST were also directionally consistent with that seen in ALT.

In previous studies, decreases in CK-18 have been associated with improvements in ballooning on liver histology, and decreases in MCP-1 have also been observed with thiazolidinediones, statins and angiotensin-converting-enzyme inhibitor treatments.



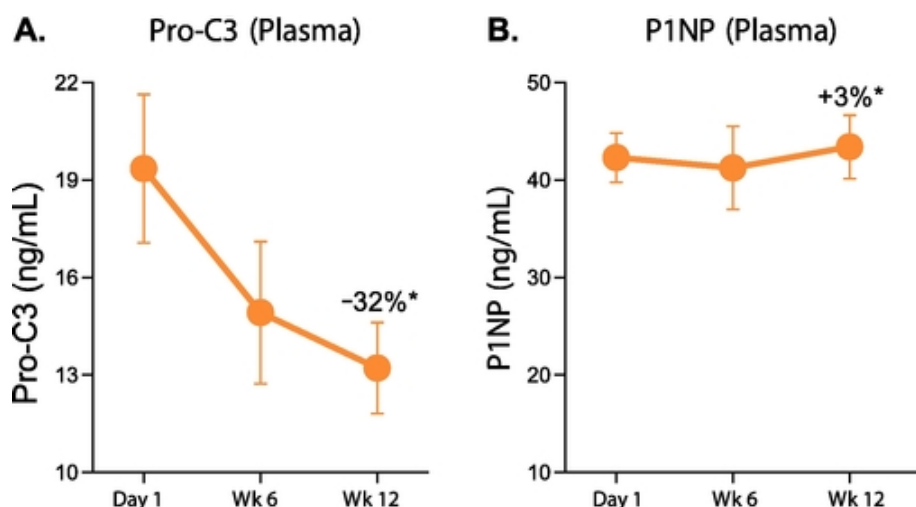
(A) Plasma ALT (n=22, Day 1; n=20, week 6; n=13, week 12); (B) Plasma CK-18 M65 (n=22, Day 1; n=14, week 6; n=13, week 12); (C) Plasma MCP-1 (n=22, Day 1; n=19, week 6; n=13, week 12) levels at baseline (Day 1), week 6, and week 12 in the Non-IND, IRB-Approved Clinical Study of AXA1125. * denotes the relative directional percentage change trend over the 12-week administration period. Values represent mean ± SEM from subjects administered AXA1125 24g TID with Day 1 PDFF greater than 10%. Some of the CK-18 M65 and MCP-1 values were below the limit of detection for these assays; hence, the lower limit of the detection values were used for the analysis. Wk means week.

The clinical observations of a decreasing trend in plasma MCP-1 in subjects with T2D and NAFLD were followed up with cell-based experiments in primary human macrophages. In these *in vitro* experiments, AXA1125 suppressed lipopolysaccharide, or LPS-induced tumor necrosis factor alpha, or TNFα, production from M1 macrophages, and simultaneously increased the anti-inflammatory cytokine, CCL18, in interleukin-4 treated M2 macrophages, both in a dose-dependent manner. Based on additional experiments interrogating cellular energetics, we believe one way in which AXA1125 exerts its potential anti-inflammatory effects is by reducing glycolytic adenosine triphosphate, or Glyco-ATP, while maintaining mitochondrial and total ATP levels within the macrophage.

Fibrosis

Changes in a key hepatic fibrogenic marker, Pro-C3, were assessed after 12 weeks of AXA1125 24g TID administration. Levels of Pro-C3 in the blood correlate with the NAFLD Activity Score on histology as well as to liver-related clinical outcomes. There was a directional trend to

decrease Pro-C3 by –32% as compared to its corresponding mean pre-administration baseline levels in those with a baseline PDFF greater than 10%. Baseline values of Pro-C3 in three subjects were greater than three standard deviations above the mean, i.e., greater than 60 ng/mL to as high as 78 ng/mL and are considered as outliers. One subject had a baseline Pro-C3 of 9.9 ng/mL, experienced a serious AE of acute cholecystitis, stopped taking AXA1125 at the end of Week 1 and then discontinued from the study on Week 5. The subject's end-of-study Pro-C3 level was 31.9 ng/mL, reflecting both the acute inflammatory state (i.e., acute cholecystitis) and also likely a washout effect of AXA1125. In light of this clinical circumstance, Pro-C3 data from this subject were excluded. We believe changes in the pro-collagen markers were specific to those that indicate a change in hepatic fibrogenesis (i.e., Pro-C3) versus a more generalized change because total procollagen type 1 N-terminal propeptide, or P1NP, considered to be a sensitive marker of bone turnover was not affected (+3%) by AXA1125. We believe these observations suggest that AXA1125 may selectively impact hepatic fibrogenesis.



(A) Plasma Pro-C3 (n=19, Day 1; n=13, week 6; n=16, week 12); (B) Plasma P1NP (n=22, Day 1; n=14, week 6; n=19, week 12) levels at baseline (Day 1), week 6, and week 12 in the Non-IND, IRB-Approved Clinical Study of AXA1125. * denotes the relative directional percentage change trend over the 12 week administration period. Values represent mean \pm SEM from subjects administered AXA1125 24g TID with Day 1 PDFF greater than 10%. Wk means week.

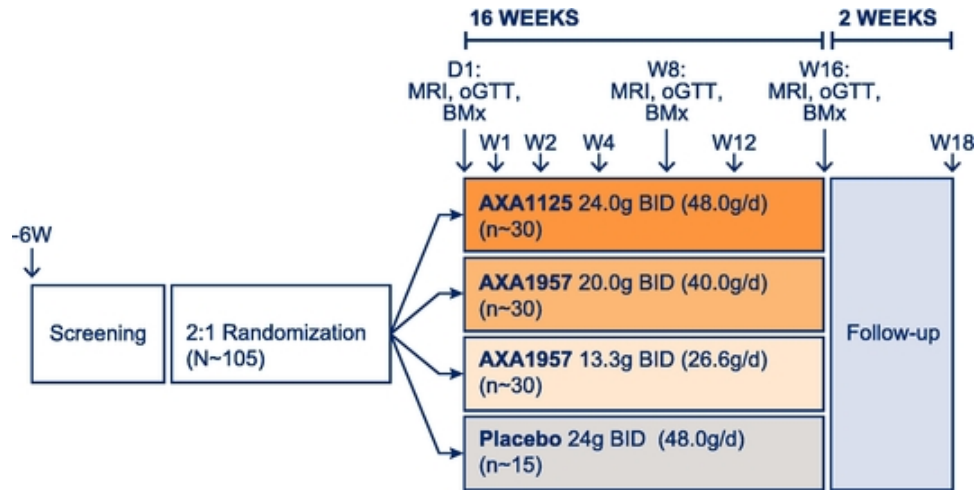
We followed up the clinical observation of a decreasing trend in plasma Pro-C3 in subjects with T2D and NAFLD with cell-based experiments in primary human stellate cells. These *in vitro* experiments revealed that AXA1125 suppressed Pro-C3 protein secretion in the transforming growth factor beta, or TGF β -activated stellate cells, and also reduced gene expression of heat-shock protein 47, a molecular chaperone required for collagen maturation, in a dose-dependent manner. Effect of AXA1125 was specific to stellate cell activation and proliferation as indicated by both a dose-dependent suppression of alpha-smooth muscle actin (a marker of stellate cell activation) and a concomitant decrease in EdU (a marker of cell proliferation).

Acknowledging the limitation of a small sample size, we believe this pilot food study also suggests a dose response effect of AXA1125, as the lower amount (6g TID; n=4) of AXA1125 yielded little to no change in the above physiological liver structure and function parameters.

Overall, we believe the weight of evidence from these results support the directional consistency of changes across both the structural and functional markers associated with liver health.

Ongoing Non-IND, IRB-Approved Clinical Study — AXA1125-003

In January 2019, we initiated AXA1125-003, a 16-week (with a two-week follow-up), randomized, single-blind, placebo-controlled, dose-ranging, Non-IND, IRB-Approved Clinical Study to assess safety, tolerability and physiological impact on the normal structures and functions of the body in approximately 105 adult subjects with NAFLD. A few key features of this study design include administration of two different AXA Candidates, AXA1125 and AXA1957, a calorie-matched placebo control, two different amounts of AXA1957 and twice a day, or BID, regimen. We anticipate data readout from this study in the second half of 2020.



Study design for AXA1125-003, a 16-week (with a two-week follow-up), randomized, single-blind, placebo-controlled, dose-ranging, Non-IND, IRB-Approved Clinical Study. W=week; BMx=biomarkers; MRI: magnetic resonance imaging; oGTT=oral glucose tolerance test.

Primary Safety & tolerability	Clinical AEs, vital signs, ECGs, clinical laboratory parameters, including standard chemistry and hematology panels, and other liver function tests
Secondary PK of AXA1125 constituents and endogenous amino acid levels	Amino acid levels
Physiological assessments	<p>Normal Structure</p> <ul style="list-style-type: none"> • MRI-PDFF and corrected T1, or cT1 assessment of liver fat and fibroinflammation <p>Normal Function</p> <ul style="list-style-type: none"> • Metabolism — glucose (FPG, HbA1c, oGTT, insulin, HOMA-IR) and lipid (BHB, FAO markers, lipid panel) homeostasis assessments • Inflammation — apoptosis (e.g., CK-18) and macrophage (e.g., MCP-1) markers • Fibrosis — fibrogenic (e.g., Pro-C3) markers

FPG: fasting plasma glucose; oGTT: oral glucose tolerance test; FAO: fatty acid oxidation; HOMA-IR: Homeostatic Model Assessment of Insulin Resistance; BHB: beta-hydroxybutyrate; CK: cytokeratin; MCP: monocyte chemoattractant protein; Pro-C3: N-terminal type III collagen propeptide.

AXA1125 Potential Product Development Paths and Market Opportunities

Potential Drug Development Path

Overview of NAFLD and NASH

The treatment of NASH is a potential indication if we elect to further develop either AXA1125 or AXA1957 or both under an IND. While the pathologies of NAFLD and NASH manifest primarily in the liver, they are systemic diseases driven by multifactorial systemic dysregulation of pathways associated with metabolism, inflammation and fibrosis. Dysfunctional lipid metabolism associated with insulin resistance and hepatocyte lipotoxicity increases liver cell death. Systemic and chronic inflammation at the cellular and cytokine level drives tissue damage and activates fibrogenic pathways. Activation of stellate cells then causes accumulation of collagen in the liver and leads to progressive fibrosis.

NAFLD is one of the most common causes of liver disease in the United States. NAFLD is characterized by excess fat accumulation in the liver, typically resulting from obesity, insulin resistance and diabetes. NAFLD in children is often more severe than in adults.

NAFLD can progress to NASH, which is characterized by necroinflammation and fibrosis, and may ultimately lead to life threatening conditions such as cirrhosis or liver cancer requiring liver transplant. With a U.S. prevalence of over 15 million people, and similar prevalence in the EU5 (France, Germany, Italy, Spain and the United Kingdom), NASH represents a substantial public health issue and thus burden on the overall healthcare system. Incidence is expected to continue increasing in parallel with the obesity and T2D epidemics.

Limitations of Current Therapies

Currently, there is no drug therapy approved to treat NAFLD or NASH. A combination of dietary modifications and increased physical activity remains the standard of care for management of NAFLD and NASH. Weight loss decreases diabetes risk and can also improve liver health. Additionally, a cornerstone of treatment of NASH is management of comorbidities. Off-label use of certain medications is outlined in most leading clinical practice guidelines.

The complex pathophysiology of NASH and the events that contribute to the advancement of the disease towards cirrhosis and liver cancer has led to a consensus that efficacious pharmacological therapies will likely require simultaneous modulation of metabolic dysfunction, inflammation and fibrosis. The current pipeline of third-party products under development includes product candidates across multiple mechanisms of action. These candidates are mostly designed against specific targets, rather than a systemic, multifactorial approach that can target the central nodes of the disease in a highly coordinated manner. Clinicians and biopharmaceutical companies are increasingly evaluating combination approaches to address the broad spectrum of the disease, improve response rates and expand the size of the treatable population. However, significant challenges to this approach include the potential compounding of overlapping side effect profiles and high development and treatment costs. Additionally, there are limited programs in development for pediatric patients.

We believe that an effective interventional approach to NASH should be intrinsically combinable, multifactorial and safe. Based on our data to date and the focus of other approaches outlined above, we believe there are important differentiated product development opportunities for both AXA1125 and AXA1957.

Potential Non-Drug Development Path

If we decide to develop AXA1125 and/or AXA1957 as a non-drug product, the target market would be defined by, or with input from, a strategic partner and supporting data from our current or additional studies. We believe a non-drug pathway could also represent a significant market opportunity given the potential benefits to generally healthy people that could result from supporting normal liver structures and functions, including when the liver may come under stress from common activities such as exposure to alcohol, heavy metals, and high caloric loads. Under a non-drug development path, we or a strategic partner may decide to develop AXA1125 and/or AXA1957 as a dietary supplement to maintain liver health.

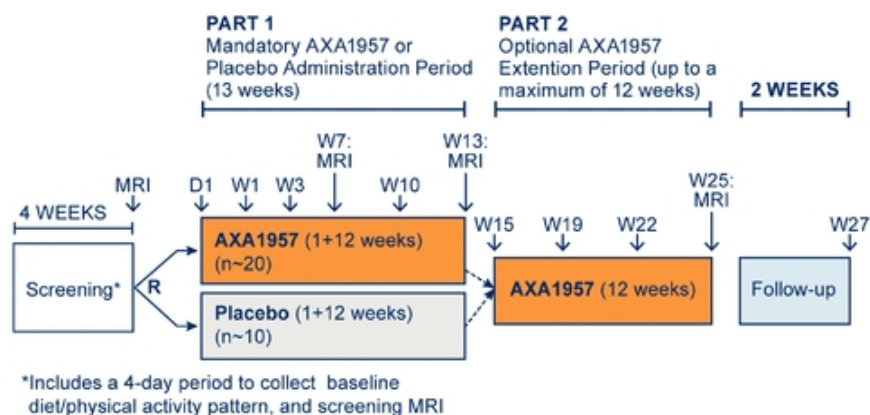
AXA1957 Program

Based on recent scientific publications in the NAFLD field, as well as our own learnings and insights from AXA1125-002 and our AXA Development Platform, we designed and developed AXA1957 with the potential to address additional biologies and populations, including pediatrics. There are no approved pharmacologic treatments and few pipeline programs targeting pediatric NASH. Recommended treatment guidelines currently center around lifestyle interventions.

Planned Non-IND, IRB Approved Clinical Study

In the second half of 2019, we plan to initiate AXA1957-002, a placebo-controlled, single-blind, randomized (2:1) controlled study to assess safety and tolerability and the physiological impact of AXA1957 on the normal structures and functions of the liver in approximately 30 adolescent

(12-17 year old) subjects with NAFLD. We anticipate data readout from this study in the second half of 2020.



Study design for the planned AXA1957-002, a placebo-controlled, single-blind, randomized (2:1) controlled Non-IND, IRB-Approved Clinical Study with up to 25 weeks of administration in 12-17 year old adolescent subjects with NAFLD.

AXA2678 Muscle Program

Overview

AXA2678 is our AXA Candidate being evaluated in muscle health. To date, we have conducted two Non-IND, IRB-Approved Clinical studies of AXA2678 in healthy subjects. AXA2678-001 was a 28-day study in healthy subjects with immobilization-induced acute muscle atrophy to assess safety, tolerability and physiological effects on normal muscle structures and functions. AXA2678-002 was a one-day study in healthy subjects to assess the plasma PK of a 24g amount of AXA2678 when administered two hours after standardized breakfast, lunch and dinner.

In both studies, we did not observe any significant safety issues with AXA2678 and it was generally well tolerated. In AXA2678-002, the average plasma concentrations of the constituent amino acids within AXA2678 increased above endogenous baseline levels in response to AXA2678 administration in all three meal periods with similar area under the curve, or AUC, and maximum serum concentration, or Cmax, and had a median time after administration of approximately two hours, suggesting a consistent PK profile of the constituent amino acids after administration. Additional observations in AXA2678-001 revealed a 76% relative difference in the average muscle cross-sectional area between placebo and AXA2678 groups during the seven-day period of unilateral limb immobilization. We are continuing to evaluate next steps for this program. One potential study design being considered is a placebo-controlled, dose-ranging randomized control trial in subjects undergoing hip arthroplasty. Subjects would receive approximately one week of treatment prior to their elective surgery and up to 12 weeks afterwards in a controlled rehabilitation setting. The potential study endpoints would assess safety, tolerability, muscle mass and function.

AXA2678 Design Rationale

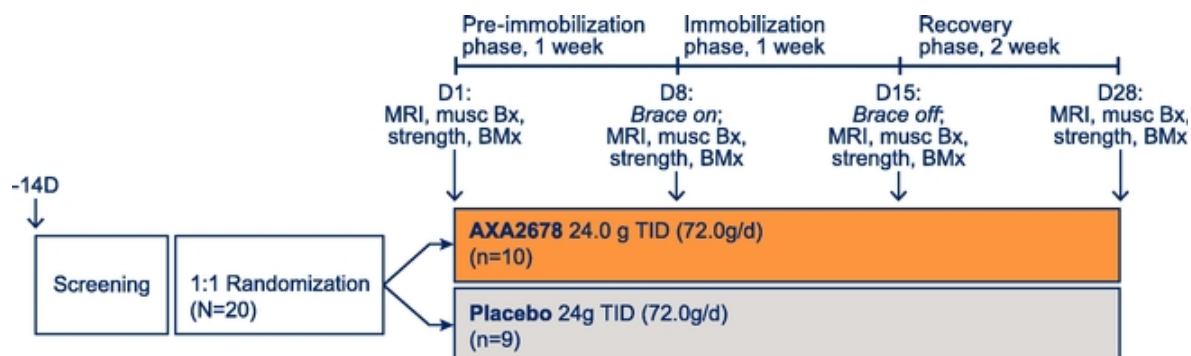
AXA2678 has been designed to target multiple biological pathways with the goal of maintaining normal muscle structure and function, especially in states of disuse atrophy.

Underlying Biology	Design Objectives
Proteostasis and anabolic resistance	<p>Optimize the balance between muscle anabolism via increased muscle protein synthesis and catabolism via decreased muscle protein breakdown</p> <p>Improve muscle insulin resistance</p> <p>Stimulate mitochondrial function and provide anaplerotic substrates for the TCA cycle</p>
Inflammation and vasodilation	Decrease inflammation cascades and reactive oxygen species
Defective myogenesis, the process of forming skeletal muscle fibers, and regeneration	Activate stem cells for muscle growth and differentiation

Completed AXA2678-001 Non-IND, IRB-Approved Clinical Study

Study Design

AXA2678-001 was a four-week, randomized, placebo-controlled, double-blind, Non-IND, IRB-Approved Clinical Study to assess the safety, tolerability and physiological impact on the normal muscle structure and functions in 20 healthy subjects undergoing one week of unilateral limb immobilization. The 28-day study consisted of a screening visit, a seven-day pre-immobilization period, a seven-day immobilization period and a 14-day recovery period. Subjects had their dominant leg immobilized by means of a knee brace. Ten subjects received AXA2678 and the other ten received a non-proteinaceous placebo, or maltodextrin, which was color- and excipient-matched, with a similar caloric content to AXA2678. Administration amounts were 24g TID or 72g/day for 28 days to be taken between meals. Subjects' daily meals were standardized with a set protein content of 1g/kg per day for the full 28-day duration of the study.



Study design of AXA2678-001, a four-week, randomized, placebo-controlled, double-blind Non-IND, IRB-Approved Clinical Study evaluating the safety, tolerability and physiological effects of AXA2678 on muscle structure and function. D=day; musc Bx=muscle biopsy; BMx=biomarkers.

Primary Safety & tolerability	Clinical AEs, vital signs, ECGs, clinical laboratory parameters, including standard chemistry and hematology panels
Secondary Physiological assessments	Normal Structure <ul style="list-style-type: none"> • Muscle MRI for CSA, Mvol, IMF Normal Function <ul style="list-style-type: none"> • Muscle biopsy for fiber type assessments • Strength, activity, electrical impedance myography and biomarkers of muscle biology, inflammation and myokine signaling

CSA: cross sectional area; MVol: muscle volume; IMF: intramuscular fat fraction

Study Results

Twenty subjects were enrolled in the study (n=10 per group). All 20 subjects were male, with an average age of 21.8 years and an average weight of 82.7 kg. Subjects in the two groups had similar age and similar mean weight. However, one subject in the placebo group had a body weight of 135kg, resulting in an inadequate bracing of his knee, and consequently, removed from the secondary analyses. Therefore, the analysis set for secondary muscle structure and function assessments are nine subjects in the placebo group and ten subjects in the AXA2678 group.

Primary

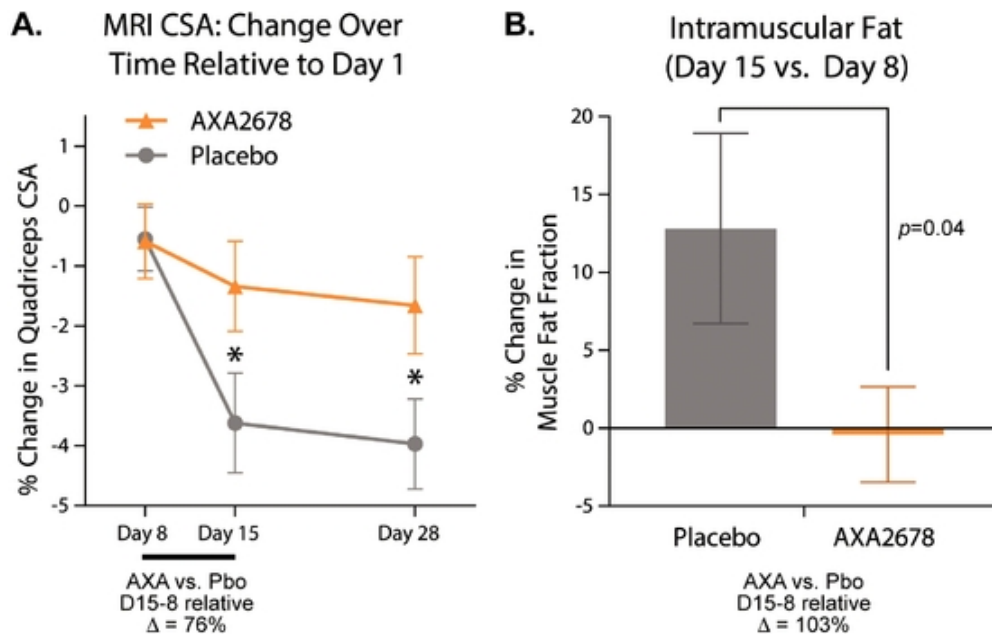
Daily consumption of AXA2678 at 24g TID (72 g/day) was well-tolerated and no significant safety issues were observed over the 28-day administration period. Two AEs of sore throat were reported in one subject on two separate occasions (on Day 6, and then again on Day 22) taking AXA2678. Another two AEs of stomach gas and nausea were reported simultaneously in one subject taking AXA2678 on Day 12. These AEs were also mild, self-resolving within one day and noted as possibly related to AXA2678 administration. No other AEs were reported with AXA2678 or with placebo. There were no clinically meaningful changes noted in routine safety labs (chemistry, hematology), vital signs or ECG.

Secondary

Changes in CSA, MVol and IMF by MRI

In the placebo group, average quadriceps peak CSA declined significantly during immobilization (Day 15 versus Day 8 CSA: -3.1% (p<0.05)). By > contrast, CSA was preserved with AXA2678 (Day 15 versus Day 8 CSA: -0.75% (p>0.3)), a relative difference of 76% between the two groups during this one-week immobilization period. We believe these findings indicate that AXA2678 administration prevented the loss of muscle mass during disuse. The magnitude of quadriceps CSA loss seen in the placebo group over the seven-day period is consistent with that observed in published studies (3% to 5% loss, typically 0.5% per day). A similar pattern was also observed in the quadriceps muscle volume (Day 15 versus Day 8 Mvol: -2.4% (p<0.05) in the placebo group versus Mvol: -0.67% (p>0.3) in the AXA2678 group) indicating the attenuation of Mvol loss during disuse with AXA2678 administration. MRI images were subjected to a third-party unbiased and independent analysis to confirm the MRI findings. The independent analysis

confirmed the muscle CSA and Mvol changes and also revealed attenuation of intramuscular fat fraction during immobilization in the AXA2678 group compared to placebo. The relative percentage change in quadriceps muscle fat fraction after one-week of immobilization (Day 15 versus Day 8) was 103% in the immobilized leg ($p=0.04$). We believe these findings imply a likely impact of AXA2678 on insulin sensitization as insulin resistance has been closely associated with increased muscle fat infiltration. The aforementioned analyses are not materially affected even when including data from the excluded outlier subject.



(A) Percentage change in quadriceps cross sectional area in the immobilized leg over 28 days compared to Day 1 in AXA2678 ($n=10$) and placebo ($n=9$) administered groups. Values represent mean \pm SEM. * denotes a statistically significant reduction in muscle CSA in the placebo group during immobilization and recovery relative to Day 1 by repeated measures Analysis of Variance ($p<0.05$). By contrast, muscle CSA did not significantly change in the AXA2678 group during the study. (B) Percentage change in intramuscular fat fraction within the immobilized quadriceps during one week of immobilization (Day 15 vs. Day 8) in AXA2678 ($n=9$) and placebo ($n=8$) administered groups. Values represent mean \pm SEM.; p -value obtained using an unpaired t -test with Welch's correction.

Muscle fiber type changes

Immunohistochemical analysis of muscle fibers within the vastus lateralis did not reveal baseline (pre-immobilization) differences in fiber CSA or fiber type distribution between placebo and AXA2678 treated groups. Immobilization did not result in a statistically significant reduction of fiber CSA in either type I or type II fibers; however, there was a trend toward the preservation of type I fibers with AXA2678 treatment as reflected by a decreasing trend in the percentage of type I fibers in the placebo, but not the AXA2678 group.

Changes in strength, activity and electrical impedance myography

At baseline, no differences in muscle strength were observed between groups in peak knee extensor isometric torque or time to peak torque. Immobilization (Day 15 vs. Day 8) resulted in equivalent relative declines in peak torque in both groups (placebo: $-7.5 \pm 17.5\%$; AXA2678: $-6.7 \pm 15.1\%$); however, at Day 28, the peak isometric torque tended to be higher in the AXA2678 administered group as compared to the placebo group, suggesting recovery of strength to pre-immobilization baseline levels even within a relatively short two week period. Time to peak torque tended to be faster with AXA2678 administration as compared to placebo during both immobilization and recovery periods. We believe the faster average time to peak torque observed in the AXA2678 group may reflect preservation of muscle fibers and potentially an enhancement in muscle perfusion.

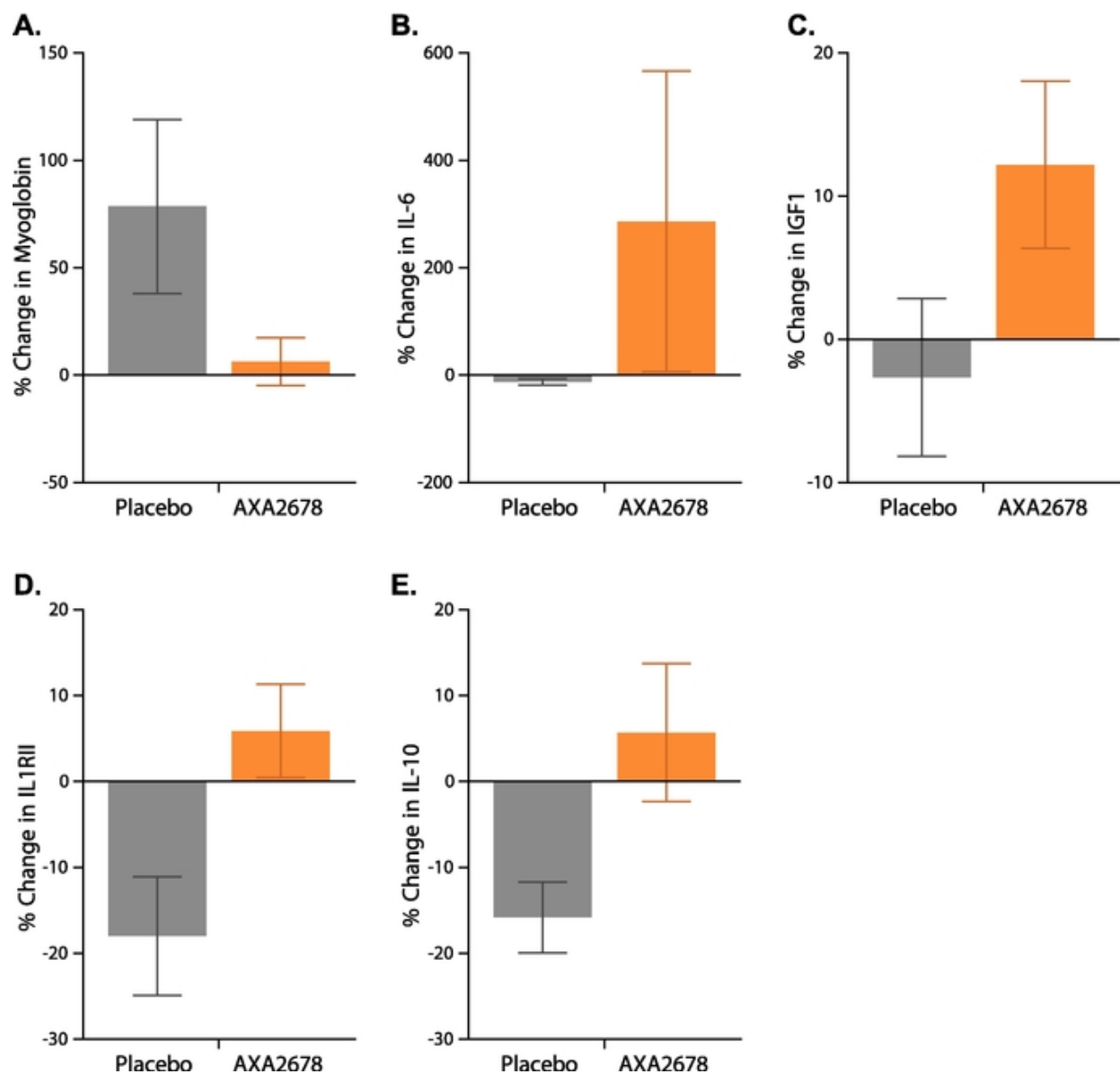
As expected, activity (steps per day) substantially decreased with limb immobilization in both groups. Between Day 8 and Day 15 there was no statistically significant correlation between the percentage change in mean CSA and the percentage change in mean activity in either group. At the end of the recovery period, as expected, activity in both groups had returned toward their respective pre-immobilization levels with no significant differences between the two groups.

Normally, immobilization-induced atrophy results in a decrease in key electrical impedance myographic parameters such as phase, maximum reactance and reactance slope, all of which were decreased as expected in the atrophied limb of the placebo group. These parameters, considered to be reflective of muscle health, tended to increase and were preserved with AXA2678 administration during immobilization, with relative differences versus placebo ranging from +115% to +155%. We believe these findings are consistent with the anti-atrophic effect of AXA2678, thereby reflecting a potentially healthier muscle even during an acute insult of limb disuse.

Changes in key biomarkers of muscle biology, myokine signaling, and inflammation

A preliminary analysis of various biomarkers associated with muscle biology, myokine signaling, and inflammation revealed several important patterns of change. Myoglobin levels, suggestive of muscle breakdown and shown to be increased in blood during immobilization, tended to increase as expected in the placebo group. By contrast, AXA2678 administration tended to attenuate this increase consistent with its anti-atrophic effect and suggests a possible attenuation of muscle breakdown during disuse. AXA2678 administration tended to increase the plasma levels of both IL-6 (myokine associated with myogenic differentiation, insulin-mediated glucose disposal, fatty acid oxidation), and IGF-1 (anabolic hormone that stimulates muscle hypertrophy and insulin sensitivity). Taken together, we believe these preliminary findings suggest AXA2678 may coordinately improve anabolism and insulin sensitivity during the immobilized period.

Subjects administered AXA2678 tended to maintain plasma levels of IL1R2, a soluble receptor that acts as an IL-1 decoy, reducing IL-1-mediated inflammation, during immobilization, and concomitantly tended to maintain plasma IL-10, an anti-inflammatory cytokine expressed during muscle regeneration, during both the immobilization and recovery periods. Thus, we believe that AXA2678 has the potential to impact inflammation associated with muscle disuse and atrophy.



Day 15 versus Day 8 relative percentage changes in plasma myoglobin (A), IL-6 (B), IGF-1 (C), IL1R2 (D), and IL-10 (E) levels during the immobilization period. Values represent mean \pm SEM in placebo (n=9) and AXA2678 (n=10) groups.

Subjects receiving AXA2678 also had a decreased loss in muscle mass and strength even in the non-immobilized leg, although these effects were smaller than those observed in the immobilized leg. The milder effects observed in the non-immobilized leg show that AXA2678 affected all muscles whether immobilized or not, albeit with a larger effect on immobilized muscles. These findings are consistent with the coordinated systemic effects observed with AXA2678 on the anabolic, inflammatory and metabolic blood markers described above.

The above clinical observations prompted additional cell-based experiments in cultured C2C12 muscle cells to gain further mechanistic insights into AXA2678's effect on muscle mass and function. These experiments sought to study myogenesis, which is important for recovery from muscle injury and to induce muscle growth. During muscle injury, satellite cells, or skeletal muscle stem cells, are activated, differentiate and fuse with damaged myofibers to induce expression of the

cytoskeletal complexes required for muscle contraction and contribute myonuclei supporting muscle repair. The results of the experiments in C2C12 cultured muscle cells revealed that AXA2678 directly increased myoblast differentiation into myotubes, i.e., enhanced myogenesis, as compared to untreated control cells.

AXA2678 Potential Product Development Paths and Market Opportunities

Potential Drug Development Path

Overview: Disuse-related muscle atrophy

Beyond its role in generating contractile force for movement, skeletal muscle is the primary site of glucose disposal, is a large contributor to circulating lipid oxidation, accounts for a large portion of resting metabolic rate, which is highly predictive of independent living with advancing age, and is an independent predictor of morbidity and mortality in several chronic diseases of the liver, kidney and heart. As a result, atrophy, or a decrease in muscle mass in an area of the body, leads to impaired functional capacity, the onset of insulin resistance and a heightened risk for morbidity and mortality. When a muscle remains unused, even for a period of several days, it begins to waste away and lose functionality, the pathophysiology of which is complex and multifactorial. A hallmark of muscle wasting is the inability to maintain proteostasis, the balance between protein synthesis and breakdown. Atrophy is then driven by an inability to maintain muscle protein synthesis. Defective myogenesis, or differentiation of muscle stem cells into myofibers, limits muscle cell growth. Chronic inflammation and related cytokines (tumor necrosis factor alpha) promote muscle wasting by decreasing protein synthesis and increasing protein breakdown. Muscle fat infiltration increases with age and impacts outcomes for certain immobilization atrophy conditions, including the outcomes in liver-related conditions.

Disuse related muscle wasting is most common in people suffering temporary disablement, such as hospitalization or an immobilized limb following injury. Limb immobilization-induced acute atrophy leads to weakness, which further complicates recovery, because movement, especially load-bearing activity, is one of the ways to induce muscle growth. Elective surgeries, including hip replacement, hip fractures, rotator cuff repair or injury, and surgical intervention addresses only the primary injury and has no effect on muscle mass or function that might have occurred prior to surgery. The preexisting presence of atrophy impacts the prognosis after surgery.

The increased recovery burden resulting from limb immobilization-induced acute muscle atrophy leads to longer patient recovery times, impaired functional capacity for independent living and time away from work and activities of daily living. With significant unmet global need, no commercialized products and few assets in development, disuse-related muscle atrophy is an attractive market opportunity. If we pursue development of AXA2678 under an IND, we believe it could potentially be investigated for multiple indications characterized by such disuse-related muscle atrophy, including total knee arthroplasty, or TKA, total hip arthroplasty, or THA, hip fracture related myopenia, or HFRM, rotator cuff repairs or injury, and other musculoskeletal atrophy or injuries, including osteoarthritis induced myopenia. In the United States, the market for these conditions each year is upwards of 140,000 patients undergoing TKA, 50,000 undergoing THA, 133,000 recovering from HFRM and 195,000 recovering from RCI annually.

Limitations of Current Therapies and Available Products

It has been challenging to effectively demonstrate the functional impact of interventions following a change in muscle mass, because mass and function are often decoupled from each other. Study design limitations have also posed a hurdle for fully assessing the efficacy of a treatment. Clinical studies frequently end shortly after immobilization and there is often limited information on recovery post-immobilization, despite recovery having a significant clinical and health

economic relevance. Thus, the clinical utility of any intervention needs to be characterized during the recovery period following injury. Because pre-operative lean body mass and nutrition state are significantly associated with surgical outcomes and hospital stay, pre-immobilization treatment could drive more significant improvements in muscle mass and strength versus post-immobilization treatment alone. For instance, it is now well known that peri-operative exercise improves post-surgery outcomes in elderly patients undergoing major surgery. We believe that a treatment for muscle disuse atrophy should be applied before, during and after immobilization (peri-immobilization) for optimal effects.

Based on emerging research in this area and our insights generated using the AXA Development Platform, we believe a multifactorial pathway-based approach is required to modulate proteostasis, overcome anabolic resistance and induce myogenesis and anti-inflammation simultaneously and in a highly coordinated manner to re-couple mass and function. We believe such an approach may hold significant promise to meaningfully impact clinical outcomes.

Potential Non-Drug Development Path

If we decide to develop AXA2678 as a non-drug product, the target market would be defined by, or with input from, a strategic partner and supporting data from our current or additional studies. We believe a non-drug pathway could also represent a significant market opportunity given the potential benefits to overall health by supporting the body's ability to maintain normal muscle mass and strength. Under a non-drug development path, we or a strategic partner may decide to develop AXA2678 as a dietary supplement to support healthy muscle structure and function.

AXA4010 Program

Overview

We believe that EMMs have the potential to support and maintain blood health, which is critical to a multitude of metabolic functions throughout the body. Using insights from our Non-IND, IRB-Approved Clinical Studies and preclinical studies of EMM compositions, published clinical studies of amino acid interventions, published and in-house metabolic profiling data, and a mechanistic understanding of blood health, we identified key metabolic paths where we believe amino acid biologies drive key aspects of normal blood health.

AXA4010 Design Rationale

AXA4010 has been designed to target multiple biological pathways with the goal of supporting normal structures and functions of the blood.

Underlying Biology	Design Objective
Blood Production & Integrity	Promote proliferation and maturation of blood cells during hematopoietic demand Maintain red blood cell, or RBC, form and function against dehydration, rigidity and support oxygen transport
Plasma and RBC amino acid imbalance	Restore amino acid balance to support RBC metabolism, including substrates for glutathione and nitric oxide synthesis, improve reactive oxygen species and delivery of amino acids to peripheral tissue
Vascular health & Inflammation	Improve defense against vascular adhesion, inflammation and stasis

Preclinical Research and Analysis on Sickled Cells To Date

To investigate the effect of certain amino acids on normal blood biology, we performed preclinical experiments on sickle cell blood from subjects. In order to study the effects of reactive oxygen species, or ROS, we challenged the blood cells with a ROS-inducing agent and attempted to rescue the phenotype with various concentrations of amino acids. The data from these preclinical cell experiments demonstrate the impact on ROS in sickled blood when exposed to certain individual amino acids and across various concentrations. We were able to observe positive effects of cysteine and N-acetylcysteine, or NAC, while also noting a negative impact from tryptophan. This observation highlighted the importance of combining only those amino acids that support the targeted biologies, while being cautious of including others that can be detrimental to the biology of interest.

In studies on macrophages and hepatocytes, we explored the relationship between both individual and combinations of amino acids on inflammation. Across both cell model systems, we observed that combinations of certain amino acids had greater anti-inflammatory activity than each amino acid alone. We also observed that combinations and certain individual amino acids had anti-inflammatory activity above baseline. This was demonstrated by both an increase in CCL18, an anti-inflammatory cytokine, in M2 macrophages as well as a decrease in MCP-1, a pro-inflammatory cytokine, in hepatocytes. We incorporated this knowledge about anti-inflammatory combinations of amino acids into the design of AXA4010.

Additionally, we incorporated insights from our pharmacokinetic and pharmacodynamic studies to determine the appropriate relative levels of AXA4010's individual constituents. We then leveraged insights related to the first-pass metabolism of amino acids to ensure sufficient exposure of amino acids to the blood.

Published amino acid profiles in blood disorders, such as sickle cell disease, typically show reductions in essential amino acids such as leucine, histidine, valine, and lysine, and sometimes also non-essential amino acids. To enhance our understanding of metabolic profiles in blood

disorders, we analyzed the concentration of amino acids in plasma and red blood cells of pediatric sickle cell patients versus healthy age-matched controls. Our results in the RBCs and plasma of patients corroborate key findings from the literature such as depleted arginine, while also generating new insights in cysteine biology and other essential amino acids.

Planned Non-IND, IRB Approved Clinical Study

We plan to initiate AXA4010-001, a Non-IND, IRB-Approved Clinical Study of AXA4010, in the second half of 2019 and anticipate the data readout(s) from this study in the second half of 2020. Based on our findings, we will make the appropriate development path decision to develop AXA4010 as a drug or as a non-drug product candidate.

AXA4010 Potential Product Development Paths and Market Opportunities

Potential Drug Development Path

In addition to supporting normal structures and functions of blood in the body, we believe EMMs may have the potential to target and address diseases of the blood such as sickle cell disease, or SCD. Single amino acid based approaches have been tested and approved for SCD. Glutamine was approved by the FDA in 2017 for the treatment of SCD.

SCD is an inherited disorder of hemoglobin affecting approximately 100,000 individuals in the United States and 4.4 million worldwide. For many patients, SCD is defined by chronic organ failure punctuated by acute complications and early mortality. Care for sickle cell patients is limited, with only two FDA-approved drugs that seek to reduce the probability of vaso-occlusion events leading to "sickle cell crises," ischemic injury and severe pain. We believe AXA4010 could be studied under an IND for its potential impact on the management of the complex and multifactorial pathology of SCD.

Non-Drug Development Path

If we decide to develop AXA4010 as a non-drug product candidate, the target market would be defined by, or with input from, a strategic partner. We believe a non-drug pathway could also represent a significant market opportunity given the potential benefits to overall health by supporting blood health and modulating inflammation. Under a non-drug development path, we or a strategic partner may decide to develop AXA4010 as a dietary supplement to support blood-related structure and function.

Preclinical Program

Many diseases are driven by multifactorial dysregulated systemic metabolism, and we have already characterized over 50 diseases for prioritization. We believe that there are also additional potential applications of our AXA Development Platform and have expanded our pool of potential disease areas by importing additional public databases, such as the Human Metabolome Database. We intend to continue to target diseases driven by dysregulated metabolic pathways and in which we can potentially leverage the vital role that EMMs play in regulating metabolic function.

Additional Potential Opportunities

Central Nervous System

Amino acids are intimately involved in the proper functioning of the CNS, which is composed of the brain and spinal cord. Many neurotransmitters, both excitatory and inhibitory, are either amino acids themselves or close metabolites thereof. The transport and metabolism of these

compounds can extend across multiple neuronal cell types, adding to the specialization and complexity of CNS function.

As a result, dysregulation of amino acid biology in the CNS contributes to conditions such as mild traumatic brain injury and highlights how an acute head injury can lead to multi-modal neurological dysfunction through energy crisis, oxidative stress, inflammation and a temporary disruption of the blood-brain barrier. Thus, the complexity of the CNS and spectrum of neuropathology in disease creates a vast potential for targeted and combinatorial EMM interventions.

Other Areas

Additionally, we are looking at the application of EMMs in other organ systems affected by metabolic dysfunction, including targets relating to kidney and pulmonary function.

Competition

The biotechnology and pharmaceutical industries utilize rapidly advancing technologies and are characterized by intense competition. There is also a strong emphasis on intellectual property and proprietary products.

We believe that our pioneering research in establishing EMM compositions for drug or non-drug pathways such as non-drug products, coupled with our capabilities across our AXA Candidate platform technology, product design, development pathway and manufacturing provide us with a competitive advantage. However, we will continue to face competition from different sources, including major pharmaceutical companies, biotechnology companies, consumer health product companies, academic institutions, government agencies, public and private research institutions, consumer nutritional supplement or conventional consumer health manufacturers and manufacturers of amino acids and other EMMs. For any products that we eventually commercialize, we will not only compete with existing products but also with new products that may become available in the future, such as microbiome products.

We compete in the consumer health, pharmaceutical and biotechnology industries. There are additional companies that are working on modulating specific metabolic pathways involved in various health and disease conditions, although we are not aware of any company creating AXA Candidate-like products with multifactorial activity. Companies with clinical programs that could compete with our AXA Candidates include Madrigal Pharmaceuticals, Inc., Intercept Pharmaceuticals, Inc., Gilead Sciences, Inc., Novartis AG, Bristol-Myers Squibb Co., Esperion Therapeutics, Inc., Viking Therapeutics, Inc., Scholar Rock Holding Corporation, NGM Biopharmaceuticals Inc., Genfit SA and Kaleido Biosciences, Inc., among others.

Finally, we anticipate competing with the largest consumer health companies and nutritional pharmaceutical and amino acid companies in the world, such as Nestlé Health Science S.A., Abbott Laboratories, Johnson & Johnson, The Procter & Gamble Company, and Ajinomoto Co., Inc., all of which are currently conducting research in competitive indications or may be interested in using amino acids and other EMMs as drugs or nutritional supplements.

Intellectual Property

As a first mover in this approach to EMMs, we are establishing a broad, global intellectual property portfolio for our pipeline and have already received our first notice of allowance for an AXA1125 patent application. This is notable considering the speed of our development model and establishes a foundation for the large number of submitted applications for our pipeline (35 patent applications filed as of April 1, 2019). Our matrixed approach to IP, trade secrets, and capabilities

that we take across the AXA Candidate, the indication, the AXA Development Platform, manufacturing processes and technologies; formulations; and amounts provides an important asset for the company.

We seek to create a multi-dimensional intellectual property portfolio as a strategic asset that has the potential to provide us with a significant competitive advantage. We strive to protect and enhance the proprietary technology, inventions and improvements that are commercially important to our business, including seeking, maintaining and defending patent rights, whether developed internally or through collaborations, or licensed from third parties. Our policy is to file patent applications related to our proprietary technology, inventions, improvements and AXA Candidates that are important to the development and implementation of our business in the United States and in jurisdictions outside of the United States. We also rely on trade secrets and know-how relating to our proprietary technology and AXA Candidates, continuing innovation and in-licensing opportunities to develop, strengthen and maintain our proprietary position in the field of rebalancing dysregulated metabolism. We additionally rely on regulatory-related protections such as data exclusivity, market exclusivity and patent term extensions when available, and where appropriate, plan to seek and rely on regulatory protection afforded through Orphan Drug designations. Our commercial success may depend in part on our ability to obtain and maintain patent and other proprietary protection for our technology, inventions and improvements; to preserve the confidentiality of our trade secrets; to maintain our licenses to use intellectual property owned by third parties; to defend and enforce our proprietary rights, including our patents; and to operate without infringing on the valid and enforceable patents and other proprietary rights of third parties.

We believe that we have a strong global intellectual property position anchored by our matrix of patents directed to proprietary AXA Candidates, technology, AXA Development Platform, related manufacturing processes and technology, unique formulations, and knowledge about amounts, uses and features established as standards for AXA Candidates. As for our AXA Candidates, AXA Development Platform, and the processes we develop and commercialize, in the normal course of business, we pursue, as appropriate, patent protection or trade secret protection relating to compositions, methods of use, treatment of indications, dosing, formulations and methods of manufacturing. As of April 1, 2019, our AXA Candidate-related patent portfolio consisted of 18 patent families, two granted U.S. patents, 22 U.S. pending patent applications (including provisional applications) and 13 pending patent applications in jurisdictions outside of the United States (including Patent Cooperation Treaty, or PCT, applications) that, in many cases, are counterparts to the foregoing U.S. patent applications. To date all of our patent rights are owned by us. Our objective is to continue to expand our portfolio of patent applications to protect our AXA Candidates and certain aspects of our AXA Development Platform, manufacturing processes, formulations, and insights into amounts, uses, and features of AXA Candidate composition.

In addition, we own a portfolio of legacy patents and patent applications related to recombinant proteins for nutrition and therapeutics, including nine granted and three pending U.S. patents, and five granted and five pending foreign patents.

Examples of the AXA Candidates and technology areas covered by our intellectual property portfolio are described below.

Indication-Related Intellectual Property

The indication-related patent rights in our intellectual property portfolio relate to conditions and disorders associated with dysregulated metabolism and provide coverage for AXA Candidates to specifically address those conditions and the associated disease states, as well as structure and function of normal organs in the context of dysregulated metabolism. The indication-related patent applications for our lead programs cover novel AXA Candidate compositions and their uses broadly

and, with respect to individual AXA Candidates, in detail. Often, we are able to exemplify even our earliest AXA Candidate inventions with human as well as animal and *in vitro* data. Each of the indication-related patent rights and applications described below are owned by us and are not licensed from any third party.

Notably, while our intellectual property covers drug and non-drug areas, each initial AXA Candidate is first tested as a food in order to better understand the impact on normal human physiology and metabolic pathways. After such initial testing, a decision may be made to deem the AXA Candidate a drug product candidate, and subsequent studies on disease endpoints are conducted under INDs. Thus, the descriptions of patent rights should not be considered as suggesting a current intent to pursue the AXA Candidate as a drug candidate.

AXA Candidate Compositions and Methods for the Treatment of Cirrhosis

Our patent applications cover a class of AXA Candidate compositions for cirrhosis, including clinical candidate AXA1665. Currently, patent rights relating to cirrhosis include a U.S. patent application, a PCT patent application, and two foreign national patent applications. We expect any granted patent based on this family to expire in 2038, excluding any patent term adjustments or extensions.

AXA Candidate Compositions and Methods for NAFLD/NASH

Our patent applications cover a class of AXA Candidate compositions for fatty liver disease, including clinical candidate AXA1125. Currently, patent rights relating to fatty liver disease include two U.S. patent applications and two granted U.S. patents, a PCT patent application, and two foreign national patent applications. We expect any granted patent based on this family to expire in 2037, excluding any patent term adjustments or extensions.

AXA Candidate Compositions and Methods for Acute Muscle Atrophy

Our patent applications cover a class of AXA Candidate compositions for muscle atrophy, including clinical candidate AXA2678. Currently, patent rights relating to muscle atrophy include three U.S. patent applications, a PCT patent application, and two foreign national patent applications. We expect any granted patent based on this family to expire in 2037, excluding any patent term adjustments or extensions.

AXA Candidate Compositions and Methods for Treatment of Traumatic Brain Injury and Stroke

Our patent applications cover a class of AXA Candidate compositions for traumatic brain injury and stroke. Currently, patent rights relating to traumatic brain injury include one U.S. patent application, two PCT patent applications, and two foreign national patent applications. We expect any granted patent based on this family to expire in 2038, excluding any patent term adjustments or extensions.

Additional Indication-Related Patents

We have filed six provisional patent applications directed to additional indications associated with dysregulated metabolism. We expect the patent applications in this portfolio, if issued, to expire in 2039, without taking into account any patent term adjustments or extensions we may obtain. Our AXA Development Platform allows us to rapidly identify and file on AXA Candidates, often including human data in the earliest patent application.

Additional AXA Combination-Related Patents

We have filed three provisional patent applications directed to combinations of particular AXAs (AXA1125, AXA1665 and AXA1957) with particular NAFLD/NASH drugs and drug candidates. We expect the patent applications in this portfolio, if issued, to expire in 2040, without taking into account any patent term adjustments or extensions we may obtain.

Platform-Related Intellectual Property

In addition to the indication-related intellectual property, our intellectual property portfolio also includes know-how and patent applications directed to our AXA Development Platform and other technologies developed internally. Exemplary platform technologies that are the subject of such patent applications include:

- manufacturing processes for complex AXA Candidate mixtures;
- taste formulations; and
- pharmacological characteristics of AXA Candidate compositions.

Our AXA Development Platform iterates and integrates data from literature, including patents, *in vitro* experiments, animal studies, and Non-IND, IRB-Approved Clinical Studies, giving us significant competitive advantages. Our AXA Development Platform, which is protected by trade secrets, is core to maintaining our first mover advantage. These advantages translate into a unique understanding of metabolism, development of many new AXA Candidates, and creation of intellectual property around AXA Candidates and our AXA Development Platform technologies.

These AXA Development Platform technologies, and our intellectual property protection related thereto, are broadly applicable to our AXA Candidates. Our patent applications directed to platform-related technologies, if issued, would expire in 2039, without taking into account any patent term adjustment or extensions we may obtain.

Therapeutic Modality Intellectual Property

Our proprietary knowledge and insights into the behavior of EMMs have yielded inventions related to categories of metabolic dysfunction, such as insulin resistance, inflammation, and fibrosis. Our patent applications directed to these underlying modalities, if issued, would expire in 2039, without taking into account any patent term adjustment or extensions we may obtain.

We continually assess and refine our intellectual property strategy as we develop new platform technologies and AXA Candidates. To that end, we are prepared to file additional patent applications if our intellectual property strategy requires such filings, or where we seek to adapt to competition or seize business opportunities. Further, we are prepared to file patent applications, as we consider appropriate under the circumstances, relating to the new technologies that we develop. In addition to filing and prosecuting patent applications in the United States, we plan to file counterpart patent applications in additional countries where we believe such foreign filing is likely to be beneficial, including, but not limited to, Australia, Brazil, Canada, China, Europe, Hong Kong, India, Israel, Japan, and South Korea.

Individual patent terms depend upon the date of filing of the patent application, the date of patent issuance and the legal term of patents in the countries in which they are obtained. Generally, patents issued for applications filed in the United States and most other countries have patent terms that expire 20 years from the earliest effective filing date. In certain instances, a patent term can be extended to recapture a portion of the term effectively lost as a result of a regulatory review period, although patent term restoration in the United States applies to a new chemical entity, so may not apply to some AXA Candidate compositions. Furthermore, any restoration period is limited

to a maximum restoration time (five years in the United States and Europe) and total effective patent life (14 years in the United States and 15 years in Europe). The actual protection afforded by a patent varies on a product-by-product basis, from country-to-country, and depends upon many factors, including the type of patent, the scope of its coverage, the availability of regulatory-related extensions, the availability of legal remedies in a particular country, and local decisions about the validity and enforceability of the patent.

Regulatory Exclusivity

Under certain circumstances, approval of a drug product by a health authority will result in a period of data exclusivity and/or market exclusivity for the product. Data exclusivity means that no party can file for approval of a drug product based on the original drug approval application data. Market exclusivity (such as Orphan Drug exclusivity) means that the health authority may not be permitted to give final approval to a drug product for a defined period of time, absent certain conditions. In the United States, five-year data exclusivity is only available upon approval of a new chemical entity, which may not apply to some AXA Candidate compositions, and market exclusivity for new indications supported by or clinical studies essential to the approval is limited to three years from approval. In Europe, the period of regulatory exclusivity for a drug product approved through the full process is 10 years (eight years of data exclusivity and two years of market exclusivity, with an additional year of market exclusivity available for a substantial new indication). We believe that AXA products, if approved, should be entitled to the full 10 years of regulatory exclusivity in Europe.

Trademark Protection

As of April 1, 2019, our trademark portfolio contains more than 50 registrations and pending applications. We have trademarks in over 12 countries, including European Union. For the marks AXCELLA and the Axcella LOGO, we have pending applications in the United States, Canada and Brazil as well as International Registrations designating China, the European Union, India, Japan and Russia. In addition, we have a pending U.S. application for AXCELLA HEALTH.

Trade Secrets

We may also rely, in some circumstances, on trade secrets to protect our technology and aspects of our AXA Development Platform. However, trade secrets are difficult to protect. We seek to protect our trade secret technology, e.g., AxcellaKB, confidential AXA Candidates, and commercial plans in part by entering into confidentiality agreements with those who have access to our confidential information, including our employees, contractors, consultants, collaborators and advisors. We also seek to preserve the integrity and confidentiality of our proprietary technology and processes by maintaining physical security of our premises and physical and electronic security of our information technology systems. Although we have confidence in these individuals, organizations and systems, agreements or security measures may be breached, and we may not have adequate remedies for any breach. In addition, our trade secrets may otherwise become known or may be independently discovered by competitors. We have policies in place to ensure that our employees, contractors, consultants, collaborators and advisors do not use intellectual property owned by others in their work for us. Nevertheless, disputes may arise as to the rights in related or resulting know-how and inventions. For this and more comprehensive risks related to our proprietary technology, inventions, improvements and AXA products, if approved, please see the section on "Risk factors — Risks related to our intellectual property."

Manufacturing

To date, we have rapidly designed and efficiently manufactured AXA Candidates and believe our process is readily scalable. Under our existing agreements with our manufacturers, we have been able to secure initial AXA Candidates to initiate our Non-IND, IRB-Approved Clinical Studies in less than three months from identifying the product amount needed. We are making great strides in our goal to create and design product candidates that are consumer-friendly, including in their formulation (e.g., taste), packaging (e.g., easy to open sachets) and administration (e.g., water soluble). Our AXA Candidates are supplied in a dry powder form, which is dissolved in water and then administered orally as an orange-flavored drink. Our formulation development expertise enables us to deliver high concentrations of raw materials at appropriate administration volumes. This expertise covers a wide range of raw material characteristics, and we believe will enable us to deliver multiple oral dosage forms to meet Non-IND, IRB-Approved Clinical Study and clinical needs, as well as commercial needs, if we decide to pursue development of any AXA Candidate under an IND.

The raw materials in our AXA Candidates are used in the pharmaceutical and non-drug product industries. These materials are sourced from commercial manufacturers who are subject to current Good Manufacturing Practice, or cGMP, requirements and who have active drug master files with the FDA wherever possible. We have identified multiple manufacturers of the raw materials. The raw materials are tested and released per defined product specifications for physical, chemical and microbiological, where applicable, properties by the commercial manufacturers using the current edition of United States Pharmacopeia, or USP, and validated methods per the commercial manufacturer's established quality system, for non-USP materials.

Our AXA Candidates are manufactured through a series of proprietary processing steps at a contract manufacturing organization, or CMO, to produce the dry powder forms in sealed foil stick packs. Each batch is tested per its defined product specification for chemical and microbiological properties, and a Certificate of Analysis, or CoA, is issued for each batch. Chemical testing is performed both in-house and at a contract research organization, or CRO, while microbiological testing is outsourced to a specialty CRO. Chemical and microbiological testing is performed using qualified test methods.

The accuracy, precision and technical robustness of our in-house test methods are confirmed through formal method validation performed by a specialty CRO. This confirmation of our quality-based assays ensures that the quality of our AXA Candidates remains consistent through the shelf life of the AXA Candidate.

Any AXA Candidates that we decide to develop as drug candidates under INDs will be manufactured through a series of proprietary processing steps at a different, well-known CMO under pharmaceutical cGMPs to produce the dry powder forms in sealed foil sachets. Chemical and microbiological testing of AXA Candidates would be performed by this same CMO per defined product specifications and CoAs will be issued for each batch. Chemical and microbiological testing will be performed using validated test methods. We believe these processing steps would enable us to readily provide high quality Clinical Trial Material, or CTM, product to support multiple Clinical Trials conducted under INDs and that are readily scalable to support a greater amount of CTM to commercial drug product requirements, if any of our AXA Candidates regulated as drugs receive regulatory approval.

Suppliers and CMOs

We have entered into clinical supply and quality agreements with our CMOs and have established manufacturing redundancy within our supply chain. The CMO for our AXA Candidates

has the capability and capacity to support clinical to commercial scale quantities of our AXA Candidates, if approved, including manufacturing redundancy between North America and Europe.

We have also entered into clinical supply agreements with well-known clinical drug product labeling, packaging and distribution organizations to support post-IND global clinical studies, as required, if we were to decide to pursue the development of any AXA Candidate as a drug. These agreements provide further redundancy within our supply chain.

At the appropriate time, we will enter into appropriate supply agreements with key commercial raw material manufacturers and additional CMOs to ensure raw material sourcing and additional AXA Candidate product supply redundancy within the supply chain, if any of our AXA Candidates is approved.

Government regulation

The FDA and other regulatory authorities at federal, state and local levels, as well as in foreign countries, extensively regulate, among other things, the research, development, testing, manufacture, quality control, import, export, safety, effectiveness, labeling, packaging, storage, distribution, record keeping, approval (when required), advertising, promotion, marketing, post-approval monitoring and post-approval reporting of drugs as well as non-drug products such as foods, dietary supplements, and medical foods. We, along with our contract research organizations and contract manufacturers, will be required to navigate the various preclinical, clinical, manufacturing and commercial approval requirements of the governing regulatory agencies of the countries in which we wish to conduct studies or seek approval for some or all of our product candidates, depending on the development pathway pursued in each case. The process of obtaining regulatory approvals of drugs for therapeutic indications or commercialization of non-drug products and ensuring subsequent compliance with appropriate federal, state, local and foreign statutes and regulations requires the expenditure of substantial time and financial resources.

In the United States, the FDA regulates drug products as well as non-drug products under the Federal Food, Drug and Cosmetic Act, or the FD&C Act, as amended, its implementing regulations and other laws. None of our product candidates has been approved by the FDA for marketing for therapeutic indications in the United States, and we have not marketed any product as a food (including dietary supplements) or medical food. If we fail to comply with applicable FDA or other requirements at any time with respect to product development, clinical testing, or any approval process, where applicable, or any other legal requirements relating to product manufacture, processing, handling, storage, quality control, safety, marketing, advertising, promotion, packaging, labeling, export, import, distribution, or sale, we may become subject to administrative or judicial sanctions or other legal consequences. These sanctions or consequences could include, among other things, the FDA's refusal to approve pending applications, issuance of clinical holds for ongoing studies, suspension or revocation of approved applications, warning or untitled letters, product withdrawals or recalls, product seizures, relabeling or repackaging, total or partial suspensions of manufacturing or distribution, injunctions, fines, civil penalties or criminal prosecution.

If we decide to pursue development of our AXA Candidates as drugs for therapeutic indications, the process required by the FDA before our EMM product candidates as drugs for therapeutic indications may be marketed in the United States generally involves the following:

- completion of extensive preclinical studies in accordance with applicable regulations, including studies conducted in accordance with good laboratory practice, or GLP, requirements;

- submission to the FDA of an IND application, which must become effective before human Clinical Trials may begin;
- approval by an IRB or independent ethics committee at each Clinical Trial site before each trial may be initiated;
- performance of adequate and well-controlled human Clinical Trials in accordance with applicable IND regulations, GCP requirements and other Clinical Trial-related regulations to establish the safety and efficacy of the investigational product for each proposed indication;
- submission to the FDA of an NDA;
- a determination by the FDA within 60 days of its receipt of a New Drug Application, or NDA, to accept the filing for review;
- satisfactory completion of one or more FDA pre-approval inspections of the manufacturing facility or facilities where the drug will be produced to assess compliance with cGMP requirements to assure that the facilities, methods and controls are adequate to preserve the drug's identity, strength, quality and purity;
- potential FDA audit of the Clinical Trial sites that generated the data in support of the NDA;
- payment of user fees for FDA review of the NDA;
- FDA review and approval of the NDA, including consideration of the views of any FDA advisory committee, prior to any commercial marketing or sale of the drug in the United States; and
- compliance with any post-approval requirements, including the potential requirement to implement a Risk Evaluation and Mitigation Strategy, or REMS, and the potential requirement to conduct post-approval studies.

The testing and approval process requires substantial time, effort and financial resources, and we cannot be certain that any approvals for our product candidates will be granted on a timely basis, if at all.

Regulatory status of AXA Candidates

We are currently developing our EMM product candidates as Non-Drug Products, and in particular, as food for humans. AXA Candidates in our pipeline are predominantly comprised of amino acids. There is a long history of safe use of many amino acids as food additives and the FDA's food regulations concerning special dietary and nutritional additives specifically provide that "certain food additive amino acids may be safely used as nutrients added to foods" when certain conditions are met. Based on the large body of studies and scientific literature on the human exposure to and safety information on amino acids, the FDA's issuance of regulations authorizing use of specific amino acids under certain conditions as safe and permissible food additives when used as nutrients, our own data on amino acids used in AXA Candidates, and the fact that we use amino acids in our AXA Candidates within amounts previously studied in humans with no significant safety concerns or issues observed, we believe we design AXA Candidates to have favorable safety profiles, but we further characterize the safety and tolerability of these AXA Candidates in our Non-IND, IRB-Approved Clinical Studies.

We believe that the use of AXA Candidates containing amino acids may be studied as a Non-Drug Product for certain non-therapeutic uses without an IND. Specifically, under FDA's September 2013 Guidance for clinical investigators, sponsors, and IRBs entitled "Investigational New Drug Applications (INDs) — Determining Whether Human Research Studies Can Be Conducted Without an IND," we believe Non-IND, IRB-Approved Clinical Studies of Non-Drug

Products may be conducted to study the safety, tolerability, effect on normal structure or function in humans and characterize the mechanism by which a substance acts to maintain such structure or function, including in individuals with disease (as long as the study is not intended to evaluate the Non-Drug Product's ability to diagnose, cure, mitigate, treat, or prevent a disease). However, if such formulations are being studied or developed for therapeutic or drug uses, studies designed to assess the potential therapeutic use of a product candidate, such as its ability to diagnose, cure, mitigate, treat or prevent disease, including effects on an abnormal and uncommon or serious condition, then such product candidate is regulated as a drug and any clinical studies in the United States must be conducted under an IND. Similarly, an investigation intended to evaluate the effects of a medical food on a disease would require an IND, unless the medical food is simply being fed to subjects for nutritional purposes during a study examining the effects of another intervention.

Depending on the results observed for our AXA Candidates in our Non-IND, IRB-Approved Clinical Studies, and other factors related to the potential market for the candidates, we may elect to pursue development of our candidates under one of four regulatory pathways: to continue development as a conventional food or food additive, dietary supplement, medical food, or drug. After meeting with the FDA in March 2019, we made a decision to pursue a drug development path for AXA1665 and plan to file an IND submission after potentially having additional interactions with the FDA. We have not yet made a development path decision for any of our other AXA Candidates, and may never successfully develop and market an AXA Candidate under either drug or non-drug paths.

The development path decision we make for an AXA Candidate will also influence our strategy in bringing an AXA Candidate to market in the appropriate channel, such as a drug product intended to cure, mitigate, treat or prevent a target disease, a Non-Drug Product intended to support the normal structures and functions of the body and to maintain health, or a consumer health product intended for the dietary management of a disease or condition for which there are distinctive nutritional requirements. We intend to focus on and carry forward development of AXA Candidates that we believe may have the potential for therapeutic benefit.

FDA regulation of conventional food

Conventional food products are subject to regulation by the FDA and other regulatory authorities, including the Federal Trade Commission, or FTC, which regulate the manufacturing, preparation, quality control, import, export, packaging, labeling, marketing, advertising, promotion, distribution, safety, and/or adverse event reporting of conventional foods. Among other things, manufacturers of conventional foods must meet applicable current good manufacturing practices, or cGMPs, and certain requirements that govern the manufacturing, packaging, labeling and holding of foods.

The FD&C Act requires that all food products be safe, meaning a reasonably scientific certainty that the substance is not harmful for its intended use. The FD&C Act prohibits the introduction into interstate commerce of a food to which has been an added an approved drug or biologic, or a drug or biologic for which substantial clinical investigations have been instituted and made public, unless such a drug was marketed as a food before approval or meets other certain exceptions.

Under sections 201(s) and 409 of the FD&C Act, any substance that is reasonably expected to become a component of food or added to food is considered to be a "food additive", with a few exceptions, and is therefore subject to FDA premarket review and approval, unless the substance is generally recognized among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures or, in the case of a substance used prior to January 1, 1958 through experience based on common use in food, to be

safe under the conditions of its intended use, a standard referred to as "generally recognized as safe," or GRAS. A food additive must either already be included within one of the number of FDA regulations authorizing the use of certain food additives under certain conditions of use or be approved for use by the FDA. To obtain approval for use of a food additive, a manufacturer must submit a petition to the FDA with sufficient data to demonstrate reasonable certainty of no harm at the intended levels of use. Any food that contains an unapproved food additive is considered adulterated under section 402(a)(2)(C) of the FD&C Act.

Ingredients that are determined to be GRAS (as described below) do not fall within the definition of a food additive, which, as noted above, requires mandatory premarket approval. Under sections 201(s) of the FD&C Act, and FDA's implementing regulations in 21 CFR § 170.3 and 21 CFR § 170.30, the use of a food substance may be GRAS either through scientific procedures or, for a substance used in food before 1958, through experience based on common use in food.

General recognition of safety through scientific procedures requires the same quantity and quality of scientific evidence as is required to obtain approval of the substance as a food additive and must be based upon the application of generally available and accepted scientific data, information, or methods, which are ordinarily published, as well as the application of scientific principles, and may be corroborated by unpublished studies and other data and information. General recognition of safety through experience based on common use in foods requires a substantial history of consumption of a substance for food use by a significant number of consumers. If an ingredient is GRAS for one use or in one form, it is not necessarily GRAS for all uses or forms. Under section 201(s) of the FD&C Act, it is the intended use of a substance, rather than the substance itself, that is eligible for classification as GRAS.

Manufacturers of GRAS substances may notify the FDA of their view that a substance is GRAS and thus not subject to the premarket approval requirements of section 409 of the FD&C Act. The notification must include, among other things, a description of the substance, the applicable conditions of use, the dietary exposure, an explanation of the basis for the determination that the substance was determined to be safe for the intended use and supporting data and information. Upon review of such a notification, the FDA may respond with a "no questions" letter stating that while it has not made its own GRAS determination, it has no questions at the time regarding the applications' own GRAS determination. Alternatively, manufacturers may elect to "self-affirm" a given substance is GRAS without the voluntary FDA notification but should retain all applicable safety data used for the GRAS determination in the case of inquiry by the FDA. However, in neither case does this constitute an approval equivalent to that achieved through the food additive process. A manufacturer's use of such food additive is at its own risk and is dependent upon adequate substantiation and/or scientific support demonstrating safe use.

With certain exceptions, clinical investigations in which an investigational drug is administered to human subjects must be conducted under an IND, as required by FDA regulations. The FDA published a guidance document in September 2013 for clinical investigators, sponsors, and IRBs, "Investigational New Drug Applications (INDs) — Determining Whether Human Research Studies Can Be Conducted without an IND," that provides the FDA's thinking on when an IND is required for human research studies. Based on this guidance, we understand and believe that the FDA's interpretation of its regulations is that they do not require human testing of food ingredients or dietary supplements to be conducted under an IND unless such testing is intended to evaluate the product's ability to diagnose, cure, mitigate, treat, or prevent a disease or condition. In this guidance, the FDA specifically recognizes an IND will not be required when a study is designed to "evaluate the tolerability of a food in a specific susceptible population, including individuals with a disease in a diseased population," provided the study is not designed to assess the impact of the food or medical food on the disease. There is no assurance that our understanding of the FDA's guidance is accurate or that the FDA's thinking on this matter will not change. If it does, the FDA

may decide to take enforcement action to prohibit the Non-IND testing of substances that it believes should be conducted under an IND. For any products that we ultimately develop as drugs, the FDA may delay or deny an IND submitted with supporting data from human studies with such products not conducted under an IND or require alternate or additional data to support the IND before authorizing an applicant to proceed.

Additionally, depending on the circumstances, the use of a substance in certain clinical investigations under an IND may restrict the marketing of such substance in food. Section 301(II) of the FD&C Act prohibits the marketing of any food containing a drug substance for which substantial clinical investigations have been instituted and for which the existence of such investigations has been made public, unless the substance was marketed in food before any substantial clinical investigations involving the drug were instituted or one of the other exceptions in section 301(II) applies. Marketing the substance of interest in food before seeking an IND or beginning any clinical investigations preserves the option to continue to market the substance in those forms after substantial clinical investigations have been instituted and their existence has been made public.

The FDA may classify some or all of our potential product candidates as containing a food additive that is not GRAS. Such classification would cause these product candidates to require pre-market approval for a food additive, or else it would need to be subject to an existing food additive regulation authorizing its use, which could substantially delay or prevent the commercialization of these product candidates for non-drug uses. Any delay in the regulatory consultation process or a determination that any of our drug or food product candidates do not meet regulatory requirements of the FDA, including any applicable GRAS requirements, could cause a delay in or prevent the commercialization of our product candidates, which may lead to reduced acceptance by the public or others or an inability to commercialize those candidates at all. Moreover, if the FDA determines that a product candidate marketed as a conventional food contains a non-GRAS additive after the product has already been commercialized, then the FDA may take enforcement or other legal consequences, including, but not limited to, warning or untitled letters, product withdrawals or recalls, product seizures, relabeling or repackaging, total or partial suspensions of manufacturing or distribution, injunctions, fines, civil penalties or criminal prosecution.

FDA regulation of dietary supplements

The Dietary Supplement Health and Education Act of 1994, defines dietary supplement products to be "foods" under the FD&C Act, and they are regulated as such by the FDA. The FDA and other regulatory authorities, including the Federal Trade Commission, or FTC, similarly with conventional foods, regulate the manufacturing, preparation, quality control, import, export, packaging, labeling, marketing, advertising, promotion, distribution, safety, and/or adverse event reporting of dietary supplements. Among other things, manufacturers of dietary supplements must meet applicable cGMPs, and certain requirements that govern the manufacturing, packaging, labeling and holding of dietary supplements.

Under federal law, dietary supplements are defined in relevant part as a product (other than tobacco) intended to supplement the diet that bears or contains one or more dietary ingredients, which include any of the following: a vitamin; a mineral; an herb or other botanical; an amino acid; a dietary substance for use by man to supplement the diet by increasing the total dietary intake; or a concentrate, metabolite, constituent, or extract, or any combination of those substances. Dietary supplements may not include articles that are approved as new drugs or biologics or that have been authorized for investigation as new drugs or biologics for which substantial clinical investigations have been instituted and made public, unless the article was marketed as a dietary supplement or food prior to such approval or authorization.

The manufacturer of a dietary supplement is responsible for ensuring the safety of its product and must demonstrate either that each dietary ingredient was marketed as a dietary supplement in the United States before October 15, 1994, or if the dietary ingredient was not marketed as a dietary supplement in the United States before October 15, 1994, referred to as a "new dietary ingredient," or NDI, then the dietary supplement contains only dietary ingredients that have been present in the food supply as an article used for food in a form in which the food has not been chemically altered. For any supplement containing a new dietary ingredient for which the dietary ingredients have not been present in the food supply as an article used for food in a form in which the food has not been chemically altered, the manufacturer or distributor of the dietary ingredient or the supplement must submit pre-market notification to the FDA at least 75 days before the initial marketing of the dietary ingredient when used under the conditions or suggested in the labeling of the dietary supplement. Even to the extent the NDI was present in the food supply prior to October 15, 1994 or is used in conventional foods, if there are any changes to the ingredient's manufacturing or form as it was present in the food supply at that time or from how it exists in its conventional food form, then the ingredient may also be considered a NDI requiring notification.

Notification of use of a "New Dietary Ingredient" must inform the FDA of the basis on which the manufacturer has concluded that the supplement containing an NDI is reasonably expected to be safe under the recommended conditions of use. The FDA may not respond to such notification, but no response does not mean the FDA has determined that the ingredient is safe or permissible for use in a dietary supplement.

If the FDA determines that a product candidate which has already been brought to market and marketed as a dietary supplement contains a NDI without prior notification or contains some other substance not permitted in supplements, it may determine that the product is adulterated and/or misbranded in violation of federal law. In such a case, the FDA may take enforcement or other legal actions, including, but not limited to, warning or untitled enforcement letters, product withdrawals or recalls, product seizures, relabeling or repackaging, total or partial suspensions of manufacturing or distribution, injunctions, fines, civil penalties or criminal prosecution. Any such enforcement actions or other consequences could have a material adverse effect on the firm and its current and future ability to development the product candidates through the selected pathway or other pathways.

In addition, manufacturers of dietary supplements must ensure that ingredients in their products that are not defined as dietary ingredients comply with all the requirements applicable to foods. For example, fillers and other constituents of the product must be approved as food additives or must be deemed GRAS for the conditions of use in order to be sold.

Permissible claims for conventional foods and dietary supplements

The FDA and other regulatory authorities, including the FTC, heavily regulate any express or implied claims made about food and dietary supplement products, and/or their ingredients, including, but not limited to, any claims made in product labeling, marketing, promotion, on social media, or on the firm's website. FTC seeks to ensure the truth, accuracy, and substantiation of dietary supplement claims, and the FDA regulates the type and specific content of such claims.

With respect to dietary supplements, products are only allowed to make certain truthful and non-misleading claims without prior FDA-approval, and may not make health or qualified health claims, or any other claims that expressly or implicitly characterize the relationship between a substance and a disease or health-related condition (e.g., drug claims). Specifically, 21 C.F.R. § 101.93(g) prohibits claims, whether express or implied, that a dietary supplement is intended to "diagnose, mitigate, treat, cure, or prevent disease" and the use of such claims could subject a dietary supplement product to regulation as a drug. The FDA defines "disease" at 21 C.F.R. § 101.93(g)(1) to include any "damage to an organ, part, structure, or system of the body such that

it does not function properly . . . , or a state of health leading to such dysfunctioning," though excludes diseases resulting from deficiencies in essential nutrients. For these types of claims, there must be significant scientific support and approval by the FDA prior to marketing the product. In other words, products marketed as dietary supplements cannot make health claims or drug claims (i.e., that the product is intended to diagnose, prevent, or cure any disease or condition) without prior FDA-approval of such claims. Dietary supplement products are permitted to make certain claims subject to post-market notification to the FDA and inclusion of an FDA-required disclaimer. These requirements apply to multiple types of claims, including "structure/function" claims that refer to a product's ability to maintain healthy bodily structure or function or claims describing the role of a nutrient or dietary ingredient or characterizing the way in which a nutrient or dietary ingredient supports or maintains such structure or function.

In determining whether or not a particular claim is permissible, the FDA considers the overall context in which that claim is made. As such, the direct recommendation of particular products to users based on deficiencies or other characteristics in their nutritional or health profiles may be viewed by the FDA as an implied disease claim and thus impermissible (except for specific allowed health claims or qualified health claims for supplements or foods or allowed nutrient content claims in foods or structure/function claims for dietary supplements).

The use of product claims on product candidates developed as non-drug products always carries a risk of regulatory enforcement action or other legal consequences, which may include class action litigation. Claims and other marketing or promotional activities also are potentially subject to federal and state consumer protection and unfair competition laws. Any such actions could materially affect us in an adverse way.

FDA regulation of medical food uses

Medical foods are a category of foods distinct from conventional food and dietary supplements. The FDA and other regulatory authorities, including the FTC, also regulate the manufacturing, preparation, quality control, import, export, packaging, labeling, marketing, advertising, promotion, distribution, safety, and/or adverse event reporting of medical foods. Among other things, manufacturers of medical foods must meet relevant cGMPs, and certain requirements that govern the manufacturing, packaging, labeling and holding of foods.

As defined in section 5(b)(3) of the Orphan Drug Act (21 U.S.C. 360ee(b)(3)), a medical food is "a food which is formulated to be consumed or administered enterally under the supervision of a physician and which is intended for the specific dietary management of a disease or condition for which distinctive nutritional requirements, based on recognized scientific principles, are established by medical evaluation." The FDA has established a regulation at 21 C.F.R. 101.9(j)(8) that further defines a medical food as a product that is (1) is specially formulated and processed product (as opposed to a naturally occurring foodstuff used in its natural state) for the partial or exclusive feeding of a patient by means of oral intake or enteral feeding by tube; (2) is intended for the dietary management of a patient who, because of therapeutic or chronic medical needs, has limited or impaired capacity to ingest, digest, absorb, or metabolize ordinary foodstuffs or certain nutrients, or who has other special medically determined nutrient requirements, the dietary management of which cannot be achieved by the modification of the normal diet alone; (3) provides nutritional support specifically modified for the management of the unique nutrient needs that result from the specific disease or condition, as determined by medical evaluation; (4) is intended to be used under medical supervision; and (5) is intended only for a patient receiving active and ongoing medical supervision wherein the patient requires medical care on a recurring basis for, among other things, instructions on the use of the medical food.

Because the marketing of medical foods generally does not require FDA pre-market approval, the medical food category may offer promising opportunities for our products should we pursue that development path. However, we understand that the FDA considers the statutory definition of medical foods to narrowly constrain the types of products that fit within this category of food. There can be no assurance we will be able to develop the data that are needed to substantiate the positioning of the product as a medical food or that the FDA would concur the product meets the definition of medical food. In such cases, the commercialization of such product candidates may be delayed or prevented. To the extent that any product candidate is marketed as a medical food and subsequently determined to not fall within the proper regulatory category or are considered to be misbranded or adulterated, the company may be subject to enforcement action or other legal consequences, including, but not limited to, warning or untitled letters, product withdrawals or recalls, product seizures, relabeling or repackaging, total or partial suspensions of manufacturing or distribution, injunctions, fines, civil penalties or criminal prosecution. Any such actions or other consequences could have a material adverse effect on the firm and its current and future ability to develop the product candidates through the selected pathway or other pathways.

Moreover, the ingredients and additives used in medical foods are subject to the same regulations as conventional foods and must be GRAS or otherwise covered by an existing food additive regulation, approved food additive petition, or authorized by a prior sanction. The FDA may determine that some or all of our potential product candidates contain ingredients that are not GRAS and are therefore food additives. Such classification would cause these product candidates to require pre-market approval for a food additive, which could substantially delay or prevent the commercialization of these product candidates for medical food uses. If the FDA determines that a product candidate marketed as a medical food contains a substance that is not GRAS and is therefore a food additive after the product has already been commercialized, and such food additive is not approved or authorized by the FDA pursuant to a food additive regulation, then the firm may face enforcement or other legal consequences including, but not limited to, those mentioned above.

Preclinical and Clinical Trials for drugs

Once a product candidate is identified for development as a drug, it generally enters the preclinical testing stage. Preclinical studies include laboratory evaluations of drug chemistry, formulation and stability, as well as *in vitro* and animal studies to evaluate the potential for adverse events, which must be conducted in accordance with federal regulations and requirements, including GLP requirements. The results of the preclinical studies, together with manufacturing information and analytical data as well as the results of our Non-IND, IRB-Approved Clinical Studies, would be submitted to the FDA as part of an IND. An IND is a request for authorization from the FDA to administer an investigational product to humans for a therapeutic indication and must become effective before human Clinical Trials for such purpose may begin. The IND automatically becomes effective 30 days after receipt by the FDA, unless the FDA, within the 30-day time period, raises concerns or questions about the conduct of the Clinical Trial, including concerns that human research subjects will be exposed to unreasonable health risks, and imposes a clinical hold. In such a case, the IND sponsor and the FDA must resolve any outstanding concerns before the Clinical Trial can begin. Submission of an IND may result in the FDA not allowing Clinical Trials to commence or not allowing Clinical Trials to commence on the terms originally specified in the IND. A separate submission to an existing IND must also be made for each successive Clinical Trial conducted during product development, and the FDA must grant permission, either explicitly or implicitly by not objecting, before each Clinical Trial can begin.

Such Clinical Trials involve the administration of the product candidate to human volunteers under the supervision of qualified investigators. Clinical Trials are conducted under protocols

detailing, among other things, the objectives of the Clinical Trial, dosing procedures, subject selection and exclusion criteria and the parameters and criteria to be used in monitoring safety and evaluating effectiveness. Each protocol for our product candidates which we decide to market through the drug development pathway for therapeutic indications must be submitted to the FDA as part of the IND. An IRB for each investigator site proposing to participate in a Clinical Trial must also review and approve the Clinical Trial before it can begin at that site, and the IRB must monitor the Clinical Trial until it is completed. The FDA, the IRB, or the sponsor may suspend or discontinue a Clinical Trial at any time on various grounds, including a finding that the subjects are being exposed to an unacceptable health risk. Clinical testing of product candidates for therapeutic indications also must satisfy extensive GCP requirements, including requirements for informed consent.

Human Clinical Trials to evaluate therapeutic indications to support New Drug Applications, or NDAs, for marketing approval are typically conducted in three sequential phases, which may overlap or be combined. In certain circumstances, where sufficient evidence of safety and tolerability are collected from preclinical studies and other human experience with a product, subject to discussions and acceptance by the FDA, such as our non-IND human clinical studies, we believe that for the development of such drug candidate, a human Clinical Trial may begin at Phase II rather than starting at Phase I. We would expect to discuss with the FDA such proposal to initiate the clinical development program of a drug candidate in a later phase study without first conducting a Phase I Clinical Trial or Trials.

- *Phase I* — Phase I Clinical Trials involve initial introduction of the investigational product into healthy human volunteers or patients with the target disease or condition. These studies are typically designed to test the safety, dosage tolerance, absorption, metabolism and distribution of the investigational product in humans, excretion the side effects associated with increasing Doses, and, if possible, to gain early evidence of effectiveness.
- *Phase II* — Phase II Clinical Trials typically involve administration of the investigational product to a limited patient population with a specified disease or condition to evaluate the preliminary efficacy, optimal dosages and dosing schedule and to identify possible adverse side effects and safety risks.
- *Phase III* — Phase III Clinical Trials typically involve administration of the investigational product to an expanded patient population to further evaluate dosage, to provide statistically significant evidence of clinical efficacy and to further test for safety, generally at multiple geographically dispersed Clinical Trial sites. These Clinical Trials are intended to establish the overall risk/benefit ratio of the investigational product and to provide an adequate basis for product approval and physician labeling.

Post-approval trials, sometimes referred to as Phase IV Clinical Trials, may be conducted after initial marketing approval. These trials are used to gain additional experience from the treatment of patients in the intended therapeutic indication and are commonly intended to generate additional safety data regarding use of the product in a clinical setting. In certain instances, the FDA may mandate the performance of Phase IV Clinical Trials as a condition of approval of an NDA.

Progress reports detailing the results of the Clinical Trials for therapeutic indications, among other information, must be submitted at least annually to the FDA and written IND safety reports must be submitted to the FDA and the investigators for serious and unexpected suspected adverse events, findings from other studies or animal or *in vitro* testing that suggest a significant risk for human volunteers and any clinically important increase in the rate of a serious suspected adverse reaction over that listed in the protocol or investigator brochure.

Concurrent with Clinical Trials, companies usually complete additional animal studies and must also develop additional information about the chemistry and physical characteristics of the product candidate and finalize a process for manufacturing the drug product in commercial quantities in accordance with cGMP requirements. The manufacturing process must be capable of consistently producing quality batches of the product candidate and manufacturers must develop, among other things, methods for testing the identity, strength, quality and purity of the final drug product. Additionally, appropriate packaging must be selected and tested, and stability studies must be conducted to demonstrate that the product candidate does not undergo unacceptable deterioration over its shelf life.

Orphan Drug Designation

Under the Orphan Drug Act, the FDA may grant orphan designation to a drug intended to treat a rare disease or condition, which is a disease or condition that affects fewer than 200,000 individuals in the United States, or if it affects more than 200,000 individuals in the United States, there is no reasonable expectation that the cost of developing and making the product available in the United States for the disease or condition will be recovered from sales of the product. Orphan designation must be requested before submitting an NDA. Orphan designation does not convey any advantage in or shorten the duration of the regulatory review and approval process, though companies developing orphan products are eligible for certain incentives, including tax credits for qualified clinical testing and waiver of application fees.

If a product that has orphan designation subsequently receives the first FDA approval for the disease or condition for which it has such designation, the product is entitled to a seven-year period of marketing exclusivity during which the FDA may not approve any other applications to market the same therapeutic agent for the same indication, except in limited circumstances, such as a subsequent product's showing of clinical superiority over the product with orphan exclusivity or where the original applicant cannot produce sufficient quantities of product. Competitors, however, may receive approval of different therapeutic agents for the indication for which the orphan product has exclusivity or obtain approval for the same therapeutic agent for a different indication than that for which the orphan product has exclusivity. Orphan product exclusivity could block the approval of one of our products for seven years if a competitor obtains approval for the same therapeutic agent for the same indication before we do, unless we are able to demonstrate that our product is clinically superior. If an orphan designated product receives marketing approval for an indication broader than what is designated, it may not be entitled to orphan exclusivity. Further, orphan drug exclusive marketing rights in the United States may be lost if the FDA later determines that the request for designation was materially defective or the manufacturer of the approved product is unable to assure sufficient quantities of the product to meet the needs of patients with the rare disease or condition.

Expedited development and review programs for drugs

The FDA maintains several programs intended to facilitate and expedite development and review of new drugs to address unmet medical needs in the treatment of serious or life-threatening diseases or conditions. These programs include Fast Track designation, Breakthrough Therapy designation, Priority Review and Accelerated Approval, and the purpose of these programs is to either expedite the development or review of important new drugs to get them to patients earlier than under standard FDA development and review procedures.

A new drug is eligible for Fast Track designation if it is intended to treat a serious or life-threatening disease or condition and demonstrates the potential to address unmet medical needs for such disease or condition. Fast Track designation provides increased opportunities for sponsor interactions with the FDA during preclinical and clinical development, in addition to the

potential for rolling review once a marketing application is filed, meaning that the agency may review portions of the marketing application before the sponsor submits the complete application, as well as Priority Review, discussed below. In addition, a new drug may be eligible for Breakthrough Therapy designation if it is intended to treat a serious or life-threatening disease or condition and preliminary clinical evidence indicates that the drug may demonstrate substantial improvement over existing therapies on one or more clinically significant endpoints, such as substantial treatment effects observed early in clinical development. Breakthrough Therapy designation provides all the features of Fast Track designation in addition to intensive guidance on an efficient drug development program beginning as early as Phase I, and FDA organizational commitment to expedited development, including involvement of senior managers and experienced review staff in a cross-disciplinary review, where appropriate.

Any product submitted to the FDA for approval, including a product with Fast Track or Breakthrough Therapy designation, may also be eligible for additional FDA programs intended to expedite the review and approval process, including Priority Review designation and accelerated approval. A product is eligible for Priority Review if it has the potential to provide a significant improvement in safety or effectiveness in the treatment, diagnosis or prevention of a serious disease or condition. Under priority review, the FDA must review an application in six months compared to ten months for a standard review. Additionally, products are eligible for accelerated approval if they can be shown to have an effect on a surrogate endpoint that is reasonably likely to predict clinical benefit, or an effect on a clinical endpoint that can be measured earlier than an effect on irreversible morbidity or mortality which is reasonably likely to predict an effect on irreversible morbidity or mortality or other clinical benefit, taking into account the severity, rarity, or prevalence of the condition and the availability or lack of alternative treatments.

Accelerated approval is usually contingent on a sponsor's agreement to conduct additional post-approval studies to verify and describe the product's clinical benefit. The FDA may withdraw approval of a drug or indication approved under accelerated approval if, for example, the confirmatory trial fails to verify the predicted clinical benefit of the product. In addition, unless otherwise informed by the FDA, the FDA currently requires, as a condition for accelerated approval, that all advertising and promotional materials that are intended for dissemination or publication within 120 days following marketing approval be submitted to the agency for review during the pre-approval review period, and that after 120 days following marketing approval, all advertising and promotional materials must be submitted at least 30 days prior to the intended time of initial dissemination or publication.

Even if a product qualifies for one or more of these programs, the FDA may later decide that the product no longer meets the conditions for qualification or the time period for FDA review or approval may not be shortened. Furthermore, Fast Track designation, Breakthrough Therapy designation, Priority Review and Accelerated Approval do not change the scientific or medical standards for approval or the quality of evidence necessary to support approval but may expedite the development or review process.

U.S. marketing approval for drugs

Assuming successful completion of the required clinical testing of our product candidates for drug uses, the results of the preclinical and clinical studies, together with detailed information relating to the product's chemistry, manufacture, controls and proposed labeling, among other things, are submitted to the FDA as part of an NDA requesting approval to market the product for one or more indications. In most cases, the submission of an NDA is subject to a substantial application user fee. An NDA is a request for approval to market a new drug for one or more specified indications and must contain proof of the drug's safety and efficacy. The marketing application may include both negative and ambiguous results of preclinical studies and Clinical

Trials, as well as positive findings. Data may come from company-sponsored Clinical Trials intended to test the safety and efficacy of a product's use or from a number of alternative sources, including studies initiated by investigators. To support marketing approval, the data submitted must be sufficient in quality and quantity to establish the safety and efficacy of the investigational product to the satisfaction of the FDA. FDA approval of an NDA must be obtained before a drug may be marketed in the United States. Under the Prescription Drug User Fee Act guidelines that are currently in effect, the FDA has a goal of ten months from the date of "filing" of a standard NDA, for a new molecular entity to review and act on the submission. This review typically takes twelve months from the date the NDA is submitted to the FDA because the FDA has approximately two months to make a "filing" decision on whether to accept the application for review.

In addition, under the Pediatric Research Equity Act of 2003, as amended and reauthorized, certain NDAs or supplements to an NDA must contain data that are adequate to assess the safety and effectiveness of the drug for the claimed indications in all relevant pediatric subpopulations, and to support dosing and administration for each pediatric subpopulation for which the product is safe and effective. The FDA may, on its own initiative or at the request of the applicant, grant deferrals for submission of some or all pediatric data until after approval of the product for use in adults, or full or partial waivers from the pediatric data requirements. An Agreed Initial Pediatric Study Plan requesting a waiver from the requirement to conduct clinical studies has been submitted to the FDA.

The FDA also may require submission of a REMS, plan to ensure that the benefits of the drug outweigh its risks. The REMS plan could include medication guides, physician communication plans, assessment plans, and/or elements to assure safe use, such as restricted distribution methods, patient registries, or other risk-minimization tools.

The FDA conducts a preliminary review of all NDAs within the first 60 days after submission, before accepting them for filing, to determine whether they are sufficiently complete to permit substantive review. The FDA may request additional information rather than accept an NDA for filing. In this event, the application must be resubmitted with the additional information. The resubmitted application is also subject to review before the FDA accepts it for filing. Once the submission is accepted for filing, the FDA begins an in-depth substantive review. The FDA reviews an NDA to determine, among other things, whether the drug is safe and effective and whether the facility in which it is manufactured, processed, packaged or held meets standards designed to assure the product's continued safety, quality and purity.

The FDA may refer an application for a novel drug to an advisory committee. An advisory committee is a panel of independent experts, including clinicians and other scientific experts, which reviews, evaluates and provides a recommendation as to whether the application should be approved and under what conditions. The FDA is not bound by the recommendations of an advisory committee, but it considers such recommendations carefully when making decisions.

Before approving an NDA, the FDA typically will inspect the facility or facilities where the product is manufactured. The FDA will not approve an application unless it determines that the manufacturing processes and facilities are in compliance with cGMP requirements and adequate to assure consistent production of the Sponsor product within required specifications. Additionally, before approving an NDA, the FDA may inspect one or more Clinical Trial sites to assure compliance with GCP and other requirements and the integrity of the clinical data submitted to the FDA.

After evaluating the NDA and all related information, including the advisory committee recommendation, if any, and inspection reports regarding the manufacturing facilities and Clinical Trial sites, the FDA may issue an approval letter, or, in some cases, a complete response letter. A complete response letter generally contains a statement of specific conditions that must be met in

order to secure final approval of the NDA and may require additional clinical or preclinical testing in order for the FDA to reconsider the application. Even with submission of this additional information, the FDA ultimately may decide that the application does not satisfy the regulatory criteria for approval. If and when those conditions have been met to the FDA's satisfaction, the FDA will typically issue an approval letter. An approval letter authorizes commercial marketing of the drug with specific prescribing information for specific indications.

Even if the FDA approves a product, depending on the specific risk(s) to be addressed it may limit the approved indications for use of the product, require that contraindications, warnings or precautions be included in the product labeling, require that post-approval studies, including Phase IV Clinical Trials, be conducted to further assess a drug's safety after approval, require testing and surveillance programs to monitor the product after commercialization, or impose other conditions, including distribution and use restrictions or other risk management mechanisms under a REMS, which can materially affect the potential market and profitability of the product. The FDA may prevent or limit further marketing of a product based on the results of post-marketing studies or surveillance programs. After approval, some types of changes to the approved product, such as adding new indications, manufacturing changes, and additional labeling claims, are subject to further testing requirements and FDA review and approval.

U.S. post-approval requirements for drugs

Drugs manufactured or distributed pursuant to FDA approvals are subject to pervasive and continuing regulation by the FDA, including, among other things, requirements relating to recordkeeping, periodic reporting, product sampling and distribution, advertising and promotion and reporting of adverse experiences with the product. There is also a continuing, annual prescription drug product program user fee.

The FDA may impose a number of post-approval requirements as a condition of approval of an NDA. For example, the FDA may require post-market testing, including Phase IV Clinical Trials, and surveillance to further assess and monitor the product's safety and effectiveness after commercialization.

In addition, drug manufacturers and their subcontractors involved in the manufacture and distribution of approved drugs are required to register their establishments with the FDA and certain state agencies and are subject to periodic unannounced inspections by the FDA and certain state agencies for compliance with ongoing regulatory requirements, including cGMP, which impose certain procedural and documentation requirements upon us and our contract manufacturers. Failure to comply with statutory and regulatory requirements can subject a manufacturer to possible legal or regulatory action, such as warning letters, suspension of manufacturing, product seizures, injunctions, civil penalties or criminal prosecution.

Later discovery of previously unknown problems with a product, including adverse events of unanticipated severity or frequency, or with manufacturing processes, or failure to comply with regulatory requirements, may result in revisions to the approved labeling to add new safety information, requirements for post-market studies or Clinical Trials to assess new safety risks, or imposition of distribution or other restrictions under a REMS. Other potential consequences include, among other things:

- restrictions on the marketing or manufacturing of the product, complete withdrawal of the product from the market or product recalls;
- safety alerts, Dear Healthcare Provider letters, press releases or other communications containing warnings or other safety information about the product;
- fines, warning letters or holds on post-approval Clinical Trials;

- refusal of the FDA to approve applications or supplements to approved applications, or suspension or revocation of product approvals;
- product seizure or detention, or refusal to permit the import or export of products; or
- injunctions or the imposition of civil or criminal penalties; and
- consent decrees, corporate integrity agreements, debarment or exclusion from federal healthcare programs; or mandated modification of promotional materials and labeling and issuance of corrective information.

Other regulatory matters

Manufacturing, sales, promotion and other activities of product candidates following product approval, where applicable, or commercialization are also subject to regulation by numerous regulatory authorities in the United States in addition to the FDA, which may include the Centers for Medicare & Medicaid Services, or CMS, other divisions of the Department of Health and Human Services, the Department of Justice, the Drug Enforcement Administration, the Consumer Product Safety Commission, the Federal Trade Commission, the Occupational Safety & Health Administration, the Environmental Protection Agency and state and local governments and governmental agencies.

Other healthcare laws

Healthcare providers, physicians, and third-party payors will play a primary role in the recommendation and prescription of any products for which we obtain marketing approval. Our business operations and any current or future arrangements with third-party payors, healthcare providers and physicians may expose us to broadly applicable fraud and abuse and other healthcare laws and regulations that may constrain the business or financial arrangements and relationships through which we develop, market, sell and distribute any drugs for which we obtain marketing approval. In the United States, these laws include, without limitation, state and federal anti-kickback, false claims, physician transparency, and patient data privacy and security laws and regulations, including but not limited to those described below.

- The Anti-Kickback Statute prohibits for any person, including a prescription drug manufacturer (or a party acting on its behalf), to knowingly and willfully solicit, receive, offer or pay any remuneration, directly or indirectly, in cash or in kind, that is intended to induce or reward referrals, including the purchase, recommendation, order or prescription of a particular drug, for which payment may be made under a federal healthcare program, such as Medicare or Medicaid. Violations of this law are punishable by up to ten years in prison, criminal fines, administrative civil money penalties and exclusion from participation in federal healthcare programs. In addition, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it.
- Federal civil and criminal false claims laws, and civil monetary penalty laws including the federal False Claims Act, which imposes civil penalties, including through civil whistleblower or qui tam actions, against individuals or entities (including manufacturers) for, among other things, knowingly presenting, or causing to be presented false or fraudulent claims for payment by a federal healthcare program or making a false statement or record material to payment of a false claim or avoiding, decreasing or concealing an obligation to pay money to the federal government. The government may deem manufacturers to have "caused" the submission of false or fraudulent claims by, for example, providing inaccurate billing or coding information to customers, with respect to drug products, purportedly concealing price concessions in the pricing information submitted to the government for government price reporting purposes, allegedly providing free product to customers with the expectation

that the customers would bill federal healthcare programs for the product, or promoting a product off-label. Claims that include items or services resulting from a violation of the federal Anti-Kickback Statute are false or fraudulent claims for purposes of the False Claims Act. Any future marketing and activities relating to the reporting of wholesaler or estimated retail prices for drug products, the reporting of prices used to calculate Medicaid rebate information and other information affecting federal, state and third-party reimbursement for our products, and the sale and marketing of our product and any future product candidates, are subject to scrutiny under this law.

- The Health Insurance Portability and Accountability Act of 1996, or HIPAA, imposes criminal and civil liability for knowingly and willfully executing a scheme, or attempting to execute a scheme, to defraud any healthcare benefit program, including private payors, knowingly and willfully embezzling or stealing from a healthcare benefit program, willfully obstructing a criminal investigation of a healthcare offense, or falsifying, concealing or covering up a material fact or making any materially false statements in connection with the delivery of or payment for healthcare benefits, items or services.
- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act of 2009, or HITECH, and their respective implementing regulations, imposes, among other things, specified requirements on covered entities and their business associates relating to the privacy and security of individually identifiable health information including mandatory contractual terms and required implementation of technical safeguards of such information. HITECH also created new tiers of civil monetary penalties, amended HIPAA to make civil and criminal penalties directly applicable to business associates in some cases, and gave state attorneys general new authority to file civil actions for damages or injunctions in federal courts to enforce the federal HIPAA laws and seek attorneys' fees and costs associated with pursuing federal civil actions.
- The Physician Payments Sunshine Act, enacted as part of the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act of 2010, or collectively, the ACA, imposed new annual reporting requirements for certain manufacturers of drugs, devices, biologics, and medical supplies for which payment is available under Medicare, Medicaid, or the Children's Health Insurance Program, for certain payments and "transfers of value" provided to physicians (defined to include doctors, dentists, optometrists, podiatrists and chiropractors) and teaching hospitals, as well as ownership and investment interests held by physicians and their immediate family members.
- Analogous state and foreign fraud and abuse laws and regulations, such as state anti-kickback and false claims laws, which may be broader in scope and apply regardless of payor. These laws are enforced by various state agencies and through private actions. Some state laws require pharmaceutical companies implement compliance to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant federal government compliance guidance, require drug manufacturers to report information related to payments and other transfers of value to physicians and other healthcare providers, and restrict marketing practices or require disclosure of marketing expenditures and pricing information. State and foreign laws also govern the privacy and security of health information in some circumstances. These data privacy and security laws may differ from each other in significant ways and often are not pre-empted by HIPAA, which may complicate compliance efforts.

The scope and enforcement of each of these laws is uncertain and subject to rapid change in the current environment of healthcare reform, especially in light of the lack of applicable precedent and regulations. Federal and state enforcement bodies have recently increased their scrutiny of interactions between healthcare companies and healthcare providers, which has led to a number of

investigations, prosecutions, convictions and settlements in the healthcare industry. It is possible that governmental authorities will conclude that our business practices do not comply with current or future statutes, regulations or case law involving applicable fraud and abuse or other healthcare laws and regulations. If our operations are found to be in violation of any of these laws or any other related governmental regulations that may apply to us, we may be subject to significant civil, criminal and administrative penalties, damages, fines, imprisonment, disgorgement, exclusion from government funded healthcare programs, such as Medicare and Medicaid, reputational harm, additional oversight and reporting obligations if we become subject to a corporate integrity agreement or similar settlement to resolve allegations of non-compliance with these laws and the curtailment or restructuring of our operations. If any of the physicians or other healthcare providers or entities with whom we expect to do business is found to be not in compliance with applicable laws, they may be subject to similar actions, penalties and sanctions. Ensuring business arrangements comply with applicable healthcare laws, as well as responding to possible investigations by government authorities, can be time- and resource-consuming and can divert a company's attention from its business.

Current and future healthcare reform legislation

In the United States and foreign jurisdictions, there have been and continue to be a number of legislative and regulatory changes and proposed changes regarding the healthcare system that could prevent or delay marketing approval of our product candidates, restrict or regulate post-approval activities, and affect our ability to profitably sell any product candidates. We expect that current laws, as well as other healthcare reform measures that may be adopted in the future, may result in more rigorous coverage criteria and additional downward pressure on the price that we, or any collaborators, may receive for any approved products.

The ACA, for example, may reduce the profitability of drug products through increased rebates for drugs reimbursed by Medicaid programs, extension of Medicaid rebates to Medicaid managed care plans, mandatory discounts for certain Medicare Part D beneficiaries and annual fees based on pharmaceutical companies' share of sales to federal health care programs. With the current Administration and Congress, there will likely be additional administrative or legislative changes, including modification, repeal, or replacement of all, or certain provisions of, the ACA, which may impact reimbursement for drugs. Since January 2017, President Trump has signed two executive orders and other directives designed to delay, circumvent or loosen certain requirements mandated by the ACA. While Congress has not passed repeal legislation, the Tax Reform Act includes a provision repealing, effective January 1, 2019, the tax-based shared responsibility payment imposed by the ACA on certain individuals who fail to maintain qualifying health coverage for all or part of a year that is commonly referred to as the "individual mandate." On December 14, 2018, a U.S. District Court Judge in the Northern District of Texas, ruled that the individual mandate is a critical and inseverable feature of the ACA, and therefore, because it was repealed as part of the Tax Act, the remaining provisions of the ACA are invalid as well. While the current administration and CMS have both stated that the ruling will have no immediate effect, it is unclear how this decision, subsequent appeals, if any, and other efforts to repeal and replace the ACA will impact the ACA. Further, the Bipartisan Budget Act of 2018, or the BBA, among other things, amends the ACA, effective January 1, 2019, to increase from 50 percent to 70 percent the point-of-sale discount that is owed by pharmaceutical manufacturers who participate in Medicare Part D and to close the coverage gap in most Medicare drug plans, commonly referred to as the "donut hole." Congress may consider other legislation to repeal and replace elements of the ACA. Litigation and legislation over the ACA are likely to continue, with unpredictable and uncertain results.

Additionally, other federal health reform measures have been proposed and adopted in the United States since the ACA was enacted:

- The Budget Control Act of 2011, among other things, included aggregate reductions to Medicare payments to providers of 2% per fiscal year, which went into effect in April 2013 and, due to subsequent legislative amendments to the statute, including the BBA, will remain in effect through 2027, unless additional Congressional action is taken.
- The American Taxpayer Relief Act of 2012, among other things, also reduced Medicare payments to several providers, and increased the statute of limitations period for the government to recover overpayments to providers.

Further, there has been heightened governmental scrutiny over the manner in which drug manufacturers set prices for their marketed products, which have resulted in several recent Congressional inquiries and proposed and enacted federal and state legislation designed to, among other things, bring more transparency to product pricing, review the relationship between pricing and manufacturer patient programs, and reform government program reimbursement methodologies for drug products. In addition, the United States government, state legislatures, and foreign governments have shown significant interest in implementing cost containment programs, including price-controls, restrictions on reimbursement and requirements for substitution of generic products for branded prescription drugs to limit the growth of government paid health care costs. For example, the United States government has passed legislation requiring pharmaceutical manufacturers to provide rebates and discounts to certain entities and governmental payors to participate in federal healthcare programs. Further, Congress and the current administration have each indicated that it will continue to seek new legislative and/or administrative measures to control drug costs, and the current administration recently released a "Blueprint," or plan, to reduce the cost of drugs. The current administrations' Blueprint contains certain measures that the U.S. Department of Health and Human Services is already working to implement. Individual states in the United States have also been increasingly passing legislation and implementing regulations designed to control pharmaceutical product pricing, including price or patient reimbursement constraints, discounts, restrictions on certain product access and marketing cost disclosure and transparency measures, and, in some cases, designed to encourage importation from other countries and bulk purchasing.

Compliance with other federal and state laws or requirements; Changing Legal requirements

If any products that we may develop are made available to authorized users of the Federal Supply Schedule of the General Services Administration, additional laws and requirements apply. Products must meet applicable child-resistant packaging requirements under the U.S. Poison Prevention Packaging Act. Manufacturing, labeling, packaging, distribution, sales, promotion and other activities also are potentially subject to federal and state consumer protection and unfair competition laws, among other requirements to which the firm or its products may be subject.

The distribution of pharmaceutical products is subject to additional requirements and regulations, including extensive record-keeping, licensing, storage and security requirements intended to prevent the unauthorized sale of pharmaceutical products.

The failure to comply with any of these laws or regulatory requirements subjects firms to possible legal or regulatory action. Depending on the circumstances, failure to meet applicable regulatory requirements can result in criminal prosecution, fines or other penalties, injunctions, exclusion from federal healthcare programs, requests for recall, seizure of products, total or partial suspension of production, denial or withdrawal of product approvals, relabeling or repackaging, or refusal to allow a firm to enter into supply contracts, including government contracts. Any claim or action against us for violation of these laws, even if we successfully defend against it, could cause

us to incur significant legal expenses and divert our management's attention from the operation of our business. Prohibitions or restrictions on marketing, sales or withdrawal of future products marketed by us could materially affect our business in an adverse way.

Changes in regulations, statutes or the interpretation of existing regulations could impact our business in the future by requiring, for example: (i) changes to our manufacturing arrangements; (ii) additions or modifications to product labeling or packaging; (iii) the recall or discontinuation of our products; or (iv) additional record-keeping requirements. If any such changes were to be imposed, they could adversely affect the operation of our business.

Other U.S. environmental, health and safety laws and regulations

We may be subject to numerous environmental, health and safety laws and regulations, including those governing laboratory procedures and the handling, use, storage, treatment and disposal of hazardous materials and wastes. From time to time and in the future, our operations may involve the use of hazardous and flammable materials, including chemicals and biological materials, and may also produce hazardous waste products. Even if we contract with third parties for the disposal of these materials and waste products, we cannot completely eliminate the risk of contamination or injury resulting from these materials. In the event of contamination or injury resulting from the use or disposal of our hazardous materials, we could be held liable for any resulting damages, and any liability could exceed our resources. We also could incur significant costs associated with civil or criminal fines and penalties for failure to comply with such laws and regulations.

We maintain workers' compensation insurance to cover us for costs and expenses we may incur due to injuries to our employees, but this insurance may not provide adequate coverage against potential liabilities. However, we do not maintain insurance for environmental liability or toxic tort claims that may be asserted against us.

In addition, we may incur substantial costs in order to comply with current or future environmental, health and safety laws and regulations. Current or future environmental laws and regulations may impair our research, development or production efforts. In addition, failure to comply with these laws and regulations may result in substantial fines, penalties or other sanctions.

Government regulation of drugs outside of the United States

To market any product outside of the United States, we would need to comply with numerous and varying regulatory requirements of other countries regarding safety and efficacy and governing, among other things, Clinical Trials, marketing authorization or identification of an alternate regulatory pathway, manufacturing, commercial sales and distribution of our products. For instance, in the European Economic Area, or the EEA (comprised of the 28 EU Member States plus Iceland, Liechtenstein and Norway), medicinal products must be authorized for marketing by using either the centralized authorization procedure or national authorization procedures.

- **Centralized procedure** — If pursuing marketing authorization of a product candidate for a therapeutic indication under the centralized procedure, following the opening of the EMA's Committee for Medicinal Products for Human Use, or, CHMP, the European Commission issues a single marketing authorization valid across the EEA. The centralized procedure is compulsory for human medicines derived from biotechnology processes or advanced therapy medicinal products (such as gene therapy, somatic cell therapy and tissue engineered products), products that contain a new active substance indicated for the treatment of certain diseases, such as HIV/AIDS, cancer, neurodegenerative disorders, diabetes, autoimmune diseases and other immune dysfunctions, viral diseases, and officially designated orphan medicines. For medicines that do not fall within these categories, an

applicant has the option of submitting an application for a centralized marketing authorization to the EMA, as long as the medicine concerned contains a new active substance not yet authorized in the EEA, is a significant therapeutic, scientific or technical innovation, or if its authorization would be in the interest of public health in the EEA. Under the centralized procedure the maximum timeframe for the evaluation of an MAA by the EMA is 210 days, excluding clock stops, when additional written or oral information is to be provided by the applicant in response to questions asked by the CHMP. Accelerated assessment might be granted by the CHMP in exceptional cases, when a medicinal product is expected to be of a major public health interest, particularly from the point of view of therapeutic innovation. The timeframe for the evaluation of an MAA under the accelerated assessment procedure is 150 days, excluding clock stops.

- *National authorization procedures* — There are also two other possible routes to authorize products for therapeutic indications in several countries, which are available for products that fall outside the scope of the centralized procedure:
 - *Decentralized procedure* — Using the decentralized procedure, an applicant may apply for simultaneous authorization in more than one EU country of medicinal products that have not yet been authorized in any EU country and that do not fall within the mandatory scope of the centralized procedure.
 - *Mutual recognition procedure* — In the mutual recognition procedure, a medicine is first authorized in one EU Member State, in accordance with the national procedures of that country. Following this, additional marketing authorizations can be sought from other EU countries in a procedure whereby the countries concerned recognize the validity of the original, national marketing authorization.

In the EEA, new products for therapeutic indications that are authorized for marketing (i.e., reference products) qualify for eight years of data exclusivity and an additional two years of market exclusivity upon marketing authorization. The data exclusivity period prevents generic or biosimilar applicants from relying on the preclinical and Clinical Trial data contained in the dossier of the reference product when applying for a generic or biosimilar marketing authorization in the EU during a period of eight years from the date on which the reference product was first authorized in the EU. The market exclusivity period prevents a successful generic or biosimilar applicant from commercializing its product in the EU until ten years have elapsed from the initial authorization of the reference product in the EU. The ten-year market exclusivity period can be extended to a maximum of eleven years if, during the first eight years of those ten years, the marketing authorization holder obtains an authorization for one or more new therapeutic indications which, during the scientific evaluation prior to their authorization, are held to bring a significant clinical benefit in comparison with existing therapies.

The criteria for designating an "orphan medicinal product" in the EEA are similar in principle to those in the United States. In the EEA a medicinal product may be designated as orphan if (1) it is intended for the diagnosis, prevention or treatment of a life-threatening or chronically debilitating condition; (2) either (a) such condition affects no more than five in 10,000 persons in the EU when the application is made, or (b) the product, without the benefits derived from orphan status, would not generate sufficient return in the EU to justify investment; and (3) there exists no satisfactory method of diagnosis, prevention or treatment of such condition authorized for marketing in the EU, or if such a method exists, the product will be of significant benefit to those affected by the condition. Orphan medicinal products are eligible for financial incentives such as reduction of fees or fee waivers and are, upon grant of a marketing authorization, entitled to ten years of market exclusivity for the approved therapeutic indication. During this ten-year orphan market exclusivity period, no marketing authorization application shall be accepted, and no marketing authorization shall be granted for a similar medicinal product for the same indication. An orphan product can

also obtain an additional two years of market exclusivity in the EU for pediatric studies. The ten-year market exclusivity may be reduced to six years if, at the end of the fifth year, it is established that the product no longer meets the criteria for orphan designation, for example, if the product is sufficiently profitable not to justify maintenance of market exclusivity. Additionally, marketing authorization may be granted to a similar product for the same indication at any time if (i) the second applicant can establish that its product, although similar, is safer, more effective or otherwise clinically superior; (ii) the applicant consents to a second orphan medicinal product application; or (iii) the applicant cannot supply enough orphan medicinal product.

Similar to the United States, the various phases of non-clinical and clinical research in the European Union are subject to significant regulatory controls.

The Clinical Trials Directive 2001/20/EC, the Directive 2005/28/EC on GCP and the related national implementing provisions of the individual EU Member States govern the system for the approval of Clinical Trials in the European Union. Under this system, an applicant must obtain prior approval from the competent national authority of the EU Member States in which the Clinical Trial is to be conducted. Furthermore, the applicant may only start a Clinical Trial at a specific study site after the competent ethics committee has issued a favorable opinion. The Clinical Trial application must be accompanied by, among other documents, an investigational medicinal product dossier (the Common Technical Document) with supporting information prescribed by Directive 2001/20/EC, Directive 2005/28/EC, where relevant the implementing national provisions of the individual EU Member States and further detailed in applicable guidance documents.

In April 2014, the new Clinical Trials Regulation, (EU) No 536/2014 (Clinical Trials Regulation) was adopted. The Regulation is anticipated to come into application in 2019. The Clinical Trials Regulation will be directly applicable in all the EU Member States, repealing the current Clinical Trials Directive 2001/20/EC. Conduct of all Clinical Trials performed in the European Union will continue to be bound by currently applicable provisions until the new Clinical Trials Regulation becomes applicable. The extent to which ongoing Clinical Trials will be governed by the Clinical Trials Regulation will depend on when the Clinical Trials Regulation becomes applicable and on the duration of the individual Clinical Trial. If a Clinical Trial continues for more than three years from the day on which the Clinical Trials Regulation becomes applicable the Clinical Trials Regulation will at that time begin to apply to the Clinical Trial. The new Clinical Trials Regulation aims to simplify and streamline the approval of Clinical Trials in the European Union. The main characteristics of the regulation include: a streamlined application procedure via a single-entry point, the "EU portal"; a single set of documents to be prepared and submitted for the application as well as simplified reporting procedures for Clinical Trial sponsors; and a harmonized procedure for the assessment of applications for Clinical Trials, which is divided in two parts. Part I is assessed by the competent authorities of all EU Member States in which an application for authorization of a Clinical Trial has been submitted (Member States concerned). Part II is assessed separately by each Member State concerned. Strict leadlines have been established for the assessment of Clinical Trial applications. The role of the relevant ethics committees in the assessment procedure will continue to be governed by the national law of the concerned EU Member State. However, overall related timelines will be defined by the Clinical Trials Regulation.

The collection and use of personal health data in the European Union, previously governed by the provisions of the Data Protection Directive, is now governed by the GDPR, which became effective on May 25, 2018. While the Data Protection Directive did not apply to organizations based outside the EU, the GDPR has expanded its reach to include any business, regardless of its location, that provides goods or services to residents in the EU. This expansion would incorporate any Clinical Trial activities in EU members states. The GDPR imposes strict requirements on controllers and processors of personal data, including special protections for "sensitive information" which includes health and genetic information of data subjects residing in the EU. GDPR grants

individuals the opportunity to object to the processing of their personal information, allows them to request deletion of personal information in certain circumstances, and provides the individual with an express right to seek legal remedies in the event the individual believes his or her rights have been violated. Further, the GDPR imposes strict rules on the transfer of personal data out of the European Union to the United States or other regions that have not been deemed to offer "adequate" privacy protections. Failure to comply with the requirements of the GDPR and the related national data protection laws of the European Union Member States, which may deviate slightly from the GDPR, may result in fines of up to 4% of global revenues, or € 20,000,000, whichever is greater. As a result of the implementation of the GDPR, we may be required to put in place additional mechanisms ensuring compliance with the new data protection rules.

There is significant uncertainty related to the manner in which data protection authorities will seek to enforce compliance with GDPR. For example, it is not clear if the authorities will conduct random audits of companies doing business in the EU, or if the authorities will wait for complaints to be filed by individuals who claim their rights have been violated. Enforcement uncertainty and the costs associated with ensuring GDPR compliance are onerous and may adversely affect our business, financial condition, results of operations and prospects.

Additionally, should we elect one or more product candidates to develop and market as non-drug products in foreign countries, such products would also be subject to regulation under various national, local, and international laws that include provision governing, among other things, the formulation, manufacturing, packaging, labeling, advertising. These regulations may prevent or delay entry into the market or prevent or delay the introduction, or require the reformulation, of certain of our non-drug product candidates.

The regulatory environment outside the United States varies and in general is less developed than in the United States, but some exceptions do exist. The regulatory requirements for nutritional non-drug products and food products outside of the United States varies greatly from jurisdiction to jurisdiction. Each jurisdiction may have its own regulatory framework regarding nutritional non-drug products and food products. The two leading jurisdictions, the United States and the European Union, currently have and may continue to in the future to have distinctly different regulatory regimes with different rules and requirements nutritional non-drug products and food products, with, for example, the European Union having a stronger process for claims review and preapproval for nutritional products. Regulation in Europe is exercised primarily through the European Union, which regulates the combined market of each of its member states. Other European countries, such as Switzerland, have voluntarily adopted laws and regulations that mirror those of the European Union with respect to dietary products.

We cannot predict how the global regulatory landscape regarding our possible nutritional non-drug products or food products, if any, will evolve and we may incur increased regulatory costs as regulations in the jurisdictions in which we operate evolve or change. We cannot predict whether or when any jurisdiction will change its regulations with respect to any of our product candidates.

Should we utilize third part distributors, compliance with such foreign governmental regulations would generally be the responsibility of such distributors, who may be independent contractors over whom we have limited control.

Government regulation of food for special medical purpose in the European Union

The regulatory requirements for foods for special medical purposes, or FSMPs, in the European Union cover FSMP development and commercialization.

In the European Union, FSMPs are designed to feed patients who, because of a particular disease, disorder or medical condition, have nutritional needs that cannot be met by consuming standard foodstuffs. European Union Regulation defines *food for special medical purposes* as food

specifically processed or formulated and intended for the dietary management of patients, including infants, to be used under medical supervision; it is intended for the exclusive or partial feeding of patients with a limited, impaired or disturbed capacity to take, digest, absorb, metabolize or excrete ordinary food or certain nutrients contained therein, or metabolites, or with other medically-determined nutrient requirements, whose dietary management cannot be achieved by modification of the normal diet alone.

Businesses intending to commercialize FSMPs in the European Union are required to register their FSMPs by submitting notifications regarding FSMP use, demonstrating compliance with applicable European Union rules, prior to market commercialization. These notifications to competent authority of each European Union Member State include information appearing on the label, and any other information the competent authority may reasonably request to establish compliance with this Regulation.

The European Commission may decide, by means of implementing acts (a) whether a given food falls within the scope of this Regulation; and (b) to which specific category of food a given food belongs. European Food Safety Authority Guidance provides, among other requirements, that the dossier must include an explanation of the scientific and medical basis on which it has been concluded that the use of the specific food product is necessary or is more practical or safer than the exclusive use of non-FSMP foodstuffs.

FSMPs can also fall within the scope of the novel food legislation in the European Union. Where an ingredient used in the FSMP to be marketed in the European Union falls within the definition of a novel food ingredient' prior authorization for use of the ingredient needs to be sought. A "novel" food or food ingredients as food that has not been consumed to a significant degree by humans in the European Union before May 15, 1997 and that falls within one of the ten food categories listed. Novel foods and novel food ingredients can only be authorized if they do not pose a safety risk to human health, their intended use does not mislead the consumer and they do not differ from the food they are intended to replace in such a way that its normal consumption would be nutritionally disadvantageous for the consumer. The authorization procedure is likely to take between 12 and 18 months.

In accordance with European Union Clinical Trials directives, before a Clinical Trial site is allowed to start enrolling patients in a Clinical Trial, the IRB/independent ethics committee, or IEC, must provide a positive opinion concerning the study protocol and all study-related materials. The competent authorities of the relevant European Union Member State must also provide their related authorization. Clinical Trials involving the investigation of the action of non-medicinal products (e.g., foods, such as many FSMPs), are not covered and are not required to register the Clinical Trial or to complete a Clinical Trial application (CTA) for approval by an European Union Member State.

Employees

As of December 31, 2018, we had 49 full-time employees. Of those employees, 23 have Ph.D. or M.D. degrees and 32 are engaged in research and development activities. None of our employees are represented by labor unions or covered by collective bargaining agreements. We consider our relationship with our employees to be good.

Facilities

We lease a facility containing 19,200 square feet of laboratory and office space, which is located at 840 Memorial Drive, Cambridge, Massachusetts. The lease expires in April 2021, subject to two options to extend the lease for a total of six years. We believe that our current facilities are sufficient to meet our current and near-term needs.

Legal proceedings

We are not currently a party to any material legal proceedings.

MANAGEMENT

Executive officers

The following table sets forth certain information, as of April 1, 2019, concerning our executive officers who, subject to rights pursuant to any employment agreements, serve at the pleasure of our board of directors:

Name	Age	Position
William Hinshaw	50	President and Chief Executive Officer, Director
Thomas Leggett	42	Senior Vice President of Finance, Chief Financial Officer
Stephen Mitchener, PharmD.	40	Senior Vice President, Chief Business Officer
Manu Chakravarthy, M.D., Ph.D.	45	Senior Vice President, Chief Medical Officer
Tony Tramontin, Ph.D.	51	Senior Vice President of Research & Development, Chief Scientific Officer
Paul Fehlner, J.D., Ph.D.	55	Senior Vice President, Chief Intellectual Property Officer

The following is a biographical summary of the experience of our executive officers.

William Hinshaw has served as our President and Chief Executive Officer and as a member of our board of directors since June 2018. Prior to joining us, Mr. Hinshaw served in increasing roles of responsibility at Novartis Pharmaceuticals Corporation, a pharmaceutical company, from December 2003 until November 2017, most recently as the Executive Vice President and Head of U.S. Oncology. Mr. Hinshaw holds a B.S. in molecular biology from the University of Wisconsin. We believe that Mr. Hinshaw's experience, qualifications, attributes and skills, including experience in operations management and executive leadership qualify him to serve on our board of directors.

Thomas Leggett has served as our Senior Vice President of Finance and Chief Financial Officer since January 2017. Prior to joining us, Mr. Leggett served as the Treasurer and Head of Business Development Finance at Purdue Pharma L.P., a pharmaceutical company, from May 2015 to December 2016. From November 2009 to May 2015, Mr. Leggett was an Executive Director at UBS Securities LLC, an investment bank, in the Global Healthcare Group with a primary focus in the biopharmaceutical sector. Mr. Leggett holds an M.B.A. in finance from The Wharton School at the University of Pennsylvania and a B.A. in economics from Columbia University.

Stephen Mitchener, PharmD. has served as our Senior Vice President and Chief Business Officer since August 2018. Prior to joining us, Dr. Mitchener served in increasing roles of responsibility at Novartis Pharmaceuticals Corporation, a pharmaceutical company, from April 2005 to August 2018, most recently as Head of U.S. Oncology Strategy, Partnering and Operations. He previously served as a board observer for COTA Healthcare on behalf of Novartis Oncology. Dr. Mitchener holds a Post-Doctorate from Rutgers University and a PharmD. from the University of North Carolina at Chapel Hill.

Manu Chakravarthy, M.D., Ph.D. has served as our Senior Vice President of Clinical Development and Chief Medical Officer since August 2017. Prior to joining us, Dr. Chakravarthy served as the Global Head of Innovation Strategy and External R&D in diabetes and cardiovascular research at Eli Lilly & Company, a pharmaceutical company, from August 2015 to June 2017. Previously, Dr. Chakravarthy spent more than seven years at Merck & Co., from September 2008 to August 2015, where he assumed positions of increasing responsibility and leadership within the company, most recently as a Distinguished Scientist and leader of the Discovery Medicine group for diabetes and cardiometabolic diseases within Translational Medicine. He is also Board-certified in Internal Medicine and Endocrinology, Diabetes & Metabolism and an Adjunct Clinical Assistant Professor of Medicine at the Rutgers School of Medicine, New Jersey. Dr. Chakravarthy holds an M.D. from the University of Texas Houston Medical School, a Ph.D. in cell biology and physiology

from the University of Texas Graduate School of Biomedical Sciences and the MD Anderson Cancer Center and a B.A. in biology and chemistry from St. John's University.

Tony Tramontin, Ph.D. has served as our Senior Vice President of Research & Development and Chief Scientific Officer since June 2017. Prior to joining us, Dr. Tramontin served as a Partner at McKinsey & Company, a consulting firm, in its Global Healthcare Practice from 2003 until May 2017. Dr. Tramontin holds a Ph.D. in biology (neuroscience and endocrinology) from the University of Washington and a B.A. in business from the University of Notre Dame.

Paul Fehlner, J.D., Ph.D. has served as our Senior Vice President and Chief Intellectual Property Officer since April 2018. In addition, Dr. Fehlner has served as a Principal at Life Sciences Innovation LLC, an intellectual property and legal consulting firm, since December 2017. From November 2008 through November 2017, Dr. Fehlner served as Global Head of Intellectual Property at Novartis Pharma AG in Basel, Switzerland. Dr. Fehlner holds a J.D. from Fordham University School of Law, a Ph.D. in immunology and biochemistry from The Rockefeller University and a B.S. in chemistry from Haverford College.

Non-employee directors

The following table sets forth certain information, as of April 1, 2019, concerning our non-employees who serve on our board of directors:

Name	Age	Position
Non-employee directors:		
David R. Epstein ⁽²⁾⁽³⁾	57	Chairman, Director
William D. Baird III ⁽¹⁾⁽²⁾	47	Director
Grégory Behar ⁽¹⁾	49	Director
David A. Berry, M.D., Ph.D. ⁽³⁾	41	Director
Stephen Hoge, M.D. ⁽²⁾	43	Director
Gary Pisano, Ph.D. ⁽¹⁾	57	Director
Cristina M. Rondinone, Ph.D. ⁽³⁾	58	Director
Christopher A. Viehbach	58	Director

(1) Member of audit committee.

(2) Member of compensation committee.

(3) Member of nominating and corporate governance committee.

The following is a biographical summary of the experience of our non-employee directors.

David R. Epstein has served as our Chairman and as a member of our board of directors since December 2017. Mr. Epstein has also served as Executive Partner at Flagship Pioneering, a private equity and venture capital firm, since January 2017. From January 2010 to July 2016, Mr. Epstein served as Chief Executive Officer of Novartis Pharmaceuticals Corporation, a pharmaceutical company. He currently serves on the boards of directors of International Flavors and Fragrances, Inc. (NYSE: IFF), Evelo Biosciences, Inc. (Nasdaq: EVLO) and of Rubius Therapeutics, Inc. (Nasdaq: RUBY), as Executive Chairman. Mr. Epstein holds an M.B.A. in finance and marketing from Columbia Business School and a B.S. in pharmacy from Rutgers University. We believe that Mr. Epstein's extensive experience serving in executive roles in the life sciences industry and leading the development and commercialization of numerous therapeutics qualify him to serve on our board of directors.

William D. Baird III has served as a member of our board of directors since June 2018. He joined bluebird bio, Inc. as Chief Financial Officer in February 2019 and previously served as Chief

Financial Officer of Amicus Therapeutics, Inc., a pharmaceutical company, from April 2012 to December 2018. Mr. Baird holds an M.B.A. in finance from The Wharton School of the University of Pennsylvania and a B.S.F.S. in international affairs from the Edmund A. Walsh School of Foreign Service of Georgetown University. We believe Mr. Baird's broad experience in pharmaceutical finance and executive management roles qualify him to serve on our board of directors.

Grégory Behar has served as a member of our board of directors since February 2016. Mr. Behar has also served as Chief Executive Officer of Nestlé Health Science S.A., a health sciences company, since October 2014. He currently serves on the board of directors of Aimmune Therapeutics, Inc. (Nasdaq: AIMT) and Seres Therapeutics, Inc. (Nasdaq: MCRB). Mr. Behar holds an M.B.A. from INSEAD in France, a M.S. in mechanical engineering and manufacturing from EPFL in Switzerland, and a B.S. in mechanical engineering from the University of California, Los Angeles. We believe that Mr. Behar's extensive business experience in the health sciences and pharmaceutical industries qualifies him to serve on our board of directors.

David A. Berry, M.D., Ph.D. helped co-found the company in 2008 and has served as a member of our board of directors since February 2011. Dr. Berry has also served in roles of increasing responsibility at Flagship Pioneering Inc. since January 2005 most recently as General Partner. He previously served as a director of Seres Therapeutics, Inc. (Nasdaq: MCRB). He holds an M.D. from Harvard Medical School, a Ph.D. in biological engineering from the Massachusetts Institute of Technology Biological Engineering Division and a B.S. in brain and cognitive sciences from the Massachusetts Institute of Technology. We believe that Dr. Berry's extensive experience in the life sciences industry qualifies him to serve on our board of directors.

Stephen Hoge, M.D. has served as a member of our board of directors since May 2014. He has also served in roles of increasing responsibility at Moderna Therapeutics, Inc., a biopharmaceutical company, since December 2012, most recently as President. Dr. Hoge holds an M.D. from the University of California, San Francisco and a B.A. in neuroscience from Amherst College. We believe that Dr. Hoge's medical knowledge and extensive experiences in the pharmaceutical industry as a management consultant and executive at a biotechnology company qualify him to serve on our board of directors.

Gary Pisano, Ph.D. has served as a member of our board of directors since October 2011. Dr. Pisano is the Harry E. Figgie, Jr. Professor of Business Administration and Senior Associate Dean for Faculty Development at the Harvard Business School. He has served on the Harvard faculty since 1988. Dr. Pisano's research and teaching focus on technology and operations strategy, the management of innovation and intellectual property, and competitive strategy. For more than two decades, he has consulted extensively on these issues with companies in the pharmaceutical, biotechnology, medical device, specialty chemical and healthcare industries. He has previously served as a director of Axovant Sciences Ltd. (Nasdaq: AXON) and Patheon NV (NYSE: PTHN). Dr. Pisano holds a Ph.D. in business administration from the University of California, Berkeley and a B.A. in economics from Yale University. We believe that Dr. Pisano's knowledge of business administration, innovation, and strategy, particularly within the healthcare industry, qualifies him to serve on our board of directors.

Cristina M. Rondinone, Ph.D. has served as a member of our board since June 2018. Dr. Rondinone has also served in roles of increasing responsibility at MedImmune, LLC, a wholly owned subsidiary of AstraZeneca, since March 2011, most recently as Senior Vice President R&D, Head of Cardiovascular, Renal and Metabolic Diseases Innovative Medicines and Early Development. Dr. Rondinone holds a Docent in molecular medicine from the University of Goteborg, Sweden School of Medicine and a M.Sc. and Ph.D. in biological sciences from the University of Buenos Aires. We believe that Dr. Rondinone's extensive industry experience qualifies her to serve on our board of directors.

Christopher A. Viehbacher has served as a member of our board of directors since September 2015. Mr. Viehbacher has also served as the Managing Partner of Gurnet Point Capital, an investment fund, since 2015. He currently serves on the boards of directors of PureTech Health plc. From 2011 to 2014, Mr. Viehbacher served as the Chief Executive Officer of Sanofi S.A., a French pharmaceutical company. He holds a B.C. from Queen's University. We believe that Mr. Viehbacher's extensive experience in the pharmaceutical and healthcare industries qualifies him to serve on our board of directors.

Our Board of Directors

As of December 31, 2018, our board of directors consisted of nine members, each of whom is a member pursuant to the board composition provisions of our certificate of incorporation and agreements with our stockholders. These board composition provisions will terminate upon the completion of this offering. Upon the termination of these provisions, there will be no further contractual obligations regarding the election of our directors. Our nominating and corporate governance committee and our board of directors may therefore consider a broad range of factors relating to the qualifications and background of nominees. Our nominating and corporate governance committee's and our board of directors' priority in selecting board members is the identification of persons who will further the interests of our stockholders through their established record of professional accomplishment, the ability to contribute positively to the collaborative culture among board members, knowledge of our business, understanding of the competitive landscape, professional and personal experiences and expertise relevant to our growth strategy. Our directors hold office until their successors have been elected and qualified or until the earlier of their resignation or removal. Our restated certificate of incorporation and amended and restated bylaws that will become effective upon the completion of this offering also provide that our directors may be removed only for cause by the affirmative vote of the holders of at least two-thirds of the votes that all of our stockholders would be entitled to cast in an annual election of directors, and that any vacancy on our board of directors, including a vacancy resulting from an enlargement of our board of directors, may be filled only by vote of a majority of our directors then in office.

Director independence

Our board of directors has determined that all members of the board of directors, except William Hinshaw, are independent directors, including for purposes of the rules of The Nasdaq Global Market and the SEC. In making such independence determination, our board of directors considered the relationships that each non-employee director has with us and all other facts and circumstances that our board of directors deemed relevant in determining their independence, including the beneficial ownership of our capital stock by each non-employee director. In considering the independence of the directors listed above, our board of directors considered the association of our directors with the holders of more than 5% of our common stock. Upon the completion of this offering, we expect that the composition and functioning of our board of directors and each of our committees will comply with all applicable requirements of The Nasdaq Global Market and the rules and regulations of the SEC, subject to applicable phase-in periods. Under Nasdaq listing rule 5615(b)(1) a company listing in connection with its initial public offering is permitted to phase in its compliance with the independent committee requirements, the committee composition requirements and the majority independent board requirement. There are no family relationships among any of our directors or executive officers. William Hinshaw is not an independent director under these rules because he is an executive officer of our company.

Staggered board

In accordance with the terms of our restated certificate of incorporation and amended and restated bylaws that will become effective upon the completion of this offering, our board of directors will be divided into three staggered classes of directors and each director will be assigned to one of the three classes. At each annual meeting of the stockholders, a class of directors will be elected for a three-year term to succeed the directors of the same class whose terms are then expiring. The terms of the directors will expire upon the election and qualification of successor directors at the annual meeting of stockholders to be held during the years 2020 for Class I directors, 2021 for Class II directors and 2022 for Class III directors.

- Our Class I directors will be Christopher Viehbacher, David Epstein and David Berry;
- Our Class II directors will be Grégory Behar, Gary Pisano and Cristina M. Rondinone; and
- Our Class III directors will be William D. Baird III, William Hinshaw and Stephen Hoge.

Our restated certificate of incorporation and amended and restated bylaws that will become effective upon the completion of this offering will provide that the number of directors shall be fixed from time to time by a resolution of the majority of our board of directors.

The division of our board of directors into three classes with staggered three-year terms may delay or prevent stockholder efforts to effect a change of our management or a change in control.

Board leadership structure and board's role in risk oversight

David R. Epstein is the current Chairman of our board of directors and William Hinshaw is our current Chief Executive Officer, hence the roles of Chairman of our board of directors and Chief Executive Officer are separated. We believe that separating these positions allows our Chief Executive Officer to focus on our day-to-day business, while allowing our Chairman of the board to lead the board of directors in its fundamental role of providing advice to and independent oversight of management. Our board of directors recognizes the time, effort and energy that the Chief Executive Officer is required to devote to his position in the current business environment, as well as the commitment required to serve as our Chairman, particularly as the board of directors' oversight responsibilities continue to grow. While our amended and restated bylaws and corporate governance guidelines do not require that our Chairman and Chief Executive Officer positions be separate, our board of directors believes that having separate positions is the appropriate leadership structure for us at this time and demonstrates our commitment to good corporate governance.

Risk is inherent with every business, and how well a business manages risk can ultimately determine its success. We face a number of risks, including risks relating to our financial condition, development and commercialization activities, operations, strategic direction and intellectual property as more fully discussed in the section entitled "Risk Factors" appearing elsewhere in this prospectus. Management is responsible for the day-to-day management of risks we face, while our board of directors, as a whole and through its committees, has responsibility for the oversight of risk management. In its risk oversight role, our board of directors has the responsibility to satisfy itself that the risk management processes designed and implemented by management are adequate and functioning as designed.

The role of the board of directors in overseeing the management of our risks is conducted primarily through committees of the board of directors, as disclosed in the descriptions of each of the committees below and in the charters of each of the committees. The full board of directors (or the appropriate board committee in the case of risks that are under the purview of a particular committee) discusses with management our major risk exposures, their potential impact on us, and

the steps we take to manage them. When a board committee is responsible for evaluating and overseeing the management of a particular risk or risks, the chairman of the relevant committee reports on the discussion to the full board of directors during the committee reports portion of the next board meeting. This enables the board of directors and its committees to coordinate the risk oversight role, particularly with respect to risk interrelationships.

Committees of our board of directors

Our board of directors has established an audit committee and a compensation committee, and intends to establish a nominating and corporate governance committee, each of which will operate pursuant to a charter adopted by our board of directors and will be effective upon the effectiveness of the registration statement of which this prospectus is a part. Upon the effectiveness of the registration statement of which this prospectus is a part, the composition and functioning of all of our committees will comply with all applicable requirements of the Sarbanes-Oxley Act of 2002, Nasdaq and SEC rules and regulations.

Audit committee

Effective upon the closing of this offering Grégory Behar, William D. Baird III, and Gary Pisano will serve on the audit committee, which will be chaired by Mr. Baird. Our board of directors has determined that each of the members of the audit committee "independent" for audit committee purposes as that term is defined in the rules of the SEC and the applicable Nasdaq rules, and each of the committee members has sufficient knowledge in financial and auditing matters to serve on the audit committee. Our board of directors has designated Mr. Baird as an "audit committee financial expert," as defined under the applicable rules of the SEC. The audit committee's responsibilities include:

- appointing, approving the compensation of, and assessing the independence of our independent registered public accounting firm;
- pre-approving auditing and permissible non-audit services, and the terms of such services, to be provided by our independent registered public accounting firm;
- reviewing the overall audit plan with our independent registered public accounting firm and members of management responsible for preparing our financial statements;
- reviewing and discussing with management and our independent registered public accounting firm our annual and quarterly financial statements and related disclosures as well as critical accounting policies and practices used by us;
- coordinating the oversight and reviewing the adequacy of our internal control over financial reporting;
- establishing policies and procedures for the receipt and retention of accounting-related complaints and concerns;
- recommending based upon the audit committee's review and discussions with management and our independent registered public accounting firm whether our audited financial statements shall be included in our Annual Report on Form 10-K;
- monitoring the integrity of our financial statements and our compliance with legal and regulatory requirements as they relate to our financial statements and accounting matters;
- preparing the audit committee report required by SEC rules to be included in our annual proxy statement;
- reviewing all related person transactions for potential conflict of interest situations and approving all such transactions; and
- reviewing quarterly earnings releases.

Compensation committee

Effective upon the closing of this offering David R. Epstein, William D. Baird III, and Stephen Hoge will serve on the compensation committee, which will be chaired by Mr. Epstein. Our board of directors has determined that each member of the compensation committee is "independent" as defined in the applicable Nasdaq rules. The compensation committee's responsibilities include:

- annually reviewing and recommending to the board of directors the corporate goals and objectives relevant to the compensation of our Chief Executive Officer;
- evaluating the performance of our Chief Executive Officer in light of such corporate goals and objectives and based on such evaluation: (i) recommending to the board of directors the cash compensation of our Chief Executive Officer and (ii) recommending grants and awards to our Chief Executive Officer under equity-based plans;
- reviewing and approving or recommending to the board of directors the cash compensation of our other executive officers;
- reviewing and establishing our overall management compensation, philosophy and policy;
- overseeing and administering our compensation and similar plans;
- evaluating and assessing potential and current compensation advisors in accordance with the independence standards identified in the applicable Nasdaq rules;
- reviewing and approving our policies and procedures for the grant of equity-based awards;
- reviewing and recommending to the board of directors the compensation of our directors;
- preparing the compensation committee report required by SEC rules, if and when required, to be included in our annual proxy statement; and
- reviewing and approving the retention, termination or compensation of any consulting firm or outside advisor to assist in the evaluation of compensation matters.

Nominating and corporate governance committee

Effective upon the closing of this offering David R. Epstein, David A. Berry, and Christina M. Rondinone will serve on the nominating and corporate governance committee, which will be chaired by Mr. Epstein. Our board of directors has determined that each of the members of the nominating and corporate governance committee are "independent" as defined in the applicable Nasdaq rules. The nominating and corporate governance committee's responsibilities include:

- developing and recommending to the board of directors criteria for board and committee membership;
- establishing procedures for identifying and evaluating board of director candidates, including nominees recommended by stockholders;
- reviewing the composition of the board of directors to ensure that it is composed of members containing the appropriate skills and expertise to advise us;
- identifying individuals qualified to become members of the board of directors;
- recommending to the board of directors the persons to be nominated for election as directors and to each of the board's committees;
- developing and recommending to the board of directors a code of business conduct and ethics and a set of corporate governance guidelines; and

- overseeing the evaluation of our board of directors and management. Our board of directors may from time to time establish other committees.

Compensation committee interlocks and insider participation

None of the members of our compensation committee has at any time during the prior three years been one of our officers or employees. None of our executive officers currently serves, or in the past fiscal year has served, as a member of the board of directors or compensation committee of any entity that has one or more executive officers serving on our board of directors or compensation committee.

Corporate governance

We have adopted a written code of business conduct and ethics, which will become effective upon the effectiveness of the registration statement of which this prospectus is a part, that applies to our directors, officers and employees, including our principal executive officer, principal financial officer, principal accounting officer or controller, or persons performing similar functions. Following the effectiveness of the registration statement of which this prospectus is a part, a current copy of the code will be posted on the investor relations section of our website, which is located at <http://www.axcellahealth.com>. If we make any substantive amendments to, or grant any waivers from, the code of business conduct and ethics for any officer or director, we will disclose the nature of such amendment or waiver on our website or in a current report on Form 8-K.

EXECUTIVE COMPENSATION

Executive compensation overview

Our executive compensation program has reflected our growth and development-oriented corporate culture. To date, the compensation of the individuals listed below, whom we refer to as our named executive officers, has primarily consisted of a combination of base salary, bonuses and long-term incentive compensation. Our named executive officers, like all of our full-time employees, are eligible to participate in our health and welfare benefit plans. As we transition from a private company to a publicly traded company, we will evaluate our compensation values and philosophy and compensation plans and arrangements as circumstances require. At a minimum, we expect to review executive compensation annually with input from a compensation consultant. As part of this review process, we expect the board of directors and the compensation committee to apply our values and philosophy, while considering the compensation levels needed to ensure our executive compensation program remains competitive. We will also review whether we are meeting our retention objectives and the potential cost of replacing a key employee.

2018 Summary compensation table

The following table presents information regarding the total compensation awarded to, earned by, and paid to our named executive officers for services rendered to us in all capacities for the year indicated.

Name and principal position	Year	Salary (\$)	Bonus (\$)	Non-Equity Incentive Plan Compensation (\$) (1)	Option awards (\$) (2)	All other compen- sation (\$) (7)	Total (\$)
William Hinshaw, President and CEO (Principal Executive Officer) ⁽³⁾	2018	278,910 ⁽⁴⁾		231,563	3,608,347	160,000 ⁽⁷⁾	4,278,820
Thomas Leggett, CFO (Principal Financial Officer)	2018	341,700		137,534	392,188	—	871,422
Stephen Mitchener, PharmD., Chief Business Officer	2018	127,563 ⁽⁵⁾	15,000 ⁽⁶⁾	53,969	674,923	21,210 ⁽⁸⁾	892,665
Robert Connelly, Former President and CEO (Principal Executive Officer) ⁽³⁾	2018	206,291		—	—	355,578 ⁽⁹⁾	561,869

- (1) The amounts reported represent cash incentive compensation based on the Board's assessment of the achievement of company and individual performance objectives for the year ended December 31, 2018, which were paid in February 2019.
- (2) The amounts reported represent the aggregate grant-date fair value of stock options awarded in 2018, calculated in accordance with FASB ASC Topic 718. The assumptions used in calculating the grant-date fair value are set forth in Note 7 to our audited consolidated financial statements appearing at the end of this prospectus.
- (3) Mr. Hinshaw currently serves as our President and Chief Executive Officer and commenced employment with us in June 2018. Previously, Mr. Connelly served as our President and Chief Executive Officer until May 2018.
- (4) Mr. Hinshaw commenced employment with us in June 2018. His annual base salary for 2018 was \$475,000.
- (5) Dr. Mitchener commenced employment with us in August 2018. His annual base salary for 2018 was \$330,000.
- (6) The amounts reported represent a one-time sign-on bonus.
- (7) The amounts reported represent a one-time relocation stipend.
- (8) The amounts reported represent a housing stipend of \$15,000 and commuting expenses of \$6,210.
- (9) The amounts reported represent \$337,500 in severance payments and \$18,078 in COBRA premiums.

Narrative disclosure to 2018 summary compensation table

Base Salary — Each named executive officer's base salary is a fixed component of annual compensation for performing specific duties and functions, and has been established by our board of directors taking into account each individual's role, responsibilities, skills and experience.

Cash Bonus — Our annual bonus program is intended to reward our named executive officers for meeting objective or subjective performance goals for a fiscal year.

Long-Term Equity Incentives — Our equity grant program is intended to align the interests of our named executive officers with those of our stockholders and to motivate them to make important contributions to our performance.

Employment and consulting arrangements with our named executive officers

William Hinshaw

Under our Amended and Restated Employment Agreement with Mr. Hinshaw, dated December 20, 2018, or the Hinshaw Employment Agreement, he will continue to serve as our President and Chief Executive Officer on an at will basis. Mr. Hinshaw currently receives a base salary of \$475,000 per year, which is subject to periodic review and adjustment. Mr. Hinshaw is also eligible for an annual performance bonus targeted at 50% of his base salary and is eligible to participate in the employee benefit plans generally available to our employees, subject to the terms of those plans. Effective upon the completion of this offering, Mr. Hinshaw's base salary will increase to \$500,000 per year and his annual performance bonus target will increase to 55% of his base salary. In addition, in March 2019, we approved a grant to Mr. Hinshaw of a performance option to purchase 60,803 shares of our common stock, contingent upon the completion of an initial public offering that the board of directors deems successful (the "Vesting Start Date"). The option will vest 25% on the first anniversary of the Vesting Start Date, with the remainder vesting in equal quarterly installments over the three years following the first anniversary of the Vesting Start Date.

The Hinshaw Employment Agreement further provides that if Mr. Hinshaw's employment is terminated by us without Cause (as defined in the Hinshaw Employment Agreement) or Mr. Hinshaw resigns for Good Reason (as defined in the Hinshaw Employment Agreement), he will be entitled to receive: (i) base salary continuation for 12 months following termination, or the Hinshaw Severance Amount, and, (ii) if Mr. Hinshaw is enrolled in our health care program immediately prior to the date of termination and properly elects to receive COBRA benefits, 12 months of COBRA premiums for himself and his eligible dependents at our normal rate of contribution for employees for coverage at the level in effect immediately prior to the date of termination (or a monthly cash payment in lieu thereof if we determine we cannot pay such amounts without potentially violating applicable law). Payment of the Hinshaw Severance Amount shall immediately cease if Mr. Hinshaw breaches the terms of the Restrictive Covenants Agreement between him and us. In lieu of the severance payments and benefits set forth above, in the event Mr. Hinshaw's employment is by us without Cause or he resigns for Good Reason, in either case within 12 months following a Change in Control (as defined in the Hinshaw Employment Agreement), he will be entitled to receive: (i) a lump sum cash amount equal to 1.5 times the sum of (A) his current base salary (or his base salary in effect prior to the Change in Control, if higher) plus (B) his target annual cash incentive compensation for the year of termination, (ii) if Mr. Hinshaw is enrolled in our health care program immediately prior to the date of termination and properly elects to receive COBRA benefits, 18 months of COBRA premiums for himself and his eligible dependents at our normal rate of contribution for employees for coverage at the level in effect immediately prior to the date of termination (or a monthly cash payment in lieu thereof if we determine we cannot pay such amounts without potentially violating applicable law), and

(iii) notwithstanding anything to the contrary provided in the applicable award agreement, accelerated vesting of 100% of all Time-Based Equity Awards held by Mr. Hinshaw.

Thomas Leggett

Under our Amended and Restated Employment Agreement with Mr. Leggett, dated December 31, 2018, or the Leggett Employment Agreement, he will continue to serve as our Senior Vice President and Chief Financial Officer on an at-will basis. Mr. Leggett currently receives a base salary of \$341,700 per year, which is subject to periodic review and adjustment. Mr. Leggett is also eligible for an annual performance bonus targeted at 40% of his base salary and is eligible to participate in the employee benefit plans generally available to our employees, subject to the terms of those plans.

The Leggett Employment Agreement further provides that if Mr. Leggett's employment is terminated by us without Cause (as defined in the Leggett Employment Agreement) or Mr. Leggett resigns for Good Reason (as defined in the Leggett Employment Agreement), he will be entitled to receive: (i) base salary continuation for nine months following termination, or the Leggett Severance Amount, and, (ii) if Mr. Leggett is enrolled in our health care program immediately prior to the date of termination and properly elects to receive COBRA benefits, nine months of COBRA premiums for himself and his eligible dependents at our normal rate of contribution for employees for coverage at the level in effect immediately prior to the date of termination (or a monthly cash payment in lieu thereof if we determine we cannot pay such amounts without potentially violating applicable law). Payment of the Leggett Severance Amount shall immediately cease if Mr. Leggett breaches the terms of the Restrictive Covenants Agreement between him and us. In lieu of the severance payments and benefits set forth above, in the event Mr. Leggett's employment is by us without Cause or he resigns for Good Reason, in either case within 12 months following a Change in Control (as defined in the Leggett Employment Agreement), he will be entitled to receive: (i) a lump sum cash amount equal to 1 times the sum of (A) his current base salary (or his base salary in effect prior to the Change in Control, if higher) plus (B) his target annual cash incentive compensation for the year of termination, (ii) if Mr. Leggett is enrolled in our health care program immediately prior to the date of termination and properly elects to receive COBRA benefits, 12 months of COBRA premiums for himself and his eligible dependents at our normal rate of contribution for employees for coverage at the level in effect immediately prior to the date of termination (or a monthly cash payment in lieu thereof if we determine we cannot pay such amounts without potentially violating applicable law), and (iii) except as otherwise provided in the applicable award agreement, accelerated vesting of 100% of all Time-Based Equity Awards held by Mr. Leggett.

Stephen Mitchener

Under our Amended and Restated Employment Agreement with Dr. Mitchener, dated December 29, 2018, or the Mitchener Employment Agreement, he will continue to serve as our Senior Vice President and Chief Business Officer on an at-will basis. Dr. Mitchener currently receives a base salary of \$330,000 per year, which is subject to periodic review and adjustment. Dr. Mitchener is also eligible for an annual performance bonus targeted at 40% of his base salary and is eligible to participate in the employee benefit plans generally available to our employees, subject to the terms of those plans.

Under the Mitchener Employment Agreement, Dr. Mitchener is entitled to a housing stipend of up to \$3,000 per month as long as his main domicile remains in New Jersey. The Company will review the housing stipend two years after Dr. Mitchener's start date and may extend or terminate it in its sole discretion. Dr. Mitchener is also entitled to receive reimbursements of up to \$600 per week for commuting expenses as long as his main domicile remains in New Jersey. In addition,

under the Mitchener Employment Agreement, Dr. Mitchener is also obligated to repay the entire signing bonus he received from the Company (equal to \$15,000 less taxes and withholding) in the event that, prior to February 13, 2019, he resigns other than for Good Reasons or his employment is terminated for Cause (as such terms are defined in the Mitchener Employment Agreement).

The Mitchener Employment Agreement also provides for the grant of the following equity awards subject to final approval by the board of directors or the compensation committee: (i) an option to purchase the Company's common stock in an amount equal to approximately 0.6% of the Company's stock on a fully diluted basis following the closing of the Company's Series E financing round (the "New Hire Options"), and (ii) if during the 12 month period after August 13, 2018, which may be extended to 24 months with modified terms at the discretion of the Compensation Committee, the Company signs a partnership agreement with an upfront cash payment of at least \$10 million with a third party to develop one or more therapeutic products an additional option to purchase the Company's common stock in an amount equal to approximately 0.25% of the Company's stock on a fully diluted basis following the closing of the Company's Series E financing round (the "Performance Options"). The New Hire Options will vest 25% on the first anniversary of Dr. Mitchener's start date, with the remainder vesting in equal quarterly installments over the three years following the first anniversary of Dr. Mitchener's start date. The Performance Options will vest 25% on the first anniversary of the closing of the partnership satisfying the performance criteria, with the remainder vesting in equal quarterly installments over the three years following the first anniversary of closing the partnership.

The Mitchener Employment Agreement further provides that if Dr. Mitchener's employment is terminated by us without Cause (as defined in the Mitchener Employment Agreement) or Dr. Mitchener resigns for Good Reason (as defined in the Mitchener Employment Agreement), he will be entitled to receive: (i) base salary continuation for nine months following termination, or the Mitchener Severance Amount, and, (ii) if Dr. Mitchener is enrolled in our health care program immediately prior to the date of termination and properly elects to receive COBRA benefits, nine months of COBRA premiums for himself and his eligible dependents at our normal rate of contribution for employees for coverage at the level in effect immediately prior to the date of termination (or a monthly cash payment in lieu thereof if we determine we cannot pay such amounts without potentially violating applicable law). Payment of the Mitchener Severance Amount shall immediately cease if Dr. Mitchener breaches the terms of the Restrictive Covenants Agreement between him and us. In lieu of the severance payments and benefits set forth above, in the event Dr. Mitchener's employment is by us without Cause or he resigns for Good Reason, in either case within 12 months following a Change in Control (as defined in the Mitchener Employment Agreement), he will be entitled to receive: (i) a lump sum cash amount equal to one times the sum of (A) his current base salary (or his base salary in effect prior to the Change in Control, if higher) plus (B) his target annual cash incentive compensation for the year of termination, (ii) if Dr. Mitchener is enrolled in our health care program immediately prior to the date of termination and properly elects to receive COBRA benefits, 12 months of COBRA premiums for himself and his eligible dependents at our normal rate of contribution for employees for coverage at the level in effect immediately prior to the date of termination (or a monthly cash payment in lieu thereof if we determine we cannot pay such amounts without potentially violating applicable law), and (iii) notwithstanding anything to the contrary provided in the applicable award agreement, accelerated vesting of 100% of all Time-Based Equity Awards held by Dr. Mitchener.

Robert Connelly

In connection with Mr. Connelly's employment relationship ending on May 31, 2018, or the Separation Date, we entered into a Separation Agreement with Mr. Connelly dated May 7, 2018. Under this Separation Agreement, subject to Mr. Connelly's compliance with his obligations under

the agreement, including a general release of any potential claims against the Company, Mr. Connelly received severance benefits that included COBRA coverage and base salary payments for nine months and an extension of the applicable exercise period for 27,766 options that were vested as of the Separation Date through the earlier of (i) a date that is six months after the closing an initial public offering by us or (ii) December 31, 2019. All unvested options were forfeited and void as of the Separation Date. In addition, we entered into a Stock Repurchase Agreement with Mr. Connelly dated May 31, 2019 in which we repurchased 91,527 shares of the Company owned by Mr. Connelly at a cost of \$6.21 per share, resulting in an aggregate repurchase price of \$568,162, which amount was applied to settle a balance of \$568,159, including principal and accrued interest, owed by Mr. Connelly under a loan granted by us under a Promissory Note dated September 5, 2013.

Other agreements

We have also entered into employee confidentiality, inventions, non-solicitation and non-competition agreements with each of our named executive officers. Under such agreements, each named executive officer has agreed (1) not to compete with us during his or her employment and for a period of one year after the termination of such employment, (2) not to solicit our employees during his or her employment and for a period of one year after the termination of such employment, (3) to protect our confidential and proprietary information and (4) to assign to us related intellectual property developed during the course of his or her employment.

Outstanding equity awards at 2018 fiscal year-end

The following table sets forth information concerning outstanding equity awards held by each of our named executive officers as of December 31, 2018. All equity awards set forth in the table below were granted under our 2010 Stock Incentive Plan, as amended, or the 2010 Plan.

Name	Option Awards					Stock Awards	
	Number of Securities Underlying Unexercised Options (#)	Number of Securities Underlying Unexercised Options (#)	Equity Incentive Plan Awards: Number of Securities Underlying Unexercised Unearned Options (#)	Option Exercise Price (\$)	Option Expiration Date	Number of Shares or Units of Stock That Have Not Vested (#)	Market Value of Shares or Units of Stock That Have Not Vested (\$)
William Hinshaw, President and CEO	—	939,028 ⁽¹⁾	—	6.21	6/21/2028	—	—
Thomas Leggett, CFO	84,817 ⁽²⁾	84,817 ⁽²⁾	—	6.52	6/13/2027	—	—
	7,204 ⁽²⁾	7,204 ⁽²⁾	—	6.52	8/9/2027	—	—
			51,033 ⁽³⁾	6.21	8/28/2028	—	—
Stephen Mitchener, PharmD, Chief Business Officer	—	51,033 ⁽⁴⁾	—	6.21	8/28/2028	—	—
		124,011 ⁽⁵⁾	—	6.21	10/1/2028	—	—
Robert Connelly, President and CEO	27,766		51,628 ⁽⁶⁾	6.21	10/1/2028	—	—
			—	6.52	6/13/2027	—	—

- (1) The shares underlying these awards vest 25% on May 31, 2019 and then in 12 equal quarterly installments thereafter.
- (2) The shares underlying these awards vested 25% on January 3, 2018 and then in 12 equal quarterly installments thereafter.
- (3) These awards may be earned upon the closing of an initial public offering of our common stock under an effective registration statement Filed on Form S-1 with the Securities Exchange Commission based on a pre-money valuation in excess of \$500,000,000 (the "Vesting Commencement Date"). The shares underlying these awards vest 25% one year after the Vesting Commencement Date and then in 12 equal quarterly installments thereafter.
- (4) The shares underlying these awards vest 25% on November 30, 2019 and then in 12 equal quarterly installments thereafter.

- (5) The shares underlying these awards vest 25% on August 13, 2019 and then in 12 equal quarterly installments thereafter.
- (6) These awards may be earned upon the Company entering into a partnership agreement with a third party to develop one or more therapeutic products that results in at least \$10,000,000 in upfront cash to the Company, only if such event occurs prior to August 13, 2019 or, at the discretion of the Company's Compensation Committee, prior to August 13, 2020 (the "Vesting Commencement Date"). The shares underlying these awards vest 25% one year after the Vesting Commencement Date and then in 12 equal quarterly installments thereafter.

Employee benefit and equity compensation plans

2019 Stock Option and Incentive Plan

Our 2019 Stock Option and Incentive Plan, or 2019 Plan, was adopted by our board of directors on April 29, 2019, and approved by our stockholders on April 29, 2019, and will become effective on the date immediately prior to the date on which the registration statement of which this prospectus is part is declared effective by the SEC. The 2019 Plan will replace our 2010 Plan, as our board of directors has determined not to make additional awards under that plan following the consummation of our initial public offering. The 2019 Plan allows the board of directors' compensation committee to make equity-based incentive awards to our officers, employees, directors and other key persons (including consultants).

We have initially reserved 6,671,662 shares of our common stock for the issuance of awards under the 2019 Plan, the Initial Limit. The 2019 Plan provides that the number of shares reserved and available for issuance under the plan will automatically increase each January 1, beginning on January 1, 2020, by 4% of the outstanding number of shares of our common stock on the immediately preceding December 31 or such lesser number of shares as determined by our compensation committee, or the Annual Increase. These limits are subject to adjustment in the event of a stock split, stock dividend or other change in our capitalization.

The shares of common stock underlying any awards that are forfeited, cancelled, held back upon exercise or settlement of an award to satisfy the exercise price or tax withholding, reacquired by us prior to vesting, satisfied without the issuance of stock, expire or are otherwise terminated (other than by exercise) under the 2019 Plan and 2010 Plan will be added back to the shares of common stock available for issuance under the 2019 Plan.

The maximum aggregate number of shares that may be issued in the form of incentive stock options shall not exceed the Initial Limit cumulatively increased on January 1, 2020 and on each January 1 thereafter by the lesser of the Annual Increase for such year or 6,671,662 shares.

The 2019 Plan will be administered by our compensation committee. Our compensation committee has full power to select, from among the individuals eligible for awards, the individuals to whom awards will be granted, to make any combination of awards to participants, and to determine the specific terms and conditions of each award, subject to the provisions of the 2019 Plan. Persons eligible to participate in the 2019 Plan will be those full or part-time officers, employees, non-employee directors and other key persons (including consultants) as selected from time to time by our compensation committee in its discretion.

The 2019 Plan permits the granting of both options to purchase common stock intended to qualify as incentive stock options under Section 422 of the Code and options that do not so qualify. The option exercise price of each option will be determined by our compensation committee but may not be less than 100% of the fair market value of our common stock on the date of grant. The term of each option will be fixed by our compensation committee and may not exceed ten years from the date of grant. Our compensation committee will determine at what time or times each option may be exercised.

Our compensation committee may award stock appreciation rights subject to such conditions and restrictions as it may determine. Stock appreciation rights entitle the recipient to shares of common stock, or cash, equal to the value of the appreciation in our stock price over the exercise price. The exercise price may not be less than 100% of the fair market value of our common stock on the date of grant. The term of each stock appreciation right will be fixed by our compensation committee and may not exceed ten years from the date of grant. Our compensation committee will determine at what time or times each stock appreciation right may be exercised.

Our compensation committee may award restricted shares of common stock and restricted stock units to participants subject to such conditions and restrictions as it may determine. These conditions and restrictions may include the achievement of certain performance goals and/or continued employment with us through a specified vesting period. Our compensation committee may also grant shares of common stock that are free from any restrictions under the 2019 Plan. Unrestricted stock may be granted to participants in recognition of past services or for other valid consideration and may be issued in lieu of cash compensation due to such participant. Our compensation committee may grant dividend equivalent rights to participants that entitle the recipient to receive credits for dividends that would be paid if the recipient had held a specified number of shares of common stock.

Our compensation committee may grant cash bonuses under the 2019 Plan to participants, subject to the achievement of certain performance goals.

The 2019 Plan provides that upon the effectiveness of a "sale event," as defined in the 2019 Plan, an acquirer or successor entity may assume, continue or substitute outstanding awards under the 2019 Plan. To the extent that awards granted under the 2019 Plan are not assumed or continued or substituted by the successor entity, upon the effective time of the sale event, such awards under the 2019 Plan shall terminate. In such a case, all options and stock appreciation rights that are not exercisable immediately prior to the effective time of the sale event will become fully exercisable as of the effective time of the sale event, all other awards with time-based vesting, conditions or restrictions, will become fully vested and nonforfeitable as of the effective time of the sale event and all awards with conditions and restrictions relating to the attainment of performance goals may become vested and nonforfeitable in the discretion of our compensation committee. In the event of such termination, individuals holding options and stock appreciation rights will be permitted to exercise such options and stock appreciation rights (to the extent exercisable) within a specified period of time prior to the sale event. In addition, in connection with the termination of the 2019 Plan upon a sale event, we may make or provide for a cash payment to participants holding vested and exercisable options and stock appreciation rights equal to the difference between the per share cash consideration payable to stockholders in the sale event and the exercise price of the options or stock appreciation rights and we may make or provide for a cash payment to participants holding other vested awards.

Our board of directors may amend or discontinue the 2019 Plan and our compensation committee may amend or cancel outstanding awards for purposes of satisfying changes in law or any other lawful purpose, but no such action may adversely affect rights under an award without the holder's consent. Certain amendments to the 2019 Plan require the approval of our stockholders.

No awards may be granted under the 2019 Plan after the date that is ten years from the date of stockholder approval of the 2019 Plan. No awards under the 2019 Plan have been made prior to the date hereof.

2019 Employee Stock Purchase Plan

On April 29, 2019, our board of directors adopted the 2019 Employee Stock Purchase Plan, or 2019 ESPP, and on April 29, 2019, our stockholders approved the 2019 ESPP. The 2019 ESPP is intended to qualify as an "employee stock purchase plan" within the meaning of Section 423 of the Code. The 2019 ESPP initially reserves and authorizes the issuance of up to a total of 237,181 shares of common stock to participating employees. The ESPP provides that the number of shares reserved and available for issuance will automatically increase each January 1, beginning on January 1, 2020, by the lesser of (i) 237,181 shares of common stock, (ii) 1% of the outstanding number of shares of our common stock on the immediately preceding December 31 or (iii) such lesser number of shares as determined by the 2019 ESPP administrator. The number of shares reserved under the 2019 ESPP is subject to adjustment in the event of a stock split, stock dividend or other change in our capitalization.

All employees whose customary employment is for more than 20 hours per week are eligible to participate in the ESPP. However, any participating employee who would own 5% or more of the total combined voting power or value of all classes of stock after an option were granted under the ESPP would not be eligible to purchase shares under the 2019 ESPP.

We will make one or more offerings each year to our employees to purchase shares under the ESPP. Offerings will usually begin on each January 1 and July 1 and will continue for six-month periods, referred to as offering periods. Each eligible employee may elect to participate in any offering by submitting an enrollment form at least 15 business days before the relevant offering date.

Each employee who is a participant in the 2019 ESPP may purchase shares by authorizing payroll deductions of up to 15% of his or her base compensation during an offering period. Unless the participating employee has previously withdrawn from the offering, his or her accumulated payroll deductions will be used to purchase shares on the last business day of the offering period at a price equal to 85% of the fair market value of the shares on the first business day or the last business day of the offering period, whichever is lower. Under applicable tax rules, an employee may purchase no more than \$25,000 worth of shares of common stock, valued at the start of the purchase period, under the ESPP in any calendar year.

The accumulated payroll deductions of any employee who is not a participant on the last day of an offering period will be refunded. An employee's rights under the 2019 ESPP terminate upon voluntary withdrawal from the plan or when the employee ceases employment with us for any reason.

The 2019 ESPP may be terminated or amended by our board of directors at any time. An amendment that increases the number of shares of common stock authorized under the ESPP and certain other amendments require the approval of our stockholders.

Senior Executive Cash Incentive Bonus Plan

On April 29, 2019, our board of directors adopted the Senior Executive Cash Incentive Bonus Plan, or the Bonus Plan. The Bonus Plan provides for cash bonus payments based upon the attainment of performance targets established by our compensation committee. The payment targets will be related to financial and operational measures or objectives with respect to our company, or Corporate Performance Goals, as well as individual performance objectives.

Our compensation committee may select Corporate Performance Goals from among the following: cash flow (including, but not limited to, operating cash flow and free cash flow); sales or revenue; corporate revenue; earnings before interest, taxes, depreciation and amortization; net income (loss) (either before or after interest, taxes, depreciation and/or amortization); changes in

the market price of our common stock; economic value-added; development, clinical, regulatory or commercial milestones; acquisitions or strategic transactions, partnerships or joint ventures; operating income (loss); return on capital, assets, equity, or investment; stockholder returns; return on sales; gross or net profit levels; productivity; expense efficiency; margins; operating efficiency; customer satisfaction; working capital; earnings (loss) per share of our common stock; sales or market shares; number of customers; operating income and/or other strategic, financial or operational objectives, any of which may be measured in absolute terms, as compared to any incremental increase, in terms of growth, as compared to results of a peer group, against the market as a whole, compared to applicable market indices and/or measured on a pre-tax or post-tax basis.

Each executive officer who is selected to participate in the Bonus Plan will have a target bonus opportunity set for each performance period. The bonus formulas will be adopted in each performance period by the compensation committee and communicated to each executive. The Corporate Performance Goals will be measured at the end of each performance period after our financial reports have been published or such other appropriate time as the compensation committee determines. If the Corporate Performance Goals and individual performance objectives are met, payments will be made as soon as practicable following the end of each performance period. The Bonus Plan also permits the compensation committee to approve additional bonuses to executive officers in its sole discretion.

2010 Stock Incentive Plan

Our 2010 Plan was approved and adopted by our board of directors on December 23, 2010, and approved by our stockholders on December 23, 2010. Under the 2010 Plan, we initially reserved for issuance an aggregate of 135,722 shares of our common stock, and most recently increased the shares reserved and available for issuance to 6,019,414 shares of our common stock on March 22, 2019. The number of shares of common stock reserved for issuance under the 2010 Plan, as amended and restated through the date hereof, is subject to adjustment in the event of a stock split, reverse stock split, stock dividend, reorganization, recapitalization, combination of shares, reclassification of shares, spin-off, or other similar change in our capitalization.

The shares of common stock underlying awards that are forfeited, cancelled, reacquired prior to vesting, satisfied without the issuance of shares of common stock, withheld to cover the exercise price or tax withholding or otherwise terminated (other than by exercise) are added back to the shares of common stock available for issuance under the 2010 Plan.

Our board of directors has acted as administrator of the 2010 Plan. The administrator has full power to select, from among the individuals eligible for awards, the individuals to whom awards will be granted, and to determine the specific terms and conditions of each award, subject to the provisions of the 2010 Plan. Persons eligible to participate in the 2010 Plan are those employees, full or part-time officers and directors, as well as consultants and key persons to our company as selected from time to time by the administrator in its discretion.

The 2010 Plan permits the granting of (1) options, including incentive stock options, to purchase common stock, (2) restricted stock, (3) unrestricted stock and (4) restricted stock units. For stock options, the administrator will determine the per share option exercise price and at what time or times each option may be exercised.

The 2010 Plan provides that in the case of and subject to the consummation of (i) the dissolution or liquidation of our company, (ii) the sale of all or substantially all of the assets of our company on a consolidated basis to an unrelated person or entity, (iii) a merger, reorganization or consolidation involving our company in which the shares of voting stock of our company outstanding immediately prior to such transaction represent or are converted into or exchanged for

securities of the surviving or resulting entity immediately upon completion of such transaction which represent less than 50 percent of the outstanding voting power of such surviving or resulting entity, (iv) the acquisition of all or a majority of the outstanding voting stock of our company in a single transaction or a series of related transactions, or (v) any other acquisition of the business of our company, as determined by our board of directors, or taken together, a Sale Event, an acquirer or successor entity may assume, continue or substitute outstanding awards under the 2010 Plan. To the extent that awards granted under the 2010 Plan are not assumed, continued or substituted by the successor entity, upon the effective time of the Sale Event, the 2010 Plan and such awards under the 2010 Plan shall terminate or be forfeited. In the event of such termination, individuals holding options will be permitted to exercise such options (to the extent exercisable) within a specified period of time prior to the Sale Event. In addition, in connection with the termination of the 2010 Plan upon a Sale Event, we may make or provide for a cash payment to participants holding vested and exercisable options equal to the difference between the per share cash consideration payable to stockholders in the Sale Event and the exercise price of the options. In the event of the forfeiture of shares of restricted stock, such shares shall be repurchased from the holder thereof at a per share price equal to the lower of the original per share purchase price or the current fair market value of such shares immediately prior to the effective time of the Sale Event. In addition in connection with the termination of the 2010 Plan upon a Sale Event, we may make or provide for a cash payment to participants holding restricted stock or restricted stock units equal to the per share cash consideration payable to stockholders in the Sale Event.

Our board of directors may amend or discontinue the 2010 Plan at any time, subject to approval by the Company stockholders entitled to vote at a meeting of stockholders where such approval is required by applicable law. Our board of directors may also amend or cancel any outstanding award, provided that no amendment to an award may materially and adversely affect a participant's rights without his or her consent.

The 2010 Plan will terminate upon the closing of this offering; however, awards previously granted may extend beyond that date. As of December 31, 2018, 845,450 shares of common stock and options to purchase 4,039,464 shares of common stock were outstanding under the 2010 Plan. Our board of directors has determined not to make any further awards under the 2010 Plan following the completion of this offering.

401(k) plan

We maintain a 401(k) retirement savings plan for the benefit of our employees, including our named executive officers, who satisfy certain eligibility requirements. Under the 401(k) plan, eligible employees may elect to defer a portion of their compensation, within the limits prescribed by the Code, on a pre-tax or after-tax (Roth) basis through contributions to the 401(k) plan. The Company is permitted to make discretionary profit sharing contributions to the Plan. The 401(k) plan is intended to qualify under Section 401(a) of the Code. As a tax-qualified retirement plan, pre-tax contributions to the 401(k) plan and earnings on those pre-tax contributions are not taxable to the employees until distributed from the 401(k) plan, and earnings on Roth contributions are not taxable when distributed from the 401(k) plan.

Health and welfare plans

All of our full-time employees, including our named executive officers, are eligible to participate in our health and welfare plans, including medical and dental benefits, short-term and long-term disability insurance, and life insurance. We believe these perquisites are necessary and appropriate to provide a competitive compensation package to our named executive officers.

Limitations on liability and indemnification matters

Our restated certificate of incorporation contains provisions that limit the liability of our directors for monetary damages to the fullest extent permitted by the Delaware General Corporation Law, or DGCL. Consequently, our directors are not personally liable to us or our stockholders for monetary damages for any breach of fiduciary duties as directors, except liability for:

- any breach of the director's duty of loyalty to us or our stockholders;
- any act or omission not in good faith or that involves intentional misconduct or a knowing violation of law;
- unlawful payments of dividends or unlawful stock repurchases or redemptions as provided in Section 174 of the DGCL; or
- any transaction from which the director derived an improper personal benefit.

Our amended and restated bylaws require us to indemnify our directors and officers to the maximum extent not prohibited by the DGCL and allow us to indemnify other employees and agents as set forth in the DGCL. Subject to certain limitations, our amended and restated bylaws also require us to advance expenses incurred by our directors and officers for the defense of any action for which indemnification is required or permitted.

We have entered, and intend to continue to enter, into separate indemnification agreements with our directors, officers and certain of our key employees, in addition to the indemnification provided for in our restated certificate of incorporation and amended and restated bylaws. These agreements, among other things, require us to indemnify our directors, officers and key employees for certain expenses, including attorneys' fees, judgments, penalties, fines and settlement amounts actually incurred by these individuals in any action or proceeding arising out of their service to us or any of our subsidiaries or any other company or enterprise to which these individuals provide services at our request. Subject to certain limitations, our indemnification agreements also require us to advance expenses incurred by our directors, officers and key employees for the defense of any action for which indemnification is required or permitted.

We believe that provisions of our restated certificate of incorporation, amended and restated bylaws and indemnification agreements are necessary to attract and retain qualified directors, officers and key employees. We also maintain directors' and officers' liability insurance.

The limitation of liability and indemnification provisions in our restated certificate of incorporation and amended and restated bylaws may discourage stockholders from bringing a lawsuit against our directors and officers for breach of their fiduciary duty. They may also reduce the likelihood of derivative litigation against our directors and officers, even though an action, if successful, might benefit us and other stockholders. Further, a stockholder's investment may be adversely affected to the extent that we pay the costs of settlement and damage awards against directors and officers as required by these indemnification provisions.

At present, there is no pending litigation or proceeding involving any of our directors or executive officers as to which indemnification is required or permitted, and we are not aware of any threatened litigation or proceeding that may result in a claim for indemnification.

Insofar as indemnification for liabilities arising under the Securities Act may be permitted to directors, executive officers or persons controlling us, we have been informed that, in the opinion of the SEC, such indemnification is against public policy as expressed in the Securities Act and is therefore unenforceable.

DIRECTOR COMPENSATION

The following table presents the total compensation for each person who served as a non-employee member of our board of directors and received compensation for such service during the year ended December 31, 2018. Other than as set forth in the table and described more fully below, we did not pay any compensation, make any additional equity awards or non-equity awards to, or pay any other compensation to any of the non-employee members of our board of directors in 2018. We reimburse non-employee members of our board of directors for reasonable travel and out-of-pocket expenses incurred in attending meetings of our board of directors and committees of our board of directors.

We also do not, and do not expect to, provide separate compensation to our directors who are also our employees, such as Mr. Hinshaw, our Chief Executive Officer and President.

Name	Fees Earned or Paid in Cash (\$)	Option Awards (\$) ⁽¹⁾	Total (\$)
William D. Baird III ⁽²⁾	—	196,460	196,460
Grégory Behar ⁽³⁾	—	—	—
David A. Berry, M.D., Ph.D. ⁽⁴⁾	—	—	—
David R. Epstein ⁽⁵⁾	225,000	—	225,000
Stephen Hoge, M.D. ⁽⁶⁾	—	—	—
Gary Pisano, Ph.D. ⁽⁷⁾	—	—	—
Cristina M. Rondinone, Ph.D. ⁽⁸⁾	—	177,650	177,650
Christopher A. Viehbacher ⁽⁹⁾	—	—	—

- (1) The amounts reported represent the aggregate grant date fair value of the stock options awarded to the non-employee directors in the fiscal year ended December 31, 2018, calculated in accordance with FASB ASC Topic 718. Such grant date fair values do not take into account any estimated forfeitures. The assumptions used in calculating the grant date fair value of the stock options reported in this column are set forth in Note 7 to our Consolidated Financial Statements included at the end of this prospectus. The amounts reported in this column reflect the accounting cost for these stock options and do not correspond to the actual economic value actually received by the non-employee directors or that may be received by the non-employee directors upon the exercise of the stock options or any sale of the underlying shares of common stock.
- (2) As of December 31, 2018, Mr. Baird held options to purchase 51,031 shares of our common stock. Such award vests 25% on the first anniversary of June 22, 2018 and then in 12 equal quarterly installments thereafter, subject to continued service — 0 shares subject to each such option were vested as of December 31, 2018.
- (3) As of December 31, 2018, Mr. Behar did not hold any outstanding equity awards.
- (4) As of December 31, 2018, Dr. Berry held 760,042 shares of stock.
- (5) As of December 31, 2018, Mr. Epstein held options to purchase 782,646 shares of our common stock. Such award vests 25% on the first anniversary of December 21, 2017 and then in 12 equal quarterly installments thereafter, subject to continued service — 195,661 shares subject to each such option were vested as of December 31, 2018. As of December 31, 2018, \$225,000 was accrued related to a \$450,000 retainer payment to Mr. Epstein for service rendered in 2018 and 2019 as Chairman of the board of directors.
- (6) As of December 31, 2018, Dr. Hoge held options to purchase 54,288 shares of our common stock, all of which were vested as of December 31, 2018.
- (7) As of December 31, 2018, Dr. Pisano held options to purchase 81,433 shares of our common stock, all of which were vested as of December 31, 2018.
- (8) As of December 31, 2018, Dr. Rondinone held options to purchase 46,144 shares of our common stock, 40,716 of which were awarded to Dr. Rondinone as compensation for her role on our board of directors and 5,428 for her role on our Scientific Advisory Board. Such awards vest 25% on the first anniversary of June 22, 2018 and July 13, 2018, respectively, and then in 12 equal quarterly installments thereafter, subject to continued service — 0 shares subject to each such option were vested as of December 31, 2018.
- (9) As of December 31, 2018, Mr. Viehbacher did not hold any outstanding equity awards.

Non-employee director compensation policy

Prior to the effectiveness of the registration statement of which this prospectus forms a part, we did not have a formal policy to compensate our non-employee directors. Prior to the effectiveness of the registration statement of which this prospectus forms a part, our board of directors intends to adopt a non-employee director compensation policy, to be effective upon effectiveness of the registration statement of which this prospectus forms a part, that is designed to enable us to attract and retain, on a long-term basis, highly qualified non-employee directors. Under the policy, each director who is not an employee will be paid cash compensation from and after the completion of this offering, as set forth below:

	Member Annual Fee	Chairman Additional Annual Fee
Board of Directors	\$ 35,000	\$ —
Audit Committee	7,500	15,000
Compensation Committee	5,000	10,000
Nominating and Corporate Governance Committee	4,000	8,000

In addition, each non-employee director serving on our board of directors upon the closing of this offering and each non-employee director elected or appointed to our board of directors following the completion of this offering will be granted a one-time equity award of 22,000 shares on the date of such director's election or appointment to the board of directors, which will vest annually over three years, subject to continued service through such vesting dates. On the date of each annual meeting of stockholders of our company, each non-employee director will be granted an annual equity award of 11,000 shares, which will vest in full on the earlier to occur of the first anniversary of the date of grant or the next annual meeting, subject to continued service as a director through such vesting date.

CERTAIN RELATIONSHIPS AND RELATED PARTY TRANSACTIONS

Other than the compensation agreements and other arrangements described under "Executive Compensation" and "Director Compensation" in this prospectus and the transactions described below, since January 1, 2016, there has not been and there is not currently proposed, any transaction or series of similar transactions to which we were, or will be, a party in which the amount involved exceeded, or will exceed, \$120,000 and in which any director, executive officer, holder of 5% or more of any class of our capital stock or any member of the immediate family of, or entities affiliated with, any of the foregoing persons, had, or will have, a direct or indirect material interest.

Stockholder	Common Stock	Shares of Series A Preferred Stock	Shares of Series B Preferred Stock	Shares of Series B-1 Preferred Stock	Shares of Series C Preferred Stock	Shares of Series D Preferred Stock	Shares of Series E Preferred Stock	Total Purchase Price (\$)
Flagship Pioneering Funds ⁽¹⁾	2,714,440	5,538,462	2,320,184		992,063		1,342,882	41,800,000
Fidelity Investments ⁽²⁾					3,799,602		895,255	48,300,000
Nestlé Health Sciences US Holdings, Inc.						2,997,179	581,915	49,000,000
Gurnet Point L.P.					1,488,095		895,255	25,000,000

(1) Flagship Pioneering Funds consists of Flagship VentureLabs IV, LLC, Flagship Ventures Fund 2007, L.P., Flagship Ventures Fund IV, L.P., Flagship Ventures Fund IV-Rx, L.P. and Flagship Ventures Opportunity Fund I, L.P.

(2) Fidelity Investments consists of Fidelity Select Portfolios: Biotechnology Portfolio, Fidelity Advisor Series VII: Fidelity Advisor Biotechnology Fund, Fidelity Securities Fund: Fidelity Series Blue Chip Growth Fund, Fidelity Growth Company Commingled Pool, Fidelity Mt. Vernon Street Trust: Fidelity Series Growth Company Fund and FIAM Target Date Blue Chip Growth Commingled Pool.

Sales of securities

Series C preferred stock financing

From January 2015 to August 2017, we issued and sold to investors in a private placement an aggregate of 6,969,044 shares of our Series C Preferred Stock at a purchase price of \$10.08 per share, for aggregate consideration of approximately \$70.3 million.

Series D preferred stock financing

In February 2016, we issued and sold to investors in a private placement an aggregate of 2,997,179 shares of our Series D Preferred Stock at a purchase price of \$14.18 per share, for aggregate consideration of approximately \$42.5 million.

Series E preferred stock financing

In November 2018, we issued and sold to investors in a private placement an aggregate of 5,282,002 shares of our Series E Preferred Stock at a purchase price of \$11.17 per share, for aggregate consideration of approximately \$59.0 million.

Services agreement

In December 2008, we entered into a services agreement with Flagship Ventures Management, Inc., now known as Flagship Pioneering, Inc., an affiliate of the Flagship Pioneering Funds, under which Flagship Pioneering provides us with advisory and administrative services on an as-needed basis. The agreement, which is invoiced monthly, may be terminated by either party upon 30 days' prior written notice. For the years ended December 31, 2017 and 2018, we paid Flagship Pioneering, Inc. an aggregate of approximately \$104,000 and \$8,000, respectively, for services provided under the services agreement, inclusive of the services provided under the services agreement.

Fifth amended and restated investors' rights agreement

In connection with the initial closing of our Series E Preferred Stock financing on November 30, 2018, we entered into a fifth amended and restated investors' rights agreement, or investors' rights agreement, with certain of our stockholders, including affiliates of Flagship Pioneering Funds, or Flagship. The investors' rights agreement, among other things:

- grants investors party thereto certain registration rights with respect to shares of our common stock, including shares of common stock issued or issuable upon conversion of our convertible preferred stock;
- obligates us to deliver periodic financial statements to Flagship, Fidelity Investments, Gurnet Point L.P. and its affiliates and any investor who, individually or together with affiliates, holds at least 350,000 shares of our preferred stock, each of whom we refer to as a "Major Investor"; and
- grants a right of first offer with respect to sales of our shares by us, subject to specified exclusions (which exclusions include the sale of the shares in connection with this offering), to Major Investors.

For more information regarding the registration rights provided in this agreement, please refer to the section of this prospectus titled "Description of Capital Stock — Registration rights."

Certain provisions of this agreement, including certain of the covenants described above, will terminate automatically prior to the completion of this offering. This is not a complete description of the investors' rights agreement and is qualified by the full text of the investors' rights agreement filed as an exhibit to the registration statement of which this prospectus is a part.

Fifth amended and restated voting agreement

In connection with the initial closing of our Series E Preferred Stock financing on November 30, 2018, we entered into a fifth amended and restated voting agreement, or the voting agreement, with certain of our stockholders, including affiliates of Flagship. The voting agreement, among other things, provides the terms for the voting of shares with respect to the constituency of our directors. Pursuant to the terms of the voting agreement, the following directors were elected to serve as members on our board of directors and, as of the date of this prospectus, continue to so serve: David R. Epstein, William Hinshaw, Gary Pisano, Cristina M. Rondinone, William D. Baird III, Stephen Hoge, David A. Berry, Christopher A. Viehbacher, and Grégory Behar. Mr. Epstein was selected to serve on our board of directors as designated by Flagship Ventures Fund IV, L.P., Mr. Hinshaw was selected to serve on our board of directors as our CEO, Dr. Berry was selected to serve on our board of directors as designated by Flagship, Mr. Behar was selected to serve on our board of directors by Nestlé Health Sciences US Holdings, Inc. and Dr. Pisano, Dr. Rondinone, Mr. Baird and Dr. Hoge were selected to serve on our board of directors as directors who are not affiliated with any investor, possess relevant industry experience and are acceptable to a majority of the investors party to the voting agreement. Mr. Viehbacher was selected to serve on our board of directors as a director who is acceptable to a majority of the other members of our board of directors.

This voting agreement will terminate automatically upon the closing of this offering.

Fifth amended and restated right of first refusal and co-sale agreement

In connection with initial closing of our Series E Preferred Stock financing on November 30, 2018, we entered into a right of first refusal and co-sale agreement with certain of our stockholders, including Flagship. The right of first refusal and co-sale agreement, among other things:

- grants our investors certain rights of first refusal and co-sale with respect to proposed transfers of our securities by certain stockholders; and
- grants us certain rights of first refusal with respect to proposed transfers of our securities by certain stockholders.

The right of first refusal and co-sale agreement will terminate automatically immediately prior to the completion of this offering.

Promissory notes

We entered into a stock repurchase agreement with Robert Connelly, our former CEO, dated May 31, 2018, in which we repurchased 91,527 shares of our common stock owned by Mr. Connelly at a cost of \$6.21 per share, resulting in an aggregate repurchase price of \$568,162, which amount was applied to settle a balance of \$568,159, including principal and accrued interest, owed to us by Mr. Connelly under a Promissory Note dated September 5, 2013.

Indemnification agreements

In connection with this offering, we intend to enter into new agreements to indemnify our directors and executive officers. These agreements will, among other things, require us to indemnify these individuals for certain expenses (including attorneys' fees), judgments, fines and settlement amounts reasonably incurred by such person in any action or proceeding, including any action by or in our right, on account of any services undertaken by such person on behalf of our company or that person's status as a member of our board of directors to the maximum extent allowed under Delaware law.

Policies for approval of related party transactions

Our board of directors reviews and approves transactions with directors, officers and holders of five percent or more of our voting securities and their affiliates, each a related party. Prior to this offering, upon consideration of a potential related party transaction, the material facts as to the related party's relationship or interest in the transaction are disclosed to our board of directors prior to their consideration of such transaction, and the transaction is not considered approved by our board of directors unless a majority of the directors who are not interested in the transaction approve the transaction. Further, when stockholders are entitled to vote on a transaction with a related party, the material facts of the related party's relationship or interest in the transaction are disclosed to the stockholders, who must approve the transaction in good faith.

We have adopted a written related party transactions policy that will become effective on the date on which the registration statement of which this prospectus is part is declared effective by the SEC. Pursuant to this policy, the audit committee has the primary responsibility for reviewing and approving or disapproving "related party transactions," which are transactions between us and related persons in which the aggregate amount involved exceeds or may be expected to exceed \$120,000 and in which a related person has or will have a direct or indirect material interest. For purposes of this policy, a related person will be defined as a director, executive officer, nominee for director, or greater than 5% beneficial owner of our common stock, in each case since the beginning of the most recently completed year, and their immediate family members.

PRINCIPAL STOCKHOLDERS

The following table sets forth certain information known to us regarding beneficial ownership of our capital stock as of December 31, 2018, as adjusted to reflect the sale of common stock offered by us in this offering, for:

- each person or group of affiliated persons known by us to be the beneficial owner of more than 5% of our capital stock;
- each of our named executive officers;
- each of our directors; and
- all of our executive officers and directors as a group.

Beneficial ownership is determined in accordance with the rules of the SEC and generally includes voting or investment power with respect to securities. Under those rules, beneficial ownership includes any shares as to which the individual or entity has sole or shared voting power or investment power and includes securities that the individual or entity has the right to acquire, such as through the exercise of stock options, within 60 days of December 31, 2018. Except as noted by footnote, and subject to community property laws where applicable, we believe, based on the information provided to us, that the persons and entities named in the table below have sole voting and investment power with respect to all common stock shown as beneficially owned by them.

The percentage of beneficial ownership prior to this offering in the table below is based on 19,416,931 shares of common stock deemed to be outstanding as of December 31, 2018, assuming the conversion of all outstanding shares of our preferred stock upon the completion of this offering into an aggregate of 14,641,997 shares of common stock upon the completion of this offering, and the percentage of beneficial ownership at this offering in the table below is based on

22,988,359 shares of common stock assumed to be outstanding after the completion of the offering.

Name and address of beneficial owner	Number of shares beneficially owned prior to offering	Percentage of shares beneficially owned	
		Prior to offering	After offering
5% Stockholders:			
Flagship Pioneering Funds ⁽¹⁾	8,248,414	42.5%	35.9%
Fidelity Investments ⁽²⁾	2,548,778	13.1%	11.1%
Nestlé Health Sciences US Holdings, Inc. ⁽³⁾	2,018,699	10.4%	8.8%
Gurnet Point L.P. ⁽⁴⁾	1,293,891	6.7%	5.6%
Named executive officers and directors:			
Thomas Leggett ⁽⁵⁾	92,021	*	*
Stephen Mitchener	—	*	*
Robert Connelly ⁽⁶⁾	563,086	2.9%	2.4%
William D. Baird III	—	*	*
Grégory Behar, M.B.A.	—	*	*
David A. Berry, M.D., Ph.D.	760,042	3.9%	3.3%
David R. Epstein ⁽⁷⁾	195,661	1.0%	0.8%
William Hinshaw ⁽⁸⁾	—	*	*
Stephen Hoge, M.D. ⁽⁹⁾	54,288	*	*
Gary Pisano, Ph.D. ⁽¹⁰⁾	81,433	*	*
Cristina M. Rondinone, Ph.D.	—	*	*
Christopher A. Viehbacher	—	*	*
All executive officers and directors as a group (12 persons)	1,746,531	8.8%	7.5%

* Represents beneficial ownership of less than 1%.

(1) Consists of (a) 678,610 shares of common stock held by Flagship Ventures Fund 2007, L.P. ("Flagship Fund 2007"), (b) 2,035,830 shares of common stock held by Flagship Ventures Fund IV, L.P. ("Flagship Fund IV"), (c) 751,691 shares of common stock issuable upon conversion of the Series A Preferred Stock held by Flagship Fund 2007, (d) 209,933 shares of common stock issuable upon conversion of the Series B/B1 Preferred Stock held by Flagship Fund 2007, (e) 120,795 shares of common stock issuable upon conversion of the Series C Preferred Stock held by Flagship Fund 2007, (f) 2,255,074 shares of common stock issuable upon conversion of the Series A Preferred Stock held by Flagship Fund IV, (g) 503,840 shares of common stock issuable upon conversion of the Series B/B1 Preferred Stock held by Flagship Fund IV, (h) 335,457 shares of common stock issuable upon conversion of the Series C Preferred Stock held by Flagship Fund IV, (i) 194,409 shares of common stock issuable upon conversion of the Series E Preferred Stock held by Flagship Fund IV (j) 545,826 shares of common stock issuable upon conversion of the Series B/B1 Preferred Stock held by Flagship Ventures Fund IV-Rx, L.P. ("Flagship Fund IV-Rx"), (k) 82,324 shares of common stock issuable upon conversion of the Series C Preferred Stock held by Flagship Fund IV-Rx, and (l) 48,602 shares of common stock issuable upon conversion of the Series E Preferred Stock held by Flagship Fund IV-Rx; and (m) 486,023 shares of common stock issuable upon conversion of the Series E Preferred Stock held by Flagship Ventures Opportunities Fund I, L.P. The General Partner of Flagship Fund 2007 is Flagship Ventures 2007 General Partner LLC ("Fund 2007 GP"). Flagship Fund IV is a member of VentureLabs IV and also serves as its manager. The General Partner of Flagship Fund IV is Flagship Ventures Fund IV General Partner LLC ("Fund IV GP"). Noubar B. Afeyan, Ph.D. and Edwin M. Kania, Jr. are the managers of Fund IV GP and Fund 2007 GP and each of these individuals may be deemed to share voting and investment power with respect to all shares held by Flagship Fund IV, VentureLabs IV, and Flagship Fund 2007. While Mr. Kania is retired from Flagship Pioneering, he continues to serve as a manager of the Fund 2007 GP and Fund IV GP. None of the Flagship General Partners, Dr. Afeyan, or Mr. Kania directly own any of the shares held by the Flagship Funds, and each of the Flagship General Partners, Dr. Afeyan, and Mr. Kania disclaims beneficial ownership of such shares except to the extent of its or his pecuniary

interest therein. The mailing address of the Flagship Funds is 55 Cambridge Parkway, Suite 800E, Cambridge, MA 02142.

- (2) Consists of (a) 891,570 shares of common stock issuable upon conversion of the Series C Preferred Stock held by Fidelity Select Portfolios: Select Biotechnology Portfolio, (b) 185,590 shares of common stock issuable upon conversion of the Series C Preferred Stock held by Fidelity Advisor Series VII: Fidelity Advisor Biotechnology Fund, (c) 296,218 shares of common stock issuable upon conversion of the Series C Preferred Stock held by Fidelity Securities Fund: Fidelity Blue Chip Growth Fund, (d) 134,644 shares of common stock issuable upon conversion of the Series C Preferred Stock held by Fidelity Securities Fund: Fidelity Series Blue Chip Growth Fund, (e) 186,693 shares of common stock issuable upon conversion of the Series C Preferred Stock and 221,318 shares of common stock issuable upon conversion of the Series E Preferred Stock held by Fidelity Growth Company Comingled Pool, (f) 60,576 shares of common stock issuable upon conversion of the Series C Preferred Stock and 65,545 shares of common stock issuable upon conversion of the Series E Preferred Stock held by Fidelity Mt. Vernon Street Trust: Fidelity Series Growth Company Fund, (g) 291,309 shares of common stock issuable upon conversion of the Series C Preferred Stock and 199,159 shares of common stock issuable upon conversion of the Series E Preferred Stock held by Fidelity Mt. Vernon Street Trust: Fidelity Growth Company Fund, and (h) 16,156 shares of common stock issuable upon conversion of the Series C Preferred Stock held by FIAM Target Date Blue Chip Growth Commingled Pool. Fidelity Select Portfolios, Fidelity Advisor Biotechnology Fund, Fidelity Mt. Vernon Street Trust, Fidelity Variable Insurance and Fidelity Advisor Series VII are managed by direct or indirect subsidiaries of FMR LLC. Edward C. Johnson 3d is a Director and the Chairman of FMR LLC and Abigail P. Johnson is a Director, the Vice Chairman and the President of FMR LLC. Members of the family of Edward C. Johnson 3d, including Abigail P. Johnson, are the predominant owners, directly or through trusts, of Series B voting common shares of FMR LLC, representing 49% of the voting power of FMR LLC. The Johnson family group and all other Series B shareholders have entered into a shareholders' voting agreement under which all Series B voting common shares will be voted in accordance with the majority vote of Series B voting common shares. Accordingly, through their ownership of voting common shares and the execution of the shareholders' voting agreement, members of the Johnson family may be deemed, under the Investment Company Act of 1940, to form a controlling group with respect to FMR LLC. Neither FMR LLC nor Edward C. Johnson 3d nor Abigail P. Johnson has the sole power to vote or direct the voting of the shares owned directly by the various investment companies registered under the Investment Company Act (Fidelity Funds) advised by Fidelity Management & Research Company (FMR Co), a wholly owned subsidiary of FMR LLC, which power resides with the Fidelity Funds' Boards of Trustees. Fidelity Management & Research Company carries out the voting of the shares under written guidelines established by the Fidelity Funds' Boards of Trustees.
- (3) Consists of (a) 1,702,785 shares of common stock issuable upon conversion of the Series D Preferred Stock and (b) 315,914 shares of common stock issuable upon conversion of the Series E Preferred Stock.
- (4) Consists of (a) 807,868 shares of common stock issuable upon conversion of the Series C Preferred Stock and (b) 486,023 shares of common stock issuable upon conversion of the Series E Preferred Stock.
- (5) 92,021 shares of common stock underlying options exercisable within 60 days of December 31, 2018.
- (6) Consists of (a) 535,320 shares held by Mr. Connelly and (b) 27,766 shares of common stock underlying options exercisable within 60 days of December 31, 2018.
- (7) 195,661 shares of common stock underlying options exercisable within 60 days of December 31, 2018.
- (8) Mr. Hinshaw currently serves as our President and Chief Executive Officer and commenced employment with us in June 2018. Previously, Mr. Connelly served as our President and Chief Executive Officer until May 2018.
- (9) 54,288 shares of common stock underlying options exercisable within 60 days of December 31, 2018.
- (10) 81,433 shares of common stock underlying options exercisable within 60 days of December 31, 2018.

DESCRIPTION OF CAPITAL STOCK

The following descriptions are summaries of the material terms of our restated certificate of incorporation, which will be effective upon the completion of this offering and amended and restated bylaws, which will be effective upon the effectiveness of the registration statement of which this prospectus is a part. The descriptions of the common stock and preferred stock give effect to changes to our capital structure that will occur immediately prior to the completion of this offering.

General

Upon the closing of this offering and after giving effect to the conversion of Series A, B, B-1, C, D and E Preferred Stock into common stock, the filing of an amended and restated certificate of incorporation solely for the purpose of eliminating any remaining designated, but unissued, shares of Series A Preferred Stock from our certificate of incorporation, and the retirement of all outstanding shares of our Series B, B-1, C, D and E preferred stock, our authorized capital stock will consist of 150,000,000 shares of common stock, par value \$0.001 per share, and 10,000,000 shares of preferred stock, par value \$0.001 per share, all of which shares of preferred stock will be undesignated.

In March 2019 and April 2019, respectively, our board of directors and our stockholders approved two amended and restated certificates of incorporation. The first amended and restated certificate of incorporation, or the First A&R Charter, contains all of the provisions that are set forth in the final restated certificate of incorporation, but also includes all of the terms of the Series A, B, B-1, C, D and E preferred stock. The First A&R Charter will be in effect immediately prior to the completion of this offering. The second amended and restated certificate of incorporation, or the Second A&R Charter, is identical to the First A&R Charter, except that it eliminates all provisions relating to the Series A preferred stock. The Second A&R Charter cannot, and will not, be filed until all outstanding shares of our Series A, B, B-1, C, D and E preferred stock have converted into common stock. Also in April 2019, our board of directors approved the retirement, following conversion of all shares of Series A, B, B-1, C, D and E preferred stock into common stock in connection with the completion of this offering, of all shares of Series B, B-1, C, D and E preferred stock following the filing of the Second A&R Charter. The certificate of retirement, or the Certificate of Retirement, will have the effect of eliminating from our certificate of incorporation all provisions relating to our Series B, B-1, C, D and E preferred stock. Finally, also in April 2019, our board of directors approved the restated certificate of incorporation, to be filed after the Certificate of Retirement eliminating the terms of our Series B, B-1, C, D and E preferred stock, which retirement occurs after the elimination of our Series A preferred stock pursuant to the filing of the Second A&R Charter, and which restated certificate of incorporation will govern the company following this offering until amended and/or restated in accordance with applicable law. The purpose of the filings described above is simply to allow us to eliminate the terms of our Series A, B, B-1, C, D and E preferred stock from our certificate of incorporation and to integrate and restate our certificate of incorporation into one operative document, namely the restated certificate of incorporation. The First A&R Charter will be filed and effective prior to the closing of this offering. The Second A&R Charter will be filed in manner that it will become effective on the date of the closing of this offering and after the effective time of the conversion our Series A, B, B-1, C, D and E preferred stock into common stock. The Certificate of Retirement will be filed in manner that it will become effective on the date of the closing of this offering and after the effective time of the Second A&R Charter. The restated certificate will be filed in a manner that it will become effective on the date of the closing and after the effective time of the Certificate of Retirement.

As of April 20, 2019, 4,785,088 shares of our common stock and 26,831,246 shares of preferred stock were outstanding and held by 64 stockholders of record. This amount does not take into account the conversion of all outstanding shares of our preferred stock into common stock upon the completion of this offering.

Common stock

The holders of our common stock are entitled to one vote for each share held on all matters submitted to a vote of the stockholders. The holders of our common stock do not have any cumulative voting rights. Holders of our common stock are entitled to receive ratably any dividends declared by our board of directors out of funds legally available for that purpose, subject to any preferential dividend rights of any outstanding preferred stock. Our common stock has no preemptive rights, conversion rights or other subscription rights or redemption or sinking fund provisions.

In the event of our liquidation, dissolution or winding up, holders of our common stock will be entitled to share ratably in all assets remaining after payment of all debts and other liabilities and any liquidation preference of any outstanding preferred stock. The shares to be issued by us in this offering will be, when issued and paid for, validly issued, fully paid and non-assessable.

Preferred stock

Upon the closing of this offering, all outstanding shares of our Series A, B, B-1, C, D and E preferred stock will be converted into shares of our common stock, and all such shares of Series A, B, B-1, C, D and E preferred stock will be retired and will no longer be subject to reissuance. As described above, our board of directors and stockholders have approved a First A&R Charter to authorize the shares of common stock to be issued in this offering and in connection with the conversion of our shares of Series A, B, B-1, C, D and E preferred stock into common stock and to otherwise include the governance and other provisions which will govern the company immediately following this offering. The Second A&R Charter and the Certificate of Retirement have been authorized simply for purposes of allowing us to eliminate the terms of our existing Series A, B, B-1, C, D and E preferred stock. Finally, the restated certificate of incorporation simply reflects the elimination of the terms of our existing Series A, B, B-1, C, D and E preferred stock from our certificate of incorporation. Upon the consummation of this offering and after giving effect to the conversion and retirement of all Series A, B, B-1, C, D and E preferred stock, we will have no shares of Series A, B, B-1, C, D and E preferred stock designated for future issuance, and our board of directors will have the authority, without further action by our stockholders, to issue up to 10,000,000 shares of preferred stock in one or more series and to fix the rights, preferences, privileges and restrictions thereof. These rights, preferences and privileges could include dividend rights, conversion rights, voting rights, terms of redemption, liquidation preferences, sinking fund terms and the number of shares constituting, or the designation of, such series, any or all of which may be greater than the rights of common stock. The issuance of our preferred stock could adversely affect the voting power of holders of common stock and the likelihood that such holders will receive dividend payments and payments upon our liquidation. In addition, the issuance of preferred stock could have the effect of delaying, deferring or preventing a change in control of our company or other corporate action. Immediately upon the closing of this offering, no shares of preferred stock will be outstanding and we have no present plan to issue any shares of preferred stock.

Stock options

As of April 20, 2019, options to purchase 4,876,830 shares of our common stock were outstanding.

Warrants

As of April 20, 2019, warrants to purchase up to 112,795 shares of our Series A preferred stock, at an exercise price of \$1.95 per share, were outstanding.

Upon the closing of this offering, and after giving effect to the conversion of our preferred stock into common stock, the warrants to purchase our Series A preferred stock will become exercisable for an aggregate of up to 61,235 shares of our common stock, at a weighted average exercise price of \$3.59. All of the warrants provide for adjustments in the event of specified mergers, reorganization, reclassification, stock dividends, stock splits or other changes in our corporate structure. The warrants to purchase shares of our Series A preferred stock expire on the earlier of the close of business April 13, 2020 or one year after the closing of our initial public offering.

Registration rights

Upon the completion of this offering, the holders of 17,356,437 shares of our common stock including those issuable upon the conversion of our preferred stock, which shares we refer to as "registrable securities," will be entitled to rights with respect to the registration of these registrable securities under the Securities Act. These rights are provided under the terms of an investors' rights agreement between us and holders of our preferred stock. The investors' rights agreement includes demand registration rights, short-form registration rights and piggyback registration rights. All fees, costs and expenses of underwritten registrations under this agreement will be borne by us and all selling expenses, including underwriting discounts and selling commissions, will be borne by the holders of the shares being registered.

Demand registration rights

Beginning 180 days after the effective date of this registration statement, the holders of registrable securities are entitled to demand registration rights under certain conditions. Under the terms of the investors' rights agreement, we will be required, upon the request of holders of a majority of the registrable securities to register registrable securities that would result in an aggregate offering price of at least \$5.0 million, to file a registration statement of all or a portion of these registrable securities for public resale. We are required to effect only two such registrations pursuant to this provision of the investors' rights agreement.

Short-form registration rights

Pursuant to the investors' rights agreement, if we are eligible to file a registration statement on Form S-3, upon the written request of holders of at least 20% of the registrable securities to register registrable securities that would result in an aggregate offering price of at least \$2.5 million, we will be required to file a registration statement on Form S-3 for such registrable securities subject to certain limitations. We are required to effect only two registrations in any twelve month period pursuant to this provision of the investors' rights agreement. The right to have such shares registered on Form S-3 is further subject to other specified conditions and limitations.

Piggyback registration rights

Pursuant to the investors' rights agreement, if we register any of our securities either for our own account or for the account of other security holders, subject to certain exceptions, the holders of these shares are entitled to include their shares in the registration. Subject to certain exceptions contained in the investors' rights agreement, we and the underwriters may limit the number of shares included in the underwritten offering to the number of shares which we and the underwriters determine in our sole discretion will not jeopardize the success of the offering. However, in such circumstances, the number of shares to be included in the offering that are held by holders of registrable shares shall only be excluded if all shares proposed to be sold by us are excluded.

Indemnification

Our investors' rights agreement contains customary cross-indemnification provisions, under which we are obligated to indemnify holders of registrable securities in the event of material misstatements or omissions in the registration statement attributable to us, and they are obligated to indemnify us for material misstatements or omissions attributable to them.

Expiration of registration rights

The demand registration rights and short form registration rights granted to any holder of registrable securities under the investors' rights agreement will terminate upon the earliest to occur of (i) a deemed liquidation event (as defined in our certificate of incorporation), (ii) the fifth anniversary of the completion of this offering or (iii) such time after this offering when the holders' shares may be sold without restriction pursuant to Rule 144 within a three-month period.

Anti-takeover effects of our restated certificate of incorporation and amended and restated bylaws and Delaware Law

Our restated certificate of incorporation and amended and restated bylaws include a number of provisions that may have the effect of delaying, deferring or preventing another party from acquiring control of us and encouraging persons considering unsolicited tender offers or other unilateral takeover proposals to negotiate with our board of directors rather than pursue non-negotiated takeover attempts. These provisions include the items described below.

Board composition and filling vacancies

Our restated certificate of incorporation provides for the division of our board of directors into three classes serving staggered three-year terms, with one class being elected each year. Our restated certificate of incorporation also provides that directors may be removed only for cause and then only by the affirmative vote of the holders of two-thirds or more of the shares then entitled to vote at an election of directors. Furthermore, any vacancy on our board of directors, however occurring, including a vacancy resulting from an increase in the size of our board, may only be filled by the affirmative vote of a majority of our directors then in office even if less than a quorum. The classification of directors, together with the limitations on removal of directors and treatment of vacancies, has the effect of making it more difficult for stockholders to change the composition of our board of directors.

No written consent of stockholders

Our restated certificate of incorporation provides that all stockholder actions are required to be taken by a vote of the stockholders at an annual or special meeting, and that stockholders may not take any action by written consent in lieu of a meeting. This limit may lengthen the amount of time required to take stockholder actions and would prevent the amendment of our amended and restated bylaws or removal of directors by our stockholders without holding a meeting of stockholders.

Meetings of stockholders

Our restated certificate of incorporation and amended and restated bylaws provide that only a majority of the members of our board of directors then in office may call special meetings of stockholders and only those matters set forth in the notice of the special meeting may be considered or acted upon at a special meeting of stockholders. Our amended and restated bylaws limit the business that may be conducted at an annual meeting of stockholders to those matters properly brought before the meeting.

Advance notice requirements

Our amended and restated bylaws establish advance notice procedures with regard to stockholder proposals relating to the nomination of candidates for election as directors or new business to be brought before meetings of our stockholders. These procedures provide that notice of stockholder proposals must be timely given in writing to our corporate secretary prior to the meeting at which the action is to be taken. Generally, to be timely, notice must be received at our principal executive offices not less than 90 days nor more than 120 days prior to the first anniversary date of the annual meeting for the preceding year. Our bylaws specify the requirements as to form and content of all stockholders' notices. These requirements may preclude stockholders from bringing matters before the stockholders at an annual or special meeting.

Amendment to restated certificate of incorporation and amended and restated bylaws

Any amendment of our restated certificate of incorporation must first be approved by a majority of our board of directors, and if required by law or our restated certificate of incorporation, must thereafter be approved by a majority of the outstanding shares entitled to vote on the amendment and a majority of the outstanding shares of each class entitled to vote thereon as a class, except that the amendment of the provisions relating to stockholder action, board composition, limitation of liability and the amendment of our bylaws and certificate of incorporation must be approved by not less than two-thirds of the outstanding shares entitled to vote on the amendment, and not less than two-thirds of the outstanding shares of each class entitled to vote thereon as a class. Our amended and restated bylaws may be amended by the affirmative vote of a majority of the directors then in office, subject to any limitations set forth in the amended and restated bylaws, and may also be amended by the affirmative vote of at least two-thirds of the outstanding shares entitled to vote on the amendment, or, if our board of directors recommends that the stockholders approve the amendment, by the affirmative vote of the majority of the outstanding shares entitled to vote on the amendment, in each case voting together as a single class.

Undesignated preferred stock

Our restated certificate of incorporation provides for 10,000,000 authorized shares of preferred stock. The existence of authorized but unissued shares of preferred stock may enable our board of directors to discourage an attempt to obtain control of us by means of a merger, tender offer, proxy contest or otherwise. For example, if in the due exercise of its fiduciary obligations, our board of directors were to determine that a takeover proposal is not in the best interests of our stockholders, our board of directors could cause shares of preferred stock to be issued without stockholder approval in one or more private offerings or other transactions that might dilute the voting or other rights of the proposed acquirer or insurgent stockholder or stockholder group. In this regard, our restated certificate of incorporation grants our board of directors broad power to establish the rights and preferences of authorized and unissued shares of preferred stock. The issuance of shares of preferred stock could decrease the amount of earnings and assets available for distribution to holders of shares of common stock. The issuance may also adversely affect the rights and powers, including voting rights, of these holders and may have the effect of delaying, deterring or preventing a change in control of us.

Choice of forum

Our amended and restated bylaws that will become effective upon the closing of this offering will provide that, unless we consent in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware will be the sole and exclusive forum for any state law claim for: (1) any derivative action or proceeding brought on our behalf; (2) any action asserting a claim of breach of a fiduciary duty or other wrongdoing by any of our directors, officers, employees or

agents to us or our stockholders; (3) any action asserting a claim against us arising pursuant to any provision of the Delaware General Corporation Law or our certificate of incorporation or bylaws; (4) any action to interpret, apply, enforce or determine the validity of our certificate of incorporation or bylaws or (5) any action asserting a claim governed by the internal affairs doctrine. The choice of forum provision does not apply to any actions arising under the Securities Act or the Exchange Act.

Section 203 of the Delaware General Corporation Law

Upon the closing of this offering, we will be subject to the provisions of Section 203 of the Delaware General Corporation Law. In general, Section 203 prohibits a publicly held Delaware corporation from engaging in a "business combination" with an "interested stockholder" for a three-year period following the time that this stockholder becomes an interested stockholder, unless the business combination is approved in a prescribed manner. Under Section 203, a business combination between a corporation and an interested stockholder is prohibited unless it satisfies one of the following conditions:

- before the stockholder became interested, our board of directors approved either the business combination or the transaction which resulted in the stockholder becoming an interested stockholder;
- upon consummation of the transaction which resulted in the stockholder becoming an interested stockholder, the interested stockholder owned at least 85% of the voting stock of the corporation outstanding at the time the transaction commenced, excluding for purposes of determining the voting stock outstanding, shares owned by persons who are directors and also officers, and employee stock plans, in some instances, but not the outstanding voting stock owned by the interested stockholder; or
- at or after the time the stockholder became interested, the business combination was approved by our board of directors and authorized at an annual or special meeting of the stockholders by the affirmative vote of at least two-thirds of the outstanding voting stock which is not owned by the interested stockholder.

Section 203 defines a business combination to include:

- any merger or consolidation involving the corporation and the interested stockholder;
- any sale, transfer, lease, pledge or other disposition involving the interested stockholder of 10% or more of the assets of the corporation;
- subject to exceptions, any transaction that results in the issuance or transfer by the corporation of any stock of the corporation to the interested stockholder;
- subject to exceptions, any transaction involving the corporation that has the effect of increasing the proportionate share of the stock of any class or series of the corporation beneficially owned by the interested stockholder; and
- the receipt by the interested stockholder of the benefit of any loans, advances, guarantees, pledges or other financial benefits provided by or through the corporation.

In general, Section 203 defines an interested stockholder as any entity or person beneficially owning 15% or more of the outstanding voting stock of the corporation and any entity or person affiliated with or controlling or controlled by the entity or person.

Nasdaq Global Market listing

We have applied to list our common stock on The Nasdaq Global Market under the symbol "AXLA."

Transfer agent and registrar

The transfer agent and registrar for our common stock will be Computershare Trust company, N.A. The transfer agent and registrar's address is 250 Royall Street, Canton, Massachusetts 02021.

SHARES ELIGIBLE FOR FUTURE SALE

Prior to this offering, there has been no public market for our shares. Future sales of our common stock in the public market, or the availability of such shares for sale in the public market, could adversely affect market prices prevailing from time to time. As described below, only a limited number of shares will be available for sale shortly after this offering due to contractual and legal restrictions on resale. Nevertheless, sales of our common stock in the public market after such restrictions lapse, or the perception that those sales may occur, could adversely affect the prevailing market price at such time and our ability to raise equity capital in the future.

Based on the number of shares outstanding as of April 20, 2019, upon the completion of this offering, 22,998,513 shares of our common stock will be outstanding. Of the outstanding shares, all of the shares sold in this offering will be freely tradable, except that any shares held by our affiliates, as that term is defined in Rule 144 under the Securities Act, may only be sold in compliance with the limitations described below. All remaining shares of common stock held by existing stockholders immediately prior to the completion of this offering will be "restricted securities" as such term is defined in Rule 144. These restricted securities were issued and sold by us, or will be issued and sold by us, in private transactions and are eligible for public sale only if registered under the Securities Act or if they qualify for an exemption from registration under the Securities Act, including the exemptions provided by Rule 144 or Rule 701, summarized below.

Rule 144

In general, a person who has beneficially owned restricted stock for at least six months would be entitled to sell their securities provided that (i) such person is not deemed to have been one of our affiliates at the time of, or at any time during the 90 days preceding, a sale and (ii) we are subject to the Exchange Act, periodic reporting requirements for at least 90 days before the sale. Persons who have beneficially owned restricted shares for at least six months but who are our affiliates at the time of, or any time during the 90 days preceding, a sale, would be subject to additional restrictions, by which such person would be entitled to sell within any three-month period only a number of securities that does not exceed the greater of either of the following:

- 1% of the number of shares then outstanding, which will equal approximately 229,985 shares immediately after this offering, assuming no exercise of the underwriters' option to purchase additional shares, based on the number of shares outstanding as of April 20, 2019; or
- the average weekly trading volume of our common stock on The Nasdaq Global Market during the four calendar weeks preceding the filing of a notice on Form 144 with respect to the sale;

provided, in each case, that we are subject to the Exchange Act periodic reporting requirements for at least 90 days before the sale. Such sales both by affiliates and by non-affiliates must also comply with the manner of sale, current public information and notice provisions of Rule 144.

Rule 701

Rule 701 under the Securities Act, as in effect on the date of this prospectus, permits resales of shares in reliance upon Rule 144 but without compliance with certain restrictions of Rule 144, including the holding period requirement. Most of our employees, executive officers or directors who purchased shares under a written compensatory plan or contract may be entitled to rely on the resale provisions of Rule 701, but all holders of Rule 701 shares are required to wait until 90 days after the date of this prospectus before selling their shares.

However, substantially all Rule 701 shares are subject to lock-up agreements as described below and under "Underwriting" included elsewhere in this prospectus and will become eligible for sale upon the expiration of the restrictions set forth in those agreements.

Lock-up agreements

We, our directors and executive officers and holders of substantially all of our common stock have signed a lock-up agreement that prevent us and them from selling any of our common stock or any securities convertible into or exercisable or exchangeable for common stock for a period of not less than 180 days from the date of this prospectus without the prior written consent of the representatives of the underwriters, subject to certain exceptions. See the section entitled "Underwriting" appearing elsewhere in this prospectus for more information.

Registration rights

Upon the closing of this offering, certain holders of our securities will be entitled to various rights with respect to registration of their shares under the Securities Act. Registration of these shares under the Securities Act would result in these shares becoming fully tradable without restriction under the Securities Act immediately upon the effectiveness of the registration. See the section entitled "Description of Capital Stock—Registration rights" appearing elsewhere in this prospectus for more information.

Equity incentive plans

We intend to file one or more registration statements on Form S-8 under the Securities Act to register our shares issued or reserved for issuance under our equity incentive plans. The first such registration statement is expected to be filed soon after the date of this prospectus and will automatically become effective upon filing with the SEC. Accordingly, shares registered under such registration statement will be available for sale in the open market, unless such shares are subject to vesting restrictions with us or the lock-up restrictions described above. As of April 20, 2019, we estimate that such registration statement on Form S-8 will cover approximately 10,930,069 shares.

CERTAIN MATERIAL U.S. FEDERAL INCOME AND ESTATE TAX CONSIDERATIONS FOR NON-U.S. HOLDERS

The following discussion is a summary of the material U.S. federal income tax considerations applicable to non-U.S. holders (as defined below) with respect to their ownership and disposition of shares of our common stock issued pursuant to this offering. For purposes of this discussion, a non-U.S. holder means a beneficial owner of our common stock that is for U.S. federal income tax purposes:

- a non-resident alien individual;
- a foreign corporation or any other foreign organization taxable as a corporation for U.S. federal income tax purposes; or
- a foreign estate or trust, the income of which is not subject to U.S. federal income tax on a net income basis.

This discussion does not address the tax treatment of partnerships or other entities that are pass-through entities for U.S. federal income tax purposes or persons that hold their common stock through partnerships or other pass-through entities. A partner in a partnership or other pass-through entity that will hold our common stock should consult his, her or its tax advisor regarding the tax consequences of acquiring, holding and disposing of our common stock through a partnership or other pass-through entity, as applicable.

This discussion is based on current provisions of the Code, existing and proposed U.S. Treasury Regulations promulgated thereunder, current administrative rulings and judicial decisions, all as in effect as of the date of this prospectus and, all of which are subject to change or to differing interpretation, possibly with retroactive effect. Any such change or differing interpretation could alter the tax consequences to non-U.S. holders described in this prospectus. There can be no assurance that the Internal Revenue Service, which we refer to as the IRS, will not challenge one or more of the tax consequences described herein. We assume in this discussion that a non-U.S. holder holds shares of our common stock as a capital asset within the meaning of Section 1221 of the Code, generally property held for investment.

This discussion does not address all aspects of U.S. federal income taxation that may be relevant to a particular non-U.S. holder in light of that non-U.S. holder's individual circumstances including the alternative minimum tax, or the Medicare tax on net investment income and any election to apply Section 1400Z-2 of the Code to gains recognized with respect to shares of our common stock. This discussion also does not address any U.S. state, local or non-U.S. taxes or any other aspect of any U.S. federal tax other than the income tax. This discussion also does not consider any specific facts or circumstances that may apply to a non-U.S. holder and does not address the special tax rules applicable to particular non-U.S. holders, such as:

- insurance companies;
- tax-exempt or governmental organizations;
- financial institutions;
- brokers or dealers in securities;
- regulated investment companies;
- pension plans;
- "controlled foreign corporations," "passive foreign investment companies," and corporations that accumulate earnings to avoid U.S. federal income tax;

- "qualified foreign pension funds," or entities wholly owned by a "qualified foreign pension fund";
- partnerships or other entities or arrangements treated as partnerships for U.S. federal income tax purposes (and partners and investors therein);
- persons deemed to sell our common stock under the constructive sale provisions of the Code;
- persons that hold our common stock as part of a straddle, hedge, conversion transaction, synthetic security or other integrated investment;
- persons who have elected to mark securities to market;
- persons who have a functional currency other than the U.S. dollar;
- persons who hold or receive our common stock pursuant to the exercise of any employee stock option or otherwise as compensation;
- persons for whom our stock constitutes "qualified small business stock" within the meaning of Section 1202 of the Code;
- certain U.S. expatriates; and
- persons subject to special tax accounting rules as a result of any item of gross income with respect to the common stock being taken into account in an applicable financial statement under Section 451(b) of the Code.

This discussion is for general information only and is not tax advice. Accordingly, all prospective non-U.S. holders of our common stock should consult their tax advisors with respect to the U.S. federal, state, local and non-U.S. tax consequences of the purchase, ownership and disposition of our common stock.

Distributions on our common stock

Distributions, if any, on our common stock will constitute dividends for U.S. federal income tax purposes to the extent paid from our current or accumulated earnings and profits, as determined under U.S. federal income tax principles. If a distribution exceeds our current and accumulated earnings and profits, the excess will be treated as a tax-free return of the non-U.S. holder's investment, up to such holder's tax basis in the common stock. Any remaining excess will be treated as capital gain, subject to the tax treatment described below in "Gain on sale or other taxable disposition of our common stock." Any such distributions will also be subject to the discussions below under the sections titled "Backup withholding and information reporting" and "Withholding and information reporting requirements—FATCA."

Subject to the discussion in the following two paragraphs in this section, dividends paid to a non-U.S. holder generally will be subject to withholding of U.S. federal income tax at a 30% rate or such lower rate as may be specified by an applicable income tax treaty between the United States and such holder's country of residence. If we or another withholding agent apply over-withholding or if a non-U.S. holder does not timely provide us with the required certification, the non-U.S. holder may be entitled to a refund or credit of any excess tax withheld by timely filing an appropriate claim with the IRS.

Dividends that are treated as effectively connected with a trade or business conducted by a non-U.S. holder within the United States and, if an applicable income tax treaty so provides, that are attributable to a permanent establishment or a fixed base maintained by the non-U.S. holder within the United States, are generally exempt from the 30% withholding tax if the non-U.S. holder

satisfies applicable certification and disclosure requirements. However, such U.S. effectively connected income, net of specified deductions and credits, is taxed at the same graduated U.S. federal income tax rates applicable to U.S. persons (as defined in the Code). Any U.S. effectively connected income received by a non-U.S. holder that is a corporation may also, under certain circumstances, be subject to an additional "branch profits tax" at a 30% rate or such lower rate as may be specified by an applicable income tax treaty between the United States and such holder's country of residence.

A non-U.S. holder of our common stock who claims the benefit of an applicable income tax treaty between the United States and such holder's country of residence generally will be required to provide a properly executed IRS Form W-8BEN or W-8BEN-E (or successor form) to the applicable withholding agent and satisfy applicable certification and other requirements. Non-U.S. holders are urged to consult their tax advisors regarding their entitlement to benefits under a relevant income tax treaty. A non-U.S. holder that is eligible for a reduced rate of U.S. withholding tax under an income tax treaty may obtain a refund or credit of any excess amounts withheld by timely filing a U.S. tax return with the IRS.

Gain on sale or other taxable disposition of our common stock

Subject to the discussions below under "Backup withholding and information reporting" and "Withholding and information reporting requirements—FATCA," a non-U.S. holder generally will not be subject to any U.S. federal income tax on any gain realized upon such holder's sale or other taxable disposition of shares of our common stock unless:

- the gain is effectively connected with the non-U.S. holder's conduct of a U.S. trade or business and, if an applicable income tax treaty so provides, is attributable to a permanent establishment or a fixed-base maintained by such non-U.S. holder in the United States, in which case the non-U.S. holder generally will be taxed on a net income basis at the graduated U.S. federal income tax rates applicable to United States persons (as defined in the Code) and, if the non-U.S. holder is a foreign corporation, the branch profits tax described above in "Distributions on Our Common Stock" also may apply;
- the non-U.S. holder is a nonresident alien individual who is present in the United States for 183 days or more in the taxable year of the disposition and certain other conditions are met, in which case the non-U.S. holder will be subject to a 30% tax (or such lower rate as may be specified by an applicable income tax treaty between the United States and such holder's country of residence) on the net gain derived from the disposition, which may be offset by certain U.S. source capital losses of the non-U.S. holder, if any (even though the individual is not considered a resident of the United States), provided that the non-U.S. holder has timely filed U.S. federal income tax returns with respect to such losses; or
- we are, or have been, at any time during the five-year period preceding such sale or other taxable disposition (or the non-U.S. holder's holding period, if shorter) a "U.S. real property holding corporation," unless our common stock is regularly traded on an established securities market and the non-U.S. holder holds no more than 5% of our outstanding common stock, directly or indirectly, actually or constructively, during the shorter of the 5-year period ending on the date of the disposition or the period that the non-U.S. holder held our common stock. Generally, a corporation is a U.S. real property holding corporation only if the fair market value of its U.S. real property interests equals or exceeds 50% of the sum of the fair market value of its worldwide real property interests plus its other assets used or held for use in a trade or business. Although there can be no assurance, we do not believe that we are, or have been, a U.S. real property holding corporation, or that we are likely to become one in the future. No assurance can be provided that our common stock will be regularly traded on an established securities market for purposes of the rules described above.

Backup withholding and information reporting

We must report annually to the IRS and to each non-U.S. holder the gross amount of the distributions on our common stock paid to such holder and the tax withheld, if any, with respect to such distributions. Non-U.S. holders may have to comply with specific certification procedures to establish that the holder is not a U.S. person (as defined in the Code) in order to avoid backup withholding at the applicable rate with respect to dividends on our common stock. Dividends paid to non-U.S. holders subject to withholding of U.S. federal income tax, as described above in "Distributions on Our Common Stock," generally will be exempt from U.S. backup withholding.

Information reporting and backup withholding will generally apply to the proceeds of a disposition of our common stock by a non-U.S. holder effected by or through the U.S. office of any broker, U.S. or foreign, unless the holder certifies its status as a non-U.S. holder and satisfies certain other requirements, or otherwise establishes an exemption. Generally, information reporting and backup withholding will not apply to a payment of disposition proceeds to a non-U.S. holder where the transaction is effected outside the United States through a non-U.S. office of a broker. However, for information reporting purposes, dispositions effected through a non-U.S. office of a broker with substantial U.S. ownership or operations generally will be treated in a manner similar to dispositions effected through a U.S. office of a broker. Non-U.S. holders should consult their tax advisors regarding the application of the information reporting and backup withholding rules to them. Copies of information returns may be made available to the tax authorities of the country in which the non-U.S. holder resides or is incorporated under the provisions of a specific treaty or agreement. Backup withholding is not an additional tax. Any amounts withheld under the backup withholding rules from a payment to a non-U.S. holder can be refunded or credited against the non-U.S. holder's U.S. federal income tax liability, if any, provided that an appropriate claim is filed with the IRS in a timely manner.

Withholding and information reporting requirements — FATCA

Provisions of the Code commonly referred to as the Foreign Account Tax Compliance Act, or FATCA, generally imposes a U.S. federal withholding tax at a rate of 30% on payments of dividends on, or gross proceeds from the sale or other disposition of, our common stock paid to a foreign entity unless (i) if the foreign entity is a "foreign financial institution," such foreign entity undertakes certain due diligence, reporting, withholding, and certification obligations, (ii) if the foreign entity is not a "foreign financial institution," such foreign entity identifies certain of its U.S. investors, if any, or (iii) the foreign entity is otherwise exempt under FATCA. Under applicable U.S. Treasury regulations, withholding under FATCA currently applies to payments of dividends on our common stock. Currently proposed U.S. Treasury Regulations provide that FATCA withholding does not apply to gross proceeds from the disposition of property of a type that can produce U.S. source dividends or interest; however, prior versions of the rules would have made such gross proceeds subject to FATCA withholding. Taxpayers (including withholding agents) can currently rely on the proposed Treasury Regulations. Under certain circumstances, a non-U.S. holder may be eligible for refunds or credits of this withholding tax. An intergovernmental agreement between the United States and an applicable foreign country may modify the requirements described in this paragraph. Non-U.S. holders should consult their tax advisors regarding the possible implications of this legislation on their investment in our common stock and the entities through which they hold our common stock, including, without limitation, the process and deadlines for meeting the applicable requirements to prevent the imposition of the 30% withholding tax under FATCA.

UNDERWRITING

The company and the underwriters named below have entered into an underwriting agreement with respect to the shares being offered. Subject to certain conditions, each underwriter has severally agreed to purchase the number of shares indicated in the following table. Goldman Sachs & Co. LLC, J.P. Morgan Securities LLC and SVB Leerink LLC are the representatives of the underwriters.

<u>Underwriters</u>	<u>Number of Shares</u>
Goldman Sachs & Co. LLC	
J.P. Morgan Securities LLC	
SVB Leerink LLC	
Total	<u><u>3,571,428</u></u>

The underwriters are committed to take and pay for all of the shares being offered, if any are taken, other than the shares covered by the option described below unless and until this option is exercised.

The underwriters have an option to buy up to an additional 535,714 shares from the company to cover sales by the underwriters of a greater number of shares than the total number set forth in the table above. They may exercise that option for 30 days. If any shares are purchased pursuant to this option, the underwriters will severally purchase shares in approximately the same proportion as set forth in the table above.

The following table shows the per share and total underwriting discounts and commissions to be paid to the underwriters by the company. Such amounts are shown assuming both no exercise and full exercise of the underwriters' option to purchase additional shares.

<u>Paid by the Company</u>	<u>No Exercise</u>	<u>Full Exercise</u>
Per Share	\$	\$
Total	\$	\$

Shares sold by the underwriters to the public will initially be offered at the initial public offering price set forth on the cover of this prospectus. Any shares sold by the underwriters to securities dealers may be sold at a discount of up to \$ per share from the initial public offering price. After the initial offering of the shares, the representatives may change the offering price and the other selling terms. The offering of the shares by the underwriters is subject to receipt and acceptance and subject to the underwriters' right to reject any order in whole or in part.

The Company has agreed that, subject to certain limited exceptions, it will not: (1) offer, pledge, sell, contract to sell, any option or contract to purchase, purchase any option or contract to sell, grant any option, right or warrant to purchase or otherwise transfer or dispose of, directly or indirectly, or file with, or submit to, the SEC a registration statement under the Securities Act relating to, any shares of our common stock or securities convertible into or exchangeable or exercisable for any shares of our common stock, or publicly disclose the intention to make any offer, sale, pledge, disposition, submission or filing, or (2) enter into any swap or other arrangement that transfers all or a portion of the economic consequences associated with the ownership of any shares of common stock or any such other securities (in either case, regardless of whether any of these transactions are to be settled by the delivery of shares of common stock or such other securities, in cash or otherwise), in each case without the prior written consent of the representatives for a period of 180 days after the date of this prospectus.

The directors and executive officers of the company and its significant shareholders have entered into lock-up agreements with the underwriters prior to the commencement of this offering

pursuant to which each of these persons or entities, subject to certain limited exceptions, for a period of 180 days after the date of this prospectus, may not, without the prior written consent of the representatives: (1) offer, pledge, sell, contract to sell, sell any option or contract to purchase, purchase any option or contract to sell, grant any option, right or warrant to purchase, or otherwise transfer or dispose of, directly or indirectly, any shares of our common stock or any securities convertible into or exercisable or exchangeable for our common stock (including, without limitation, common stock or such other securities which may be deemed to be beneficially owned by such directors, executive officers, managers and members in accordance with the rules and regulations of the Securities and Exchange Commission and securities which may be issued upon exercise of a stock option or warrant); or (2) enter into any swap or other agreement that transfers, in whole or in part, any of the economic consequences of ownership of the common stock or such other securities, whether any such transaction described in clause (1) or (2) above is to be settled by delivery of common stock or such other securities, in cash or otherwise; or (3) make any demand for or exercise any right with respect to the registration of any shares of our common stock or any security convertible into or exercisable or exchangeable for our common stock.

Prior to the offering, there has been no public market for the shares. The initial public offering price has been negotiated among the company and the representatives. Among the factors to be considered in determining the initial public offering price of the shares, in addition to prevailing market conditions, will be the company's historical performance, estimates of the business potential and earnings prospects of the company, an assessment of the company's management and the consideration of the above factors in relation to market valuation of companies in related businesses.

We have applied to quote the common stock on The Nasdaq Global Market under the symbol "AXLA."

In connection with the offering, the underwriters may purchase and sell shares of common stock in the open market. These transactions may include short sales, stabilizing transactions and purchases to cover positions created by short sales. Short sales involve the sale by the underwriters of a greater number of shares than they are required to purchase in the offering, and a short position represents the amount of such sales that have not been covered by subsequent purchases. A "covered short position" is a short position that is not greater than the amount of additional shares for which the underwriters' option described above may be exercised. The underwriters may cover any covered short position by either exercising their option to purchase additional shares or purchasing shares in the open market. In determining the source of shares to cover the covered short position, the underwriters will consider, among other things, the price of shares available for purchase in the open market as compared to the price at which they may purchase additional shares pursuant to the option described above. "Naked" short sales are any short sales that create a short position greater than the amount of additional shares for which the option described above may be exercised. The underwriters must cover any such naked short position by purchasing shares in the open market. A naked short position is more likely to be created if the underwriters are concerned that there may be downward pressure on the price of the common stock in the open market after pricing that could adversely affect investors who purchase in the offering. Stabilizing transactions consist of various bids for or purchases of common stock made by the underwriters in the open market prior to the completion of the offering.

The underwriters may also impose a penalty bid. This occurs when a particular underwriter repays to the underwriters a portion of the underwriting discount received by it because the representatives have repurchased shares sold by or for the account of such underwriter in stabilizing or short covering transactions.

Purchases to cover a short position and stabilizing transactions, as well as other purchases by the underwriters for their own accounts, may have the effect of preventing or retarding a decline in

the market price of the company's stock, and together with the imposition of the penalty bid, may stabilize, maintain or otherwise affect the market price of the common stock. As a result, the price of the common stock may be higher than the price that otherwise might exist in the open market. The underwriters are not required to engage in these activities and may end any of these activities at any time. These transactions may be effected on The Nasdaq Global Market, in the over-the-counter market or otherwise.

The company estimates that its share of the total expenses of the offering, excluding underwriting discounts and commissions, will be approximately \$1.9 million. The company has agreed to reimburse the underwriters for certain of their expenses in an amount up to \$50,000.

The company has agreed to indemnify the several underwriters against certain liabilities, including liabilities under the Securities Act of 1933.

The underwriters and their respective affiliates are full service financial institutions engaged in various activities, which may include sales and trading, commercial and investment banking, advisory, investment management, investment research, principal investment, hedging, market making, brokerage and other financial and non-financial activities and services. Certain of the underwriters and their respective affiliates have provided, and may in the future provide, a variety of these services to the issuer and to persons and entities with relationships with the issuer, for which they received or will receive customary fees and expenses.

In the ordinary course of their various business activities, the underwriters and their respective affiliates, officers, directors and employees may purchase, sell or hold a broad array of investments and actively trade securities, derivatives, loans, commodities, currencies, credit default swaps and other financial instruments for their own account and for the accounts of their customers, and such investment and trading activities may involve or relate to assets, securities or instruments of the issuer (directly, as collateral securing other obligations or otherwise) or persons and entities with relationships with the issuer. The underwriters and their respective affiliates may also communicate independent investment recommendations, market color or trading ideas and/or publish or express independent research views in respect of such assets, securities or instruments and may at any time hold, or recommend to clients that they should acquire, long and/or short positions in such assets, securities and instruments.

European Economic Area

In relation to each Member State of the EEA which has implemented the Prospectus Directive (each, a "Relative Member State") an offer to the public of shares of our common stock may not be made in that Relevant Member State, except that an offer to the public in that Relevant Member State of shares of our common stock may be made at any time under the following exemptions under the Prospectus Directive:

- To any legal entity which is a qualified investor as defined in the Prospectus Directive;
- To fewer than 150 natural or legal persons (other than qualified investors as defined in the Prospectus Directive), subject to obtaining the prior consent of the Representatives for any such offer; or
- In any other circumstances falling within Article 3(2) of the Prospectus Directive;

provided that no such offer or shares of our common stock shall result in a requirement for the publication by us or any Brazilian placement agent of a prospectus pursuant to Article 3 of the Prospectus Directive.

For the purposes of this provision, the expression an "offer to public" in relation to shares of our common stock in any Relevant Member State means the communication in any form and by any means of sufficient information on the terms of the offer and shares of our common stock to be offered so as to enable an investor to decide to purchase shares of our common stock, as the

same may be varied in that Member State by any measure implementing the Prospectus Directive in that Member State, the expression "Prospectus Directive" means Directive 2003/71/EC (as amended), including by Directive 2010/73/EU and includes any relevant implementing measure in the Relevant Member State.

This EEA selling restriction is in addition to any other selling restrictions set out below.

United Kingdom

In the United Kingdom, this prospectus is only addressed to and directed as qualified investors who are (i) investment professionals falling within Article 19(5) of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005 (the Order); or (ii) high net worth entities and other persons to whom it may lawfully be communicated, falling within Article 49(2)(a) to (d) of the Order (all such persons together being referred to as "relevant persons"). Any investment or investment activity to which this prospectus relates is available only to relevant persons and will only be engaged with relevant persons. Any person who is not a relevant person should not act or rely on this prospectus or any of its contents.

Canada

The shares may be sold in Canada only to purchasers purchasing, or deemed to be purchasing, as principal that are accredited investors, as defined in National Instrument 45-106 Prospectus Exemptions or subsection 73.3(1) of the Securities Act (Ontario), and are permitted clients, as defined in National Instrument 31-103 Registration Requirements, Exemptions, and Ongoing Registrant Obligations. Any resale of the shares must be made in accordance with an exemption form, or in a transaction not subject to, the prospectus requirements of applicable securities laws.

Securities legislation in certain provinces or territories of Canada may provide a purchaser with remedies for rescission or damages if this offering memorandum (including any amendment thereto) contains a misrepresentation, provided that the remedies for rescission or damages are exercised by the purchaser within the time limit prescribed by the securities legislation of the purchaser's province or territory. The purchaser should refer to any applicable provisions of the securities legislation of the purchaser's province or territory of these rights or consult with a legal advisor.

Pursuant to section 3A.3 of National Instrument 33-105 Underwriting Conflicts (NI 33-105), the underwriters are not required to comply with the disclosure requirements of NI 33-105 regarding underwriter conflicts of interest in connection with this offering.

Hong Kong

The shares may not be offered or sold in Hong Kong by means of any document other than (i) in circumstances which do not constitute an offer to the public within the meaning of the Companies (Winding Up and Miscellaneous Provisions) Ordinance (Cap. 32 of the Laws of Hong Kong) ("Companies (Winding Up and Miscellaneous Provisions) Ordinance") or which do not constitute an invitation to the public within the meaning of the Securities and Futures Ordinance (Cap. 571 of the Laws of Hong Kong) ("Securities and Futures Ordinance"), or (ii) to "professional investors" as defined in the Securities and Futures Ordinance and any rules made thereunder, or (iii) in other circumstances which do not result in the document being a "prospectus" as defined in the Companies (Winding Up and Miscellaneous Provisions) Ordinance, and no advertisement, invitation or document relating to the shares may be issued or may be in the possession of any person for the purpose of issue (in each case whether in Hong Kong or elsewhere), which is directed at, or the contents of which are likely to be accessed or read by, the public in Hong Kong (except if permitted to do so under the securities laws of Hong Kong) other than with respect to

shares which are or are intended to be disposed of only to persons outside Hong Kong or only to "professional investors" in Hong Kong as defined in the Securities and Futures Ordinance and any rules made thereunder.

Singapore

This prospectus has not been registered as a prospectus with the Monetary Authority of Singapore. Accordingly, this prospectus and any other document or material in connection with the offer or sale, or invitation for subscription or purchase, of the shares may not be circulated or distributed, nor may the shares be offered or sold, or be made the subject of an invitation for subscription or purchase, whether directly or indirectly, to persons in Singapore other than (i) to an institutional investor (as defined under Section 4A of the Securities and Futures Act, Chapter 289 of Singapore (the "SFA")) under Section 274 of the SFA, (ii) to a relevant person (as defined in Section 275(2) of the SFA) pursuant to Section 275(1) of the SFA, or any person pursuant to Section 275(1A) of the SFA, and in accordance with the conditions specified in Section 275 of the SFA or (iii) otherwise pursuant to, and in accordance with the conditions of, any other applicable provision of the SFA, in each case subject to conditions set forth in the SFA.

Where the shares are subscribed or purchased under Section 275 of the SFA by a relevant person which is a corporation (which is not an accredited investor (as defined in Section 4A of the SFA)) the sole business of which is to hold investments and the entire share capital of which is owned by one or more individuals, each of whom is an accredited investor, the securities (as defined in Section 239(1) of the SFA) of that corporation shall not be transferable for 6 months after that corporation has acquired the shares under Section 275 of the SFA except: (1) to an institutional investor under Section 274 of the SFA or to a relevant person (as defined in Section 275(2) of the SFA), (2) where such transfer arises from an offer in that corporation's securities pursuant to Section 275(1A) of the SFA, (3) where no consideration is or will be given for the transfer, (4) where the transfer is by operation of law, (5) as specified in Section 276(7) of the SFA, or (6) as specified in Regulation 32 of the Securities and Futures (Offers of Investments) (Shares and Debentures) Regulations 2005 of Singapore ("Regulation 32").

Where the shares are subscribed or purchased under Section 275 of the SFA by a relevant person which is a trust (where the trustee is not an accredited investor (as defined in Section 4A of the SFA)) whose sole purpose is to hold investments and each beneficiary of the trust is an accredited investor, the beneficiaries' rights and interest (howsoever described) in that trust shall not be transferable for 6 months after that trust has acquired the shares under Section 275 of the SFA except: (1) to an institutional investor under Section 274 of the SFA or to a relevant person (as defined in Section 275(2) of the SFA), (2) where such transfer arises from an offer that is made on terms that such rights or interest are acquired at a consideration of not less than S\$200,000 (or its equivalent in a foreign currency) for each transaction (whether such amount is to be paid for in cash or by exchange of securities or other assets), (3) where no consideration is or will be given for the transfer, (4) where the transfer is by operation of law, (5) as specified in Section 276(7) of the SFA, or (6) as specified in Regulation 32.

Japan

The shares have not been and will not be registered under the Financial Instruments and Exchange Act of Japan (Act No. 25 of 1948, as amended), or the FIEA. The shares may not be offered or sold, directly or indirectly, in Japan or to or for the benefit of any resident of Japan (including any person resident in Japan or any corporation or other entity organized under the laws of Japan) or to others for reoffering or resale, directly or indirectly, in Japan or to or for the benefit of any resident of Japan, except pursuant to an exemption from the registration requirements of the FIEA and otherwise in compliance with any relevant laws and regulations of Japan.

LEGAL MATTERS

The validity of the shares of common stock offered by this prospectus will be passed upon for us by Goodwin Procter LLP, Boston, Massachusetts. Certain legal matters related to this offering will be passed upon for the underwriters by Latham & Watkins LLP.

EXPERTS

The consolidated financial statements included in this prospectus have been audited by Deloitte & Touche LLP, an independent registered public accounting firm, as stated in their report appearing herein. Such consolidated financial statements have been so included in reliance upon the report of such firm given upon their authority as experts in accounting and auditing.

WHERE YOU CAN FIND MORE INFORMATION

We have filed with the SEC a registration statement on Form S-1 (File Number 333-230822) under the Securities Act with respect to the common stock we are offering by this prospectus. This prospectus does not contain all of the information included in the registration statement. For further information pertaining to us and our common stock, you should refer to the registration statement and to its exhibits. Whenever we make reference in this prospectus to any of our contracts, agreements or other documents, the references are not necessarily complete, and you should refer to the exhibits attached to the registration statement for copies of the actual contract, agreement or other document.

Upon the closing of the offering, we will be subject to the informational requirements of the Exchange Act and will file annual, quarterly and current reports, proxy statements and other information with the SEC. You can read our SEC filings, including the registration statement, at the SEC's website at www.sec.gov. We also maintain a website at <https://www.axcellahealth.com/>. Upon completion of the offering, you may access, free of charge, our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and amendment to those reports filed or furnished pursuant to Section 13(a) or 15(d) of the Exchange Act as soon as reasonably practicable after such material is electronically filed with, or furnished to, the SEC.

AXCELLA HEALTH INC. AND SUBSIDIARIES

INDEX TO THE CONSOLIDATED FINANCIAL STATEMENTS

Report of Independent Registered Public Accounting Firm	F-2
Consolidated Balance Sheets	F-3
Consolidated Statements of Operations	F-4
Consolidated Statements of Redeemable Convertible Preferred Stock and Stockholders' Equity (Deficit)	F-5
Consolidated Statements of Cash Flows	F-6
Notes to Consolidated Financial Statements	F-7

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the stockholders and Board of Directors of Axcella Health Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheet of Axcella Health Inc. and subsidiaries (the "Company") as of December 31, 2017 and 2018, and the related consolidated statements of operations, redeemable convertible preferred stock and stockholders' equity (deficit), and cash flows for the years then ended and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2017 and 2018, and the results of its operations and its cash flows for the years then ended, in conformity with accounting principles generally accepted in the United States of America.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulation of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB and in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits, we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion.

Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Deloitte & Touche LLP

Boston, Massachusetts

March 15, 2019 (April 29, 2019 as to the effects of the reverse stock split described in Note 13)

We have served as the Company's auditor since 2012.

Axcella Health Inc.

Consolidated Balance Sheets

(in thousands, except share and per share data)

	December 31,		Pro Forma December 31,
	2017	2018	2018
			(Unaudited)
Assets			
Current assets:			
Cash and cash equivalents	\$ 46,817	\$ 79,466	\$ 79,466
Prepaid expenses and other current assets	255	835	835
Total current assets	47,072	80,301	80,301
Property and equipment, net	1,525	1,076	1,076
Security deposits and other assets	216	216	216
Deferred offering costs	—	251	251
Total assets	<u>\$ 48,813</u>	<u>\$ 81,844</u>	<u>\$ 81,844</u>
Liabilities, Redeemable Convertible Preferred Stock and Stockholders' Equity (Deficit)			
Current liabilities:			
Accounts payable	\$ 1,019	\$ 1,612	\$ 1,612
Accrued expenses	4,076	5,299	5,299
Total current liabilities	5,095	6,911	6,911
Long term debt, net of discount	19,557	24,521	24,521
Other liabilities	1,276	1,898	1,898
Preferred stock warrant liability	411	425	—
Total liabilities	26,339	33,755	33,330
Commitments and contingencies (Note 9)	—	—	—
Redeemable convertible preferred stock (Note 7)	138,828	197,842	—
Stockholders' equity (deficit):			
Common stock, \$0.001 par value; 45,000,000 and 47,000,000 shares authorized, 5,274,926 and 5,193,915 shares issued and 4,855,945 and 4,774,934 shares outstanding at December 31, 2017 and 2018, respectively, actual; 47,000,000 shares authorized, 19,835,912 shares issued and 19,416,931 shares outstanding, pro forma as of December 31, 2018 (unaudited)	5	6	19
Additional paid-in-capital	4,621	7,290	205,544
Treasury stock, 418,981 shares at cost	—	—	—
Accumulated deficit	(120,980)	(157,049)	(157,049)
Total stockholders' equity (deficit)	(116,354)	(149,753)	48,514
Total liabilities, redeemable convertible preferred stock and stockholders' equity (deficit)	<u>\$ 48,813</u>	<u>\$ 81,844</u>	<u>\$ 81,844</u>

The accompanying notes are an integral part of these consolidated financial statements

Axcella Health Inc.

Consolidated Statements of Operations

(in thousands, except share and per share data)

	December 31,	
	2017	2018
Operating expenses:		
Research and development	\$ 22,916	\$ 25,486
General and administrative	6,005	8,410
Total operating expenses	<u>28,921</u>	<u>33,896</u>
Loss from operations	(28,921)	(33,896)
Other income (expense):		
Change in fair value of preferred stock warrant liability	81	(14)
Interest income (expense), net	(2,100)	(2,159)
Total other income (expense), net	<u>(2,019)</u>	<u>(2,173)</u>
Net loss	\$ (30,940)	\$ (36,069)
Net loss per share, basic and diluted	\$ (7.37)	\$ (7.97)
Weighted average common shares outstanding, basic and diluted	<u>4,211,918</u>	<u>4,546,373</u>
Pro forma net loss per share, basic and diluted (unaudited)		\$ (2.19)
Pro forma weighted average common shares outstanding, basic and diluted (unaudited)		<u>16,528,448</u>

The accompanying notes are an integral part of these consolidated financial statements

Axcella Health Inc.

**Consolidated Statements of Redeemable Convertible Preferred Stock and
Stockholders' Equity (Deficit)**

(in thousands, except share data)

	Redeemable convertible preferred stock		Common stock		Additional paid-in capital	Treasury stock		Accumulated deficit	Total stockholders' equity (deficit)
	Shares	Amount	Shares	Par Value		Shares	Amount		
BALANCE — January 1, 2017	18,976,824	\$ 113,040	4,624,196	\$ 5	\$ 3,466	418,981	\$ —	\$ (90,040)	\$ (86,569)
Issuance of Series C redeemable convertible preferred stock (net of issuance costs of \$259)	2,572,420	25,671							—
Exercise of common stock options			23,882		26				26
Accretion of preferred stock to redemption value		117			(117)				(117)
Stock-based compensation					1,246				1,246
Net loss								(30,940)	(30,940)
BALANCE — December 31, 2017	21,549,244	138,828	4,648,078	5	4,621	418,981	—	(120,980)	(116,354)
Issuance of Series E redeemable convertible preferred stock (net of issuance costs of \$139)	5,282,002	58,861							—
Exercise of common stock options			545,837	1	44				45
Accretion of preferred stock to redemption value		153			(153)				(153)
Stock-based compensation					2,778				2,778
Net loss								(36,069)	(36,069)
BALANCE — December 31, 2018	26,831,246	\$ 197,842	5,193,915	\$ 6	\$ 7,290	418,981	\$ —	\$ (157,049)	\$ (149,753)

The accompanying notes are an integral part of these consolidated financial statements

Axcella Health Inc.

Consolidated Statements of Cash Flows

(in thousands)

	Year Ended December 31,	
	2017	2018
Cash flows from operating activities:		
Net loss	\$ (30,940)	\$ (36,069)
Adjustment to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization	1,389	1,071
Stock-based compensation expense	1,246	2,778
Change in fair value of preferred stock warrant liability	(81)	14
Non-cash interest expense	509	529
Gain on sale of property and equipment	(175)	(36)
Changes in current assets and liabilities:		
Prepaid expenses and other current assets	132	(580)
Accounts payable	40	595
Accrued expense	1,019	986
Net cash used in operating activities	(26,861)	(30,712)
Cash flows from investing activities:		
Purchases of property and equipment	(1,090)	(659)
Proceeds from the sale of property and equipment	175	73
Net cash used in investing activities	(915)	(586)
Cash flows from financing activities:		
Payment of deferred offering costs	—	(14)
Proceeds from issuance of long term debt	—	6,000
Payment of debt issuance costs	—	(945)
Proceeds from issuance of redeemable convertible preferred stock, net of issuance costs	25,671	58,861
Proceeds from exercise of common stock options	26	45
Net cash provided by financing activities	25,697	63,947
Net increase (decrease) in cash and cash equivalents	(2,079)	32,649
Cash and cash equivalents, beginning of year	48,896	46,817
Cash and cash equivalents, end of year	\$ 46,817	\$ 79,466
Supplemental cash flow information:		
Cash paid during the year for interest	\$ 2,002	\$ 2,255
Deferred offering costs included in accounts payable and accrued expenses	\$ —	\$ 237

The accompanying notes are an integral part of these consolidated financial statements

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

1. NATURE OF BUSINESS

Axcella Health Inc. and subsidiaries (the "Company" or "we") is a biotechnology company that was incorporated in Delaware on August 27, 2008 and has a principal place of business in Cambridge, Massachusetts. The Company is a biotechnology company pioneering the research and development of novel multifactorial interventions to support health and address dysregulated metabolism across a broad spectrum of consumers and patients who have limited options.

The Company is subject to risks common to companies in the biotechnology industry, including, but not limited to, successful development of technology, obtaining additional funding, protection of proprietary technology, compliance with government regulations, risks of failure of preclinical studies, clinical studies and clinical trials, the need to obtain marketing approval for its product candidates and successfully market consumer products, fluctuations in operating results, economic pressure impacting therapeutic pricing, dependence on key personnel, risks associated with changes in technologies, development by competitors of technological innovations and the ability to scale manufacturing to large scale production. Product candidates currently under development will require significant additional research and development efforts, including clinical testing and regulatory approval prior to commercialization. These efforts require significant amounts of additional capital, adequate personnel and infrastructure and extensive compliance-reporting capabilities. Even if the Company's development efforts are successful, it is uncertain when, if ever, the Company will realize significant revenue from product sales.

The accompanying consolidated financial statements have been prepared on a going concern basis, which contemplates the realization of assets and the satisfaction of liabilities and commitments in the ordinary course of business. The Company has funded its operations with proceeds from sales of preferred stock and borrowings under a loan and security agreement. Since its inception, the Company has incurred recurring losses, including net losses of \$30.9 million and \$36.1 million for the years ended December 31, 2017 and 2018, respectively. As of December 31, 2018, the Company had an accumulated deficit of \$157.0 million. The Company expects to continue to generate operating losses in the foreseeable future. The Company expects that its cash and cash equivalents as of December 31, 2018 will be sufficient to fund its operations for at least the next twelve months from the date of the issuance of the financial statements.

The Company is seeking to complete an initial public offering ("IPO") of its common stock. Upon completion of a qualified public offering on specified terms, the Company's outstanding convertible preferred stock will automatically convert into shares of common stock (see Note 7). In the event the Company does not complete an IPO, the Company expects to seek additional funding through private equity financings, debt financings, strategic alliances and marketing, distribution, or licensing arrangements. The Company may not be able to obtain financing on acceptable terms, or at all, and may not be able to enter into collaborations or other arrangements. The terms of any financing may adversely affect the holdings or the rights of the Company's stockholders. If the Company is unable to secure funding, it could be forced to delay, reduce, or eliminate some or all of its research development programs, product portfolio expansion or commercialization efforts, which could adversely affect its business prospects. Although management continues to pursue these plans, there is no assurance that the Company will be successful in obtaining sufficient funding on terms acceptable to the Company to fund continuing operations, if at all.

AXCELLA HEALTH INC.**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)****2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES*****Basis of Presentation and Principles of Consolidation***

The Company's consolidated financial statements have been prepared in conformity with accounting principles generally accepted in the United States of America ("US GAAP").

The accompanying consolidated financial statements include the accounts of the Company and its wholly owned subsidiaries. All intercompany accounts and transactions have been eliminated in consolidation.

Use of Estimates

The preparation of the consolidated financial statements in accordance with US GAAP requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the consolidated financial statements and the reported amounts of expenses during the reporting period. The Company bases its estimates on historical experience, known trends and other market-specific or relevant factors that it believes to be reasonable under the circumstances. On an ongoing basis, management evaluates its estimates as there are changes in circumstances, facts and experience. Actual results may differ from those estimates or assumptions.

Unaudited pro forma

On December 18, 2018, the Company's board of directors (the "Board") authorized the Company to submit a confidential draft registration statement with the Securities and Exchange Commission to sell shares of its common stock to the public. Upon the closing of an IPO, all of the Company's outstanding shares of redeemable convertible preferred stock will automatically convert into shares of common stock. The unaudited pro forma consolidated balance sheet information as of December 31, 2018 reflects the conversion of all outstanding shares of redeemable convertible preferred stock into common stock upon the closing of an IPO and the conversion of the outstanding warrants to purchase shares of redeemable convertible preferred stock as of December 31, 2018 into warrants to purchase shares of common stock as if the proposed IPO had occurred on December 31, 2018.

For purposes of calculating pro forma basic and diluted loss per share, all shares of redeemable convertible preferred stock outstanding as of the last reporting date have been treated as if they had been converted to common stock as of the beginning of the year or on the issuance date of the preferred stock, if later.

Subsequent Events

The Company considers events or transactions that occur after the balance sheet date but before the final financial statements are issued to provide additional evidence relative to certain estimates or to identify matters that require additional disclosure.

Cash and Cash Equivalents

Cash includes cash in readily available checking and money market accounts. Cash equivalents include all highly liquid investments maturing within 90 days from the date of purchase. The cash equivalents consisted of money market funds.

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (Continued)

Concentrations of Credit Risk

Financial instruments that subject the Company to significant concentrations of credit risk consist primarily of cash and cash equivalents. The Company's cash deposits on hand at one financial institution often exceed federally insured limits. The Company places its cash in a financial institution that management believes to be of high credit quality.

Deferred offering costs

The Company capitalizes certain legal, professional accounting and other third-party fees that are directly associated with the proposed IPO as deferred offering costs. The deferred offering costs will be offset against the IPO proceeds upon the consummation of the IPO. In the event the IPO is abandoned, the deferred offering costs will be expensed immediately as a charge to operating expenses in the statements of operations. The Company did not record any deferred offering costs as of December 31, 2017. As of December 31, 2018, the Company capitalized \$0.3 million of deferred issuance costs related to the proposed IPO.

Property and Equipment

Property and equipment are stated at cost and depreciated using the straight-line method over the estimated useful lives of the respective assets as follows:

	Estimated useful life
Laboratory equipment	3 - 5 years
Production Equipment	3 - 15 years
Furniture and fixtures	3 - 5 years
Office and computer equipment	3 - 5 years
Leasehold improvements	Shorter of the asset's estimated useful life or the remaining lease term

Major additions and betterments are capitalized; expenditures for repairs and maintenance, which do not improve or extend the life of the respective assets, are charged to operating expense as incurred.

Impairment of Long-Lived Assets

Long-lived assets to be held and used, including property and equipment, are tested for impairment whenever events or changes in circumstances indicate that the carrying amount of the asset may not be fully recoverable. Factors that the Company considers in deciding when to perform an impairment review include significant underperformance of the business in relation to expectations, significant negative industry or economic trends and significant changes or planned changes in the use of the assets. Evaluation of the recoverability of the asset or asset group is based on an estimate of undiscounted future cash flows resulting from the use of the asset or asset group and its eventual disposition. In the event that such cash flows are not expected to be sufficient to recover the carrying amount of the asset or asset group, the assets are written down to their estimated fair values. The impairment loss would be based on the excess of the carrying value

AXCELLA HEALTH INC.**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)****2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (Continued)**

of the impaired asset over its fair value, determined based on discounted cash flows. The Company did not record any impairment losses on long-lived assets during the periods presented.

Fair Value Measurements

Certain assets and liabilities are carried at fair value under US GAAP. Fair value is defined as the exchange price that would be received for an asset or paid to transfer a liability (an exit price) in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants on the measurement date. Valuation techniques used to measure fair value must maximize the use of observable inputs and minimize the use of unobservable inputs. Financial assets and liabilities carried at fair value are to be classified and disclosed in one of the following three levels of the fair value hierarchy, of which the first two are considered observable and the last is considered unobservable:

- **Level 1** — Unadjusted quoted prices in active markets that are accessible to the reporting entity at the measurement date for identical assets and liabilities.
- **Level 2** — Inputs other than quoted prices in active markets for identical assets and liabilities that are observable either directly or indirectly for substantially the full term of the asset or liability. Level 2 inputs include the following:
 - quoted prices for similar assets and liabilities in active markets
 - quoted prices for identical or similar assets or liabilities in markets that are not active
 - observable inputs other than quoted prices that are used in the valuation of the asset or liabilities (e.g., interest rate and yield curve quotes at commonly quoted intervals)
 - inputs that are derived principally from or corroborated by observable market data by correlation or other means
- **Level 3** — Unobservable inputs for the assets or liability (i.e., supported by little or no market activity). Level 3 inputs include management's own assumptions about the assumptions that market participants would use in pricing the asset or liability (including assumptions about risk).

Research and Development Costs

Research and development costs are expensed as incurred. Research and development costs consist of expenses incurred in performing research and development activities, including salaries, bonuses, stock-based compensation and benefits of employees, lab supplies and materials, depreciation, manufacturing expenses, facilities expenses, overhead expenses, and external costs of vendors engaged to conduct preclinical development activities and clinical trials. Research and development costs that are paid in advance of performance (if any) are capitalized as a prepaid expense and expensed as the goods are delivered or services performed.

Research and manufacturing contract costs and accruals

The Company has entered into various research and development and manufacturing contracts. These agreements are generally cancelable, and related payments are recorded as the

AXCELLA HEALTH INC.**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)****2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (Continued)**

corresponding expenses are incurred. The Company records accruals for estimated ongoing costs. When evaluating the adequacy of the accrued liabilities, the Company analyzes progress of the research studies or clinical trials and manufacturing activities, including the phase or completion of events, invoices received and contracted costs. Significant judgments and estimates are made in determining the accrued balances at the end of any reporting period. Actual results could differ from the Company's estimates. The Company's historical accrual estimates have not been materially different from the actual costs.

Patent Costs

All patent-related costs incurred in connection with filing and prosecuting patent applications are expensed as incurred due to the uncertainty about the recovery of the expenditure. Amounts incurred are classified as research and development expenses.

Income Taxes

Deferred tax assets and liabilities are recognized for the expected future tax consequences of events that have been included in the consolidated financial statements or tax returns. Under this method, deferred tax assets and liabilities are determined based on the difference between the consolidated financial statement and tax basis of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse. A valuation allowance is provided to reduce the deferred tax asset to an amount, which, more likely than not, will be realized.

The Company recognizes the tax benefit from any uncertain tax positions only if it is more likely than not that the tax position will be sustained on examination by the taxing authorities, based on the technical merits of the position. The tax benefits recognized in the consolidated financial statements from such a position are measured based on the largest benefit that has a greater than fifty percent likelihood of being realized upon ultimate settlement. Interest and penalties associated with uncertain tax positions are recorded as a component of income tax expense. As of December 31, 2017 and 2018, the Company has not identified any uncertain tax positions for which reserves would be required.

Segment Information

The Company manages its operations as a single segment for the purposes of assessing performance and making operating decisions. The Company's one business segment is the development of our products. All of the Company's assets are held in the United States.

Redeemable Convertible Preferred Stock

The Company classifies stock that is redeemable in circumstances outside of the Company's control outside of permanent equity. The Company records redeemable convertible preferred stock at fair value upon issuance, net of any issuance costs, and the carrying value is increased by periodic accretion to its redemption value at the earliest redemption date, when the events that give rise to redemption are deemed probable of occurrence. These increases are effected through charges against retained earnings, if any, and then to additional paid-in capital. In the absence of paid-in capital, the accretion is charged to the accumulated deficit. The Company's redeemable

AXCELLA HEALTH INC.**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)****2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (Continued)**

convertible preferred stock is subject to a dividend when and if declared by the Board. From inception through December 31, 2018, no dividend has been declared.

Stock-Based Compensation

The Company accounts for stock-based awards granted to employees and non-employees at fair value, which is measured using the Black-Scholes option-pricing model. The measurement date for employee awards is generally the date of grant. Prior to the adoption of ASU No. 2018-07, *Compensation — Stock Compensation (Topic 718)* ("ASU 2018-07"), which simplifies the accounting for non-employee share based payment transactions and is discussed below under "Recently Issued Accounting Pronouncements," the fair value measurement date for non-employee awards was the date the performance of services was completed. Stock-based compensation costs are recognized as expense over the requisite service period, which is generally the vesting period, on a straight-line basis for all time-vested awards.

Upon adoption of ASU 2018-07 on January 1, 2018, the measurement date for non-employee awards is the date of grant. The compensation expense for non-employees is recognized, without changes in the fair value of the award, over the requisite service period, which is the vesting period of the respective award. The impact on its consolidated financial statements was immaterial.

The Company classifies equity-based compensation expense in its consolidated statement of operations in the same manner in which the award recipient's salary and related costs are classified or in which the award recipient's service payments are classified.

Preferred Stock Warrant Liability

Warrants to purchase shares of redeemable or contingently redeemable preferred stock are classified as a liability on the consolidated balance sheets and carried at fair value with the change in fair value recorded in the consolidated statements of operations. The liability has been classified as long-term as the warrants are not expected to be settled in the next 12 months. The warrants will expire the earlier of the close of business April 13, 2020 or one year after closing an IPO.

Upon the closing of an IPO, the preferred stock warrants will become exercisable for common stock instead of preferred stock, and the fair value of the warrant liability at that time will be reclassified to additional paid-in capital. As a result, subsequent to the closing of this IPO, the Company will no longer remeasure the fair value of the warrant liability at each reporting date.

Comprehensive Loss

Comprehensive loss includes net loss as well as other changes in stockholders' equity (deficit) that result from transactions and economic events other than those with stockholders. For the years ended December 31, 2017 and 2018, there was no difference between net loss and comprehensive loss in the accompanying consolidated financial statements.

Net Income (Loss) Per Share

Basic net loss per share attributable to common stockholders is calculated by dividing net loss attributable to common stockholders by the weighted average shares outstanding during the period. During periods of income, the Company allocates participating securities a proportional

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (Continued)

share of income determined by dividing total weighted average participating securities by the sum of the total weighted average common shares and participating securities (the "two class method"). The Company's redeemable convertible preferred stock participates in any dividends declared by the Company and are therefore considered to be participating securities. Participating securities have the effect of diluting both basic and diluted earnings per share during periods of income. During periods of loss, the Company allocates no loss to participating securities because they have no contractual obligation to share in the losses of the Company. Diluted net income (loss) per share attributable to common stockholders is calculated by adjusting weighted average shares outstanding for the dilutive effect of common stock equivalents outstanding for the period, determined using the treasury-stock and if-converted methods. For purposes of the diluted net income (loss) per share attributable to common stockholders' calculation, redeemable convertible preferred stock, stock options, and preferred stock warrants are considered to be common stock equivalents. All common stock equivalents have been excluded from the calculation of diluted net loss per share attributable to common stockholders, as their effect would be anti-dilutive for all periods presented. Therefore, basic and diluted net loss per share were the same for all periods presented.

Recently Issued Accounting Pronouncements

In February 2016, the FASB issued ASU No. 2016-02, *Leases*, which alters the accounting model and financial statement presentation and disclosure of leases. The new standard increases the transparency and comparability among organizations by recognizing lease assets and lease liabilities on the balance sheet and disclosing key information about leasing arrangements. ASU 2016-02 is effective for the Company's fiscal years beginning January 1, 2020. We are assessing the impact the adoption of ASU 2016-02 will have on our consolidated financial statements and will recognize a lease obligation and right of use asset for our existing operating leases upon adoption. See additional information regarding the Company's lease obligations in Note 9.

In June 2018, the FASB issued ASU No. 2018-07, *Compensation — Stock Compensation (Topic 718)*. ASU 2018-07 simplifies the accounting for non-employee share-based payment transactions. The Company adopted this ASU on January 1, 2018 and applied the standard prospectively in accordance with the guidance. The impact on the Company's consolidated financial statements was immaterial.

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
3. PROPERTY AND EQUIPMENT

Property and equipment consist of the following (in thousands):

	December 31,	
	2017	2018
Laboratory equipment	\$ 3,319	\$ 3,489
Production equipment	119	—
Leasehold improvements	601	564
Office and computer equipment	299	294
Furniture and fixtures	122	122
Property and equipment	4,460	4,469
Less: accumulated depreciation and amortization	(2,935)	(3,393)
Property and equipment, net	<u>\$ 1,525</u>	<u>\$ 1,076</u>

Depreciation and amortization expense for the years ended December 31, 2017 and 2018 was \$1.4 million and \$1.1 million, respectively.

4. FAIR VALUE MEASUREMENTS

The following table sets forth by level, within the fair value hierarchy, the assets (liabilities) carried at fair value as of December 31, 2018 (in thousands):

	Fair value measurements at December 31, 2018 using:			
	Level 1	Level 2	Level 3	Total
Cash Equivalents	\$ 79,216	\$ —	\$ —	\$ 79,216
Success Fee Liability	—	—	1,220	1,220
Preferred Stock Warrant Liability	—	—	425	425
Total	<u>\$ 79,216</u>	<u>\$ —</u>	<u>\$ 1,645</u>	<u>\$ 80,861</u>

The following table sets forth by level, within the fair value hierarchy, the assets (liabilities) carried at fair value as of December 31, 2017 (in thousands):

	Fair value measurements at December 31, 2017 using:			
	Level 1	Level 2	Level 3	Total
Cash Equivalents	\$ 46,567	\$ —	\$ —	\$ 46,567
Success Fee Liability	—	—	700	700
Preferred Stock Warrant Liability	—	—	411	411
Total	<u>\$ 46,567</u>	<u>\$ —</u>	<u>\$ 1,111</u>	<u>\$ 47,678</u>

The cash equivalents are comprised of funds held in an exchange traded money market fund and the fair value of the cash equivalents is determined based upon quoted market price for that fund. The fair value of the preferred stock warrant was determined using the Black-Scholes option-

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

4. FAIR VALUE MEASUREMENTS (Continued)

pricing model with the assumptions as disclosed in Note 7. These assumptions include significant judgments including the fair value of the underlying preferred stock. An increase or decrease in the estimated fair value will result in increases or decreases in the fair value of the warrant liability and such changes could be material.

The fair value of the success fee liability was determined using a probability weighted present value of cash flows. The Company has projected that 100% of the liability will be paid and that the time value of discounting those cash flows does not have a material impact on the fair value measurement due to the expected term. The liability could decrease if the Company changes its assessment of the probability of the paying the success fee.

A roll forward of the fair value of the success fee liability and preferred stock warrant liability categorized with Level 3 inputs for the years ended December 31, 2017 and 2018 is as follows (in thousands):

	Success fee	Preferred stock warrant liability
Balance — January 1, 2017	\$ 700	\$ 492
Decrease in warrant fair value included in other expense	—	(81)
Balance — December 31, 2017	700	411
Increase in success fee included in other liabilities	520	—
Increase in warrant fair value included in other expense	—	14
Balance — December 31, 2018	<u>\$ 1,220</u>	<u>\$ 425</u>

There were no transfers among Level 1, Level 2, or Level 3 categories in the periods presented.

The carrying value of cash, cash equivalents, accounts payable and accrued expenses that are reported on the consolidated balance sheets approximate their fair value due to the short-term nature of these assets and liabilities. The carrying value of the long-term debt approximates fair value as evidenced by the recent amendment.

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
5. ACCRUED EXPENSES AND OTHER CURRENT LIABILITIES

Accrued expenses and other liabilities consisted of the following (in thousands):

	December 31,	
	2017	2018
Accrued employee compensation and benefits	\$ 1,765	\$ 1,957
Accrued external research and development expenses	1,537	1,679
Accrued professional fees	252	678
Other	522	985
Total accrued expenses and other current liabilities	<u>\$ 4,076</u>	<u>\$ 5,299</u>

6. DEBT FINANCING

Long-term debt consisted of the following (in thousands):

	December 31,	
	2017	2018
Principal amount of long term debt	\$ 20,000	\$ 26,000
Debt discount	(257)	(612)
Deferred financing fees	(186)	(867)
Long term debt, net of discount	<u>\$ 19,557</u>	<u>\$ 24,521</u>

In February 2017, the Company amended and restated the August 2015 debt facility (the "February 2017 amended facility") to extend the interest only period through February 2018. Monthly principal payments of \$1.0 million were to commence March 2018 for 10 months and then increase to \$1.3 million for the eight months thereafter. The loan had an interest rate equal to the LIBOR rate plus 8.80% per annum (9.97% as of December 31, 2017) payable monthly and a \$0.7 million success fee, payable upon the occurrence of certain events, including the completion of an IPO. The initial fair value of the success fee was recorded as an obligation to the lenders and creates a debt discount, which is then amortized to interest expense through the term of the loan.

In January 2018, the Company entered into a new secured debt facility (the "2018 Facility") with the existing lender that replaced the February 2017 amended facility. The 2018 Facility provided funding of \$21.0 million. The Company paid a transaction fee of \$0.9 million to the lender in connection with the 2018 Facility, and that fee was recognized as debt discount. The 2018 Facility requires interest only payments through January 2019 with the ability to extend the interest only payment period through January 2020 if certain conditions are met. Monthly principal payments of \$0.6 million were to commence in February 2019 for 36 months. The 2018 Facility has an interest rate equal to the LIBOR plus 8.50% per annum (10.54% as of December 31, 2018) payable monthly and a \$1.1 million success fee which is payable upon the occurrence of certain events. The success fee is comprised of \$0.7 million associated with the February 2017 amended facility and an additional \$0.4 million arising from the January 2018 amendment. The fair value of the additional success fee was recorded as an obligation to the lenders and created an additional debt discount. The Company granted the lender a first security interest in all assets of the

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

6. DEBT FINANCING (Continued)

Company, excluding intellectual property and granted a negative pledge on such intellectual property.

In October 2018, the Company amended the 2018 Facility (the "Amended 2018 Facility") to extend the interest only period through July 2020 or January 2021 and the Maturity Date to July 2022 or January 2023 if certain conditions are met. The Amended 2018 Facility provides additional funding in the amounts of \$5.0 million ("Term B Loan") and \$4.0 million ("Term C Loan") if certain conditions are met. The Term B Loan of \$5.0 million was drawn in December 2018. Monthly principal payments of \$1.1 million are to commence August 2020 for 24 months. The success fee increased to \$1.2 million, which increased the debt discount by \$0.1 million. Deferred financing costs of \$0.1 million were incurred related to the amendment. The interest rate was not changed through the amendment.

For the years ended December 31, 2017 and 2018, interest expense arising from the amortization of the debt discount and deferred financing fees was \$0.2 million and \$0.4 million, respectively.

Terminal Interest Fee

The Company's August 2015 debt facility, as amended and the 2018 Facility, included a terminal interest fee obligation, which is due with the final principal payment of the loan and has been modified from time to time as the facilities were amended. The Company is accruing the terminal fee obligation over the term of the facility. At December 31, 2017, the terminal fee obligation was \$1.1 million. The October 2018 amendment increased the terminal interest fee to \$1.4 million.

The following summarizes the accrued terminal fee payable activity (in thousands):

	December 31,	
	2017	2018
Balance at beginning of year	\$ 266	\$ 576
Terminal interest fees accrued during the year	310	101
Balance at end of year	<u>\$ 576</u>	<u>\$ 677</u>

The scheduled principal maturity of the long-term debt, reflecting the 2018 Amended Facility and the Term B Loan draw offers, is as follows (in thousands):

<u>Year Ended December 31,</u>	
2020	\$ 5,417
2021	13,000
2022	7,583
	<u>\$ 26,000</u>

AXCELLA HEALTH INC.**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)****7. STOCKHOLDERS' EQUITY**

The following summarizes the significant terms of the Company's capital stock and stock- based compensation plans.

Series A Preferred Stock

On April 8, 2011, the Company entered into the Series A Preferred Stock Purchase Agreement with its founding investor committing \$10.8 million in Series A Preferred Stock equity financing. During 2011 and 2012, the Company issued an aggregate of 5,538,462 shares of Series A Redeemable Convertible Preferred Stock ("Series A Preferred Stock") at \$1.95 per share. In 2013, an additional 223,077 shares of Series A Preferred Stock was issued. Issuance costs associated with the transaction were \$30,000.

Series B Preferred Stock

On October 10, 2013 and December 11, 2013, the Company entered into the Series B Preferred Stock Purchase Agreements with its founding investor and other investors providing \$12.3 million in Series B Preferred Stock equity financing (the "Series B Agreement"). In connection with entering into the Series B Agreement, the Company issued 4,737,041 shares of Series B Redeemable Convertible Preferred Stock ("Series B Preferred Stock") at \$2.59 per share for gross cash proceeds of \$12.3 million (inclusive of \$4.1 million in convertible notes and accrued interest that were converted). Issuance costs associated with the transaction were \$57,000.

Series B-1 Preferred Stock

On March 12, 2014, the Company entered into the Series B-1 Preferred Stock Purchase Agreement with a new investor providing \$3.0 million in Series B-1 Preferred Stock equity financing (the "Series B-1 Agreement"). In connection with entering into the Series B-1 Agreement, the Company issued 1,084,441 shares of Series B-1 Redeemable Convertible Preferred Stock ("Series B-1 Preferred Stock") at \$2.77 per share for gross cash proceeds of \$3.0 million. Issuance costs associated with the transaction were \$38,000.

Series C Preferred Stock

On each of January 30, 2015, April 28, 2015 and September 16, 2015, the Company entered into the Series C Preferred Stock Purchase Agreements with its founding investor and other investors providing \$44.3 million in Series C Preferred Stock equity financing (the "Series C Agreement"). In connection with entering into the Series C Agreement, the Company issued 4,396,624 shares of Series C Redeemable Convertible Preferred Stock ("Series C Preferred Stock") at \$10.08 per share for gross cash proceeds of \$44.3 million. Issuance costs associated with the transaction were \$175,000.

On August 11, 2017, the Company extended the Series C Agreement with existing investors providing an additional \$25.9 million in Series C Preferred Stock equity financing (the "Series C Extension Agreement"). In connection with the Series C Extension Agreement, the Company issued 2,572,420 shares of Series C Preferred Stock at \$10.08 per share for gross cash proceeds of \$25.9 million. Issuance costs associated with the transaction were \$259,000.

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
7. STOCKHOLDERS' EQUITY (Continued)
Series D Preferred Stock

On February 10, 2016, the Company entered into the Series D Preferred Stock Purchase Agreement with a new strategic investor providing \$42.5 million in Series D Preferred Stock equity financing (the "Series D Agreement"). In connection with entering into the Series D Agreement, the Company issued 2,997,179 shares of Series D Redeemable Convertible Preferred Stock ("Series D Preferred Stock") at \$14.18 per share for gross cash proceeds of \$42.5 million. Issuance costs associated with the transaction were \$150,000.

Series E Preferred Stock

On November 30, 2018, the Company entered into the Series E Preferred Stock Purchase Agreement with a new strategic investor and existing investors providing \$59.0 million in Series E Preferred Stock equity financing (the "Series E Agreement"). In connection with entering into the Series E Agreement, the Company issued 5,282,002 shares of Series E Redeemable Convertible Preferred Stock ("Series E Preferred Stock") at \$11.17 per share for gross cash proceeds of \$59.0 million. Issuance costs associated with the transaction were \$139,000.

As of each balance sheet date, the Preferred Stock consisted of the following (in thousands, except for share data):

	December 31, 2018				
	Preferred Stock Authorized	Preferred Stock Issued and Outstanding	Carrying Value	Liquidation Preference	Common stock issuable upon conversion
Series A preferred stock	5,874,334	5,761,539	\$ 11,235	\$ 11,235	3,127,870
Series B preferred stock	4,737,041	4,737,041	12,250	12,250	2,571,679
Series B-1 preferred stock	1,084,441	1,084,441	2,998	3,000	588,730
Series C preferred stock	6,969,044	6,969,044	70,062	70,248	3,783,401
Series D preferred stock	2,997,179	2,997,179	42,434	42,500	1,702,785
Series E preferred stock	6,266,786	5,282,002	58,863	59,000	2,867,532
	<u>27,928,825</u>	<u>26,831,246</u>	<u>\$ 197,842</u>	<u>\$ 198,233</u>	<u>14,641,997</u>

	December 31, 2017				
	Preferred Stock Authorized	Preferred Stock Issued and Outstanding	Carrying Value	Liquidation Preference	Common stock issuable upon conversion
Series A preferred stock	5,874,334	5,761,539	\$ 11,235	\$ 11,235	3,127,870
Series B preferred stock	4,737,041	4,737,041	12,244	12,250	2,571,679
Series B-1 preferred stock	1,084,441	1,084,441	2,990	3,000	588,730
Series C preferred stock	9,356,941	6,969,044	69,950	70,248	3,783,401
Series D preferred stock	2,997,179	2,997,179	42,409	42,500	1,663,498
	<u>24,049,936</u>	<u>21,549,244</u>	<u>\$ 138,828</u>	<u>\$ 139,233</u>	<u>11,735,178</u>

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

7. STOCKHOLDERS' EQUITY (Continued)

The terms and conditions of the Series A, Series B, Series B-1, Series C, Series D and Series E Preferred Stock are as follows:

Dividends — Dividends shall accrue at the rate of 8% annually and are non-cumulative in nature. Dividends are payable only when and if declared by the Board. The Company shall not declare, pay, or set aside any dividends on shares of any class of common stock, unless the holders of the preferred stock shall first receive dividends on each outstanding share of preferred stock in the amount of the accrued dividends unpaid as of such date. No dividends have been declared or paid.

Liquidation — In the event of any liquidation, dissolution, or winding-up of the Company, which would include the sale of the Company, Series E Preferred Stock is senior to the Series A, Series B, and Series B-1 Preferred Stock, and *pari-passu* with the Series C and Series D Preferred Stock. The Series C, Series D, and Series E Preferred stockholders would be entitled to be paid before any payment shall be made to the holders of common stock, Series A Preferred Stock, Series B Preferred Stock, or Series B-1 Preferred Stock an amount per share equal to (i) in the case of the Series C Preferred Stock, the greater of the Series C original issue price of \$10.08, plus any dividends declared but unpaid or such amount per share as would have been payable had all shares of Series C Preferred Stock been converted into Common Stock immediately prior to such liquidation, dissolution, or winding up of the Company, (ii) in the case of the Series D Preferred Stock, the greater of the Series D original issue price of \$14.18, plus any dividends declared but unpaid or such amount per share as would have been payable had all shares of Series D Preferred Stock been converted into Common Stock immediately prior to such liquidation, dissolution, or winding up of the Company, and (iii) in the case of the Series E Preferred Stock, the greater of the Series E original issue price of \$11.17, plus any dividends declared but unpaid or such amount per share as would have been payable had all shares of Series E Preferred Stock been converted into Common Stock immediately prior to such liquidation, dissolution, or winding up of the Company. Following the payment of the Series C, Series D, and Series E liquidation amount, the Series A Preferred stockholders would be entitled to be paid *pari-passu* with the Series B Preferred stockholders and Series B-1 Preferred Stockholders and before any distribution or payment is made to the holders of the common stock. The amount to be paid to the holders of Series A, Series B and Series B-1 Preferred Stock is an amount equal to the greater of the original purchase price per share, plus all declared but unpaid dividends thereon or such amount per share as would have been payable had all shares of Series A, Series B, Series B-1, and Series C Preferred Stock been converted to common stock prior to such liquidation, dissolution, or winding up of the Company. The original issue purchase price per share of the Series A Preferred Stock was \$1.95 per share, the original issue price of the Series B Preferred Stock was \$2.59 per share and the original issue price of the Series B-1 Preferred Stock was \$2.77 per share. Any assets remaining following the preferential distribution to the holders of Series A, Series B, and Series B-1 Preferred Stock would be available for distribution ratably among the holders of common stock.

Voting — The preferred stockholders are entitled to the number of votes equal to the number of shares of common stock into which the shares of preferred stock held by each holder are then convertible.

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

7. STOCKHOLDERS' EQUITY (Continued)

Conversion — Each share of Series A, Series B, Series B-1, Series C, Series D and Series E Preferred Stock is convertible at any time at the option of the holder. The number of shares into which the preferred stock converts is equal to the issuance price divided by the conversion price. The conversion price shall initially be \$3.59 per share for the Series A Preferred Stock, \$4.76 per share for the Series B Preferred Stock, \$5.10 per share for the Series B-1 Preferred Stock, \$18.57 for the Series C Preferred Stock, \$26.12 for the Series D Preferred Stock, and \$20.58 for the Series E Preferred Stock and may be adjusted for certain dilutive events. Conversion to common stock shall be mandatory upon the closing of an IPO resulting in net proceeds of at least \$35.0 million or upon the decision of the holders of at least a majority of the outstanding preferred stock shares and the holders of at least a majority of the outstanding shares of Series C Preferred Stock. The conversion price at December 31, 2018 was \$3.59 per share for the Series A Preferred Stock, \$4.76 per share for the Series B Preferred Stock, \$5.10 per share for the Series B-1 Preferred Stock, \$18.57 for the Series C Preferred Stock, \$24.96 for the Series D Preferred Stock and \$20.58 for the Series E Preferred Stock.

Redemption — The preferred stock may be redeemed at the option of the majority of the holders in three annual installments on or after February 10, 2021, at a price per share equal to \$1.95 per share for the Series A Preferred Stock, \$2.59 per share for the Series B Preferred Stock, \$2.77 per share for the Series B-1 Preferred Stock, \$10.08 per share for the Series C Preferred Stock, \$14.18 per share for the Series D Preferred Stock and \$11.17 per share for the Series E Preferred Stock plus all declared but unpaid dividends.

Preferred Stock Warrants — In connection with the issuance of debt in 2012, the Company issued warrants to purchase 112,795 shares of Series A Preferred Stock with an exercise price of \$1.95 per share. The warrants expire upon the earliest of April 13, 2020 or the first anniversary of the consummation of the initial public offering. Fair value has been estimated using a Black-Scholes option-pricing model with the following assumptions:

	December 31,	
	2017	2018
Expected volatility	71%	65%
Risk-free interest rate	2.09%	2.49%
Weighted-average remaining contractual term (in years)	2.28	1.28
Expected dividend yield	0%	0%
Fair value of underlying Series A Preferred Stock	\$5.23	\$5.59

Unvested Common Stock — The Company has entered into stock purchase agreements with certain senior executives of the Company.

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

7. STOCKHOLDERS' EQUITY (Continued)

In August 2013, the Company issued 626,848 shares of nonvested common stock to a then-executive with an aggregate fair value of \$0.5 million, or \$0.85 per share, in exchange for \$1,155 in cash and \$0.5 million in a promissory note. The note bears interest at a rate of 1.22% per annum and has partial recourse for up to 50% of the value of the note. The promissory note is collateralized by all of the underlying shares of common stock (626,848 shares) and is due within 60 days of termination of the executive, immediately prior to a liquidity or liquidation event, or five years from the date of issuance. The vesting period for the shares is over a four-year period and reflects the period the stock-based compensation expense is recognized for the award. The outstanding principal balance on the promissory note as of December 31, 2017 and December 31, 2018, totaled \$0.5 million and \$0.0 million, respectively.

The Company determined that the promissory note did not represent a substantive exercise of an option as the employee does not bear the risks and rewards of ownership as the note is partial recourse and, therefore, was accounted for as a nonrecourse note. The promissory note was accounted for as a stock option grant and the note receivable and related shares of common stock are not recorded until such time as they are repaid. The Company has estimated the aggregate grant date fair value of the awards at \$0.3 million using the Black-Scholes option-pricing model with assumptions consistent with the assumptions outlined below. During the years ended December 31, 2017 and 2018, the Company recognized \$0.03 million and \$0.0 million, respectively, of stock-based compensation relating to these awards.

The shares of common stock securing the promissory notes are not considered outstanding shares for accounting purposes until the shares vest, the repurchase right lapses and the holders have repaid the promissory notes. At December 31, 2017 and 2018, 626,848 and 0 shares of stock, respectively, were subject to repurchase agreements and partial recourse promissory notes.

In 2018, upon termination of the executive, the Company withheld 91,527 shares of vested common stock in exchange for the settlement of the outstanding promissory note. The former executive retained ownership of the remaining 535,320 shares of vested common stock.

No other shares of stock of the Company were subject to repurchase agreements or partial recourse promissory notes at December 31, 2017 or December 31, 2018.

Stock Option Plan — On December 23, 2010, the Company adopted the 2010 Stock Option and Grant Plan (the "2010 Plan"). The 2010 Plan, as amended, provides for the issuance of up to 5,205,082 shares of common stock to employees, officers, directors, consultants, and advisors in the form of nonqualified and incentive stock options, unvested stock awards, and other stock-based awards. In general, options typically vest over four years. An option's maximum term is 10 years. At December 31, 2018, there were 41,230 shares of common stock available for issuance under the 2010 Plan.

The Company typically grants stock options to employees and non-employees at exercise prices deemed by the Board to be equal to the fair value of the common stock at the time of grant. The fair value of the common stock has been determined by the Board at each measurement date based on a variety of different factors, including the results obtained from independent third-party appraisals, the Company's financial position and historical financial performance, the status of development of the Company's services, the current climate in the marketplace, the illiquid nature

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
7. STOCKHOLDERS' EQUITY (Continued)

of the common stock, the effect of the rights and preferences of the preferred stockholders, and the prospects of a liquidity event, among others.

The Company utilized the Black-Scholes option-pricing model to estimate the fair value of stock options awarded to employees. The Black-Scholes option-pricing model requires several key assumptions. The key assumptions used to apply this pricing model during the years ended December 31, 2017 and 2018, were as follows:

	2017	2018
Risk-free interest rate	1.93% - 2.34%	1.93% - 3.02%
Expected term (in years)	6.25	0.25 - 6.25
Expected dividend yield	0%	0%
Expected volatility of underlying common stock	65%	65%

The risk-free interest rate was based on rates associated with U.S. Treasury issues approximating the expected life of the stock options. The expected term of options granted to employees was determined using the simplified method, which represents the midpoint of the contractual term of the option and the weighted-average vesting period of the option. The Company uses the simplified method because it does not have sufficient historical option exercise data to provide a reasonable basis upon which to estimate the expected term. The expected dividend-yield assumption was based on the Company's expectation of no future dividend payments. The expected volatility of the underlying stock was based on the average historical volatility of comparable publicly traded companies based on weekly price returns as reported by a pricing service, as the Company does not have a trading history for its stock.

The weighted-average grant date fair value of the options granted during the years ended December 31, 2017 and 2018, was \$4.46 per share and \$3.63 per share, respectively. As of December 31, 2018, there was \$9.7 million of unrecognized compensation expense related to unvested stock options that is expected to be recognized over a weighted-average period of 3.0 years. Stock-based compensation related to stock options and unvested stock awards are classified as follows (in thousands):

	December 31,	
	2017	2018
Research and development	\$ 604	\$ 1,088
General and administrative	642	1,690
	<u>\$ 1,246</u>	<u>\$ 2,778</u>

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
7. STOCKHOLDERS' EQUITY (Continued)

The following table summarizes the option activity under the 2010 Plan:

	Options	Weighted Average Exercise Price	Weighted Average Remaining Life (in Years)	Intrinsic Value (in thousands)
Outstanding January 1, 2018	2,624,321	\$ 5.41	8.7	\$ 2,900
Granted	1,807,814	5.87		
Exercised	(10,517)	4.31		
Canceled	(382,154)	6.38		
Outstanding December 31, 2018	<u>4,039,464</u>	\$ 5.67	8.6	
Options vested or expected to vest as of December 31, 2018	<u>3,936,746</u>	\$ 5.67	8.6	\$ 11,328
Options exercisable as of December 31, 2018	1,201,096	\$ 4.11	6.7	\$ 5,331

The intrinsic value of options exercised during the years ended December 31, 2017 and 2018 was nominal.

Common Stock Reserved — As of December 31, 2018, the Company had authorized 47,000,000 shares of common stock. The number of shares of common stock has been reserved for the potential conversion of Series A, Series B, Series B-1, Series C, Series D and Series E Preferred Stock and exercise of stock options as of December 31, 2018, is as follows:

	As of December 31, 2018
Series A Preferred Stock	3,127,870
Series B Preferred Stock	2,571,679
Series B-1 Preferred Stock	588,730
Series C Preferred Stock	3,783,401
Series D Preferred Stock	1,702,785
Series E Preferred Stock	2,867,532
Common Stock Options	<u>4,039,464</u>
Total shares reserved for issuance	<u>18,681,461</u>

8. INCOME TAXES

There is no provision for income taxes because the Company has historically incurred operating losses and maintains a full valuation allowance against its deferred tax assets. A

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
8. INCOME TAXES (Continued)

reconciliation of income taxes computed using the U.S. federal statutory rate to that reflected in operations as of December 31, 2017 and 2018 are as follows:

	December 31,	
	2017	2018
Tax at U.S. statutory rate	34.0 %	21.0 %
State taxes, net of federal benefit	5.4 %	6.2 %
Permanent differences	(2.2)%	(1.5)%
Tax credits	3.3 %	3.8 %
U.S. tax reform impact	(44.9)%	0.0 %
Change in valuation allowance	4.4 %	(29.5)%
Effective income tax rate	<u>0.0 %</u>	<u>0.0 %</u>

With enactment of the Tax Cuts and Jobs Act (the "Act"), which was signed by President Trump on December 22, 2017, Congress substantially amended the Internal Revenue Code, which, among other things, permanently reduced the U.S. corporate income tax rate from 34% to 21% effective for tax years including or commencing January 1, 2018. As such in 2017, the Company remeasured its existing cumulative temporary differences at the enacted rate of 21% as compared to the previous rate of 34%. The remeasurement of the Company's deferred tax balances of \$13.9 million was offset by the application of its valuation allowance. The change in the U.S. corporate income tax rate is reflected in the Company's deferred tax table. The Company finalized its assessment of the Act during the fourth quarter of 2018 and did not record any changes from its initial remeasurement.

Significant components of the Company's deferred tax asset at December 31, 2017 and 2018 are as follows (in thousands):

	December 31,	
	2017	2018
Net operating loss carryforwards	\$ 29,456	\$ 38,337
Research and development tax credit carryforwards	4,107	5,470
Start-up costs	50	43
Capitalized research and development costs	384	277
Depreciation	457	479
Accrued expenses	725	811
Stock-based compensation	412	600
Other items	499	710
Total deferred tax assets	<u>36,090</u>	<u>46,727</u>
Valuation allowance	<u>(36,090)</u>	<u>(46,727)</u>
Net deferred tax asset	<u>\$ —</u>	<u>\$ —</u>

As of December 31, 2018, the Company had federal and state net operating loss carryforwards of \$140.6 million and \$139.4 million, respectively, which may be used to offset future taxable income, if any. These amounts begin to expire in 2030. The federal net operating losses

AXCELLA HEALTH INC.**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)****8. INCOME TAXES (Continued)**

generated in 2018 can be carried forward indefinitely. As of December 31, 2018, the Company had federal and state research and development tax credit carryforwards of \$4.2 million and \$1.6 million, respectively. These amounts expire at various dates through 2038. Due to the degree of uncertainty related to the ultimate use of the deferred tax assets, the Company has fully reserved these tax benefits, as the determination of the realization of the deferred tax benefits was not determined to be more likely than not. The valuation allowance increased in 2018 by \$10.6 million, due to the increase in deferred tax assets by the same amount (primarily due to net operating loss carryforwards) and the Company's recording of a full valuation allowance. In 2017, the valuation allowance decreased by \$1.4 million which was driven by the \$13.9 million reduction in the U.S. corporate income tax rate discussed above and partially offset by the current period net operating loss.

Utilization of the net operating loss and research and development credit carryforwards may be subject to a substantial annual limitation under Sections 382 and 383 of the Internal Revenue Code of 1986 due to ownership change limitations that have occurred previously or that could occur in the future. These ownership changes may limit the amount of net operating loss and research and development credit carryforwards that can be utilized annually to offset future taxable income and tax, respectively. As of December 31, 2018, the Company had not yet completed an analysis of whether its net operating loss and research and development credit carryforwards may be limited.

At December 31, 2017 and 2018, the Company had no unrecognized tax benefits. As of December 31, 2017 and 2018, the Company had no accrued interest or penalties related to uncertain tax positions and no amounts have been recognized in our consolidated statements of operations. The Company will recognize interest and penalties related to uncertain tax positions in income tax expense.

For years through December 31, 2018, the Company generated research credits but has not conducted a study to document the qualified activities. This study may result in an adjustment to the Company's research and development credit carryforwards; however, until a study is completed and any adjustment is known, no amounts are being presented as an uncertain tax position. A full valuation allowance has been provided against the Company's research and development credits and, if an adjustment is required, this adjustment would be offset by an adjustment to the deferred tax asset established for the research and development credit carryforwards and the valuation allowance.

The Company files income tax returns in the U.S. federal and Massachusetts and New Jersey jurisdictions. The statute of limitations for assessment by the Internal Revenue Service, or IRS, and state tax authorities is closed for tax years prior to 2015, although carryforward attributes that were generated prior to tax year 2015 may still be adjusted upon examination by the IRS or state tax authorities if they either have been or will be used in a future period. There are no federal or state audits in progress.

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
9. COMMITMENTS AND CONTINGENCIES
Leases

The Company entered into a facility lease agreement for laboratory and office space with an expiration date of April 1, 2021. The lease agreement and most recent amendment contained escalating rent payments. Rent expense is recorded on a straight-line basis. The Company had deferred rent of \$0.1 million as of both December 31, 2017 and 2018. The Company is obligated to make minimum lease payments under the facility lease as follows (in thousands):

Years Ending December 31,	
2019	\$ 1,187
2020	1,226
2021	415
Total	<u>\$ 2,828</u>

Rent expense for the years ended December 31, 2017 and 2018 was \$1.1 million and \$1.2 million, respectively.

10. RETIREMENT PLAN

The Company has a 401(k) retirement and savings plan (the "Plan") covering all qualified employees. The Plan allows each participant to contribute a portion of his or her base wages up to an amount not to exceed an annual statutory maximum. The Company is permitted to make discretionary matching contributions to the Plan. The Company has not made any discretionary contributions.

11. NET LOSS AND PRO FORMA NET LOSS PER SHARE
Net Loss Per Share

Basic and diluted net loss per share attributable to common stockholders was calculated as follows (in thousands, except share and per share amounts):

	Year ended December 31,	
	2017	2018
Numerator:		
Net loss	\$ (30,940)	\$ (36,069)
Accretion of redeemable convertible preferred stock	(117)	(153)
Net loss attributable to common stockholders	<u>\$ (31,057)</u>	<u>\$ (36,222)</u>
Denominator:		
Weighted average common shares outstanding, basic and diluted	4,211,918	4,546,373
Net loss per share attributable to common stockholders, basic and diluted	<u>\$ (7.37)</u>	<u>\$ (7.97)</u>

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
11. NET LOSS AND PRO FORMA NET LOSS PER SHARE (Continued)

The Company's potential dilutive securities, which include redeemable convertible preferred stock, warrants to purchase redeemable convertible preferred stock, vested unvested stock purchased with promissory notes and common stock options, have been excluded from the computation of diluted net loss per share as the effect would be to reduce the net loss per share. Therefore, the weighted average number of common shares outstanding used to calculate both basic and diluted net loss per share is the same. The Company excluded the following potential common shares, presented based on amounts outstanding at each period end, from the computation of diluted net loss per share attributable to common stockholders for the periods indicated because including them would have had an anti-dilutive effect:

	Year ended December 31,	
	2017	2018
Redeemable convertible preferred stock (as converted to common stock)	11,735,178	14,641,997
Warrants to purchase redeemable convertible preferred stock (as converted to common stock)	61,235	61,235
Options to purchase common stock	2,624,321	4,039,464
	<u>14,420,734</u>	<u>18,742,696</u>

Pro Forma Net Loss Per Share (Unaudited)

The pro forma basic and diluted net loss per share for the year ended December 31, 2018 has been prepared to give effect to adjustments arising upon the completion of a qualified IPO. The pro forma net loss used in the calculation of pro forma basic and diluted net loss per share attributable to common stockholders does not include the change in the fair value of the warrant liability because the calculation gives effect to all warrants to purchase redeemable convertible preferred stock becoming warrants to purchase common stock as if the proposed IPO had occurred on the later of January 1, 2018 or the date of issuance of the preferred stock. The pro forma basic and diluted weighted average common shares outstanding used in the calculation of pro forma basic and diluted net loss per share for the year ended December 31, 2018 has been prepared to give effect, upon a qualified IPO, to the automatic conversion of all outstanding shares of redeemable convertible preferred stock into common stock as if the proposed IPO had occurred on the later of January 1, 2018 or the issuance date of the redeemable convertible preferred stock.

AXCELLA HEALTH INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)
11. NET LOSS AND PRO FORMA NET LOSS PER SHARE (Continued)

Pro forma basic and diluted net loss per share attributable to common stockholders was calculated as follows (in thousands, except share and per share amounts):

	Year ended December 31, 2018 (unaudited)
Numerator:	
Net loss attributable to common stockholders	\$ (36,222)
Accretion of redeemable convertible preferred stock	153
Net loss	\$ (36,069)
Change in fair value of preferred stock warrant liability	14
Pro forma net loss attributable to common stockholders	\$ (36,055)
Denominator:	
Weighted average common shares outstanding, basic and diluted	4,546,373
Pro forma adjustment to reflect automatic conversion of redeemable convertible preferred stock into common stock upon the completion of the proposed IPO	11,982,075
Pro forma weighted average common shares outstanding, basic and diluted	16,528,448
Pro forma net loss per share, basic and diluted	\$ (2.19)

12. RELATED-PARTY TRANSACTIONS

In April 2013, the Company entered into a services agreement with Flagship Ventures Management, Inc. ("Flagship"), an affiliate of one of the Company's principal stockholders, to provide various strategic consulting services to the Company. The total expense under the agreement for the years ended December 31, 2017 and 2018 was \$0.1 million and \$0, respectively. As of December 31, 2017 and 2018, there were no amounts payable to Flagship for costs related to the services agreement.

13. SUBSEQUENT EVENTS

The Company has evaluated subsequent events for financial statement purposes occurring through March 15, 2019, the date that these consolidated financial statements were originally issued, and April 29, 2019, the date on which the retrospectively revised consolidated financial statements were reissued (as a result of the reverse stock split discussed below), and determined that no additional subsequent events had occurred that would require recognition in these consolidated financial statements and that all subsequent events that require disclosure have been disclosed.

2019 Stock Option and Incentive Plan — The 2019 Stock Option and Incentive Plan (the "2019 Plan") was approved by our board of directors on April 29, 2019, and will become effective on the date immediately prior to the date on which the registration statement for the Company's proposed initial public offering is declared effective. The 2019 Plan provides for the grant of incentive stock options, nonqualified stock options, stock appreciation rights, restricted stock units,

AXCELLA HEALTH INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (Continued)

13. SUBSEQUENT EVENTS (Continued)

restricted stock awards, unrestricted stock awards, cash-based awards and dividend equivalent rights to the Company's officers, employees, directors and consultants. The number of shares initially reserved for issuance under the 2019 Plan is 652,248, which shall be cumulatively increased on January 1, 2020 and each January 1 thereafter by 4% of the number of shares of the Company's common stock outstanding on the immediately preceding December 31 or such lesser number of shares determined by the Company's board of directors or compensation committee of the board of directors.

2019 Employee Stock Purchase Plan — The 2019 Employee Stock Purchase Plan (the "2019 ESPP") was approved by our board of directors on April 29, 2019, and will become effective on the date immediately prior to the date on which the registration statement for the Company's proposed initial public offering is declared effective. A total of 237,181 shares of common stock were initially reserved for issuance under this plan, which shall be cumulatively increased on January 1, 2020 and each January 1 thereafter by 1% of the number of shares of the Company's common stock outstanding on the immediately preceding December 31 or such lesser number of shares determined by the Company's board of directors or compensation committee of the board of directors.

Reverse Stock Split — On April 29, 2019, the Company effected a 1-for-1.842 reverse stock split of the Company's common stock. All shares, stock options, warrants and per share information presented in the consolidated financial statements have been adjusted to reflect the reverse stock split on a retroactive basis for all periods presented. There was no change in the par value of the Company's common stock. The ratio by which shares of preferred stock are convertible into shares of common stock was adjusted to reflect the effects of the reverse stock split.

* * * * *

3,571,428 Shares



Axcella Health Inc.

Common Stock

PRELIMINARY PROSPECTUS

Joint Book-Running Managers

GOLDMAN SACHS & CO. LLC

J.P. MORGAN

SVB LEERINK

Until _____, 2019 (25 days after the date of this prospectus), all dealers that effect transactions in these securities, whether or not participating in this offering, may be required to deliver a prospectus. This is in addition to the dealers' obligation to deliver a prospectus when acting as underwriters and with respect to their unsold allotments or subscriptions.

PART II**INFORMATION NOT REQUIRED IN PROSPECTUS****Item 13. Other Expenses of Issuance and Distribution.**

The following table sets forth the fees and expenses, other than underwriting discounts and commissions, payable in connection with the registration of the common stock hereunder. All amounts are estimates except the SEC registration fee, the FINRA filing fee and the Nasdaq Global Market listing fee.

	Amount to be Paid
SEC registration fee	\$ 10,951
FINRA filing fee	\$ 14,054
Nasdaq Global Market listing fee	150,000
Printing and mailing	150,000
Legal fees and expenses	1,200,000
Accounting fees and expenses	400,000
Transfer agent and registrar fees and expenses	4,500
Miscellaneous	10,495
Total	\$ 1,940,000

Item 14. Indemnification of Directors and Officers.

Section 145 of the Delaware General Corporation Law, or the DGCL, authorizes a corporation to indemnify its directors and officers against liabilities arising out of actions, suits and proceedings to which they are made or threatened to be made a party by reason of the fact that they have served or are currently serving as a director or officer to a corporation. The indemnity may cover expenses (including attorneys' fees) judgments, fines and amounts paid in settlement actually and reasonably incurred by the director or officer in connection with any such action, suit or proceeding. Section 145 permits corporations to pay expenses (including attorneys' fees) incurred by directors and officers in advance of the final disposition of such action, suit or proceeding. In addition, Section 145 provides that a corporation has the power to purchase and maintain insurance on behalf of its directors and officers against any liability asserted against them and incurred by them in their capacity as a director or officer, or arising out of their status as such, whether or not the corporation would have the power to indemnify the director or officer against such liability under Section 145.

We have adopted provisions in our restated certificate of incorporation to be in effect upon the completion of this offering and amended and restated bylaws to be in effect upon the effectiveness of this registration statement that limit or eliminate the personal liability of our directors to the fullest extent permitted by the DGCL, as it now exists or may in the future be amended. Consequently, a director will not be personally liable to us or our stockholders for monetary damages or breach of fiduciary duty as a director, except for liability for:

- any breach of the director's duty of loyalty to us or our stockholders; any act or omission not in good faith or that involves intentional misconduct or a knowing violation of law; any unlawful payments related to dividends or unlawful stock purchases, redemptions or other distributions; or any transaction from which the director derived an improper personal benefit.

These limitations of liability do not alter director liability under the federal securities laws and do not affect the availability of equitable remedies such as an injunction or rescission.

In addition, our bylaws provide that:

- we will indemnify our directors, officers and, in the discretion of our board of directors, certain employees to the fullest extent permitted by the DGCL, as it now exists or may in the future be amended; and
- we will advance reasonable expenses, including attorneys' fees, to our directors and, in the discretion of our board of directors, to our officers and certain employees, in connection with legal proceedings relating to their service for or on behalf of us, subject to limited exceptions.

We intend to enter into indemnification agreements with each of our directors and certain of our executive officers. These agreements will provide that we will indemnify each of our directors, certain of our executive officers and, at times, their affiliates to the fullest extent permitted by Delaware law. We will advance expenses, including attorneys' fees (but excluding judgments, fines and settlement amounts), to each indemnified director, executive officer or affiliate in connection with any proceeding in which indemnification is available and we will indemnify our directors and officers for any action or proceeding arising out of that person's services as a director or officer brought on behalf of us or in furtherance of our rights. Additionally, certain of our directors or officers may have certain rights to indemnification, advancement of expenses or insurance provided by their affiliates or other third parties, which indemnification relates to and might apply to the same proceedings arising out of such director's or officer's services as a director referenced herein. Nonetheless, we will agree in the indemnification agreements that our obligations to those same directors or officers are primary and any obligation of such affiliates or other third parties to advance expenses or to provide indemnification for the expenses or liabilities incurred by those directors are secondary.

We will maintain general liability insurance which covers certain liabilities of our directors and officers arising out of claims based on acts or omissions in their capacities as directors or officers, including liabilities under the Securities Act of 1933, as amended, or the Securities Act.

The underwriting agreement filed as Exhibit 1.1 to this registration statement provides for indemnification of us and our directors and officers by the underwriters against certain liabilities under the Securities Act and the Securities Exchange Act of 1934.

Item 15. *Recent Sales of Unregistered Securities.*

In the three years preceding the filing of this registration statement, we have issued the following securities that were not registered under the Securities Act:

(a) *Issuances of Capital Stock*

In February 2016, we issued and sold to an investor in a private placement an aggregate of 2,997,179 shares of our Series D Preferred Stock at a purchase price of \$14.18 per share, for aggregate consideration of approximately \$42,500,000.

In August 2017, we issued and sold to investors in a private placement an aggregate of 2,572,420 shares of our Series C Preferred Stock at a purchase price of \$10.08 per share, for aggregate consideration of approximately \$25,930,000.

In November 2018, we issued we issued and sold to investors in a private placement an aggregate of 5,282,002 shares of our Series E Preferred Stock at a purchase price of \$11.17 per share, for aggregate consideration of approximately \$59,000,000.

No underwriters were involved in the foregoing sales of securities. Unless otherwise stated, the sales of securities described above were deemed to be exempt from registration pursuant to

Section 4(a)(2) of the Securities Act, including Regulation D and Rule 506 promulgated thereunder, as transactions by an issuer not involving a public offering. All of the purchasers in these transactions represented to us in connection with their purchase that they were acquiring the securities for investment and not distribution, that they could bear the risks of the investment and could hold the securities for an indefinite period of time. Such purchasers received written disclosures that the securities had not been registered under the Securities Act and that any resale must be made pursuant to a registration or an available exemption from such registration. All of the foregoing securities are deemed restricted securities for the purposes of the Securities Act.

(b) Grants and Exercises of Stock Options

We have granted stock options to purchase an aggregate of 4,392,674 shares of our common stock, with exercise prices ranging from \$6.21 to \$13.83 per share, to employees, directors and consultants pursuant to the 2010 Plan. Since April 2016, 49,271 shares of common stock have been issued upon the exercise of stock options pursuant to the 2010 Plan.

The issuances of the securities described above were deemed to be exempt from registration pursuant to Section 4(a)(2) of the Securities Act or Rule 701 promulgated under the Securities Act as transactions pursuant to compensatory benefit plans. The shares of common stock issued upon the exercise of options are deemed to be restricted securities for purposes of the Securities Act.

(c) Warrants to purchase capital stock

Since January 2016, we have not issued any warrants to purchase shares of our capital stock.

Item 16. Exhibits and Financial Statement Schedules.

(a) Exhibits

Exhibit No.	Exhibit Index
1.1	Form of Underwriting Agreement
3.1*	Amended and Restated Certificate of Incorporation of the Registrant, as currently in effect
3.2	Certificate of Amendment to the Amended and Restated Certificate of Incorporation of the Registrant, as currently in effect
3.3	Form of Amended and Restated Certificate of Incorporation of the Registrant (to be effective upon the effectiveness of the registration statement for this offering)
3.4	Form of Amended and Restated Certificate of Incorporation of the Registrant (to be effective immediately prior to the completion of this offering)
3.5	Form of Certificate of Retirement of Convertible Preferred Stock of the Registrant (to be effective immediately prior to the completion of this offering)
3.6	Form of Restated Certificate of Incorporation of the Registrant (to be effective upon the completion of this offering)
3.7*	Bylaws of the Registrant, as currently in effect
3.8	Form of Amended and Restated Bylaws (to be effective upon the completion of this offering)
4.1	Specimen Stock Certificate evidencing shares of common stock

Exhibit No.	Exhibit Index
4.2*	Fifth Amended and Restated Investors' Rights Agreement among the Registrant and certain of its stockholders, dated November 30, 2018
4.3*	Fifth Amended and Restated Voting Agreement among the Registrant and certain of its stockholders, dated November 30, 2018
4.4*	Fifth Amended and Restated Right of First Refusal and Co-Sale Agreement among the Registrant and certain of its stockholders, dated November 30, 2018, as amended
5.1	Opinion of Goodwin Procter LLP
10.1	2010 Stock Incentive Plan, as amended
10.2	2019 Stock Option and Incentive Plan and forms of award agreements thereunder
10.3	2019 Employee Stock Purchase Plan
10.4	Senior Executive Cash Incentive Bonus Plan
10.5*	Amended and Restated Employment Agreement between the Registrant and William Hinshaw, dated April 18, 2018
10.6*	Amended and Restated Employment Agreement between the Registrant and Thomas Leggett, dated December 14, 2016
10.7*	Amended and Restated Employment Agreement between the Registrant and Stephen Mitchener, dated July 23, 2018
10.8*	Form of Indemnification Agreement between the Registrant and each of its directors
10.9*	Form of Indemnification Agreement between the Registrant and each of its executive officers
10.10	Riverside Technology Center Commercial Lease Agreement between Rivertech Associates II, LLC and the Registrant, dated as of December 28, 2010
10.11	Fifth Lease Extension and Modification Agreement to the Lease Agreement between Rivertech Associates II, LLC and the Registrant, dated as of April 28, 2017
10.12	Loan and Security Agreement among Solar Capital Ltd. and the Lenders thereto and the Registrant, dated as of January 9, 2018
10.13	First Amendment to Loan and Security Agreement, dated October 5, 2018
10.14	Second Amendment to Loan and Security Agreement, dated November 30, 2018
10.15*	Stock Repurchase Agreement between the Registrant and Robert Connelly, effective as of May 31, 2018
10.16	Separation Agreement between the Registrant and Robert Connelly, effective as of May 31, 2018
21.1*	Subsidiaries of the Registrant
23.1	Consent of Deloitte and Touche LLP, Independent Registered Public Accounting Firm
23.2	Consent of Goodwin Procter LLP (included in Exhibit 5.1)
24.1*	Power of Attorney (included on the signature page hereto)

* Previously filed.

(b) Financial Statements Schedules:

Schedules have been omitted because the information required to be set forth therein is not applicable or is shown in the financial statements or notes thereto.

Item 17. Undertakings.

Insofar as indemnification for liabilities arising under the Securities Act of 1933, as amended, or the Act, may be permitted to directors, officers and controlling persons of the Registrant pursuant to the foregoing provisions, or otherwise, the Registrant has been advised that in the opinion of the Securities and Exchange Commission such indemnification is against public policy as expressed in the Act and is therefore unenforceable. In the event that a claim for indemnification against such liabilities (other than the payment by the Registrant of expenses incurred or paid by a director, officer or controlling person of the Registrant in the successful defense of any action, suit or proceeding) is asserted by such director, officer or controlling person in connection with the securities being registered, the Registrant will, unless in the opinion of its counsel the matter has been settled by controlling precedent, submit to a court of appropriate jurisdiction the question whether such indemnification by it is against public policy as expressed in the Act and will be governed by the final adjudication of such issue.

The Registrant hereby undertakes that:

(a) The Registrant will provide to the underwriter at the closing as specified in the underwriting agreement, certificates in such denominations and registered in such names as required by the underwriter to permit prompt delivery to each purchaser.

(b) For purposes of determining any liability under the Securities Act of 1933, as amended, the information omitted from a form of prospectus filed as part of this registration statement in reliance upon Rule 430A and contained in the form of prospectus filed by the Registrant pursuant to Rule 424(b)(1) or (4) or 497(h) under the Securities Act of 1933, as amended, shall be deemed to be part of this registration statement as of the time it was declared effective.

(c) For the purpose of determining any liability under the Securities Act of 1933, as amended, each post-effective amendment that contains a form of prospectus shall be deemed to be a new registration statement relating to the securities offered therein, and the offering of such securities at that time shall be deemed to be the initial bona fide offering thereof.

SIGNATURES

Pursuant to the requirements of the Securities Act of 1933, the registrant has duly caused this Registration Statement on Form S-1 to be signed on its behalf by the undersigned, thereunto duly authorized, in the City of Boston, Massachusetts, on the 30th day of April, 2019.

AXCELLA HEALTH INC.By: /s/ WILLIAM HINSHAW

Name: William Hinshaw
Title: *Chief Executive Officer, President and Director*

Pursuant to the requirements of the Securities Act of 1933, as amended, this Registration Statement has been signed by the following person in the capacities and on the date indicated.

<u>Name</u>	<u>Title</u>	<u>Date</u>
<u>/s/ WILLIAM HINSHAW</u> William Hinshaw	Chief Executive Officer, President and Director (Principal Executive Officer)	April 30, 2019
<u>/s/ THOMAS LEGGETT</u> Thomas Leggett	Senior Vice President of Finance and Chief Financial Officer (Principal Financial and Accounting Officer)	April 30, 2019
<u>*</u> David R. Epstein	Executive Chair	April 30, 2019
<u>*</u> Grégory Behar	Director	April 30, 2019
<u>*</u> David A. Berry, M.D., Ph.D.	Director	April 30, 2019
<u>*</u> William D. Baird III	Director	April 30, 2019
<u>*</u> Stephen Hoge, M.D.	Director	April 30, 2019

<u>Name</u>	<u>Title</u>	<u>Date</u>
* _____ Gary Pisano, Ph.D.	Director	April 30, 2019
* _____ Cristina M. Rondinone, Ph.D.	Director	April 30, 2019
* _____ Christopher A. Viehbacher	Director	April 30, 2019
*By: /s/ THOMAS LEGGETT _____ Thomas Leggett Attorney-in-Fact		

AXCELLA HEALTH, INC.

Shares of Common Stock

Underwriting Agreement

, 2019

Goldman Sachs & Co. LLC
J.P. Morgan Securities LLC
SVB Leerink LLC

As Representatives of the
several Underwriters listed
in Schedule 1 hereto

c/o Goldman Sachs & Co. LLC
200 West Street
New York, New York 10282

c/o J.P. Morgan Securities LLC
383 Madison Avenue
New York, New York 10179

c/o SVB Leerink LLC
1301 Avenue of the Americas, 12th Floor
New York, New York 10019

Ladies and Gentlemen:

Axcella Health, Inc., a Delaware corporation (the “Company”), proposes to issue and sell to the several underwriters listed in Schedule 1 hereto (the “Underwriters”), for whom you are acting as representatives (the “Representatives”), an aggregate of shares of common stock, \$0.001 par value per share, of the Company (the “Underwritten Shares”) and, at the option of the Underwriters, up to an additional shares of common stock of the Company (the “Option Shares”). The Underwritten Shares and the Option Shares are herein referred to as the “Shares”. The shares of common stock of the Company to be outstanding after giving effect to the sale of the Shares are referred to herein as the “Stock”.

The Company hereby confirms its agreement with the several Underwriters concerning the purchase and sale of the Shares, as follows:

1. Registration Statement. The Company has prepared and filed with the Securities and Exchange Commission (the “Commission”) under the Securities Act of 1933, as amended, and the rules and regulations of the Commission thereunder (collectively, the “Securities Act”), a registration statement (File No. 333-230822), including a prospectus, relating to the Shares. Such registration statement, as amended at the time it became effective, including the information, if any, deemed pursuant to Rule 430A, 430B or 430C under the Securities Act to be part of the registration statement at the time of its effectiveness (“Rule 430 Information”), is referred to herein as the “Registration Statement”; and as used herein, the term “Preliminary Prospectus” means each prospectus included in such registration statement (and any amendments thereto) before effectiveness, any prospectus filed with the Commission pursuant to Rule 424(a) under the Securities Act and the prospectus included in the Registration Statement at the time of its effectiveness that omits Rule 430 Information, and the term “Prospectus” means the prospectus in the form first used (or made available upon request of purchasers pursuant to Rule 173 under the Securities Act) in connection with confirmation of sales of the Shares. If the Company has filed an abbreviated registration statement pursuant to Rule 462(b) under the Securities Act (the “Rule 462 Registration Statement”), then any reference herein to the term “Registration Statement” shall be deemed to include such Rule 462 Registration Statement. Capitalized terms used but not defined herein shall have the meanings given to such terms in the Registration Statement and the Prospectus.

At or prior to the Applicable Time (as defined below), the Company had prepared the following information (collectively with the pricing information set forth on Annex A, the “Pricing Disclosure Package”): a Preliminary Prospectus dated April 30, 2019, 2019 and each “free-writing prospectus” (as defined pursuant to Rule 405 under the Securities Act) listed on Annex A hereto.

“Applicable Time” means P.M., New York City time, on , 2019.

2. Purchase of the Shares. (a) The Company agrees to issue and sell the Underwritten Shares to the several Underwriters as provided in this underwriting agreement (this “Agreement”), and each Underwriter, on the basis of the representations, warranties and agreements set forth herein and subject to the conditions set forth herein, agrees, severally and not jointly, to purchase at a price per share of \$ (the “Purchase Price”) from the Company the respective number of Underwritten Shares set forth opposite such Underwriter’s name in Schedule 1 hereto.

In addition, the Company agrees to issue and sell the Option Shares to the several Underwriters as provided in this Agreement, and the Underwriters, on the basis of the representations, warranties and agreements set forth herein and subject to the conditions set forth herein, shall have the option to purchase, severally and not jointly, from the Company the Option Shares at the Purchase Price less an amount per share equal to any dividends or distributions declared by the Company and payable on the Underwritten Shares but not payable on the Option Shares. If any Option Shares are to be purchased, the number of Option Shares to be purchased by each Underwriter shall be the number of Option Shares which bears the same ratio to the aggregate number of Option Shares being purchased as the number of Underwritten Shares set forth opposite the name of such Underwriter in Schedule 1 hereto (or such number increased as set forth in Section 10 hereof) bears to the aggregate number of Underwritten Shares being purchased from the Company by the several Underwriters, subject, however, to such adjustments to eliminate any fractional Shares as the Representatives in their sole discretion shall make.

The Underwriters may exercise the option to purchase Option Shares at any time in whole, or from time to time in part, on or before the thirtieth day following the date of the Prospectus, by written notice from the Representatives to the Company. Such notice shall set forth the aggregate number of Option Shares as to which the option is being exercised and the date and time when the Option Shares are to be delivered and paid for, which may be the same date and time as the Closing Date (as hereinafter defined) but shall not be earlier than the Closing Date nor later than the tenth full business day (as hereinafter defined) after the date of such notice (unless such time and date are postponed in accordance with the provisions of Section 10 hereof). Any such notice shall be given at least two business days prior to the date and time of delivery specified therein.

(b) The Company understands that the Underwriters intend to make a public offering of the Shares as soon after the effectiveness of this Agreement as in the judgment of the Representatives is advisable, and initially to offer the Shares on the terms set forth in the Pricing Disclosure Package. The Company acknowledges and agrees that the Underwriters may offer and sell Shares to or through any affiliate of an Underwriter.

(c) Payment for the Shares shall be made by wire transfer in immediately available funds to the account specified by the Company to the Representatives in the case of the Underwritten Shares, at the offices of Latham & Watkins LLP, 200 Clarendon Street, Boston, Massachusetts 02116, at 10:00 A.M., New York City time, on _____, 2019, or at such other time or place on the same or such other date, not later than the fifth business day thereafter, as the Representatives and the Company may agree upon in writing or, in the case of the Option Shares, on the date and at the time and place specified by the Representatives in the written notice of the Underwriters' election to purchase such Option Shares. The time and date of such payment for the Underwritten Shares is referred to herein as the "Closing Date" and the time and date for such payment for the Option Shares, if other than the Closing Date, is herein referred to as the "Additional Closing Date."

Payment for the Shares to be purchased on the Closing Date or the Additional Closing Date, as the case may be, shall be made against delivery to Goldman Sachs & Co. LLC for the respective accounts of the several Underwriters of the Shares to be purchased on such date with any transfer taxes payable in connection with the sale of such Shares duly paid by the Company. Delivery of the Shares shall be made through the facilities of The Depository Trust Company ("DTC") unless the Representatives shall otherwise instruct. The certificates for the Shares will be made available for inspection and packaging by the Representatives at the office of DTC or its designated custodian not later than 1:00 P.M., New York City time, on the business day prior to the Closing Date or the Additional Closing Date, as the case may be.

(d) The Company acknowledges and agrees that the Representatives and the other Underwriters are acting solely in the capacity of an arm's length contractual counterparty to the Company with respect to the offering of Shares contemplated hereby (including in connection with determining the terms of the offering) and not as a financial advisor or a fiduciary to, or an agent of, the Company or any other person. Additionally, none of the Representatives nor any other Underwriter is advising the Company or any other person as to any legal, tax, investment, accounting or regulatory matters in any jurisdiction. The Company shall consult with their own advisors concerning such matters and shall be responsible for making its own independent investigation and appraisal of the transactions contemplated hereby, and neither the Representatives nor the

Underwriters shall have any responsibility or liability to the Company with respect thereto. Any review by the Representatives or the other Underwriters of the Company, the transactions contemplated hereby or other matters relating to such transactions will be performed solely for the benefit of the Underwriters and shall not be on behalf of the Company.

3. Representations and Warranties of the Company. The Company represents and warrants to each Underwriter that:

(a) *Preliminary Prospectus.* No order preventing or suspending the use of any Preliminary Prospectus has been issued by the Commission, and each Preliminary Prospectus included in the Pricing Disclosure Package, at the time of filing thereof, complied in all material respects with the Securities Act, and no Preliminary Prospectus, at the time of filing thereof, contained any untrue statement of a material fact or omitted to state a material fact necessary in order to make the statements therein, in the light of the circumstances under which they were made, not misleading; provided that the Company makes no representation or warranty with respect to any statements or omissions made in reliance upon and in conformity with information relating to any Underwriter furnished to the Company in writing by such Underwriter through the Representatives expressly for use in any Preliminary Prospectus, it being understood and agreed that the only such information furnished by any Underwriter consists of the information described as such in Section 7(b) hereof.

(b) *Pricing Disclosure Package.* The Pricing Disclosure Package as of the Applicable Time did not, and as of the Closing Date and as of the Additional Closing Date, as the case may be, will not, contain any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements therein, in the light of the circumstances under which they were made, not misleading; provided that the Company makes no representation or warranty with respect to any statements or omissions made in reliance upon and in conformity with information relating to any Underwriter furnished to the Company in writing by such Underwriter through the Representatives expressly for use in such Pricing Disclosure Package, it being understood and agreed that the only such information furnished by any Underwriter consists of the information described as such in Section 7(b) hereof. No statement of material fact included in the Prospectus has been omitted from the Pricing Disclosure Package and no statement of material fact included in the Pricing Disclosure Package that is required to be included in the Prospectus has been omitted therefrom.

(c) *Issuer Free Writing Prospectus.* Other than the Registration Statement, the Preliminary Prospectus and the Prospectus, the Company (including its agents and representatives, other than the Underwriters in their capacity as such) has not prepared, made, used, authorized, approved or referred to and will not prepare, make, use, authorize, approve or refer to any “written communication” (as defined in Rule 405 under the Securities Act) that constitutes an offer to sell or solicitation of an offer to buy the Shares (each such communication by the Company or its agents and representatives (other than a communication referred to in clause (i) below) an “Issuer Free Writing Prospectus”) other than (i) any document not constituting a prospectus pursuant to Section 2(a)(10)(a) of the Securities Act or Rule 134 under the Securities Act or (ii) the documents listed on Annex A hereto,

each electronic road show and any other written communications approved in writing in advance by the Representatives, such approval not to be unreasonably withheld or delayed. Each such Issuer Free Writing Prospectus complies in all material respects with the Securities Act, has been or will be (within the time period specified in Rule 433) filed in accordance with the Securities Act (to the extent required thereby) and does not conflict with the information contained in the Registration Statement or the Pricing Disclosure Package, and, when taken together with any other Issuer Free Writing Prospectus(es) and the Preliminary Prospectus accompanying, or delivered prior to delivery of, such Issuer Free Writing Prospectus, did not, and as of the Closing Date and as of the Additional Closing Date, as the case may be, will not, contain any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements therein, in the light of the circumstances under which they were made, not misleading; provided that the Company makes no representation or warranty with respect to any statements or omissions made in each such Issuer Free Writing Prospectus or Preliminary Prospectus in reliance upon and in conformity with information relating to any Underwriter furnished to the Company in writing by such Underwriter through the Representatives expressly for use in such Issuer Free Writing Prospectus or Preliminary Prospectus, it being understood and agreed that the only such information furnished by any Underwriter consists of the information described as such in Section 7(b) hereof.

(d) *Emerging Growth Company.* From the time of initial confidential submission of the Registration Statement to the Commission (or, if earlier, the first date on which the Company engaged directly or through any person authorized to act on its behalf in any Testing-the-Waters Communication) through the date hereof, the Company has been and is an “emerging growth company,” as defined in Section 2(a) of the Securities Act (an “Emerging Growth Company”). “Testing-the-Waters Communication” means any oral or written communication with potential investors undertaken in reliance on Section 5(d) of the Securities Act.

(e) *Testing-the-Waters Materials.* The Company (i) has not alone engaged in any Testing-the-Waters Communications other than Testing-the-Waters Communications with the consent of the Representatives with entities that are qualified institutional buyers within the meaning of Rule 144A under the Securities Act or institutions that are accredited investors within the meaning of Rule 501 under the Securities Act and (ii) has not authorized anyone other than the Representatives to engage in Testing-the-Waters Communications. The Company reconfirms that the Representatives have been authorized to act on its behalf in undertaking Testing-the-Waters Communications by virtue of a writing substantially in the form of Exhibit A hereto. The Company has not distributed or approved for distribution any Written Testing-the-Waters Communications other than those listed on Annex B hereto. “Written Testing-the-Waters Communication” means any Testing-the-Waters Communication that is a written communication within the meaning of Rule 405 under the Securities Act. Any individual Written Testing-the-Waters Communication does not conflict with the information contained in the Registration Statement or the Pricing Disclosure Package, complied in all material respects with the Securities Act, and when taken together with the Pricing Disclosure Package as of the Applicable Time, did not, and as of the Closing Date and as of the Additional Closing Date, as the case may be, will not, contain any untrue statement of a material fact or omit to state a material fact necessary in

order to make the statements therein, in the light of the circumstances under which they were made, not misleading.

(f) *Registration Statement and Prospectus.* The Registration Statement has been declared effective by the Commission. No order suspending the effectiveness of the Registration Statement has been issued by the Commission, and no proceeding for that purpose or pursuant to Section 8A of the Securities Act against the Company or related to the offering of the Shares has been initiated or, to the knowledge of the Company, threatened by the Commission; as of the applicable effective date of the Registration Statement and any post-effective amendment thereto, the Registration Statement and any such post-effective amendment complied and will comply in all material respects with the applicable requirements of the Securities Act, and did not and will not contain any untrue statement of a material fact or omit to state a material fact required to be stated therein or necessary in order to make the statements therein not misleading; and as of the date of the Prospectus and any amendment or supplement thereto and as of the Closing Date and as of the Additional Closing Date, as the case may be, the Prospectus will comply in all material respects with the applicable requirements of the Securities Act and will not contain any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements therein, in the light of the circumstances under which they were made, not misleading; provided that the Company makes no representation or warranty with respect to any statements or omissions made in reliance upon and in conformity with information relating to any Underwriter furnished to the Company in writing by such Underwriter through the Representatives expressly for use in the Registration Statement and the Prospectus and any amendment or supplement thereto, it being understood and agreed that the only such information furnished by any Underwriter consists of the information described as such in Section 7(b) hereof.

(g) *Financial Statements.* The financial statements (including the related notes thereto) of the Company and its consolidated subsidiaries included in the Registration Statement, the Pricing Disclosure Package and the Prospectus comply in all material respects with the applicable requirements of the Securities Act and present fairly the financial position of the Company and its consolidated subsidiaries as of the dates indicated and the results of their operations and the changes in their cash flows for the periods specified; such financial statements have been prepared in conformity with generally accepted accounting principles (“GAAP”) in the United States applied on a consistent basis throughout the periods covered thereby, except in the case of unaudited financial statements, which are subject to normal year end adjustment and do not contain certain footnotes as permitted by the applicable rules of the Commission, and any supporting schedules included in the Registration Statement present fairly in all material respects the information required to be stated therein; and the other financial information included in the Registration Statement, the Pricing Disclosure Package and the Prospectus has been derived from the accounting records of the Company and its consolidated subsidiaries and presents fairly in all material respects the information shown thereby; no “non-GAAP financial measures” (as such term is defined by the rules and regulations of the Commission) are disclosed in the Registration Statement, the Pricing Disclosure Package or the Prospectus.

(h) *No Material Adverse Change.* Since the date of the most recent financial statements of the Company included in the Registration Statement, the Pricing Disclosure Package and the Prospectus, (i) there has not been any change in the capital stock (other than the issuance of shares of Common Stock upon exercise of stock options and warrants described as outstanding in, and the grant of options and awards under existing equity incentive plans described in, the Registration Statement, the Pricing Disclosure Package and the Prospectus), short-term debt or long-term debt of the Company or any of its subsidiaries, or any dividend or distribution of any kind declared, set aside for payment, paid or made by the Company on any class of capital stock, or any material adverse change, or any development that would reasonably be expected to result in a prospective material adverse change, in or affecting the business, properties, management, financial position, stockholders' equity, results of operations or prospects of the Company and its subsidiaries taken as a whole; (ii) neither the Company nor any of its subsidiaries has entered into any transaction or agreement (whether or not in the ordinary course of business) that is material to the Company and its subsidiaries taken as a whole or incurred any liability or obligation, direct or contingent, that is material to the Company and its subsidiaries taken as a whole; and (iii) neither the Company nor any of its subsidiaries has sustained any loss or interference with its business that is material to the Company and its subsidiaries taken as a whole and that is either from fire, explosion, flood or other calamity, whether or not covered by insurance, or from any labor disturbance or dispute or any action, order or decree of any court or arbitrator or governmental or regulatory authority, except in each case as otherwise disclosed in the Registration Statement, the Pricing Disclosure Package and the Prospectus.

(i) *Organization and Good Standing.* The Company and each of its subsidiaries have been duly organized and are validly existing and in good standing under the laws of their respective jurisdictions of organization, are duly qualified to do business and are in good standing in each jurisdiction in which their respective ownership or lease of property or the conduct of their respective businesses requires such qualification, and have all power and authority necessary to own or hold their respective properties and to conduct the businesses in which they are engaged, except where the failure to be so qualified or in good standing or have such power or authority would not, individually or in the aggregate, have a material adverse effect on the business, properties, management, financial position, stockholders' equity, results of operations or prospects of the Company and its subsidiaries taken as a whole or on the performance by the Company of its obligations under this Agreement (a "Material Adverse Effect"). The Company does not own or control, directly or indirectly, any corporation, association or other entity other than the subsidiaries listed in Exhibit 21 to the Registration Statement. The subsidiaries listed in Schedule 2 to this Agreement are the only significant subsidiaries of the Company.

(j) *Capitalization.* The Company has an authorized capitalization as set forth in the Registration Statement, the Pricing Disclosure Package and the Prospectus under the heading "Capitalization"; all the outstanding shares of capital stock of the Company have been duly and validly authorized and issued and are fully paid and non-assessable and are not subject to any pre-emptive or similar rights; except as described in or expressly contemplated by the Registration Statement, the Pricing Disclosure Package and the Prospectus, there are no outstanding rights (including, without limitation, pre-emptive rights), warrants or options to acquire, or instruments convertible into or exchangeable for, any shares

of capital stock or other equity interest in the Company or any of its subsidiaries, or any contract, commitment, agreement, understanding or arrangement of any kind relating to the issuance of any capital stock of the Company or any such subsidiary, any such convertible or exchangeable securities or any such rights, warrants or options; the capital stock of the Company conforms in all material respects to the description thereof contained in the Registration Statement, the Pricing Disclosure Package and the Prospectus; and all the outstanding shares of capital stock or other equity interests of each subsidiary owned, directly or indirectly, by the Company have been duly and validly authorized and issued, are fully paid and non-assessable and are owned directly or indirectly by the Company, free and clear of any lien, charge, encumbrance, security interest, restriction on voting or transfer or any other claim of any third party.

(k) *Stock Options.* With respect to the stock options (the “Stock Options”) granted pursuant to the stock-based compensation plans of the Company and its subsidiaries (the “Company Stock Plans”), (i) each Stock Option intended to qualify as an “incentive stock option” under Section 422 of the Internal Revenue Code of 1986, as amended (the “Code”) so qualifies, (ii) each grant of a Stock Option was duly authorized no later than the date on which the grant of such Stock Option was by its terms to be effective (the “Grant Date”) by all necessary corporate action, including, as applicable, approval by the board of directors of the Company (or a duly constituted and authorized committee thereof) and any required stockholder approval by the necessary number of votes or written consents, and the award agreement governing such grant (if any) was duly executed and delivered by each party thereto, (iii) each such grant was made in all material respects in accordance with the terms of the Company Stock Plans and all other applicable laws and regulatory rules or requirements, and (iv) each such grant was properly accounted for in accordance with GAAP in the financial statements (including the related notes) of the Company.

(l) *Due Authorization.* The Company has full right, power and authority to execute and deliver this Agreement and to perform its obligations hereunder; and all action required to be taken for the due and proper authorization, execution and delivery by it of this Agreement and the consummation by it of the transactions contemplated hereby has been duly and validly taken.

(m) *Underwriting Agreement.* This Agreement has been duly authorized, executed and delivered by the Company.

(n) *The Shares.* The Shares to be issued and sold by the Company hereunder have been duly authorized by the Company and, when issued and delivered and paid for as provided herein, will be duly and validly issued, will be fully paid and nonassessable and will conform in all material respects to the descriptions thereof in the Registration Statement, the Pricing Disclosure Package and the Prospectus; and the issuance of the Shares is not subject to any preemptive or similar rights.

(o) *Descriptions of the Underwriting Agreement.* This Agreement conforms in all material respects to the description thereof contained in the Registration Statement, the Pricing Disclosure Package and the Prospectus.

8

(p) *No Violation or Default.* Neither the Company nor any of its subsidiaries is (i) in violation of its charter or by-laws or similar organizational documents; (ii) in default, and no event has occurred that, with notice or lapse of time or both, would constitute such a default, in the due performance or observance of any term, covenant or condition contained in any indenture, mortgage, deed of trust, loan agreement or other agreement or instrument to which the Company or any of its subsidiaries is a party or by which the Company or any of its subsidiaries is bound or to which any property or asset of the Company or any of its subsidiaries is subject; or (iii) in violation of any law or statute or any judgment, order, rule or regulation of any court or arbitrator or governmental or regulatory authority, except, in the case of clauses (ii) and (iii) above, for any such default or violation that would not, individually or in the aggregate, have a Material Adverse Effect.

(q) *No Conflicts.* The execution, delivery and performance by the Company of this Agreement, the issuance and sale of the Shares by the Company and the consummation by the Company of the transactions contemplated by this Agreement or the Pricing Disclosure Package and the Prospectus will not (i) conflict with or result in a breach or violation of any of the terms or provisions of, or constitute a default under, result in the termination, modification or acceleration of, or result in the creation or imposition of any lien, charge or encumbrance upon any property, right or asset of the Company or any of its subsidiaries pursuant to, any indenture, mortgage, deed of trust, loan agreement or other agreement or instrument to which the Company or any of its subsidiaries is a party or by which the Company or any of its subsidiaries is bound or to which any property, right or asset of the Company or any of its subsidiaries is subject, (ii) result in any violation of the provisions of the charter or by-laws or similar organizational documents of the Company or any of its subsidiaries or (iii) result in the violation of any law or statute or any judgment, order, rule or regulation of any court or arbitrator or governmental or regulatory authority, except, in the case of clauses (i) and (iii) above, for any such conflict, breach, violation, default, lien, charge or encumbrance that would not, individually or in the aggregate, have a Material Adverse Effect.

(r) *No Consents Required.* No consent, approval, authorization, order, registration or qualification of or with any court or arbitrator or governmental or regulatory authority is required for the execution, delivery and performance by the Company of this Agreement, the issuance and sale of the Shares and the consummation of the transactions contemplated by this Agreement, except for the registration of the Shares under the Securities Act and such consents, approvals, authorizations, orders and registrations or qualifications as may be required by the Financial Industry Regulatory Authority, Inc. (“FINRA”) and under applicable state securities laws in connection with the purchase and distribution of the Shares by the Underwriters.

(s) *Legal Proceedings.* Except as described in the Registration Statement, the Pricing Disclosure Package and the Prospectus, there are no legal, governmental or regulatory investigations, actions, demands, claims, suits, arbitrations, inquiries or proceedings (“Actions”) pending to which the Company or any of its subsidiaries is or may be a party or to which any property of the Company or any of its subsidiaries is or may be the subject that, individually or in the aggregate, if determined adversely to the Company or any of its

9

subsidiaries, could reasonably be expected to have a Material Adverse Effect; no such Actions are threatened or, to the knowledge of the Company, contemplated by any governmental or regulatory authority or threatened by others; and (i) there are no current or pending Actions that are required under the Securities Act to be described in the Registration Statement, the Pricing Disclosure Package or the Prospectus that are not so described in the Registration Statement, the Pricing Disclosure Package and the Prospectus and (ii) there are no statutes, regulations or contracts or other documents that are required under the Securities Act to be filed as exhibits to the Registration Statement or described in the Registration Statement, the Pricing Disclosure Package or the Prospectus that are not so filed as exhibits to the Registration Statement or described in the Registration Statement, the Pricing Disclosure Package and the Prospectus.

(t) *Independent Accountants.* Deloitte & Touche LLP, who have certified certain financial statements of the Company and its subsidiaries, is an independent registered public accounting firm with respect to the Company and its subsidiaries within the applicable rules and regulations adopted by the Commission and the Public Company Accounting Oversight Board (United States) and as required by the Securities Act.

(u) *Title to Real and Personal Property.* The Company and its subsidiaries have good and marketable title in fee simple to, or have valid rights to lease or otherwise use, all items of real and personal property that are material to the respective businesses of the Company and its subsidiaries, in each case free and clear of all liens, encumbrances, claims and defects and imperfections of title except those that (i) do not materially interfere with the use made and proposed to be made of such property by the Company and its subsidiaries or (ii) would not reasonably be expected, individually or in the aggregate, to have a Material Adverse Effect.

(v) *Intellectual Property.* The Company and its subsidiaries own, have valid and enforceable license to, or otherwise have the right to use all patents, patent applications, trademarks (both registered and unregistered), service marks, trade names, trademark registrations, service mark registrations, domain names and other source indicators, copyrights and copyrightable works, know-how, trade secrets, systems, procedures, proprietary or confidential information and all other intellectual property and proprietary rights, including registrations and applications for registration thereof (collectively, "Intellectual Property") which are necessary for or material to the conduct of their respective businesses, or which are described in the Registration Statement, the Pricing Disclosure Package, and the Prospectus as being owned or licensed by them (collectively, "Company Intellectual Property"). To the knowledge of the Company and its subsidiaries, (i) the Company's and its subsidiaries' conduct of their respective businesses does not infringe, misappropriate or otherwise violate any Intellectual Property of any third party; and (ii) the Company Intellectual Property is not being infringed, misappropriated or otherwise violated by any third party. There is no pending or, to the knowledge of the Company or its subsidiaries, threatened action, suit, proceeding or claim by others: (A) challenging the Company's or its subsidiaries rights in or to any Company Intellectual Property, and the Company and its subsidiaries are unaware of any facts which would form a reasonable basis for any such action, suit, proceeding or claim; (B) challenging the validity, enforceability or scope of any Company Intellectual Property, and the Company and its subsidiaries are unaware of any facts which would form a

reasonable basis for any such action, suit, proceeding or claim; or (C) asserting that the Company or any of its subsidiaries infringes or otherwise violates, or would, upon the commercialization of any product or service described in the Registration Statement, the Pricing Disclosure Package or the Prospectus as under development, infringe or violate, any Intellectual Property of third parties, and the Company and its subsidiaries have not received any notice of, and is unaware of any facts which would form a reasonable basis for any such action, suit, proceeding or claim. To the knowledge of the Company and its subsidiaries, the Company and its subsidiaries have complied with the terms of each agreement pursuant to which Company Intellectual Property has been licensed to the Company or any subsidiary, and all such agreements are in full force and effect. To the knowledge of the Company and its subsidiaries, no technology employed by the Company or its subsidiaries has been obtained or is being used by the Company or its subsidiaries in violation of any contractual or legal obligation binding on the Company, its subsidiaries, or any of their officers, directors, employees, or contractors, which violation relates to the breach of a confidentiality obligation, an obligation to assign Intellectual Property to a previous employer, or an obligation otherwise not to use the Intellectual Property of any third party. The product candidates described in the Registration Statement, the Pricing Disclosure Package and the Prospectus as under development by the Company or any subsidiary fall within the scope of the claims of one or more patents or patent applications owned by, or exclusively licensed to, the Company or any subsidiary. To the knowledge of the Company and its subsidiaries, (A) there is no patent or published patent application in the U.S. or other jurisdiction that contains claims that interfere with the issued or pending claims of any patent within the Company Intellectual Property; (B) there is no prior art of which the Company is aware that may render any patent within the Company Intellectual Property invalid or any patent application within the Company Intellectual Property unpatentable; (C) there are no material defects in any of the patents or patent applications included in the Company Intellectual Property; and (D) the duty of candor and good faith as required by the United States Patent and Trademark Office during the prosecution of the United States patents and patent applications within the Company Intellectual Property have been complied with, and in all foreign offices having similar requirements, such requirements have been complied with.

(w) *No Undisclosed Relationships.* No relationship, direct or indirect, exists between or among the Company or any of its subsidiaries, on the one hand, and the directors, officers, stockholders, customers, suppliers or other affiliates of the Company or any of its subsidiaries, on the other, that is required by the Securities Act to be described in each of the Registration Statement and the Prospectus and that is not so described in such documents and in the Pricing Disclosure Package.

(x) *Investment Company Act.* The Company is not and, after giving effect to the offering and sale of the Shares and the application of the proceeds thereof as described in the Registration Statement, the Pricing Disclosure Package and the Prospectus, will not be required to register as an “investment company” or an entity “controlled” by an “investment company” within the meaning of the Investment Company Act of 1940, as amended, and the rules and regulations of the Commission thereunder (collectively, the “Investment Company Act”).

(y) *Taxes.* The Company and its subsidiaries have paid all federal, state, local and foreign taxes and filed all tax returns required to be paid or filed through the date hereof, except where the failure to pay or file any such taxes would not have a Material Adverse Effect; there is no tax deficiency that has been, or would reasonably be expected to be, asserted against the Company or any of its subsidiaries or any of their respective properties or assets and which could have a Material Adverse Effect.

(z) *Licenses and Permits.* The Company and its subsidiaries possess all licenses, sub-licenses, certificates, permits and other authorizations (collectively, “Permits”) issued by, and have made all declarations and filings with or required by, the appropriate federal, state, local or foreign governmental or regulatory authorities, including without limitation, the U.S. Food and Drug Administration or any component thereof (collectively, “Regulatory Authorities”), that are necessary for the ownership or lease of their respective properties or the conduct of their respective businesses as described in each of the Registration Statement, the Pricing Disclosure Package and the Prospectus, except where the failure to possess or make the same would not, individually or in the aggregate, have a Material Adverse Effect. The Company is in compliance with the terms and conditions of all such Permits, except where the failure to comply would not, individually or in the aggregate, reasonably be expected to have a Material Adverse Effect. All of the Permits are valid and in full force and effect. The Company has fulfilled and performed all of its material obligations with respect to the Permits. To the Company’s knowledge, no event has occurred which allows, or after notice or lapse of time would allow, revocation or termination thereof or results in any other material impairment of the rights of the holder of any Permit. Except as described in each of the Registration Statement, the Pricing Disclosure Package and the Prospectus, neither the Company nor any of its subsidiaries has received notice of any revocation or modification of, or notice of any proceedings relating to the revocation or modification of, any such Permit or has any reason to believe that any such Permit will not be renewed in the ordinary course, except where such revocation, modification or nonrenewal would not have a Material Adverse Effect.

(aa) *Compliance with Health Care Laws.* The Company, its or its subsidiaries’ directors, officers, and to the knowledge of the Company, its or its subsidiaries’ employees and agents, are, and at all times have been, in compliance with all health care laws applicable to the Company or its product candidates or activities, including, without limitation, the Federal Food, Drug, and Cosmetic Act (the “FDCA”) (21 U.S.C. § 301 et seq.), the federal Anti-kickback Statute (42 U.S.C. § 1320a-7b(b)), the federal Physician Payments Sunshine Act (42 U.S.C. § 1320a-7h), the civil False Claims Act (31 U.S.C. §§3729 et seq.), all criminal laws relating to health care fraud and abuse, including but not limited to the criminal False Claims Law (42 U.S.C. § 1320a-7b(a)), 18 U.S.C. Sections 286 and 287, and the health care fraud criminal provisions under the U.S. Health Insurance Portability and Accountability Act of 1996 (42 U.S.C. Section 1320d et seq.), as amended by the Health Information Technology for Economic and Clinical Health Act (42 U.S.C. §§ 17921 et seq.), the exclusion laws (42 U.S.C. § 1320a-7), the civil monetary penalties law (42 U.S.C. § 1320a-7a), Medicare (Title XVIII of the Social Security Act), Medicaid (Title XIX of the Social Security Act), the Public Health Service Act (42 U.S.C. § 201 et seq.), any similar local, state or federal laws, and the regulations promulgated pursuant to such laws (collectively, the “Health Care Laws”), except where failure to be so in compliance

have not, and would not reasonably be expected to have a Material Adverse Effect. The Company has not received any FDA Form 483, notice of adverse finding, warning letter, untitled letter or other correspondence or notice from any Regulatory Authority or governmental authority alleging or asserting noncompliance with any Health Care Laws applicable to the Company or its subsidiaries. Neither the Company, nor, to the knowledge of the Company, any of its or its subsidiaries' employees, officers or directors has been excluded, suspended or debarred from participation in any U.S. federal health care program or human clinical research or, is subject to a governmental inquiry, investigation, proceeding, or other similar action that could reasonably be expected to result in debarment, suspension, or exclusion.

(bb) *Studies, Tests, and Trials.* The pre-clinical, clinical (as applicable) and other studies, tests, trials and research conducted by or on behalf of or sponsored by the Company are being and have been conducted in compliance with the experimental protocols established for each study, test, trial or research and in accordance, in all material respects, with the Health Care Laws, including, but not limited to, the FDCA and its applicable implementing regulations at 21 C.F.R. Parts 50, 54, 56, 58, 170 and 312. The published descriptions of the results of such studies, tests and research are accurate and complete in all material respects and fairly present the data derived from such studies, tests and research, and the Company does not have any knowledge of any other studies, tests or research the results of which are materially inconsistent with or otherwise reasonably call into question the results described or referred to in the Registration Statement, the Pricing Disclosure Package or the Prospectus. The Company has not received any notices or other correspondence from any Regulatory Authority with respect to any clinical or pre-clinical studies, tests or research that are, or whose results of which are, described in the Registration Statement, the Pricing Disclosure Package or the Prospectus that require the termination, suspension, or material modification of such studies, tests or research.

(cc) *No Labor Disputes.* No labor disturbance by or dispute with employees of the Company or any of its subsidiaries exists or, to the knowledge of the Company, is contemplated or threatened, and the Company is not aware of any existing or imminent labor disturbance by, or dispute with, the employees of any of its or its subsidiaries' principal suppliers, contractors or customers, except as would not, individually or in the aggregate, have a Material Adverse Effect. Neither the Company nor any of its subsidiaries has received any notice of cancellation or termination with respect to any collective bargaining agreement to which it is a party.

(dd) *Certain Environmental Matters.* (i) The Company and its subsidiaries (x) are in compliance with all, and have not violated any, applicable federal, state, local and foreign laws (including common law), rules, regulations, requirements, decisions, judgments, decrees, orders and other legally enforceable requirements relating to pollution or the protection of human health or safety, the environment, natural resources, hazardous or toxic substances or wastes, pollutants or contaminants (collectively, "Environmental Laws"); (y) have received and are in compliance with all, and have not violated any, permits, licenses, certificates or other authorizations or approvals required of them under any Environmental Laws to conduct their respective businesses; and (z) have not received notice of any actual or potential liability or obligation under or relating to, or any actual or

potential violation of, any Environmental Laws, including for the investigation or remediation of any disposal or release of hazardous or toxic substances or wastes, pollutants or contaminants, and have no knowledge of any event or condition that would reasonably be expected to result in any such notice, and (ii) there are no costs or liabilities associated with Environmental Laws of or relating to the Company or its subsidiaries, except in the case of each of (i) and (ii) above, for any such matter as would not, individually or in the aggregate, reasonably be expected to have a Material Adverse Effect; and (iii) except as described in each of the Registration Statement, Pricing Disclosure Package and the Prospectus, (x) there is no proceeding that is pending, or to the Company's knowledge, contemplated, against the Company or any of its subsidiaries under any Environmental Laws in which a governmental entity is also a party, other than such proceeding regarding which it is reasonably believed no monetary sanctions of \$100,000 or more will be imposed, (y) the Company and its subsidiaries are not aware of any facts or issues regarding compliance with Environmental Laws, or liabilities or other obligations under Environmental Laws or concerning hazardous or toxic substances or wastes, pollutants or contaminants, that could reasonably be expected to have a material effect on the capital expenditures, earnings or competitive position of the Company and its subsidiaries, and (z) none of the Company or its subsidiaries anticipates material capital expenditures relating to any Environmental Laws.

(ee) *Compliance with ERISA.* (i) Each employee benefit plan, within the meaning of Section 3(3) of the Employee Retirement Income Security Act of 1974, as amended ("ERISA"), for which the Company or any member of its "Controlled Group" (defined as any entity, whether or not incorporated, that is under common control with the Company within the meaning of Section 4001(a)(14) of ERISA or any entity that would be regarded as a single employer with the Company under Section 414(b), (c), (m) or (o) of the Code) would have any liability (each, a "Plan") has been maintained in compliance with its terms and the requirements of any applicable statutes, orders, rules and regulations, including but not limited to ERISA and the Code; (ii) no prohibited transaction, within the meaning of Section 406 of ERISA or Section 4975 of the Code, has occurred with respect to any Plan, excluding transactions effected pursuant to a statutory or administrative exemption; (iii) for each Plan that is subject to the funding rules of Section 412 of the Code or Section 302 of ERISA, no Plan has failed (whether or not waived), or is reasonably expected to fail, to satisfy the minimum funding standards (within the meaning of Section 302 of ERISA or Section 412 of the Code) applicable to such Plan; (iv) no Plan is, or is reasonably expected to be, in "at risk status" (within the meaning of Section 303(i) of ERISA) and no Plan that is a "multiemployer plan" within the meaning of Section 4001(a)(3) of ERISA is in "endangered status" or "critical status" (within the meaning of Sections 304 and 305 of ERISA); (v) the fair market value of the assets of each Plan exceeds the present value of all benefits accrued under such Plan (determined based on those assumptions used to fund such Plan); (vi) no "reportable event" (within the meaning of Section 4043(c) of ERISA and the regulations promulgated thereunder) has occurred or is reasonably expected to occur; (vii) each Plan that is intended to be qualified under Section 401(a) of the Code is so qualified, and nothing has occurred, whether by action or by failure to act, which would cause the loss of such qualification; (viii) neither the Company nor any member of the Controlled Group has incurred, nor reasonably expects to incur, any liability under Title IV of ERISA (other than contributions to the Plan or premiums to the Pension Benefit

Guarantee Corporation, in the ordinary course and without default) in respect of a Plan (including a “multiemployer plan” within the meaning of Section 4001(a)(3) of ERISA); and (ix) none of the following events has occurred or is reasonably likely to occur: (A) a material increase in the aggregate amount of contributions required to be made to all Plans by the Company or its Controlled Group affiliates in the current fiscal year of the Company and its Controlled Group affiliates compared to the amount of such contributions made in the Company’s and its Controlled Group affiliates’ most recently completed fiscal year; or (B) a material increase in the Company and its subsidiaries’ “accumulated post-retirement benefit obligations” (within the meaning of Accounting Standards Codification Topic 715-60) compared to the amount of such obligations in the Company and its subsidiaries’ most recently completed fiscal year, except in each case with respect to the events or conditions set forth in (i) through (ix) hereof, as would not, individually or in the aggregate, have a Material Adverse Effect.

(ff) *Disclosure Controls.* The Company and its subsidiaries maintain an effective system of “disclosure controls and procedures” (as defined in Rule 13a-15(e) of the Securities Exchange Act of 1934, as amended (together with all rules and regulations of the Commission thereunder (the “Exchange Act”)) that complies with the requirements of the Exchange Act and that has been designed to ensure that information required to be disclosed by the Company in reports that it will file or submit under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in the Commission’s rules and forms, including controls and procedures designed to ensure that such information is accumulated and communicated to the Company’s management as appropriate to allow timely decisions regarding required disclosure. The Company and its subsidiaries have carried out evaluations of the effectiveness of their disclosure controls and procedures as required by Rule 13a-15 of the Exchange Act.

(gg) *Accounting Controls.* The Company and its subsidiaries maintain systems of “internal control over financial reporting” (as defined in Rule 13a-15(f) of the Exchange Act) that comply with the requirements of the Exchange Act and have been designed by, or under the supervision of, their respective principal executive and principal financial officers, or persons performing similar functions, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with GAAP. The Company and its subsidiaries maintain internal accounting controls sufficient to provide reasonable assurance that (i) transactions are executed in accordance with management’s general or specific authorizations; (ii) transactions are recorded as necessary to permit preparation of financial statements in conformity with GAAP and to maintain asset accountability; (iii) access to assets is permitted only in accordance with management’s general or specific authorization; and (iv) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action is taken with respect to any differences. There are no material weaknesses in the Company’s internal controls. The Company’s auditors and the Audit Committee of the Board of Directors of the Company have been advised of: (i) all significant deficiencies and material weaknesses in the design or operation of internal controls over financial reporting which have adversely affected or are reasonably likely to adversely affect the Company’s ability to record, process, summarize and report financial information; and (ii) to

the knowledge of the Company, any fraud, whether or not material, that involves management or other employees who have a significant role in the Company's internal controls over financial reporting.

(hh) *Cybersecurity.* (i)(x) To the Company's knowledge, there has been no material security breach or other compromise of or relating to any of the Company's or its subsidiaries' information technology and computer systems, networks, hardware, software, data (including the data of their respective customers, employees, suppliers, vendors and any third party data maintained by or on behalf of them), equipment or technology (collectively, "IT Systems and Data") and (y) the Company and its subsidiaries have not been notified of, and have no knowledge of any event or condition that would reasonably be expected to result in, any material security breach or other compromise to their IT Systems and Data; (ii) the Company and its subsidiaries are presently in compliance with all applicable laws or statutes and all judgments, orders, rules and regulations of any court or arbitrator or governmental or regulatory authority, internal policies and contractual obligations relating to the privacy and security of IT Systems and Data and to the protection of such IT Systems and Data from unauthorized use, access, misappropriation or modification, except as would not, in the case of this clause (ii), individually or in the aggregate, have a Material Adverse Effect; and (iii) the Company and its subsidiaries have implemented backup and disaster recovery technology consistent with industry standards and practices.

(ii) *Insurance.* The Company and its subsidiaries have insurance covering their respective properties, operations, personnel and businesses, including business interruption insurance, which insurance is in amounts and insures against such losses and risks as are generally maintained by similarly situated companies and which the Company believes are reasonably adequate to protect the Company and its subsidiaries and their respective businesses; and neither the Company nor any of its subsidiaries has (i) received notice from any insurer or agent of such insurer that capital improvements or other expenditures are required or necessary to be made in order to continue such insurance or (ii) knowledge of any events that have occurred, or circumstances that exist, with respect to the Company that would cause it to be unable to renew its existing insurance coverage as and when such coverage expires or to obtain similar coverage at reasonable cost from similar insurers as may be necessary to continue its business.

(jj) *No Unlawful Payments.* Neither the Company nor any of its subsidiaries nor any director, officer or employee of the Company or any of its subsidiaries or affiliates nor, to the knowledge of the Company, any agent, affiliate or other person associated with or acting on behalf of the Company or any of its subsidiaries or affiliates (i) has used any corporate funds for any unlawful contribution, gift, entertainment or other unlawful expense relating to political activity; (ii) has made or taken an act in furtherance of an offer, promise or authorization of any direct or indirect unlawful payment or benefit to any foreign or domestic government official or employee, including of any government-owned or controlled entity or of a public international organization, or any person acting in an official capacity for or on behalf of any of the foregoing, or any political party or party official or candidate for political office; (iii) has violated or is in violation of any provision of the Foreign Corrupt Practices Act of 1977, as amended, or any applicable law or regulation implementing the OECD Convention on Combating Bribery of Foreign Public Officials in

16

International Business Transactions, or has committed an offence under the Bribery Act 2010 of the United Kingdom, or any other applicable anti-bribery or anti-corruption law; or (iv) has made, offered, agreed, requested or taken an act in furtherance of any unlawful bribe or other unlawful benefit, including, without limitation, any rebate, payoff, influence payment, kickback or other unlawful or improper payment or benefit. The Company and its subsidiaries and affiliates have conducted their businesses in compliance with applicable anti-corruption laws and have instituted, maintain and enforce, and will continue to maintain and enforce policies and procedures designed to promote and ensure compliance with all applicable anti-bribery and anti-corruption laws. Neither the Company nor its subsidiaries will use, directly or indirectly, the proceeds of the offering in furtherance of an offer, payment, promise to pay, or authorization of the payment or giving of money, or anything else of value, to any person in violation of any applicable anti-corruption laws.

(kk) *Compliance with Anti-Money Laundering Laws.* The operations of the Company and its subsidiaries are and have been conducted at all times in compliance with financial recordkeeping and reporting requirements applicable to such entities, including those of the Currency and Foreign Transactions Reporting Act of 1970, as amended, the applicable money laundering statutes of all jurisdictions where the Company or any of its subsidiaries conducts business, the rules and regulations thereunder and any related or similar rules, regulations or guidelines applicable to such entities, issued, administered or enforced by any governmental agency (collectively, the "Anti-Money Laundering Laws"), and no action, suit or proceeding by or before any court or governmental agency, authority or body or any arbitrator involving the Company or any of its subsidiaries with respect to the Anti-Money Laundering Laws is pending or, to the knowledge of the Company, threatened.

(ll) *No Conflicts with Sanctions Laws.* Neither the Company nor any of its subsidiaries, directors, officers or employees, nor, to the knowledge of the Company, any agent, affiliate or other person associated with or acting on behalf of the Company or any of its subsidiaries is, or is owned or controlled by one or more Persons that is, (i) currently the subject or the target of any sanctions administered or enforced by the U.S. government (including, without limitation, the Office of Foreign Assets Control of the U.S. Department of the Treasury ("OFAC") or the U.S. Department of State and including, without limitation, the designation as a "specially designated national" or "blocked person"), the United Nations Security Council ("UNSC"), the European Union, Her Majesty's Treasury ("HMT") or other relevant sanctions authority (collectively, "Sanctions"), nor (ii) located, organized or resident in a country or territory that is the subject or target of Sanctions, including, without limitation, Crimea, Cuba, Iran, North Korea and Syria (each, a "Sanctioned Country"); and the Company will not directly or indirectly use the proceeds of the offering of the Shares hereunder, or lend, contribute or otherwise make available such proceeds to any subsidiary, joint venture partner or other person or entity (i) to fund or facilitate any activities of or business with any person that, at the time of such funding or facilitation, is the subject or target of Sanctions, (ii) to fund or facilitate any activities of or business in any Sanctioned Country or (iii) in any other manner that will result in a violation by any person (including any person participating in the transaction, whether as underwriter, advisor, investor or otherwise) of Sanctions. For the past five years, the Company

17

and its subsidiaries have not knowingly engaged in and are not now knowingly engaged in any dealings or transactions with any person that at the time of the dealing or transaction is or was the subject or the target of Sanctions or with any Sanctioned Country.

(mm) *No Restrictions on Subsidiaries.* No subsidiary of the Company is currently prohibited, directly or indirectly, under any agreement or other instrument to which it is a party or is subject, from paying any dividends to the Company, from making any other distribution on such subsidiary's capital stock or similar ownership interest, from repaying to the Company any loans or advances to such subsidiary from the Company or from transferring any of such subsidiary's properties or assets to the Company or any other subsidiary of the Company.

(nn) *No Broker's Fees.* Neither the Company nor any of its subsidiaries is a party to any contract, agreement or understanding with any person (other than this Agreement) that would give rise to a valid claim against any of them or any Underwriter for a brokerage commission, finder's fee or like payment in connection with the offering and sale of the Shares.

(oo) *No Registration Rights.* No person has the right to require the Company or any of its subsidiaries to register any securities for sale under the Securities Act by reason of the filing of the Registration Statement with the Commission or the issuance and sale of the Shares by the Company.

(pp) *No Stabilization.* Neither the Company nor any of its subsidiaries has taken, directly or indirectly, any action designed to or that could reasonably be expected to cause or result in any stabilization or manipulation of the price of the Shares.

(qq) *Margin Rules.* Neither the issuance, sale and delivery of the Shares nor the application of the proceeds thereof by the Company as described in each of the Registration Statement, the Pricing Disclosure Package and the Prospectus will violate Regulation T, U or X of the Board of Governors of the Federal Reserve System or any other regulation of such Board of Governors.

(rr) *Forward-Looking Statements.* No forward-looking statement (within the meaning of Section 27A of the Securities Act and Section 21E of the Exchange Act) included or incorporated by reference in any of the Registration Statement, the Pricing Disclosure Package or the Prospectus has been made or reaffirmed without a reasonable basis or has been disclosed other than in good faith.

(ss) *Statistical and Market Data.* Nothing has come to the attention of the Company that has caused the Company to believe that the statistical and market-related data included in each of the Registration Statement, the Pricing Disclosure Package and the Prospectus is not based on or derived from sources that are reliable and accurate in all material respects.

(tt) *Sarbanes-Oxley Act.* There is and has been no failure on the part of the Company or any of the Company's directors or officers, in their capacities as such, to comply with any applicable provision of the Sarbanes-Oxley Act of 2002, as amended and the

rules and regulations promulgated in connection therewith (the “Sarbanes-Oxley Act”), including Section 402 related to loans and Sections 302 and 906 related to certifications.

(uu) *Status under the Securities Act.* At the time of filing the Registration Statement and any post-effective amendment thereto, at the earliest time thereafter that the Company or any offering participant made a *bona fide* offer (within the meaning of Rule 164(h)(2) under the Securities Act) of the Shares and at the date hereof, the Company was not and is not an “ineligible issuer,” as defined in Rule 405 under the Securities Act.

(vv) *No Ratings.* There are (and prior to the Closing Date, will be) no debt securities or preferred stock issued or guaranteed by the Company or any of its subsidiaries that are rated by a “nationally recognized statistical rating organization”, as such term is defined in Section 3(a)(62) under the Exchange Act.

4. Further Agreements of the Company. The Company covenants and agrees with each Underwriter that:

(a) *Required Filings.* The Company will file the final Prospectus with the Commission within the time periods specified by Rule 424(b) and Rule 430A, 430B or 430C under the Securities Act, will file any Issuer Free Writing Prospectus to the extent required by Rule 433 under the Securities Act; and the Company will furnish copies of the Prospectus and each Issuer Free Writing Prospectus (to the extent not previously delivered) to the Underwriters in New York City prior to 10:00 A.M., New York City time, on the business day next succeeding the date of this Agreement in such quantities as the Representatives may reasonably request.

(b) *Delivery of Copies.* The Company will deliver, without charge, (i) to the Representatives, five signed copies of the Registration Statement as originally filed and each amendment thereto, in each case including all exhibits and consents filed therewith; and (ii) to each Underwriter (A) a conformed copy of the Registration Statement as originally filed and each amendment thereto (without exhibits) and (B) during the Prospectus Delivery Period (as defined below), as many copies of the Prospectus (including all amendments and supplements thereto and each Issuer Free Writing Prospectus) as the Representatives may reasonably request. As used herein, the term “Prospectus Delivery Period” means such period of time after the first date of the public offering of the Shares as in the opinion of counsel for the Underwriters a prospectus relating to the Shares is required by law to be delivered (or required to be delivered but for Rule 172 under the Securities Act) in connection with sales of the Shares by any Underwriter or dealer.

(c) *Amendments or Supplements, Issuer Free Writing Prospectuses.* Before making, preparing, using, authorizing, approving, referring to or filing any Issuer Free Writing Prospectus, and before filing any amendment or supplement to the Registration Statement, the Pricing Disclosure Package or the Prospectus, the Company will furnish to the Representatives and counsel for the Underwriters a copy of the proposed Issuer Free Writing Prospectus, amendment or supplement for review and will not make, prepare, use, authorize, approve, refer to or file any such Issuer Free Writing Prospectus or file any such proposed amendment or supplement to which the Representatives reasonably objects.

(d) *Notice to the Representatives.* The Company will advise the Representatives promptly, and confirm such advice in writing (which confirmation may be delivered by electronic mail), (i) when the Registration Statement has become effective; (ii) when any amendment to the Registration Statement has been filed or becomes effective; (iii) when any supplement to the Pricing Disclosure Package, the Prospectus, any Issuer Free Writing Prospectus or any Written Testing-the-Waters Communication or any amendment to the Prospectus has been filed or distributed; (iv) of any request by the Commission for any amendment to the Registration Statement or any amendment or supplement to the Prospectus or the receipt of any comments from the Commission relating to the Registration Statement or any other request by the Commission for any additional information including, but not limited to, any request for information concerning any Testing-the-Waters Communication; (v) of the issuance by the Commission or any other governmental or regulatory authority of any order suspending the effectiveness of the Registration Statement or preventing or suspending the use of any Preliminary Prospectus, any of the Pricing Disclosure Package, the Prospectus or any Written Testing-the-Waters Communication or the initiation or, to the Company's knowledge, threatening of any proceeding for that purpose or pursuant to Section 8A of the Securities Act; (vi) of the occurrence of any event or development within the Prospectus Delivery Period as a result of which the Prospectus, any of the Pricing Disclosure Package, any Issuer Free Writing Prospectus or any Written Testing-the-Waters Communication as then amended or supplemented would include any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements therein, in the light of the circumstances existing when the Prospectus, the Pricing Disclosure Package, any such Issuer Free Writing Prospectus or any such Written Testing-the-Waters Communication is delivered to a purchaser, not misleading; and (vii) of the receipt by the Company of any notice with respect to any suspension of the qualification of the Shares for offer and sale in any jurisdiction or the initiation or, to the Company's knowledge, threatening of any proceeding for such purpose; and the Company will use its reasonable best efforts to prevent the issuance of any such order suspending the effectiveness of the Registration Statement, preventing or suspending the use of any Preliminary Prospectus, any of the Pricing Disclosure Package or the Prospectus or any Written Testing-the-Waters Communication or suspending any such qualification of the Shares and, if any such order is issued, will obtain as soon as possible the withdrawal thereof.

(e) *Ongoing Compliance.* (1) If during the Prospectus Delivery Period (i) any event or development shall occur or condition shall exist as a result of which the Prospectus as then amended or supplemented would include any untrue statement of a material fact or omit to state any material fact necessary in order to make the statements therein, in the light of the circumstances existing when the Prospectus is delivered to a purchaser, not misleading or (ii) it is necessary to amend or supplement the Prospectus to comply with applicable law, the Company will promptly notify the Underwriters thereof and forthwith prepare and, subject to paragraph (c) above, file with the Commission and furnish to the Underwriters and to such dealers as the Representatives may designate such amendments or supplements to the Prospectus as may be necessary so that the statements in the Prospectus as so amended or supplemented will not, in the light of the circumstances existing when the Prospectus is delivered to a purchaser, be misleading or so that the Prospectus will comply with applicable law and (2) if at any time prior to the Closing Date (i) any event or development

shall occur or condition shall exist as a result of which the Pricing Disclosure Package as then amended or supplemented would include any untrue statement of a material fact or omit to state any material fact necessary in order to make the statements therein, in the light of the circumstances existing when the Pricing Disclosure Package is delivered to a purchaser, not misleading or (ii) it is necessary to amend or supplement the Pricing Disclosure Package to comply with applicable law, the Company will promptly notify the Underwriters thereof and forthwith prepare and, subject to paragraph (c) above, file with the Commission (to the extent required) and furnish to the Underwriters and to such dealers as the Representatives may designate, such amendments or supplements to the Pricing Disclosure Package as may be necessary so that the statements in the Pricing Disclosure Package as so amended or supplemented will not, in the light of the circumstances existing when the Pricing Disclosure Package is delivered to a purchaser, be misleading or so that the Pricing Disclosure Package will comply with applicable law.

(f) *Blue Sky Compliance.* The Company will qualify the Shares for offer and sale under the securities or Blue Sky laws of such jurisdictions as the Representatives shall reasonably request and will continue such qualifications in effect so long as required for distribution of the Shares; provided that the Company shall not be required to (i) qualify as a foreign corporation or other entity or as a dealer in securities in any such jurisdiction where it would not otherwise be required to so qualify, (ii) file any general consent to service of process in any such jurisdiction or (iii) subject itself to taxation in any such jurisdiction if it is not otherwise so subject.

(g) *Earning Statement.* The Company will make generally available to its security holders and the Representatives as soon as practicable an earning statement that satisfies the provisions of Section 11(a) of the Securities Act and Rule 158 of the Commission promulgated thereunder covering a period of at least twelve months beginning with the first fiscal quarter of the Company occurring after the “effective date” (as defined in Rule 158) of the Registration Statement; provided that the Company will be deemed to have furnished such statements to its security holders and the Representatives to the extent they are filed on the Commission’s Electronic Data Gathering Analysis and Retrieval system (“EDGAR”) or any successor system.

(h) *Clear Market.* For a period of 180 days after the date of the Prospectus, the Company will not (i) offer, pledge, sell, contract to sell, sell any option or contract to purchase, purchase any option or contract to sell, grant any option, right or warrant to purchase, or otherwise transfer or dispose of, directly or indirectly, or file with, or submit to, the Commission a registration statement under the Securities Act relating to, any shares of Stock or any securities convertible into or exercisable or exchangeable for Stock, or publicly disclose the intention to make any offer, sale, pledge, disposition, submission or filing, or (ii) enter into any swap or other agreement that transfers, in whole or in part, any of the economic consequences of ownership of the Stock or any such other securities, whether any such transaction described in clause (i) or (ii) above is to be settled by delivery of Stock or such other securities, in cash or otherwise, without the prior written consent of the Representatives, other than (A) the Shares to be sold hereunder, (B) any shares of Stock of the Company issued upon the conversion of preferred stock outstanding on the date of this

Agreement in connection with the offering contemplated by this Agreement and as described in the Registration Statement, the Pricing Disclosure Package and the Prospectus, (C) any shares of Stock of the Company issued upon the exercise of options granted under Company Stock Plans described in the Registration Statement, the Pricing Disclosure Package and the Prospectus, (D) any options and other awards granted under a Company Stock Plan described in the Registration Statement, the Pricing Disclosure Package and the Prospectus, (E) the filing by the Company of any registration statement on Form S-8 or a successor form thereto relating to a Company Stock Plan described in the Registration Statement, the Pricing Disclosure Package and the Prospectus and (F) shares of Stock or other securities issued in connection with a transaction with an unaffiliated third party that includes a bona fide commercial relationship (including joint ventures, marketing or distribution arrangements, collaboration agreements, intellectual property license agreements, or lending agreements or arrangements) or any acquisition of assets or acquisition of equity of another entity, provided that the aggregate number of shares issued pursuant to this clause (F) shall not exceed five percent (5%) of the total number of outstanding shares of Stock immediately following the issuance and sale of the Underwritten Shares pursuant hereto; provided further that, in the case of clauses (C), (D) and (F), (x) the Company shall cause each recipient of such shares of Stock or other securities of the Company to execute and deliver, on or prior to the issuance of such shares, a lock-up agreement on substantially the same terms as the lock-up agreements described in Section 6(l) hereof to the extent and for the duration that such terms remain in effect at the time of the transfer, and (y) the Company shall authorize its transfer agent to decline to make any transfer of such shares in violation of such lock-up agreements.

If the Representatives, in their sole discretion, agree to release or waive the restrictions set forth in a lock-up letter described in Section 6(l) hereof for an officer or director of the Company and provide the Company with notice of the impending release or waiver substantially in the form of Exhibit B hereto at least three business days before the effective date of the release or waiver, the Company agrees to announce the impending release or waiver by a press release substantially in the form of Exhibit C hereto through a major news service at least two business days before the effective date of the release or waiver.

(i) *Use of Proceeds.* The Company will apply the net proceeds from the sale of the Shares as described in each of the Registration Statement, the Pricing Disclosure Package and the Prospectus under the heading "Use of proceeds".

(j) *No Stabilization.* The Company will not take, directly or indirectly, any action designed to or that would reasonably be expected to cause or result in any stabilization or manipulation of the price of the Stock.

(k) *Exchange Listing.* The Company will use its reasonable best efforts to list, subject to notice of issuance, the Shares on the Nasdaq Global Market (the "Nasdaq Market").

(l) *Reports.* For a period of two years from the date of this Agreement, so long as the Shares are outstanding, the Company will furnish to the Representatives, as soon as

they are available, copies of all reports or other communications (financial or other) furnished to holders of the Shares, and copies of any reports and financial statements furnished to or filed with the Commission or any national securities exchange or automatic quotation system; provided the Company will be deemed to have furnished such reports and financial statements to the Representatives to the extent they are filed on EDGAR or any successor.

(m) *Record Retention.* The Company will, pursuant to reasonable procedures developed in good faith, retain copies of each Issuer Free Writing Prospectus that is not filed with the Commission in accordance with Rule 433 under the Securities Act.

(n) *Filings.* The Company will file with the Commission such reports as may be required by Rule 463 under the Securities Act.

(o) *Emerging Growth Company.* The Company will promptly notify the Representatives if the Company ceases to be an Emerging Growth Company at any time prior to the later of (i) completion of the distribution of Shares within the meaning of the Securities Act and (ii) completion of the 180-day restricted period referred to in Section 4(h) hereof.

5. Certain Agreements of the Underwriters. Each Underwriter hereby represents and agrees that:

(a) It has not and will not use, authorize use of, refer to or participate in the planning for use of, any “free writing prospectus”, as defined in Rule 405 under the Securities Act (which term includes use of any written information furnished to the Commission by the Company and not incorporated by reference into the Registration Statement and any press release issued by the Company) other than (i) a free writing prospectus that contains no “issuer information” (as defined in Rule 433(h)(2) under the Securities Act) that was not included (including through incorporation by reference) in the Preliminary Prospectus or a previously filed Issuer Free Writing Prospectus, (ii) any Issuer Free Writing Prospectus listed on Annex A or prepared pursuant to Section 3(c) or Section 4(c) above (including any electronic road show approved in advance by the Company), or (iii) any free writing prospectus prepared by such underwriter and approved by the Company in advance in writing (each such free writing prospectus referred to in clauses (i) or (iii), an “Underwriter Free Writing Prospectus”).

(b) It has not and will not, without the prior written consent of the Company, use any free writing prospectus that contains the final terms of the Shares unless such terms have previously been included in a free writing prospectus filed with the Commission; provided that Underwriters may use a term sheet substantially in the form of Annex C hereto without the consent of the Company; provided further that any Underwriter using such term sheet shall notify the Company, and provide a copy of such term sheet to the Company, prior to, or substantially concurrently with, the first use of such term sheet.

(c) It is not subject to any pending proceeding under Section 8A of the Securities Act with respect to the offering (and will promptly notify the Company if any such proceeding against it is initiated during the Prospectus Delivery Period).

6. Conditions of Underwriters' Obligations. The obligation of each Underwriter to purchase the Underwritten Shares on the Closing Date or the Option Shares on the Additional Closing Date, as the case may be, as provided herein is subject to the performance by the Company of its covenants and other obligations hereunder and to the following additional conditions:

(a) *Registration Compliance; No Stop Order.* No order suspending the effectiveness of the Registration Statement shall be in effect, and no proceeding for such purpose or pursuant to Section 8A under the Securities Act shall be pending before or threatened by the Commission; the Prospectus and each Issuer Free Writing Prospectus shall have been timely filed with the Commission under the Securities Act (in the case of an Issuer Free Writing Prospectus, to the extent required by Rule 433 under the Securities Act) and in accordance with Section 4(a) hereof; and all requests by the Commission for additional information shall have been complied with to the reasonable satisfaction of the Representatives.

(b) *Representations and Warranties.* The representations and warranties of the Company contained herein shall be true and correct on the date hereof and on and as of the Closing Date or the Additional Closing Date, as the case may be; and the statements of the Company and its officers made in any certificates delivered pursuant to this Agreement shall be true and correct on and as of the Closing Date or the Additional Closing Date, as the case may be.

(c) *No Material Adverse Change.* No event or condition of a type described in Section 3(h) hereof shall have occurred or shall exist, which event or condition is not described in the Pricing Disclosure Package (excluding any amendment or supplement thereto) and the Prospectus (excluding any amendment or supplement thereto) and the effect of which in the judgment of the Representatives makes it impracticable or inadvisable to proceed with the offering, sale or delivery of the Shares on the Closing Date or the Additional Closing Date, as the case may be, on the terms and in the manner contemplated by this Agreement, the Pricing Disclosure Package and the Prospectus.

(d) *Officer's Certificate.* The Representatives shall have received on and as of the Closing Date or the Additional Closing Date, as the case may be, (x) a certificate of the chief financial officer or chief accounting officer of the Company and one additional senior executive officer of the Company who is satisfactory to the Representatives (i) confirming that such officers have carefully reviewed the Registration Statement, the Pricing Disclosure Package and the Prospectus and, to the knowledge of such officers, the representations of the Company set forth in Sections 3(b) and 3(f) hereof are true and correct, (ii) confirming that the other representations and warranties of the Company in this Agreement are true and correct and that the Company has complied with all agreements and satisfied all conditions on its part to be performed or satisfied hereunder at or prior to the Closing Date or the Additional Closing Date, as the case may be, and (iii) to the effect set forth in paragraphs (a) and (c) above.

24

(e) *Comfort Letters and CFO Certificates.* (i) On the date of this Agreement and on the Closing Date or the Additional Closing Date, as the case may be, Deloitte & Touche LLP shall have furnished to the Representatives, at the request of the Company, letters, dated the respective dates of delivery thereof and addressed to the Underwriters, in form and substance reasonably satisfactory to the Representatives, containing statements and information of the type customarily included in accountants' "comfort letters" to underwriters with respect to the financial statements and certain financial information contained in each of the Registration Statement, the Pricing Disclosure Package and the Prospectus; provided that the letter delivered on the Closing Date or the Additional Closing Date, as the case may be, shall use a "cut-off" date no more than two business days prior to such Closing Date or such Additional Closing Date, as the case may be; and (ii) on the date of this Agreement and on the Closing Date or the Additional Closing Date, as the case may be, the Company shall have furnished to the Representatives a certificate, dated the respective dates of delivery thereof and addressed to the Underwriters, of its chief financial officer with respect to certain financial data contained in the Pricing Disclosure Package and the Prospectus in form and substance reasonably satisfactory to the Representatives.

(f) *Opinion and 10b-5 Statement of Counsel for the Company.* Goodwin Procter LLP, counsel for the Company, shall have furnished to the Representatives, at the request of the Company, their written opinion and 10b-5 statement, dated the Closing Date or the Additional Closing Date, as the case may be, and addressed to the Underwriters, in form and substance reasonably satisfactory to the Representatives.

(g) *Opinion of Intellectual Property Counsel for the Company.* Lando & Anastasi, LLP, intellectual property counsel for the Company, shall have furnished to the Representatives, at the request of the Company, its written opinion, dated the Closing Date or the Additional Closing Date, as the case may be, and addressed to the Underwriters, in form and substance reasonably satisfactory to the Representatives.

(h) *Opinion and 10b-5 Statement of Counsel for the Underwriters.* The Representatives shall have received on and as of the Closing Date or the Additional Closing Date, as the case may be, an opinion and 10b-5 statement, addressed to the Underwriters, of Latham & Watkins LLP, counsel for the Underwriters, with respect to such matters as the Representatives may reasonably request, and such counsel shall have received such documents and information as they may reasonably request to enable them to pass upon such matters.

(i) *No Legal Impediment to Issuance and/or Sale.* No action shall have been taken and no statute, rule, regulation or order shall have been enacted, adopted or issued by any federal, state or foreign governmental or regulatory authority that would, as of the Closing Date or the Additional Closing Date, as the case may be, prevent the issuance or sale of the Shares by the Company; and no injunction or order of any federal, state or foreign court shall have been issued that would, as of the Closing Date or the Additional

25

Closing Date, as the case may be, prevent the issuance or sale of the Shares by the Company.

(j) *Good Standing.* The Representatives shall have received on and as of the Closing Date or the Additional Closing Date, as the case may be, satisfactory evidence of the good standing of the Company and its subsidiaries in their respective jurisdictions of organization and their good standing in such other jurisdictions as the Representatives may reasonably request, in each case in writing or any standard form of telecommunication from the appropriate governmental authorities of such jurisdictions.

(k) *Exchange Listing.* The Shares to be delivered on the Closing Date or the Additional Closing Date, as the case may be, shall have been approved for listing on the Nasdaq Market, subject to official notice of issuance.

(l) *Lock-up Agreements.* The “lock-up” agreements, each substantially in the form of Exhibit D-1 or Exhibit D-2, as applicable, hereto, between you and certain shareholders, officers and directors of the Company relating to sales and certain other dispositions of shares of Stock or certain other securities, delivered to you on or before the date hereof, shall be in full force and effect on the Closing Date or the Additional Closing Date, as the case may be.

(m) *Certificate Regarding Beneficial Ownership.* On or before the date of this Agreement, the Underwriters shall have received a certificate satisfying the beneficial ownership due diligence requirements of the Financial Crimes Enforcement Network from the Company in form and substance reasonably satisfactory to the Underwriters, along with such additional supporting documentation as the Underwriters have requested in connection with the verification of the foregoing certificate.

(n) *Additional Documents.* On or prior to the Closing Date or the Additional Closing Date, as the case may be, the Company shall have furnished to the Representatives such further certificates and documents as the Representatives may reasonably request.

All opinions, letters, certificates and evidence mentioned above or elsewhere in this Agreement shall be deemed to be in compliance with the provisions hereof only if they are in form and substance reasonably satisfactory to counsel for the Underwriters.

7. Indemnification and Contribution.

(a) *Indemnification of the Underwriters.* The Company agrees to indemnify and hold harmless each Underwriter, its affiliates, directors and officers and each person, if any, who controls such Underwriter within the meaning of Section 15 of the Securities Act or Section 20 of the Exchange Act, from and against any and all losses, claims, damages and liabilities (including, without limitation, reasonably incurred legal fees and other reasonably incurred expenses incurred in connection with any suit, action or proceeding or any claim asserted, as such fees and expenses are incurred), joint or several, that arise out of, or are based upon, (i) any untrue statement or alleged untrue statement of a material fact contained in the Registration Statement or caused by any omission or alleged omission to state therein a material fact required to be stated therein or necessary in order to make the statements therein, not misleading, or (ii) any untrue statement or

alleged untrue statement of a material fact contained in the Prospectus (or any amendment or supplement thereto), any Preliminary Prospectus, any Issuer Free Writing Prospectus, any “issuer information” filed or required to be filed pursuant to Rule 433(d) under the Securities Act, any Written Testing-the-Waters Communication, any road show as defined in Rule 433(h) under the Securities Act (a “road show”) or any Pricing Disclosure Package (including any Pricing Disclosure Package that has subsequently been amended), or caused by any omission or alleged omission to state therein a material fact necessary in order to make the statements therein, in light of the circumstances under which they were made, not misleading, in each case except insofar as such losses, claims, damages or liabilities arise out of, or are based upon, any untrue statement or omission or alleged untrue statement or omission made in reliance upon and in conformity with any information relating to any Underwriter furnished to the Company in writing by such Underwriter through the Representatives expressly for use therein, it being understood and agreed that the only such information furnished by any Underwriter consists of the information described as such in subsection (b) below.

(b) *Indemnification of the Company.* Each Underwriter agrees, severally and not jointly, to indemnify and hold harmless the Company, its directors, its officers who signed the Registration Statement and each person, if any, who controls the Company within the meaning of Section 15 of the Securities Act or Section 20 of the Exchange Act to the same extent as the indemnity set forth in paragraph (a) above, but only with respect to any losses, claims, damages or liabilities that arise out of, or are based upon, any untrue statement or omission or alleged untrue statement or omission made in reliance upon and in conformity with any information relating to such Underwriter furnished to the Company in writing by such Underwriter through the Representatives expressly for use in the Registration Statement, the Prospectus (or any amendment or supplement thereto), any Preliminary Prospectus, any Issuer Free Writing Prospectus, any Written Testing-the-Waters Communication, any road show or any Pricing Disclosure Package (including any Pricing Disclosure Package that has subsequently been amended), it being understood and agreed upon that the only such information furnished by any Underwriter consists of the following information in the Prospectus furnished on behalf of each Underwriter: the concession figures appearing in the third paragraph under the caption “Underwriting” and the information contained in the thirteenth paragraph related to passive market making under the caption “Underwriting”.

(c) *Notice and Procedures.* If any suit, action, proceeding (including any governmental or regulatory investigation), claim or demand shall be brought or asserted against any person in respect of which indemnification may be sought pursuant to the preceding paragraphs of this Section 7, such person (the “Indemnified Person”) shall promptly notify the person against whom such indemnification may be sought (the “Indemnifying Person”) in writing; provided that the failure to notify the Indemnifying Person shall not relieve it from any liability that it may have under the preceding paragraphs of this Section 7 except to the extent that it has been materially prejudiced (through the forfeiture of substantive rights or defenses) by such failure; and provided further that the failure to notify the Indemnifying Person shall not relieve it from any liability that it may have to an Indemnified Person otherwise than under the preceding paragraphs of this Section 7. If any such proceeding shall be brought or asserted against an Indemnified Person and it shall have notified the Indemnifying Person thereof, the Indemnifying Person shall retain counsel reasonably satisfactory to the Indemnified Person (who shall not, without the consent of the Indemnified Person, be counsel to the Indemnifying Person) to represent the Indemnified Person and any others entitled to

indemnification pursuant to this Section that the Indemnifying Person may designate in such proceeding and shall pay the reasonably incurred and documented fees and expenses in such proceeding and shall pay the reasonably incurred and documented fees and expenses of such counsel related to such proceeding, as incurred. In any such proceeding, any Indemnified Person shall have the right to retain its own counsel, but the fees and expenses of such counsel shall be at the expense of such Indemnified Person unless (i) the Indemnifying Person and the Indemnified Person shall have mutually agreed to the contrary; (ii) the Indemnifying Person has failed within a reasonable time to retain counsel reasonably satisfactory to the Indemnified Person; (iii) the Indemnified Person shall have reasonably concluded that there may be legal defenses available to it that are different from or in addition to those available to the Indemnifying Person; or (iv) the named parties in any such proceeding (including any impleaded parties) include both the Indemnifying Person and the Indemnified Person and representation of both parties by the same counsel would be inappropriate due to actual or potential differing interests between them. It is understood and agreed that the Indemnifying Person shall not, in connection with any proceeding or related proceeding in the same jurisdiction, be liable for the fees and expenses of more than one separate firm (in addition to any local counsel) for all Indemnified Persons, and that all such fees and expenses shall be paid or reimbursed as they are incurred. Any such separate firm for any Underwriter, its affiliates, directors and officers and any control persons of such Underwriter shall be designated in writing by the Representatives and any such separate firm for the Company, its directors, its officers who signed the Registration Statement and any control persons of the Company shall be designated in writing by the Company. The Indemnifying Person shall not be liable for any settlement of any proceeding effected without its written consent, but if settled with such consent or if there be a final judgment for the plaintiff, the Indemnifying Person agrees to indemnify each Indemnified Person from and against any loss or liability by reason of such settlement or judgment. Notwithstanding the foregoing sentence, if at any time an Indemnified Person shall have requested that an Indemnifying Person reimburse the Indemnified Person for fees and expenses of counsel as contemplated by this paragraph, the Indemnifying Person shall be liable for any settlement of any proceeding effected without its written consent if (i) such settlement is entered into more than 30 days after receipt by the Indemnifying Person of such request and (ii) the Indemnifying Person shall not have reimbursed the Indemnified Person in accordance with such request prior to the date of such settlement. No Indemnifying Person shall, without the written consent of the Indemnified Person, effect any settlement of any pending or threatened proceeding in respect of which any Indemnified Person is or could have been a party and indemnification could have been sought hereunder by such Indemnified Person, unless such settlement (x) includes an unconditional release of such Indemnified Person, in form and substance reasonably satisfactory to such Indemnified Person, from all liability on claims that are the subject matter of such proceeding and (y) does not include any statement as to or any admission of fault, culpability or a failure to act by or on behalf of any Indemnified Person.

(d) *Contribution.* If the indemnification provided for in paragraphs (a) and (b) above is unavailable to an Indemnified Person or insufficient in respect of any losses, claims, damages or liabilities referred to therein, then each Indemnifying Person under such paragraph, in lieu of indemnifying such Indemnified Person thereunder, shall contribute to the amount paid or payable by such Indemnified Person as a result of such losses, claims, damages or liabilities (i) in such proportion as is appropriate to reflect the relative benefits received by the Company, on the one hand, and the Underwriters, on the other, from the offering of the Shares or (ii) if the allocation provided by clause (i) is not permitted by applicable law, in such proportion as is appropriate to

reflect not only the relative benefits referred to in clause (i) but also the relative fault of the Company, on the one hand, and the Underwriters, on the other, in connection with the statements or omissions that resulted in such losses, claims, damages or liabilities, as well as any other relevant equitable considerations. The relative benefits received by the Company, on the one hand, and the Underwriters, on the other, shall be deemed to be in the same respective proportions as the net proceeds (before deducting expenses) received by the Company from the sale of the Shares and the total underwriting discounts and commissions received by the Underwriters in connection therewith, in each case as set forth in the table on the cover of the Prospectus, bear to the aggregate offering price of the Shares. The relative fault of the Company, on the one hand, and the Underwriters, on the other, shall be determined by reference to, among other things, whether the untrue or alleged untrue statement of a material fact or the omission or alleged omission to state a material fact relates to information supplied by the Company or by the Underwriters, and the parties' relative intent, knowledge, access to information and opportunity to correct or prevent such statement or omission.

(e) *Limitation on Liability.* The Company and the Underwriters agree that it would not be just and equitable if contribution pursuant to paragraph (d) were determined by pro rata allocation (even if the Underwriters were treated as one entity for such purpose) or by any other method of allocation that does not take account of the equitable considerations referred to in paragraph (d) above. The amount paid or payable by an Indemnified Person as a result of the losses, claims, damages and liabilities referred to in paragraph (d) above shall be deemed to include, subject to the limitations set forth above, any reasonably incurred and documented legal or other reasonably incurred and documented expenses incurred by such Indemnified Person in connection with any such action or claim. Notwithstanding the provisions of paragraphs (d) and (e), in no event shall an Underwriter be required to contribute any amount in excess of the amount by which the total underwriting discounts and commissions received by such Underwriter with respect to the offering of the Shares exceeds the amount of any damages that such Underwriter has otherwise been required to pay by reason of such untrue or alleged untrue statement or omission or alleged omission. No person guilty of fraudulent misrepresentation (within the meaning of Section 11(f) of the Securities Act) shall be entitled to contribution from any person who was not guilty of such fraudulent misrepresentation. The Underwriters' obligations to contribute pursuant to paragraphs (d) and (e) are several in proportion to their respective purchase obligations hereunder and not joint.

(f) *Non-Exclusive Remedies.* The remedies provided for in paragraphs (a) through (e) are not exclusive and shall not limit any rights or remedies which may otherwise be available to any Indemnified Person at law or in equity.

8. Effectiveness of Agreement. This Agreement shall become effective as of the date first written above upon the execution and delivery hereof by the parties hereto.

9. Termination. This Agreement may be terminated in the absolute discretion of the Representatives, by notice to the Company, if after the execution and delivery of this Agreement and on or prior to the Closing Date or, in the case of the Option Shares, prior to the Additional Closing Date (i) trading generally shall have been suspended or materially limited on or by any of the New York Stock Exchange or the Nasdaq Market; (ii) trading of any securities issued or guaranteed by the Company shall have been suspended on any exchange or in any over-the-counter market; (iii) a general moratorium on commercial banking activities shall have been declared by

federal or New York State authorities; or (iv) there shall have occurred any outbreak or escalation of hostilities or any change in financial markets or any calamity or crisis, either within or outside the United States, that, in the judgment of the Representatives, is material and adverse and makes it impracticable or inadvisable to proceed with the offering, sale or delivery of the Shares on the Closing Date or the Additional Closing Date, as the case may be, on the terms and in the manner contemplated by this Agreement, the Pricing Disclosure Package and the Prospectus.

10. Defaulting Underwriter.

(a) If, on the Closing Date or the Additional Closing Date, as the case may be, any Underwriter defaults on its obligation to purchase the Shares that it has agreed to purchase hereunder on such date, the non-defaulting Underwriters may in their discretion arrange for the purchase of such Shares by other persons satisfactory to the Company on the terms contained in this Agreement. If, within 36 hours after any such default by any Underwriter, the non-defaulting Underwriters do not arrange for the purchase of such Shares, then the Company shall be entitled to a further period of 36 hours within which to procure other persons satisfactory to the non-defaulting Underwriters to purchase such Shares on such terms. If other persons become obligated or agree to purchase the Shares of a defaulting Underwriter, either the non-defaulting Underwriters or the Company may postpone the Closing Date or the Additional Closing Date, as the case may be, for up to five full business days in order to effect any changes that in the opinion of counsel for the Company or counsel for the Underwriters may be necessary in the Registration Statement and the Prospectus or in any other document or arrangement, and the Company agrees to promptly prepare any amendment or supplement to the Registration Statement and the Prospectus that effects any such changes. As used in this Agreement, the term “Underwriter” includes, for all purposes of this Agreement unless the context otherwise requires, any person not listed in Schedule 1 hereto that, pursuant to this Section 10, purchases Shares that a defaulting Underwriter agreed but failed to purchase.

(b) If, after giving effect to any arrangements for the purchase of the Shares of a defaulting Underwriter or Underwriters by the non-defaulting Underwriters and the Company as provided in paragraph (a) above, the aggregate number of Shares that remain unpurchased on the Closing Date or the Additional Closing Date, as the case may be, does not exceed one-eleventh of the aggregate number of Shares to be purchased on such date, then the Company shall have the right to require each non-defaulting Underwriter to purchase the number of Shares that such Underwriter agreed to purchase hereunder on such date plus such Underwriter’s pro rata share (based on the number of Shares that such Underwriter agreed to purchase on such date) of the Shares of such defaulting Underwriter or Underwriters for which such arrangements have not been made.

(c) If, after giving effect to any arrangements for the purchase of the Shares of a defaulting Underwriter or Underwriters by the non-defaulting Underwriters and the Company as provided in paragraph (a) above, the aggregate number of Shares that remain unpurchased on the Closing Date or the Additional Closing Date, as the case may be, exceeds one-eleventh of the aggregate amount of Shares to be purchased on such date, or if the Company shall not exercise the right described in paragraph (b) above, then this Agreement or, with respect to any Additional Closing Date, the obligation of the Underwriters to purchase Shares on the Additional Closing Date, as the case may be, shall terminate without liability on the part of the non-defaulting Underwriters. Any termination of this Agreement pursuant to this Section 10 shall be without liability

on the part of the Company, except that the Company will continue to be liable for the payment of expenses as set forth in Section 11 hereof and except that the provisions of Section 7 hereof shall not terminate and shall remain in effect.

(d) Nothing contained herein shall relieve a defaulting Underwriter of any liability it may have to the Company or any non-defaulting Underwriter for damages caused by its default.

11. Payment of Expenses.

(a) Whether or not the transactions contemplated by this Agreement are consummated or this Agreement is terminated, the Company will pay or cause to be paid all costs and expenses incident to the performance of its obligations hereunder, including without limitation, (i) the costs incident to the authorization, issuance, sale, preparation and delivery of the Shares and any taxes payable in that connection; (ii) the costs incident to the preparation, printing and filing under the Securities Act of the Registration Statement, the Preliminary Prospectus, any Issuer Free Writing Prospectus, any Pricing Disclosure Package and the Prospectus (including all exhibits, amendments and supplements thereto) and the distribution thereof; (iii) the fees and expenses of the Company's counsel and independent accountants; (iv) the fees and expenses incurred in connection with the registration or qualification and determination of eligibility for investment of the Shares under the laws of such jurisdictions as the Representatives may designate and the preparation, printing and distribution of a Blue Sky Memorandum (including the related reasonable fees and expenses of counsel for the Underwriters if such fees and expenses are required to be incurred); (v) the cost of preparing stock certificates; (vi) the costs and charges of any transfer agent and any registrar; (vii) all expenses and application fees incurred in connection with any filing with, and clearance of the offering by, FINRA (including the related reasonable fees and expenses of counsel for the Underwriters); (viii) all expenses incurred by the Company in connection with any "road show" presentation to potential investors; and (ix) all expenses and application fees related to the listing of the Shares on the Nasdaq Market; provided, however, that the amount payable by the Company pursuant to clauses (iv) and (vii) of this Section 11(a) shall not exceed \$50,000 in the aggregate. Notwithstanding the foregoing, it is understood and agreed that except as expressly provided in Section 7 or Section 11(b) of this Agreement, the Underwriters will pay all of their own costs and expenses, including without limitation, fees and disbursements of their counsel other than for Blue Sky and FINRA matters to the extent expressly provided for in this Section 11(a), transfer taxes on the resale by them of any of the Shares, the transportation and other expenses incurred by or on their behalf in connection with "road show" presentations to potential investors (including 50% of the cost of any aircraft or other transportation chartered in connection with such "road show" that is actually utilized by the Underwriters) and any advertising expenses relating to offers of Shares that they make.

(b) If (i) this Agreement is terminated pursuant to Section 9, (ii) the Company for any reason fails to tender the Shares for delivery to the Underwriters or (iii) the Underwriters decline to purchase the Shares for any reason permitted under this Agreement, the Company agrees to reimburse the Underwriters for all out-of-pocket costs and expenses (including the fees and expenses of their counsel) reasonably incurred by the Underwriters in connection with this Agreement and the offering contemplated hereby. For the avoidance of doubt, it is understood that the Company shall not pay or reimburse any costs, fees or expenses incurred by any Underwriter that defaults on its obligation to purchase the Shares.

12. Persons Entitled to Benefit of Agreement. This Agreement shall inure to the benefit of and be binding upon the parties hereto and their respective successors and the officers and directors and any controlling persons referred to herein and the affiliates of each Underwriter referred to in Section 7 hereof. Nothing in this Agreement is intended or shall be construed to give any other person any legal or equitable right, remedy or claim under or in respect of this Agreement or any provision contained herein. No purchaser of Shares from any Underwriter shall be deemed to be a successor merely by reason of such purchase.

13. Survival. The respective indemnities, rights of contribution, representations, warranties and agreements of the Company and the Underwriters contained in this Agreement or made by or on behalf of the Company or the Underwriters pursuant to this Agreement or any certificate delivered pursuant hereto shall survive the delivery of and payment for the Shares and shall remain in full force and effect, regardless of any termination of this Agreement or any investigation made by or on behalf of the Company or the Underwriters.

14. Certain Defined Terms. For purposes of this Agreement, (a) except where otherwise expressly provided, the term “affiliate” has the meaning set forth in Rule 405 under the Securities Act; (b) the term “business day” means any day other than a day on which banks are permitted or required to be closed in New York City; (c) the term “subsidiary” has the meaning set forth in Rule 405 under the Securities Act; and (d) the term “significant subsidiary” has the meaning set forth in Rule 1-02 of Regulation S-X under the Exchange Act.

15. Compliance with USA Patriot Act. In accordance with the requirements of the USA Patriot Act (Title III of Pub. L. 107-56 (signed into law October 26, 2001)), the Underwriters are required to obtain, verify and record information that identifies their respective clients, including the Company, which information may include the name and address of their respective clients, as well as other information that will allow the Underwriters to properly identify their respective clients.

16. Miscellaneous.

(a) Notices. All notices and other communications hereunder shall be in writing and shall be deemed to have been duly given if mailed or transmitted and confirmed by any standard form of telecommunication. Notices to the Underwriters shall be given to the Representatives c/o Goldman Sachs & Co. LLC, 200 West Street, New York, New York 10282-2198, Attention: Registration Department; c/o J.P. Morgan Securities LLC, 383 Madison Avenue, New York, New York 10179 (fax: (212) 622-8358); Attention: Equity Syndicate Desk; c/o SVB Leerink LLC, One Federal Street, 37th Floor, Boston, Massachusetts 02110, Attention: Jack Fitzgerald; with a copy to Peter N. Handrinos, Latham & Watkins LLP, 200 Clarendon Street, Boston, Massachusetts 02116. Notices to the Company shall be given to it at Axcella Health, Inc., 840 Memorial Drive, Cambridge, Massachusetts 02139; Attention: William Hinshaw with a copy to Kingsley Taft, Goodwin Procter LLP, 100 Northern Avenue, Boston, Massachusetts 02210.

(b) Governing Law. This Agreement and any claim, controversy or dispute arising under or related to this Agreement shall be governed by and construed in accordance with the laws of the State of New York.

(c) *Waiver of Jury Trial.* Each of the parties hereto hereby waives any right to trial by jury in any suit or proceeding arising out of or relating to this Agreement.

(d) *Counterparts.* This Agreement may be signed in counterparts (which may include counterparts delivered by any standard form of telecommunication), each of which shall be an original and all of which together shall constitute one and the same instrument.

(e) *Amendments or Waivers.* No amendment or waiver of any provision of this Agreement, nor any consent or approval to any departure therefrom, shall in any event be effective unless the same shall be in writing and signed by the parties hereto.

(f) *Headings.* The headings herein are included for convenience of reference only and are not intended to be part of, or to affect the meaning or interpretation of, this Agreement.

33

If the foregoing is in accordance with your understanding, please indicate your acceptance of this Agreement by signing in the space provided below.

Very truly yours,

AXCELLA HEALTH, INC.

By: _____

Name: _____

Title: _____

34

Accepted: As of the date first written above

GOLDMAN SACHS & CO. LLC

J.P. MORGAN SECURITIES LLC

SVB LEERINK LLC

For themselves and on behalf of the
several Underwriters listed in Schedule 1 hereto.

GOLDMAN SACHS & CO. LLC

By: _____
Name:
Title:

J.P. MORGAN SECURITIES LLC

By: _____
Name:
Title:

SVB LEERINK LLC

By: _____
Name:
Title:

Underwriter	Number of Underwritten Shares	Number of Option Shares
Goldman Sachs & Co. LLC		
J.P. Morgan Securities LLC		
SVB Leerink LLC		

Total

Significant Subsidiaries

None.

Sch. 2-1

a. **Pricing Disclosure Package**

b. **Pricing Information Provided Orally by Underwriters**

Public Offering Price Per Share: \$

Number of Underwritten Shares Purchased by the Underwriters:

Number of Option Shares:

Written Testing-the-Waters Communications

Company Presentation dated February, 2019

Annex B-1

Pricing Term Sheet**Axcella Health, Inc.
Shares of Common Stock**

Issuer:	Axcella Health, Inc.
Symbol:	AXLA
Size (Pre-Greenshoe):	\$
Total Underwritten Shares Offered by Issuer:	shares of common stock
Option Shares Offered by Issuer:	shares of common stock
Price to Public:	\$
Trade Date:	, 2019
Closing Date:	, 2019
CUSIP No:	05454B 105
Underwriters:	Goldman Sachs & Co. LLC J.P. Morgan Securities LLC SVB Leerink LLC

Annex C-1

Exhibit A

EGC — Testing the waters authorization (to be delivered by the issuer to the Representatives in email or letter form)

In reliance on Section 5(d) of the Securities Act of 1933, as amended (the “Act”), Axcella Health, Inc. (the “Issuer”) hereby authorizes Goldman Sachs & Co. LLC, J.P. Morgan Securities LLC and SVB Leerink LLC (together, the “Representatives”) and their affiliates and respective employees (collectively, “Authorized Persons”) to engage on behalf of the Issuer in oral and written communications with potential investors that are “qualified institutional buyers”, as defined in Rule 144A under the Act, or institutions that are “accredited investors”, as defined in Rule 501 of Regulation D under the Act, to determine whether such investors might have an interest in the Issuer’s contemplated initial public offering (“Testing the Waters Communications”). As previously discussed, it is our and your expectation that, unless otherwise approved by the Issuer or the Representatives, neither the Issuer nor any Authorized Person will send or give to any potential investor any Testing the Waters Communication that is a “written communication” as defined in Rule 405 of the Act, other than such Testing the Waters Communications that are limited to any one or more statements described in Rule 134 under the Act (whether or not reliance on Rule 134 would otherwise be permitted or available under the Act for such Testing the Waters Communication) and/or any customary legal or regulatory legends or disclaimers.

The Issuer represents that, (i) except as disclosed to the Representatives, it has not alone engaged in any Testing-the-Waters Communication and (ii) it has not authorized anyone other than the Representatives to engage in Testing-the-Waters Communications. The Issuer agrees that it shall not authorize any other third party to engage on its behalf in oral or written communications with potential investors without the written consent of the Representatives.

The Issuer represents that it is an “emerging growth company” as defined in Section 2(a)(19) of the Act (“Emerging Growth Company”) and agrees to promptly notify the Representatives in writing if the Issuer hereafter ceases to be an Emerging Growth Company while this authorization is in effect.

Nothing in this authorization is intended to limit or otherwise affect the ability of Authorized Persons to engage in communications in which they could otherwise lawfully engage in the absence of this authorization. This authorization shall remain in effect until the Issuer has provided to the Representatives a written notice revoking this authorization. All notices as described herein shall be sent by email to the attention of Jack Bannister at jack.bannister@gs.com, Henry Portwood at henry.r.portwood@jpmorgan.com and Patrick Morley at patrick.morley@leerink.com.

[Form of Waiver of Lock-up]

Goldman Sachs & Co. LLC
200 West Street
New York, New York 10282

J.P. Morgan Securities LLC
383 Madison Avenue
New York, New York 10179

SVB Leerink LLC
1301 Avenue of the Americas
New York, New York 10019

Axcella Health, Inc.
Public Offering of Common Stock

, 20

[Name and Address of
Officer or Director
Requesting Waiver]

Dear Mr./Ms. [Name]:

This letter is being delivered to you in connection with the offering by Axcella Health, Inc. (the “Company”) of _____ shares of common stock, \$0.001 par value (the “Common Stock”), of the Company and the lock-up agreement dated _____, 2019 (the “Lock-up Letter”), executed by you in connection with such offering, and your request for a [waiver] [release] dated _____, 20____, with respect to _____ shares of Common Stock (the “Shares”).

The Representatives hereby agree to [waive] [release] the transfer restrictions set forth in the Lock-up Letter, but only with respect to the Shares, effective _____, 20____; provided, however, that such [waiver] [release] is conditioned on the Company announcing the impending [waiver] [release] by press release through a major news service at least two business days before effectiveness of such [waiver] [release]. This letter will serve as notice to the Company of the impending [waiver] [release].

Except as expressly [waived] [released] hereby, the Lock-up Letter shall remain in full force and effect.

Yours very truly,

GOLDMAN SACHS & CO. LLC

By: _____
Name:
Title:

J.P. MORGAN SECURITIES LLC

By: _____
Name:
Title:

SVB LEERINK LLC

By: _____
Name:
Title:

cc: Axcella Health, Inc.

[Form of Press Release]**Axcella Health, Inc.****[Date]**

Axcella Health, Inc. (the “Company”) announced today that Goldman Sachs & Co. LLC, J.P. Morgan Securities LLC and SVB Leerink LLC, the lead book-running managers in the Company’s recent public sale of shares of common stock, are [waiving] [releasing] a lock-up restriction with respect to shares of the Company’s common stock held by [certain officers or directors] [an officer or director] of the Company. The [waiver] [release] will take effect on , 20 , and the shares may be sold on or after such date.

This press release is not an offer for sale of the securities in the United States or in any other jurisdiction where such offer is prohibited, and such securities may not be offered or sold in the United States absent registration or an exemption from registration under the United States Securities Act of 1933, as amended.

Exhibit D-1

FORM OF LOCK-UP AGREEMENT FOR STOCKHOLDER ENTITIES
AFFILIATED WITH FLAGSHIP PIONEERING, INC.

, 2019

Goldman Sachs & Co. LLC
J.P. Morgan Securities LLC
SVB Leerink LLC

As Representatives of
the several Underwriters listed in
Schedule 1 to the Underwriting
Agreement referred to below

c/o Goldman Sachs & Co. LLC
 200 West Street
 New York, New York 10282

c/o J.P. Morgan Securities LLC
 383 Madison Avenue
 New York, New York 10179

c/o SVB Leerink LLC
 1301 Avenue of the Americas, 12th Floor
 New York, New York 10019

Re: Axcella Health, Inc. — Initial Public Offering

Ladies and Gentlemen:

The undersigned understands that you, as Representatives of the several Underwriters, propose to enter into an Underwriting Agreement (the “**Underwriting Agreement**”) with Axcella Health, Inc., a Delaware corporation (the “**Company**”), providing for the initial public offering (the “**Public Offering**”) by the several Underwriters named in Schedule 1 to the Underwriting Agreement (the “**Underwriters**”), of shares (the “**Shares**”) of the common stock, par value \$0.001 per share, of the Company (the “**Common Stock**”). If more than one entity executes this agreement, this agreement shall constitute a separate agreement with respect to each such entity as the “undersigned,” and the rights and obligations of each such entity hereunder shall be several and not joint. Capitalized terms used herein and not otherwise defined shall have the meanings set forth in the Underwriting Agreement. “**Representatives**” means, collectively, Goldman Sachs & Co. LLC, J.P. Morgan Securities LLC and SVB Leerink LLC.

To induce the Underwriters that may participate in the Public Offering to continue their efforts in connection with the Public Offering, the undersigned hereby agrees that, without the prior written consent of the Representatives on behalf of the Underwriters, it will not, during the period commencing on the date of the initial public filing of the preliminary prospectus relating to the Public Offering and ending 180 days after the date of the final prospectus (the “**Restricted Period**”) relating to the Public Offering (the “**Prospectus**”), (1) offer, pledge, sell, contract to sell, sell any option or contract to purchase, purchase any option or contract to sell, grant any option, right or warrant to purchase, or otherwise transfer or dispose of, directly or indirectly, any shares of Common Stock or any securities convertible into or exercisable or exchangeable for Common Stock beneficially owned (as such term is used in Rule 13d-3 of the Securities Exchange Act of 1934, as amended (the “**Exchange Act**”)) by the undersigned (including without limitation, shares of Common Stock and other securities convertible into or exercisable or exchangeable for Common Stock, in each case, that are issued or issuable upon exercise of a stock option or warrant so owned), or publicly disclose the intention to make any offer, sale, pledge or disposition, (2) enter into any swap or other agreement that transfers, in whole or in part, any of the economic consequences of ownership of the Common Stock or such other securities described in clause (1) above, whether any such transaction described in clause (1) or (2) above is to be settled by delivery of Common Stock or such other securities, in cash or otherwise.

The foregoing sentence shall not apply to:

- (a) transactions relating to shares of Common Stock or other securities acquired in the Public Offering (other than any issuer-directed shares of Common Stock purchased in the Public Offering by an officer or director of the Company) or in open market transactions after the pricing of the Public Offering; provided that such transfers are not required to be reported with the SEC on Form 4 in accordance with Section 16 under the Exchange Act and no other public announcement shall be voluntarily made in connection with subsequent sales of Common Stock or other securities acquired in such open market transactions (other than Schedule 13 filings filed with the SEC);
- (b) transfers of shares of Common Stock or any security convertible into Common Stock as a bona fide gift, or to a charitable organization or educational institution in a transaction not involving a disposition for value;
- (c) transfers or dispositions of shares of Common Stock or other securities to any member of the immediate family of the undersigned or any trust for the direct or indirect benefit of the undersigned or the immediate family of the undersigned in a transaction not involving a disposition for value;
- (d) transfers or dispositions of shares of Common Stock or other securities to any corporation, partnership, limited liability company, investment fund or other entity all of the beneficial ownership interests of which are held, controlled or managed by the undersigned or the immediate family of the undersigned in a transaction not involving a disposition for value;
- (e) transfers or dispositions of shares of Common Stock or other securities (x) by will, other testamentary document or intestate succession to the legal representative, heir, beneficiary or a member of the immediate family of the undersigned upon the death

of the undersigned, or (y) by operation of law pursuant to orders of a court or regulatory agency, a domestic order or negotiated divorce settlement; or

(f) if the undersigned is an entity, (x) transfers or dispositions of shares of Common Stock or other securities to another corporation, member, partnership, limited liability company, trust or other entity that is a direct or indirect affiliate (as defined under Rule 12b-2 of the Exchange Act) of the undersigned, or to an investment fund or other entity that controls or manages, or is under common control with, the undersigned, or (y) distributions of shares of Common Stock or any security convertible into Common Stock to partners, members, stockholders, beneficiaries or other equity holders of the undersigned;

provided that in the case of any transfer, disposition or distribution pursuant to clause (b), (c), (d), (e) or (f), (i) each transferee, donee or distributee shall sign and deliver a lock-up agreement substantially in the form of this agreement and (ii) such transfer, disposition or distribution is not required to be reported with the SEC on Form 4 in accordance with Section 16 under the Exchange Act and no other public announcement shall be voluntarily made during the Restricted Period (other than, (1) Schedule 13 filings filed with the SEC (2) in the case of a transfer or other disposition pursuant to clause (e) above, any Form 4 or Form 5 required to be filed under the Exchange Act if the undersigned is subject to Section 16 reporting with respect to the Company under the Exchange Act and indicating by footnote disclosure or otherwise the nature of the transfer or disposition, and (3) any required filings on Form 13F, or Schedule 13G under the Exchange Act);

(g) transfers or dispositions of Common Stock or any security convertible into or exercisable or exchangeable for Common Stock to the Company pursuant to any contractual arrangement in effect on the date of this agreement that provides for the repurchase of the undersigned's Common Stock or other securities by the Company or in connection with the termination of the undersigned's employment with or service to the Company, provided that such transfers or dispositions are not required to be reported with the SEC on Form 4 in accordance with Section 16 under the Exchange Act and no other public announcement shall be voluntarily made during the Restricted Period in connection with any such transfers or dispositions (other than (1) Schedule 13 filings filed with the SEC, and (2) any Form 4 or Form 5 required to be filed under the Exchange Act if the undersigned is subject to Section 16 reporting with respect to the Company under the Exchange Act and indicating by footnote disclosure or otherwise the nature of the transfer or disposition);

(h) transfers or dispositions of shares of Common Stock or other securities to the Company in connection with the conversion of any convertible security into, or the exercise of any option or warrant for, shares of Common Stock; provided that (i) any such shares of Common Stock received by the undersigned shall be subject to the terms of this agreement and (ii) such transfers or dispositions are not required to be reported with the SEC on Form 4 in accordance with Section 16 under the Exchange Act and no other public announcement shall be voluntarily made during the Restricted Period (other than Form 13F and Schedule 13 filings filed with the SEC);

(i) transfers or dispositions of shares of Common Stock or other securities to a nominee or custodian of a person or entity to whom a disposition or transfer would be permissible under clauses (a) through (h) above;

(j) the establishment of a trading plan pursuant to Rule 10b5-1 under the Exchange Act for the transfer of shares of Common Stock, provided that (i) such plan does not provide for the transfer of Common Stock during the Restricted Period and (ii) no filing under the Exchange Act or other public announcement shall be required or shall be voluntarily made during the Restricted Period; or

(k) transfers or dispositions of shares of Common Stock or such other securities pursuant to a bona fide tender offer for shares of the Company's capital stock, merger, consolidation or other similar transaction made to all holders of the Company's securities involving a Change of Control (as defined below) of the Company (including without limitation, the entering into of any lock-up, voting or similar agreement pursuant to which the undersigned may agree to transfer, sell, tender or otherwise dispose of shares of Common Stock or other securities in connection with such transaction) that has been approved by the board of directors of the Company; provided that, in the event that such Change of Control transaction is not consummated, this clause (k) shall not be applicable and the undersigned's shares and other securities shall remain subject to the restrictions contained in this agreement.

For purposes of this agreement, "**immediate family**" shall mean any relationship by blood, marriage, domestic partnership or adoption, not more remote than first cousin, and "**Change of Control**" shall mean the transfer (whether by tender offer, merger, consolidation or other similar transaction), in one transaction or a series of related transactions, to a person or group of affiliated persons (other than an Underwriter pursuant to the Public Offering), of the Company's voting securities if, after such transfer, such person or group of affiliated persons would hold at least 50% of the outstanding voting securities of the Company (or the surviving entity), provided that, for the avoidance of doubt, the Public Offering shall not constitute a Change of Control. In addition, the undersigned agrees that, without the prior written consent of the Representatives on behalf of the Underwriters, it will not, during the Restricted Period, make any demand for or exercise any right with respect to, the registration of any shares of Common Stock or any security convertible into or exercisable or exchangeable for Common Stock; provided that the undersigned may make a demand under any registration rights agreement with the Company described in the Prospectus for, and exercise its rights under any such registration rights agreement with respect to, the registration after the expiration of the Restricted Period of shares of Common Stock that does not require the filing of any registration statement or any public announcement or activity regarding such registration during the Restricted Period (and no such public announcement or activity shall be voluntarily made or taken by the undersigned during the Restricted Period).

The undersigned also agrees and consents to the entry of stop transfer instructions with the Company's transfer agent and registrar against the transfer of the undersigned's shares of Common Stock except in compliance with the foregoing restrictions.

If the undersigned is an officer or director of the Company, the undersigned further agrees that the foregoing provisions shall be equally applicable to any issuer-directed shares of Common Stock the undersigned may purchase in the Public Offering.

In the event that a release is granted to any Major Holder (as defined below) other than the undersigned relating to the lock-up restrictions set forth above for shares of the Company's Common Stock, the same percentage of shares of the Company's Common Stock held by the undersigned (the "**Pro-rata Release**") shall be immediately and fully released on the same terms from any remaining lock-up restrictions set forth herein; provided, however, that such Pro-rata Release shall not be applied in the event of releases granted from such lockup restrictions to any individual party or parties (other than shareholders subject to Section 16 reporting with respect to the Company under the Exchange Act) to sell or otherwise transfer or dispose of shares of the Company's Common Stock or other securities in an amount up to an aggregate of \$2,500,000. In the event that any percentage of such Common Stock released from the lock-up restrictions are subject to any restrictions of the type set forth in clause (1) or (2) of the second paragraph of this agreement, the same restrictions shall be applicable to the release of the same percentage of the Company's Common Stock held by the undersigned. In the event that the undersigned is released from any of its obligations under this agreement or, by virtue of this agreement, becomes entitled to offer, pledge, sell, contract to sell, or otherwise dispose of any Common Stock (or any securities convertible into Common Stock) prior to the date that is 180 days after the date of the Prospectus, the Representatives shall use its commercially reasonable efforts to provide notification of such to the undersigned within three business days thereof; provided that the failure to provide such notice shall not give rise to any claim or liability against the Representatives or the Underwriters. For purposes of this agreement, each of the following persons is a "**Major Holder**": each officer and director of the Company and each record or beneficial owner, as of the date hereof, of more than 1% of the outstanding shares of securities of the Company (for purposes of determining record or beneficial ownership of a stockholder, all shares of securities held by investment funds affiliated with such stockholder shall be aggregated).

If the undersigned is an officer or director of the Company, (i) the Representatives agree that, at least three business days before the effective date of any release or waiver of the foregoing restrictions in connection with a transfer of shares of Common Stock, the Representatives notifies the Company of the impending release or waiver, and (ii) the Company has agreed in the Underwriting Agreement to announce the impending release or waiver by press release through a major news service at least two business days before the effective date of the release or waiver. Any release or waiver granted by the Representatives hereunder to any such officer or director shall only be effective two business days after the publication date of such press release. The provisions of this paragraph will not apply if (a) the release or waiver is effected solely to permit a transfer not for consideration and (b) the transferee has agreed in writing to be bound by the same terms described in this agreement to the extent and for the duration that such terms remain in effect at the time of the transfer.

The undersigned understands that the Company and the Underwriters are relying upon this agreement in proceeding toward consummation of the Public Offering. The undersigned further understands that this agreement is irrevocable and shall be binding upon the undersigned's heirs, legal representatives, successors and assigns.

Whether or not the Public Offering actually occurs depends on a number of factors, including market conditions. Any Public Offering will only be made pursuant to an Underwriting Agreement, the terms of which are subject to negotiation between the Company and the Underwriters.

The undersigned understands that, if (i) the Representatives, on the one hand, or the Company, on the other hand, informs the other in writing, prior to the execution of the Underwriting Agreement, that it has determined not to proceed with the Public Offering, (ii) the Underwriting Agreement (other than the provisions thereof which survive termination) shall terminate or be terminated prior to payment for and delivery of the securities to be sold thereunder, (iii) the registration statement related to the Public Offering is withdrawn or (iv) the Underwriting Agreement is not executed on or before the earlier of (A) July 31, 2019 and (B) the date that is 45 days after the date of the initial public filing of the preliminary prospectus relating to the Public Offering (provided that the Securities and Exchange Commission is actively reviewing and declaring registrations statements effective under normal operating conditions during such 45-day period), then, in each case, this agreement shall automatically, and without any action on the part of any other party, be of no further force and effect, and the undersigned shall be automatically released from all obligations under this agreement.

[Signature Pages Follow]

This Letter Agreement and any claim, controversy or dispute arising under or related to this Letter Agreement shall be governed by and construed in accordance with the laws of the State of New York.

Very truly yours,

By:

Name: _____

Title: _____

7

Exhibit D-2

FORM OF LOCK-UP AGREEMENT FOR DIRECTORS, OFFICERS AND STOCKHOLDERS NOT AFFILIATED WITH FLAGSHIP
PIONEERING, INC.

, 2019

Goldman Sachs & Co. LLC
J.P. SVB Morgan Securities LLC
SBB Leerink LLC

As Representatives of
the several Underwriters listed in
Schedule 1 to the Underwriting
Agreement referred to below

c/o Goldman Sachs & Co. LLC
200 West Street
New York, New York 10282

c/o J.P. Morgan Securities LLC
383 Madison Avenue
New York, New York 10179

c/o SVB Leerink LLC
1301 Avenue of the Americas, 12th Floor
New York, New York 10019

Re: Axcella Health, Inc. — Initial Public Offering

Ladies and Gentlemen:

The undersigned understands that you, as Representatives of the several Underwriters, propose to enter into an underwriting agreement (the “Underwriting Agreement”) with Axcella Health, Inc., a Delaware corporation (the “Company”), providing for the public offering (the “Public Offering”) by the several Underwriters named in Schedule 1 to the Underwriting Agreement (the “Underwriters”), of shares of common stock of the Company (the “Securities”). Capitalized terms used herein and not otherwise defined shall have the meanings set forth in the Underwriting Agreement.

In consideration of the Underwriters’ agreement to purchase and make the Public Offering of the Securities, and for other good and valuable consideration receipt of which is hereby acknowledged, the undersigned hereby agrees that, without the prior written consent of the Representatives on behalf of the Underwriters, the undersigned will not, during the period beginning

8

on the date of this letter agreement (this “Letter Agreement”) and ending one-hundred-eighty (180) days after the date of the prospectus relating to the Public Offering (the “Prospectus”) (such period, the “Restricted Period”), (1) offer, pledge, sell, contract to sell, sell any option or contract to purchase, purchase any option or contract to sell, grant any option, right or warrant to purchase, or otherwise transfer or dispose of, directly or indirectly, any shares of common stock, \$0.001 per share par value, of the Company (the “Common Stock”) or any securities convertible into or exercisable or exchangeable for Common Stock (including without limitation, Common Stock or such other securities which may be deemed to be beneficially owned by the undersigned in accordance with the rules and regulations of the Securities and Exchange Commission and securities which may be issued upon exercise of a stock option or warrant), or publicly disclose the intention to make any offer, sale, pledge or disposition, (2) enter into any swap or other agreement that transfers, in whole or in part, any of the economic consequences of ownership of the Common Stock or such other securities, whether any such transaction described in clause (1) or (2) above is to be settled by delivery of Common Stock or such other securities, in cash or otherwise or (3) make any demand for or exercise any right with respect to the registration of any shares of Common Stock or any security convertible into or exercisable or exchangeable for Common Stock, in each case other than:

(A) transfers of shares of Common Stock or any security convertible into Common Stock as a bona fide gift or gifts, or to a charitable organization or educational institution in a transaction not involving a disposition for value;

(B) transfers, distributions or dispositions of shares of Common Stock to members or stockholders of the undersigned, any member of the immediate family of the undersigned or any trust for the direct or indirect benefit of the undersigned or the immediate family of the undersigned in a transaction not involving a disposition for value;

(C) transactions relating to shares of Common Stock or other securities acquired in the Public Offering (other than any issuer-directed shares of Common Stock purchased in the Public Offering by an officer or director of the Company) or in open market transactions after the pricing of the Public Offering;

(D) transfers or dispositions of shares of Common Stock or other securities to any corporation, partnership, limited liability company or other entity, in each case, all of the beneficial ownership interests of which are held by the undersigned or the immediate family of the undersigned in a transaction not involving a disposition for value;

(E) transfers or dispositions of shares of Common Stock or other securities (x) by will, other testamentary document or intestate succession to the legal representative, heir, beneficiary or a member of the immediate family of the undersigned upon the death of the undersigned, or (y) by operation of law pursuant to a domestic order or negotiated divorce settlement;

provided that in the case of any transfer or distribution pursuant to clause (A), (B), (D) or (E), each donee, distributee or transferee shall execute and deliver to the Representatives a lock-up letter in the form of this Letter Agreement; and provided, further, that in the case of any transfer, distribution or transaction pursuant to clauses (A), (B), (C), (D) or (E), no filing by any party (donor,

donee, transferor or transferee) under the Securities Exchange Act of 1934, as amended (the “Exchange Act”), or other public announcement shall be required or shall be made voluntarily in connection with such transfer or distribution (other than (i) a filing on a Form 5 made after the expiration of the Restricted Period referred to above and (ii) in the case of a transfer or other disposition pursuant to clause (E) above, any Form 4 or Form 5 required to be filed under the Exchange Act if the undersigned is subject to Section 16 reporting with respect to the Company under the Exchange Act and indicating by footnote disclosure or otherwise the nature of the transfer or disposition);

(F) transfers or dispositions of Common Stock or any security convertible into or exercisable or exchangeable for Common Stock to the Company pursuant to any contractual arrangement in effect on the date of this agreement that provides for the repurchase of the undersigned’s Common Stock or other securities by the Company or in connection with the termination of the undersigned’s employment with or service to the Company, provided that no filing by any party under the Exchange Act or other public announcement, reporting a reduction in beneficial ownership of shares of Common Stock, shall be required or shall be voluntarily made during the Restricted Period in connection with any such transfers or dispositions (other than any Form 4 or Form 5 required to be filed under the Exchange Act if the undersigned is subject to Section 16 reporting with respect to the Company under the Exchange Act and indicating by footnote disclosure or otherwise the nature of the transfer or disposition);

(G) transfers or dispositions of shares of Common Stock or other securities to the Company in connection with the conversion of any convertible preferred stock into, or the exercise of any option or warrant for, shares of Common Stock; provided that (i) any such shares of Common Stock received by the undersigned shall be subject to the terms of this agreement and (ii) no filing by any party under the Exchange Act or other public announcement shall be required or shall be made voluntarily during the Restricted Period (other than a filing on a Form 4 that reports such disposition under the transaction code “F”);

(H) transfers or dispositions of shares of Common Stock or other securities to a nominee or custodian of a person or entity to whom a disposition or transfer would be permissible under clauses (A) through (G) above;

(I) the establishment of a trading plan pursuant to Rule 10b5-1 under the Exchange Act for the transfer of shares of Common Stock, provided that (i) such plan does not provide for the transfer of Common Stock during the Restricted Period and (ii) no filing by any party under the Exchange Act or other public announcement shall be required or shall be made voluntarily by or on behalf of the undersigned or the Company in connection with the establishment of such plan; or

(J) transfers or dispositions of shares of Common Stock or such other securities pursuant to a bona fide tender offer for shares of the Company’s capital stock, merger, consolidation or other similar transaction made to all holders of the Company’s securities involving a Change of Control (as defined below) of the Company (including without limitation, the entering into of any lock-up, voting or similar agreement pursuant to which the undersigned may agree to transfer, sell, tender or otherwise dispose of shares of Common Stock or other securities in connection with such transaction) that has been approved by the board of directors of the Company; provided that, in the event that such Change of Control transaction is not consummated, this clause (J) shall not be

applicable and the undersigned's shares and other securities shall remain subject to the restrictions contained in this agreement.

For purposes of this agreement, "immediate family" shall mean any relationship by blood, marriage, domestic partnership or adoption, not more remote than first cousin, and "Change of Control" shall mean the transfer (whether by tender offer, merger, consolidation or other similar transaction), in one transactions or a series of related transactions, to a person or group of affiliated persons (other than an Underwriter pursuant to the Public Offering), of the Company's voting securities if, after such transfer, such person or group of affiliated persons would hold at least 90% of the outstanding voting securities of the Company (or the surviving entity), provided that, for the avoidance of doubt, the Public Offering shall not constitute a Change of Control.

If the undersigned is an officer or director of the Company, the undersigned further agrees that the foregoing provisions shall be equally applicable to any Company-directed Securities the undersigned may purchase in the Public Offering.

If the undersigned is an officer or director of the Company, (i) the Representatives on behalf of the Underwriters agree that, at least three business days before the effective date of any release or waiver of the foregoing restrictions in connection with a transfer of shares of Common Stock, the Representatives on behalf of the Underwriters will notify the Company of the impending release or waiver, and (ii) the Company has agreed in the Underwriting Agreement to announce the impending release or waiver by press release through a major news service at least two business days before the effective date of the release or waiver. Any release or waiver granted by the Representatives on behalf of the Underwriters hereunder to any such officer or director shall only be effective two business days after the publication date of such press release. The provisions of this paragraph will not apply if (a) the release or waiver is effected solely to permit a transfer not for consideration and (b) the transferee has agreed in writing to be bound by the same terms described in this letter to the extent and for the duration that such terms remain in effect at the time of the transfer.

In furtherance of the foregoing, the Company, and any duly appointed transfer agent for the registration or transfer of the securities described herein, are hereby authorized to decline to make any transfer of securities if such transfer would constitute a violation or breach of this Letter Agreement.

The undersigned hereby represents and warrants that the undersigned has full power and authority to enter into this Letter Agreement. All authority herein conferred or agreed to be conferred and any obligations of the undersigned shall be binding upon the successors, assigns, heirs or personal representatives of the undersigned.

The undersigned understands that, if the Underwriting Agreement does not become effective by September 30, 2019, or if the Underwriting Agreement (other than the provisions thereof which survive termination) shall terminate or be terminated prior to payment for and delivery of the Common Stock to be sold thereunder, the undersigned shall be released from all obligations under this Letter Agreement. The undersigned understands that the Underwriters are entering into the Underwriting Agreement and proceeding with the Public Offering in reliance upon this Letter Agreement.

This Letter Agreement and any claim, controversy or dispute arising under or related to this Letter Agreement shall be governed by and construed in accordance with the laws of the State of New York.

Very truly yours,

By: _____
Name:
Title:

**CERTIFICATE OF AMENDMENT
TO THE
AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
AXCELLA HEALTH INC.**

(Pursuant to Section 242 of the
General Corporation Law of the State of Delaware)

Axcella Health Inc. (the “Corporation”), a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware (the “DGCL”), does hereby certify that:

1. The Corporation was originally incorporated on August 27, 2008, under the name Newco LS16, Inc., and its Amended and Restated Certificate of Incorporation was filed with the Secretary of State of Delaware on November 30, 2018 (the “Charter”). Pursuant to Section 242 of the DGCL, this Certificate of Amendment (this “Amendment”) amends certain provisions of the Charter.
2. This Amendment has been approved and duly adopted by the Board of Directors of the Corporation.
3. This Amendment has been duly adopted in accordance with the provisions of Section 242 of the DGCL by written consent of the stockholders holding the requisite number of shares, with written notice to be given as required by Section 228 of the DGCL.
4. The Charter is hereby amended as follows:

The following is hereby inserted into Article FOURTH immediately before the first sentence therein:

“Effective upon the filing of this Certificate of Amendment to the Amended and Restated Certificate of Incorporation with the Secretary of State of the State of Delaware (the “Effective Time”), every 1.842 shares of Common Stock then issued and outstanding or held in the treasury of the Corporation immediately prior to the Effective Time shall automatically be combined into one (1) share of Common Stock, without any further action by the holders of such shares (the “Reverse Stock Split”). The Reverse Stock Split will be effected on a certificate-by-certificate basis, and any fractional shares resulting from such combination shall be rounded down to the nearest whole share on a certificate-by-certificate basis. No fractional shares shall be issued in connection with the Reverse Stock Split. In lieu of any fractional shares to which a holder would otherwise be entitled, the Corporation shall pay cash equal to such fraction multiplied by the fair market value of a share of Common Stock as determined in good faith by the Corporation’s Board of Directors. The Reverse Stock Split shall occur automatically without any further action by the holders of the shares of Common Stock and Preferred Stock affected thereby. All rights, preferences and privileges of the Common Stock and the Preferred Stock shall be

appropriately adjusted to reflect the Reverse Stock Split in accordance with this Amended and Restated Certificate of Incorporation.”

[Remainder of page intentionally left blank]

IN WITNESS WHEREOF, this Amendment, having been duly adopted in accordance with Section 242 of the DGCL, has been duly executed by a duly authorized officer of the corporation on this 29th day of April, 2019.

By: /s/ William R. Hinshaw, Jr.
Name: William R. Hinshaw, Jr.
Title: President and Chief Executive Officer

[Signature Page to Axcella Health Inc. Certificate of Amendment]

AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
AXCELLA HEALTH INC.

Axcella Health Inc., a corporation organized and existing under the laws of the State of Delaware (the “Corporation”), hereby certifies as follows:

1. The name of the Corporation is Axcella Health Inc. The date of the filing of its original Certificate of Incorporation with the Secretary of State of the State of Delaware was August 27, 2008 (the “Original Certificate”). The name under which the Corporation filed the Original Certificate was Newco LS16, Inc.
2. This Amended and Restated Certificate of Incorporation (the “Certificate”) which restates and integrates and also further amends the provisions of the Corporation’s Certificate of Incorporation, as amended and restated, was duly adopted in accordance with the provisions of Sections 242 and 245 of the General Corporation Law of the State of Delaware (the “**DGCL**”) and by the written consent of its stockholders in accordance with Section 228 of the DGCL.
3. The text of the Certificate of the Corporation, as previously amended and restated, is hereby further amended and restated in its entirety as herein set forth in full.

ARTICLE I

The name of the Corporation is Axcella Health Inc.

ARTICLE II

The address of the Corporation’s registered office in the State of Delaware is c/o The Corporation Trust Company, 1209 Orange Street in the City of Wilmington, County of New Castle, 19801. The name of its registered agent at such address is The Corporation Trust Company.

ARTICLE III

The purpose of the Corporation is to engage in any lawful act or activity for which corporations may be organized under the DGCL.

ARTICLE IV

CAPITAL STOCK

The total number of shares of capital stock which the Corporation shall have authority to issue is one hundred eighty-seven million nine hundred twenty-eight thousand eight hundred and

twenty-five (187,928,825) of which (i) one hundred fifty million (150,000,000) shares shall be a class designated as common stock, par value \$0.001 per share (the “Common Stock”), and (ii) thirty-seven million nine hundred twenty-eight thousand eight hundred and twenty-five (37,928,825) shares shall be a class designated as preferred stock, par value \$0.001 per share (the “Preferred Stock”), of which 5,874,334 shares are designated Series A Preferred Stock, 4,737,041 shares are designated Series B Preferred Stock, 1,084,441 shares are designated Series B-1 Preferred Stock, 6,969,044 shares are designated Series C Preferred Stock, 2,997,179 shares are designated Series D Preferred Stock, and 6,266,786 shares are designated Series E Preferred Stock (the “Designated Preferred Stock”) and ten million (10,000,000) shares shall be undesignated preferred stock (together, the “Preferred Stock”).

Except as otherwise provided in any certificate of designations of any series of Preferred Stock, the number of authorized shares of the class of Common Stock or Preferred Stock may from time to time be increased or decreased (but not below the number of shares of such class outstanding) by the affirmative vote of the holders of a majority in voting power of the outstanding shares of capital stock of the Corporation irrespective of the provisions of Section 242(b)(2) of the DGCL.

The powers, preferences and rights of, and the qualifications, limitations and restrictions upon, each class or series of stock shall be determined in accordance with, or as set forth below in, this Article IV except that the powers, preferences and rights of, and the qualifications, limitations and restrictions upon the Designated Preferred Stock are as set forth on Exhibit A. Every reference to Preferred Stock in Exhibit A means the Designated Preferred Stock. Immediately following the conversion of all outstanding Designated Preferred Stock into Common Stock upon the earlier to occur of (i) a Qualified Public Offering (as defined in Exhibit A) or (ii) a Majority Conversion (as defined in Exhibit A), the Corporation shall no longer have the authority to issue any Designated Preferred Stock.

A. COMMON STOCK

Subject to all the rights, powers and preferences of the Preferred Stock and except as provided by law or in this Certificate (or in any certificate of designations of any series of Preferred Stock):

(a) the holders of the Common Stock shall have the exclusive right to vote for the election of directors of the Corporation (the “Directors”) and on all other matters requiring stockholder action, each outstanding share entitling the holder thereof to one vote on each matter properly submitted to the stockholders of the Corporation for their vote; provided, however, that, except as otherwise required by law, holders of Common Stock, as such, shall not be entitled to vote on any amendment to this Certificate (or on any amendment to a certificate of designations of any series of Preferred Stock) that alters or changes the powers, preferences, rights or other terms of one or more outstanding series of Preferred Stock if the holders of such affected series of Preferred Stock are entitled to vote, either separately or together with the holders of one or more other such series, on such amendment pursuant to this Certificate (or pursuant to a certificate of designations of any series of Preferred Stock) or pursuant to the DGCL;

(b) dividends may be declared and paid or set apart for payment upon the Common Stock out of any assets or funds of the Corporation legally available for the payment of dividends, but only when and as declared by the Board of Directors or any authorized committee thereof; and

(c) upon the voluntary or involuntary liquidation, dissolution or winding up of the Corporation, the net assets of the Corporation shall be distributed pro rata to the holders of the Common Stock.

B. PREFERRED STOCK

The Board of Directors or any authorized committee thereof is expressly authorized, to the fullest extent permitted by law, to provide by resolution or resolutions for, out of the unissued shares of Preferred Stock, the issuance of the shares of Preferred Stock in one or more series of such stock, and by filing a certificate of designations pursuant to applicable law of the State of Delaware, to establish or change from time to time the number of shares of each such series, and to fix the designations, powers, including voting powers, full or limited, or no voting powers, preferences and the relative, participating, optional or other special rights of the shares of each series and any qualifications, limitations and restrictions thereof.

ARTICLE V

STOCKHOLDER ACTION

The following sections shall become effective immediately following the time that the Corporation has a class or series of capital stock listed on a national securities exchange (the "IPO Time").

1. Action without Meeting. Any action required or permitted to be taken by the stockholders of the Corporation at any annual or special meeting of stockholders of the Corporation must be effected at a duly called annual or special meeting of stockholders and may not be taken or effected by a written consent of stockholders in lieu thereof; *provided, however*, that any action required or permitted to be taken by the holders of Preferred Stock, voting separately as a series or separately as a class with one or more other such series, may be taken without a meeting, without prior notice and without a vote, to the extent expressly so provided by the applicable certificate of designation relating to such series of Preferred Stock. Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article V, Section 1.

2. Special Meetings. Except as otherwise required by statute and subject to the rights, if any, of the holders of any series of Preferred Stock, special meetings of the stockholders of the Corporation may be called only by the Board of Directors acting pursuant to a resolution approved by the affirmative vote of a majority of the Directors then in office, and special meetings of

stockholders may not be called by any other person or persons. Only those matters set forth in the notice of the special meeting may be considered or acted upon at a special meeting of stockholders of the Corporation.

ARTICLE VI

DIRECTORS

Sections 3, 4 and 5 of this Article VI shall become effective at the IPO Time.

1. General. The business and affairs of the Corporation shall be managed by or under the direction of the Board of Directors except as otherwise provided herein or required by law.
2. Election of Directors. Election of Directors need not be by written ballot unless the By-laws of the Corporation (the “By-laws”) shall so provide.
3. Number of Directors; Term of Office. The number of Directors of the Corporation shall be fixed solely and exclusively by resolution duly adopted from time to time by the Board of Directors. The Directors, other than those who may be elected by the holders of any series of Preferred Stock, shall be classified, with respect to the term for which they severally hold office, into three classes, as nearly equal in number as possible. The Board of Directors shall assign Directors into classes at the time the classification becomes effective. The initial Class I Directors shall serve for a term expiring at the first annual meeting of stockholders to be held after the date the Board initially became classified (the “Classification Date”), the initial Class II Directors shall serve for a term expiring at the second annual meeting of stockholders to be held after the Classification Date, and the initial Class III Directors shall serve for a term expiring at the third annual meeting of stockholders to be held after the Classification Date. At each annual meeting of stockholders, Directors elected to succeed those Directors whose terms expire shall be elected for a term of office to expire at the third succeeding annual meeting of stockholders after their election. Notwithstanding the foregoing, the Directors elected to each class shall hold office until their successors are duly elected and qualified or until their earlier resignation, death or removal.

Notwithstanding the foregoing, whenever, pursuant to the provisions of Article IV of this Certificate, the holders of any one or more series of Preferred Stock shall have the right, voting separately as a series or together with holders of other such series, to elect Directors at an annual or special meeting of stockholders, the election, term of office, filling of vacancies and other features of such directorships shall be governed by the terms of this Certificate and any certificate of designations applicable to such series.

Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article VI, Section 3.

4. Vacancies. Subject to the rights, if any, of the holders of any series of Preferred Stock to elect Directors and to fill vacancies in the Board of Directors relating thereto, any and all vacancies in the Board of Directors, however occurring, including, without limitation, by reason of an increase in the size of the Board of Directors, or the death, resignation, disqualification or removal of a Director, shall be filled solely and exclusively by the affirmative vote of a majority of the remaining Directors then in office, even if less than a quorum of the Board of Directors, and not by the stockholders. Any Director appointed in accordance with the preceding sentence shall hold office for the remainder of the full term of the class of Directors in which the new directorship was created or the vacancy occurred and until such Director's successor shall have been duly elected and qualified or until his or her earlier resignation, death or removal. Subject to the rights, if any, of the holders of any series of Preferred Stock to elect Directors, when the number of Directors is increased or decreased, the Board of Directors shall, subject to Article VI, Section 3 hereof, determine the class or classes to which the increased or decreased number of Directors shall be apportioned; provided, however, that no decrease in the number of Directors shall shorten the term of any incumbent Director. In the event of a vacancy in the Board of Directors, the remaining Directors, except as otherwise provided by law, shall exercise the powers of the full Board of Directors until the vacancy is filled.

5. Removal. Subject to the rights, if any, of any series of Preferred Stock to elect Directors and to remove any Director whom the holders of any such series have the right to elect, any Director (including persons elected by Directors to fill vacancies in the Board of Directors) may be removed from office (i) only with cause and (ii) only by the affirmative vote of the holders of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock then entitled to vote at an election of Directors. At least forty-five (45) days prior to any annual or special meeting of stockholders at which it is proposed that any Director be removed from office, written notice of such proposed removal and the alleged grounds thereof shall be sent to the Director whose removal will be considered at the meeting.

ARTICLE VII

LIMITATION OF LIABILITY

A Director of the Corporation shall not be personally liable to the Corporation or its stockholders for monetary damages for breach of his or her fiduciary duty as a Director, except for liability (a) for any breach of the Director's duty of loyalty to the Corporation or its stockholders, (b) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (c) under Section 174 of the DGCL or (d) for any transaction from which the Director derived an improper personal benefit. If the DGCL is amended after the effective date of this Certificate to authorize corporate action further eliminating or limiting the personal liability of Directors, then the liability of a Director of the Corporation shall be eliminated or limited to the fullest extent permitted by the DGCL, as so amended.

Any amendment, repeal or modification of this Article VII by either of (i) the stockholders of the Corporation or (ii) an amendment to the DGCL, shall not adversely affect any right or protection existing at the time of such amendment, repeal or modification with respect to any acts

or omissions occurring before such amendment, repeal or modification of a person serving as a Director at the time of such amendment, repeal or modification.

Notwithstanding anything herein to the contrary, from and after the IPO Time, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article VII.

ARTICLE VIII

AMENDMENT OF BY-LAWS

1. Amendment by Directors. Except as otherwise provided by law, the By-laws of the Corporation may be amended or repealed by the Board of Directors.

2. Amendment by Stockholders. Effective from and after the IPO Time, the By-laws of the Corporation may be amended or repealed by the stockholders at any annual meeting of stockholders, or special meeting of stockholders called for such purpose, by the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class; provided, however, that if the Board of Directors recommends that stockholders approve such amendment or repeal at such meeting of stockholders, such amendment or repeal shall only require the affirmative vote of the majority in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class.

ARTICLE IX

AMENDMENT OF CERTIFICATE OF INCORPORATION

The Corporation reserves the right to amend or repeal this Certificate in the manner now or hereafter prescribed by statute and this Certificate, and all rights conferred upon stockholders herein are granted subject to this reservation. Except as otherwise required by this Certificate or by law, whenever any vote of the holders of capital stock of the Corporation is required to amend or repeal any provision of this Certificate, such amendment or repeal shall require the affirmative vote of the majority in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of the majority in voting power of the outstanding shares of each class entitled to vote thereon as a class, at a duly constituted meeting of stockholders called expressly for such purpose; *provided, however*, that from and after the IPO Time, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of Article V, Article VI, Article VII, Article VIII or Article IX of this Certificate.

[End of Text]

THIS AMENDED AND RESTATED CERTIFICATE OF INCORPORATION is executed as of this day of , 2019.

By: _____
Name: _____
Title: _____

[Signature Page to Axcella Health Inc. Amended and Restated Certificate of Incorporation]

EXHIBIT A

1. **Dividends.** The Corporation shall not declare, pay or set aside any dividends on shares of any other class or series of capital stock of the Corporation (other than dividends on shares of Common Stock payable in shares of Common Stock) unless (in addition to the obtaining of any consents required elsewhere in the Certificate of Incorporation) the holders of the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock and Series D Preferred Stock then outstanding on a pari passu basis, shall receive, or simultaneously receive, a dividend on each outstanding share of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock or Series D Preferred Stock as the case may be, in an amount at least equal to the greater of (i) \$0.1560 per share of Series A Preferred Stock in the case of the Series A Preferred Stock, \$0.2069 per share of the Series B Preferred Stock in the case of the Series B Preferred Stock, \$0.2213 per share of the Series B-1 Preferred Stock in the case of the Series B-1 Preferred Stock, \$0.8064 per share of the Series C Preferred Stock in the case of the Series C Preferred Stock, \$1.1344 per share of the Series D Preferred Stock in the case of the Series D Preferred Stock, and \$0.8936 per share of the Series E Preferred Stock in the case of the Series E Preferred Stock (in each case, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization affecting such shares) per year from and after the date of the issuance of any shares of Series A Preferred Stock in the case of the Series A Preferred Stock (to the extent not previously paid), from and after the date of the issuance of any shares of Series B Preferred Stock in the case of the Series B Preferred Stock, from and after the date of the issuance of any shares of Series B-1 Preferred Stock in the case of the Series B-1 Preferred Stock (to the extent not previously paid), from and after the date of the issuance of any shares of Series C Preferred Stock in the case of the Series C Preferred Stock (to the extent not previously paid), from and after the date of the issuance of any shares of Series D Preferred Stock in the case of the Series D Preferred Stock (to the extent not previously paid), and from and after the date of the issuance of any shares of Series E Preferred Stock in the case of the Series E Preferred Stock (to the extent not previously paid) and (ii) (A) in the case of a dividend on Common Stock or any class or series that is convertible into Common Stock, that dividend per share of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock, as the case may be, as would equal the product of (1) the dividend payable on each share of such class or series determined, if applicable, as if all shares of such class or series had been converted into Common Stock and (2) the number of shares of Common Stock issuable upon conversion of a share of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock as the case may be, in each case calculated on the record date for determination of holders entitled to receive such dividend or (B) in the case of a dividend on any class or series that is not convertible into Common Stock, at a rate per share of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock, as the case may be, determined by (1) dividing the amount of the dividend payable on each share of such class or series of capital stock by the original issuance price of such class or series of capital stock (subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization affecting such shares) and (2) multiplying such fraction by an amount equal to, in the case of the Series A Preferred Stock, the Series A Original Issue Price (as defined below), in the case of the Series B Preferred Stock, the Series B Original Issue Price (as defined below), in the case of the Series B-1 Preferred Stock, the Series B-1 Original Issue Price (as defined

below), in the case of the Series C Preferred Stock, the Series C Original Issue Price (as defined below), in the case of the Series D Preferred Stock, the Series D Original Issue Price (as defined below), and in the case of the Series E Preferred Stock, the Series E Original Issue Price (as defined below); provided that, if the Corporation declares, pays or sets aside, on the same date, a dividend on shares of more than one class or series of capital stock of the Corporation, the dividend payable to the holders of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock pursuant to this Section 1 shall be calculated based upon the dividend on the class or series of capital stock that would result in the highest dividend for the Series A Preferred Stock, the Series B Preferred Stock, the Series B-1 Preferred Stock, the Series C Preferred Stock, the Series D Preferred Stock, and the Series E Preferred Stock. The foregoing dividend shall not be cumulative. The “**Series A Original Issue Price**” shall mean \$3.5919 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series A Preferred Stock. The “**Series B Original Issue Price**” shall mean \$4.7634 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series B Preferred Stock. The “**Series B-1 Original Issue Price**” shall mean \$5.0957 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series B-1 Preferred Stock. The “**Series C Original Issue Price**” shall mean \$18.5674 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series C Preferred Stock. The “**Series D Original Issue Price**” shall mean \$24.9591 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series D Preferred Stock. The “**Series E Original Issue Price**” shall mean \$20.5751 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series E Preferred Stock.

2. Liquidation, Dissolution or Winding Up; Certain Mergers, Consolidations and Asset Sales.

2.1 Preferential Payments to Holders of Preferred Stock.

2.1.1 In the event of any voluntary or involuntary liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, the holders of shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock then outstanding shall be entitled on a pari passu basis to be paid out of the assets of the Corporation available for distribution to its stockholders before any payment shall be made to the holders of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock or Common Stock by reason of their ownership thereof, an amount per share equal to (a) in the case of the Series C Preferred Stock, the greater of (i) the Series C Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series C Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series C Liquidation Amount**”), (b) in the case of the Series D Preferred Stock, the greater of (i) the Series D Original Issue Price, plus any dividends

declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series D Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series D Liquidation Amount**”), and (c) in the case of the Series E Preferred Stock, the greater of (i) the Series E Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series E Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series E Liquidation Amount**”). If upon any such liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, the assets of the Corporation available for distribution to its stockholders shall be insufficient to pay the holders of shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock the full amount to which they shall be entitled under this Subsection 2.1.1, the holders of shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall share ratably in any distribution of the assets available for distribution in proportion to the respective amounts which would otherwise be payable in respect of the shares held by them upon such distribution if all amounts payable on or with respect to such shares were paid in full.

2.1.2 Following the payment of the Series C Liquidation Amount, the Series D Liquidation Amount, and the Series E Liquidation Amount, the holders of shares of Series A Preferred Stock, Series B Preferred Stock, and Series B-1 Preferred Stock then outstanding shall be entitled on a pari passu basis to be paid out of the assets of the Corporation available for distribution to its stockholders before any payment shall be made to the holders of Common Stock by reason of their ownership thereof, an amount per share equal to (a) in the case of the Series A Preferred Stock, the greater of (i) the Series A Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series A Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this clause (a) is hereinafter referred to as the “**Series A Liquidation Amount**”), (b) in the case of the Series B Preferred Stock, the greater of (i) the Series B Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series B Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this clause (b) is hereinafter referred to as the “**Series B Liquidation Amount**”), and (c) in the case of the Series B-1 Preferred Stock, the greater of (i) the Series B-1 Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series B-1 Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this clause (c) is hereinafter referred to as the “**Series B-1 Liquidation Amount**”). If upon any such liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, the assets of the Corporation available for distribution to its stockholders shall be insufficient to pay the holders of shares of Series A Preferred Stock, Series B Preferred Stock, and Series B-1 Preferred Stock the full amount to which they shall be entitled under this Subsection 2.1.2, the holders of shares of Series A Preferred Stock, Series B Preferred Stock, and Series B-1 Preferred Stock shall

share ratably in any distribution of the assets available for distribution in proportion to the respective amounts which would otherwise be payable in respect of the shares held by them upon such distribution if all amounts payable on or with respect to such shares were paid in full.

2.2 Payments to Holders of Common Stock. In the event of any voluntary or involuntary liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, after the payment of all preferential amounts required to be paid to the holders of shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, the remaining assets of the Corporation available for distribution to its stockholders shall be distributed among the holders of shares of Common Stock, pro rata based on the number of shares held by each such holder.

2.3 Deemed Liquidation Events.

2.3.1 Definition. Each of the following events shall be considered a “**Deemed Liquidation Event**” unless (A) the holders of at least a majority of the outstanding shares of Preferred Stock, voting or consenting together as a single class on an as-converted basis, and (B) the holders of at least a majority of the outstanding shares of Series C Preferred Stock, voting or consenting separately as a single class (the votes and consents described in clauses (A) and (B) together, the “**Requisite Vote**”), elect otherwise by written notice sent to the Corporation at least 20 days prior to the effective date of any such event:

- (a) a merger or consolidation in which
 - (i) the Corporation is a constituent party or
 - (ii) a subsidiary of the Corporation is a constituent party and the Corporation issues shares of its capital stock pursuant to such merger or consolidation,

except any such merger or consolidation involving the Corporation or a subsidiary in which the shares of capital stock of the Corporation outstanding immediately prior to such merger or consolidation continue to represent, or are converted into or exchanged for shares of capital stock that represent, immediately following such merger or consolidation, at least a majority, by voting power, of the capital stock of (1) the surviving or resulting corporation or (2) if the surviving or resulting corporation is a wholly owned subsidiary of another corporation immediately following such merger or consolidation, the parent corporation of such surviving or resulting corporation (provided that, for the purpose of this Subsection 2.3.1, all shares of Common Stock issuable upon exercise of Options (as defined below) outstanding immediately prior to such merger or consolidation or upon conversion of Convertible Securities (as defined below) outstanding immediately prior to such merger or consolidation shall be deemed to be outstanding immediately prior to such merger or consolidation and, if applicable, converted or exchanged in such merger or consolidation on the same terms as the actual outstanding shares of Common Stock are converted or exchanged); or

(b) the sale, lease, transfer, exclusive license or other disposition, in a single transaction or series of related transactions, by the Corporation or any subsidiary of the Corporation of all or substantially all the assets of the Corporation and its subsidiaries taken as a whole, or the sale or disposition (whether by merger, consolidation or otherwise) of one or more subsidiaries of the Corporation if all or substantially all of the assets of the Corporation and its subsidiaries taken as a whole are held by such subsidiary or subsidiaries, except where such sale, lease, transfer, exclusive license or other disposition is to a wholly-owned subsidiary of the Corporation.

2.3.2 Effecting a Deemed Liquidation Event.

(a) The Corporation shall not have the power to effect a Deemed Liquidation Event referred to in Subsection 2.3.1(a)(i) unless the agreement or plan of merger or consolidation for such transaction (the “**Merger Agreement**”) provides that the consideration payable to the stockholders of the Corporation shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2.

(b) In the event of a Deemed Liquidation Event referred to in Subsection 2.3.1(a)(ii) or 2.3.1(b), if the Corporation does not effect a dissolution of the Corporation under the General Corporation Law within 90 days after such Deemed Liquidation Event, then (i) the Corporation shall send a written notice to each holder of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock no later than the 90th day after the Deemed Liquidation Event advising such holders of their right (and the requirements to be met to secure such right) pursuant to the terms of the following clause (ii) to require the redemption of such shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock and (ii) if the holders of the Requisite Vote so request in a written instrument delivered to the Corporation not later than 120 days after such Deemed Liquidation Event, the Corporation shall use the consideration received by the Corporation for such Deemed Liquidation Event (net of any retained liabilities associated with the assets sold or technology licensed, as determined in good faith by the Board of Directors of the Corporation), together with any other assets of the Corporation available for distribution to its stockholders (the “**Available Proceeds**”), to the extent legally available therefor, on or before the 150th day after such Deemed Liquidation Event, to redeem all outstanding shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock at a price per share equal to the Series A Liquidation Amount, the Series B Liquidation Amount, the Series B-1 Liquidation Amount, the Series C Liquidation Amount, the Series D Liquidation Amount, and the Series E Liquidation Amount, respectively. Notwithstanding the foregoing, in the event of a redemption pursuant to the preceding sentence, if the Available Proceeds are not sufficient to redeem all outstanding shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, the Corporation shall redeem first a pro rata portion on a pari passu basis of each holder’s shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to the fullest extent of such Available Proceeds, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the Available Proceeds were sufficient to redeem

all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor; and second, after all of the shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock have been redeemed, a pro rata portion on a pari passu basis of each holder's shares of Series A Preferred Stock, Series B Preferred Stock and Series B-1 Preferred Stock to the fullest extent of such Available Proceeds, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the Available Proceeds were sufficient to redeem all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor. The provisions of Subsections 6.2 through 6.4 shall apply, with such necessary changes in the details thereof as are necessitated by the context, to the redemption of the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock pursuant to this Subsection 2.3.2(b). Prior to the distribution or redemption provided for in this Subsection 2.3.2(b), the Corporation shall not expend or dissipate the consideration received for such Deemed Liquidation Event, except to discharge expenses incurred in connection with such Deemed Liquidation Event or in the ordinary course of business.

2.3.3 Amount Deemed Paid or Distributed. If the amount deemed paid or distributed under this Subsection 2.3.3 is made in property other than in cash, the value of such distribution shall be the fair market value of such property, determined as follows:

- (a) For securities not subject to investment letters or other similar restrictions on free marketability,
 - (i) if traded on a securities exchange, the value shall be deemed to be the average of the closing prices of the securities on such exchange or market over the 30-day period ending three days prior to the closing of such transaction;
 - (ii) if actively traded over-the-counter, the value shall be deemed to be the average of the closing bid prices over the 30-day period ending three days prior to the closing of such transaction; or
 - (iii) if there is no active public market, the value shall be the fair market value thereof, as determined in good faith by the Board of Directors of the Corporation.

(b) The method of valuation of securities subject to investment letters or other similar restrictions on free marketability (other than restrictions arising solely by virtue of a stockholder's status as an affiliate or former affiliate) shall take into account an appropriate discount (as determined in good faith by the Board of Directors of the Corporation) from the market value as determined pursuant to clause (a) above so as to reflect the approximate fair market value thereof.

(c) For other assets, the value shall be the fair market value thereof, as determined in good faith by the Board of Directors of the Corporation.

2.3.4 Allocation of Escrow. In the event of a Deemed Liquidation Event pursuant to Subsections 2.3.1(a)(i) or 2.3.1(b), if any portion of the consideration payable to the stockholders of the Corporation is placed into escrow and/or is payable to the stockholders of the Corporation subject to contingencies, the Merger Agreement shall provide that (a) the portion of such consideration that is not placed in escrow and not subject to any contingencies (the “**Initial Consideration**”) shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2 as if the Initial Consideration were the only consideration payable in connection with such Deemed Liquidation Event and (b) any additional consideration which becomes payable to the stockholders of the Corporation upon release from escrow or satisfaction of contingencies shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2 after taking into account the previous payment of the Initial Consideration as part of the same transaction.

3. Voting.

3.1 General. On any matter presented to the stockholders of the Corporation for their action or consideration at any meeting of stockholders of the Corporation (or by written consent of stockholders in lieu of meeting), each holder of outstanding shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall be entitled to cast the number of votes equal to the number of whole shares of Common Stock into which the shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock held by such holder are convertible as of the record date for determining stockholders entitled to vote on such matter. Except as provided by law or by the other provisions of the Certificate of Incorporation, holders of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall vote together with the holders of Common Stock as a single class.

3.2 Election of Directors. So long as any shares of Preferred Stock are outstanding, the holders of record of the shares of Preferred Stock, exclusively and voting together as a single, separate class on an as-converted to Common Stock basis, shall be entitled to elect one (1) director of the Corporation (the “**Preferred Director**”). The Preferred Director may be removed without cause by, and only by, the affirmative vote of the holders of shares of Preferred Stock, given either at a special meeting of such stockholders duly called for that purpose or pursuant to a written consent of stockholders. If the holders of shares of Preferred Stock, voting exclusively and as a separate class, fail to elect a sufficient number of directors to fill all directorships for which they are entitled to elect directors, voting exclusively and as a separate class, pursuant to the first sentence of this Subsection 3.2, then any directorship not so filled shall remain vacant until such time as the holders of the Preferred Stock elect a person to fill such directorship by vote or written consent in lieu of a meeting; and such directorship may not be filled by stockholders of the Corporation other than by the holders of shares of Preferred Stock, voting exclusively and as a separate class. The holders of record of the shares of Common Stock and of

any other class or series of voting stock (including the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock), exclusively and voting together as a single class on an as-converted basis, shall be entitled to elect the balance of the total number of directors of the Corporation. At any meeting held for the purpose of electing a director, the presence in person or by proxy of the holders of a majority of the outstanding shares of the class or series entitled to elect such director shall constitute a quorum for the purpose of electing such director. Except as otherwise provided in this Subsection 3.2, a vacancy in any directorship filled by the holders of any class or series shall be filled only by vote or written consent in lieu of a meeting of the holders of such class or series or by any remaining director or directors elected by the holders of such class or series pursuant to this Subsection 3.2.

3.3 Protective Provisions.

3.3.1 Preferred Stock Protective Provisions. At any time when any shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the outstanding shares of Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single class on an as-converted basis:

- (a) liquidate, dissolve or wind-up the business and affairs of the Corporation, effect any Deemed Liquidation Event, or consent to any of the foregoing;
 - (b) amend, alter or repeal any provision of the Certificate of Incorporation or Bylaws of the Corporation;
 - (c) create, or authorize the creation of, or issue or obligate itself to issue shares of, any additional class or series of capital stock unless the same ranks junior to the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock with respect to the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends and rights of redemption, or increase the authorized number of shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock or increase the authorized number of shares of any additional class or series of capital stock unless the same ranks junior to the Series A Preferred Stock, the Series B Preferred Stock, the Series B-1 Preferred Stock, the Series C Preferred Stock, the Series D Preferred Stock, and the Series E Preferred Stock with respect to the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends and rights of redemption;
 - (d) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred
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Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock in respect of any such right, preference or privilege;

(e) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(f) create, or authorize the creation of, or issue, or authorize the issuance of any debt security, or permit any subsidiary to take any such action with respect to any debt security if the aggregate indebtedness of the Corporation and its subsidiaries for borrowed money following such action would exceed \$250,000, unless such debt security has received the prior approval of the Board of Directors of the Corporation, including the Preferred Director;

(g) create or hold capital stock in any subsidiary that is not a wholly-owned subsidiary or sell, transfer or otherwise dispose of any capital stock of any direct or indirect subsidiary of the Corporation, or permit any direct or indirect subsidiary to sell, lease, transfer, exclusively license or otherwise dispose (in a single transaction or series of related transactions) of all or substantially all of the assets of such subsidiary;

(h) increase or decrease the authorized number of directors constituting the Board of Directors of the Corporation;

or

(i) create or establish any new employee stock option plan, employee stock purchase plan, employee restricted stock plan or other similar equity incentive plan or increase the number of shares of capital stock of the Corporation reserved for issuance under any current or new employee stock option plan, employee stock purchase plan, employee restricted stock plan or other similar equity incentive plan.

3.3.2 Series C Preferred Stock Protective Provisions. At any time when any shares of Series C Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series C Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class:

(a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series C Preferred Stock in a manner that is adverse to the Series C Preferred Stock;

(b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series C Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series C Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series C Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series C Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series C Preferred Stock in respect of any such right, preference or privilege; or

(d) increase or decrease the authorized number of shares of the Series C Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series C Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series C Preferred Stock that is in a manner adverse to the Series C Preferred Stock.

3.3.3 Series A/B/B-1 Preferred Stock Protective Provisions. At any time when any shares of Series A Preferred Stock, Series B Preferred Stock or Series B-1 Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate

of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series A Preferred Stock, Series B Preferred Stock and Series B-1 Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class, on an as-converted basis:

(a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock in a manner that is adverse to the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock;

(b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock in respect of any such right, preference or privilege; or

(d) increase or decrease the authorized number of shares of the Series A Preferred Stock, the Series B Preferred Stock or the Series B-1 Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series A Preferred Stock, the Series B Preferred Stock, or the Series B-1 Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series A Preferred Stock, the Series B Preferred Stock, or the Series B-1 Preferred Stock that is in a manner adverse to any such series of Preferred Stock.

3.3.4 Series D Preferred Stock Protective Provisions. At any time when any shares of Series D Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series D Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class:

(a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series D Preferred Stock in a manner that is adverse to the Series D Preferred Stock;

(b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series D Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series D Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series D Preferred Stock in respect of any such right, preference or privilege; or

(d) increase or decrease the authorized number of shares of the Series D Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series D Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series D Preferred Stock that is in a manner adverse to the Series D Preferred Stock.

3.3.5 Series E Preferred Stock Protective Provisions. At any time when any shares of Series E Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or

the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series E Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class:

(a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series E Preferred Stock in a manner that is adverse to the Series E Preferred Stock;

(b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series E Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series E Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series E Preferred Stock in respect of any such right, preference or privilege; or

(d) increase or decrease the authorized number of shares of the Series E Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series E Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series E Preferred Stock that is in a manner adverse to the Series E Preferred Stock.

4. Optional Conversion. The holders of the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall have conversion rights as follows (the "Conversion Rights"):

4.1 Right to Convert.

4.1.1 Conversion Ratio. Each share of Series A Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the

payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series A Original Issue Price by the Series A Conversion Price (as defined below) in effect at the time of conversion. The “**Series A Conversion Price**” shall initially be equal to \$1.95. Such initial Series A Conversion Price, and the rate at which shares of Series A Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series B Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series B Original Issue Price by the Series B Conversion Price (as defined below) in effect at the time of conversion. The “**Series B Conversion Price**” shall initially be equal to \$2.586. Such initial Series B Conversion Price, and the rate at which shares of Series B Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series B-1 Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series B-1 Original Issue Price by the Series B-1 Conversion Price (as defined below) in effect at the time of conversion. The “**Series B-1 Conversion Price**” shall initially be equal to \$2.7664. Such initial Series B-1 Conversion Price, and the rate at which shares of Series B-1 Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series C Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series C Original Issue Price by the Series C Conversion Price (as defined below) in effect at the time of conversion. The “**Series C Conversion Price**” shall initially be equal to \$10.08. Such initial Series C Conversion Price, and the rate at which shares of Series C Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series D Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series D Original Issue Price by the Series D Conversion Price (as defined below) in effect at the time of conversion. The “**Series D Conversion Price**” shall initially be equal to \$13.87. Such initial Series D Conversion Price, and the rate at which shares of Series D Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series E Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series E Original Issue Price by the Series E Conversion Price (as defined below) in effect at the time of conversion. The “**Series E Conversion Price**” shall initially be equal to \$11.17. Such initial Series E Conversion Price, and the rate at which shares of Series E Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below.

4.1.2 Termination of Conversion Rights. In the event of a notice of redemption of any shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock

pursuant to Section 6, the Conversion Rights of the shares designated for redemption shall terminate at the close of business on the last full day preceding the date fixed for redemption, unless the redemption price is not fully paid on such redemption date, in which case the Conversion Rights for such shares shall continue until such price is paid in full. In the event of a liquidation, dissolution or winding up of the Corporation or a Deemed Liquidation Event, the Conversion Rights shall terminate at the close of business on the last full day preceding the date fixed for the payment of any such amounts distributable on such event to the holders of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock.

4.2 Fractional Shares. No fractional shares of Common Stock shall be issued upon conversion of the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock. In lieu of any fractional shares to which the holder would otherwise be entitled, the Corporation shall pay cash equal to such fraction multiplied by the fair market value of a share of Common Stock as determined in good faith by the Board of Directors of the Corporation. Whether or not fractional shares would be issuable upon such conversion shall be determined on the basis of the total number of shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, as the case may be, the holder is at the time converting into Common Stock and the aggregate number of shares of Common Stock issuable upon such conversion.

4.3 Mechanics of Conversion.

4.3.1 Notice of Conversion. In order for a holder of Preferred Stock to voluntarily convert shares of Preferred Stock into shares of Common Stock, such holder shall surrender the certificate or certificates for such shares of Preferred Stock (or, if such registered holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate), at the office of the transfer agent for the Preferred Stock (or at the principal office of the Corporation if the Corporation serves as its own transfer agent), together with written notice that such holder elects to convert all or any number of the shares of the Preferred Stock represented by such certificate or certificates and, if applicable, any event on which such conversion is contingent. Such notice shall state such holder's name or the names of the nominees in which such holder wishes the certificate or certificates for shares of Common Stock to be issued. If required by the Corporation, certificates surrendered for conversion shall be endorsed or accompanied by a written instrument or instruments of transfer, in form satisfactory to the Corporation, duly executed by the registered holder or his, her or its attorney duly authorized in writing. The close of business on the date of receipt by the transfer agent (or by the Corporation if the Corporation serves as its own transfer agent) of such certificates (or lost certificate affidavit and agreement) and notice shall be the time of conversion (the "**Conversion Time**"), and the shares of Common Stock issuable upon conversion of the shares represented by such certificate shall be deemed to be outstanding of record as of such date. The Corporation shall, as soon as practicable

after the Conversion Time, (i) issue and deliver to such holder of Preferred Stock, or to his, her or its nominees, a certificate or certificates for the number of full shares of Common Stock issuable upon such conversion in accordance with the provisions hereof and a certificate for the number (if any) of the shares of Preferred Stock represented by the surrendered certificate that were not converted into Common Stock, (ii) pay in cash such amount as provided in Subsection 4.2 in lieu of any fraction of a share of Common Stock otherwise issuable upon such conversion and (iii) pay all declared but unpaid dividends on the shares of Preferred Stock converted.

4.3.2 Reservation of Shares. The Corporation shall at all times when the Preferred Stock shall be outstanding, reserve and keep available out of its authorized but unissued capital stock, for the purpose of effecting the conversion of the Preferred Stock, such number of its duly authorized shares of Common Stock as shall from time to time be sufficient to effect the conversion of all outstanding Preferred Stock; and if at any time the number of authorized but unissued shares of Common Stock shall not be sufficient to effect the conversion of all then outstanding shares of the Preferred Stock, the Corporation shall take such corporate action as may be necessary to increase its authorized but unissued shares of Common Stock to such number of shares as shall be sufficient for such purposes, including, without limitation, engaging in best efforts to obtain the requisite stockholder approval of any necessary amendment to the Certificate of Incorporation. Before taking any action which would cause an adjustment reducing the Conversion Price below the then par value of the shares of Common Stock issuable upon conversion of the Preferred Stock, the Corporation will take any corporate action which may, in the opinion of its counsel, be necessary in order that the Corporation may validly and legally issue fully paid and nonassessable shares of Common Stock at such adjusted Conversion Price.

4.3.3 Effect of Conversion. All shares of Preferred Stock which shall have been surrendered for conversion as herein provided shall no longer be deemed to be outstanding and all rights with respect to such shares shall immediately cease and terminate at the Conversion Time, except only the right of the holders thereof to receive shares of Common Stock in exchange therefor, to receive payment in lieu of any fraction of a share otherwise issuable upon such conversion as provided in Subsection 4.2 and to receive payment of any dividends declared but unpaid thereon. Any shares of Preferred Stock so converted shall be retired and cancelled and may not be reissued as shares of such series, and the Corporation may thereafter take such appropriate action (without the need for stockholder action) as may be necessary to reduce the authorized number of shares of Preferred Stock accordingly.

4.3.4 No Further Adjustment. Upon any such conversion, no adjustment to the Conversion Price shall be made for any declared but unpaid dividends on the Preferred Stock surrendered for conversion or on the Common Stock delivered upon conversion.

4.3.5 Taxes. The Corporation shall pay any and all issue and other similar taxes that may be payable in respect of any issuance or delivery of shares of Common Stock upon conversion of shares of Preferred Stock pursuant to this Section 4. The Corporation shall not, however, be required to pay any tax which may be payable in respect of any transfer involved in the issuance and delivery of shares of Common Stock in a name other than that in which the shares of Preferred Stock so converted were registered, and no such issuance or delivery shall be made unless and until the person or entity requesting such issuance has paid to the Corporation the

amount of any such tax or has established, to the satisfaction of the Corporation, that such tax has been paid.

4.4 Adjustments to Conversion Price for Diluting Issues.

4.4.1 Special Definitions. For purposes of this Article Fourth, the following definitions shall apply:

or Convertible Securities.

(a) “**Option**” shall mean rights, options or warrants to subscribe for, purchase or otherwise acquire Common Stock

(b) “**Original Issue Date**” shall mean the date on which the first share of Series E Preferred Stock was issued.

(c) “**Convertible Securities**” shall mean any evidences of indebtedness, shares or other securities directly or indirectly convertible into or exchangeable for Common Stock, but excluding Options.

(d) “**Additional Shares of Common Stock**” shall mean all shares of Common Stock issued (or, pursuant to Subsection 4.4.2 below, deemed to be issued) by the Corporation after the Original Issue Date, other than (1) the following shares of Common Stock and (2) shares of Common Stock deemed issued pursuant to the following Options and Convertible Securities (clauses (1) and (2), collectively, “**Exempted Securities**”):

- (i) shares of Common Stock, Options or Convertible Securities issued upon the conversion of Preferred Stock or as a dividend or distribution on Preferred Stock;
 - (ii) shares of Common Stock, Options or Convertible Securities issued by reason of a dividend, stock split, split-up or other distribution on shares of Common Stock that is covered by Subsection 4.5, 4.6, 4.7 or 4.8;
 - (iii) shares of Common Stock or Options issued to employees or directors of, or consultants or advisors to, the Corporation or any of its subsidiaries pursuant to a plan, agreement or arrangement approved by the Board of Directors of the Corporation, including the Preferred Director;
 - (iv) shares of Common Stock or Convertible Securities actually issued upon the exercise of Options or shares of Common Stock actually issued upon the conversion or exchange of Convertible Securities, in
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each case provided such issuance is pursuant to the terms of such Option or Convertible Security;

- (v) shares of Common Stock, Options or Convertible Securities issued to banks, equipment lessors or other financial institutions, or to real property lessors, pursuant to a debt financing, equipment leasing or real property leasing transaction approved by the Board of Directors of the Corporation, including the Preferred Director;
- (vi) shares of Common Stock, Options or Convertible Securities issued to suppliers or third party service providers in connection with the provision of goods or services pursuant to transactions approved by the Board of Directors of the Corporation, including the Preferred Director;
- (vii) shares of Common Stock, Options or Convertible Securities issued in connection with sponsored research, collaboration, technology license, development, marketing or other similar agreements or strategic partnerships approved by the Board of Directors of the Corporation, including the Preferred Director; or
- (viii) shares of Common Stock issued or issuable in or in connection with an initial public offering.

4.4.2 Deemed Issue of Additional Shares of Common Stock.

(a) If the Corporation at any time or from time to time after the Original Issue Date shall issue any Options or Convertible Securities (excluding Options or Convertible Securities which are themselves Exempted Securities) or shall fix a record date for the determination of holders of any class of securities entitled to receive any such Options or Convertible Securities, then the maximum number of shares of Common Stock (as set forth in the instrument relating thereto, assuming the satisfaction of any conditions to exercisability, convertibility or exchangeability but without regard to any provision contained therein for a subsequent adjustment of such number) issuable upon the exercise of such Options or, in the case of Convertible Securities and Options therefor, the conversion or exchange of such Convertible Securities, shall be deemed to be Additional Shares of Common Stock issued as of the time of such issue or, in case such a record date shall have been fixed, as of the close of business on such record date.

(b) If the terms of any Option or Convertible Security, the issuance of which resulted in an adjustment to the Conversion Price of any series of Preferred

Stock pursuant to the terms of Subsection 4.4.3, are revised as a result of an amendment to such terms or any other adjustment pursuant to the provisions of such Option or Convertible Security (but excluding automatic adjustments to such terms pursuant to anti-dilution or similar provisions of such Option or Convertible Security) to provide for either (1) any increase or decrease in the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any such Option or Convertible Security or (2) any increase or decrease in the consideration payable to the Corporation upon such exercise, conversion and/or exchange, then, effective upon such increase or decrease becoming effective, the Conversion Price of such series of Preferred Stock computed upon the original issue of such Option or Convertible Security (or upon the occurrence of a record date with respect thereto) shall be readjusted to the Conversion Price of such series of Preferred Stock as would have obtained had such revised terms been in effect upon the original date of issuance of such Option or Convertible Security. Notwithstanding the foregoing, no readjustment pursuant to this clause (b) shall have the effect of increasing the Conversion Price of any series of Preferred Stock to an amount which exceeds the lower of (i) the Conversion Price of such series of Preferred Stock in effect immediately prior to the original adjustment made as a result of the issuance of such Option or Convertible Security, or (ii) the Conversion Price of such series of Preferred Stock that would have resulted from any issuances of Additional Shares of Common Stock (other than deemed issuances of Additional Shares of Common Stock as a result of the issuance of such Option or Convertible Security) between the original adjustment date and such readjustment date.

(c) If the terms of any Option or Convertible Security (excluding Options or Convertible Securities which are themselves Exempted Securities), the issuance of which did not result in an adjustment to the Conversion Price of any series of Preferred Stock pursuant to the terms of Subsection 4.4.3 (either because the consideration per share (determined pursuant to Subsection 4.4.4) of the Additional Shares of Common Stock subject thereto was equal to or greater than the Conversion Price of such series of Preferred Stock then in effect, or because such Option or Convertible Security was issued before the Original Issue Date), are revised after the Original Issue Date as a result of an amendment to such terms or any other adjustment pursuant to the provisions of such Option or Convertible Security (but excluding automatic adjustments to such terms pursuant to anti-dilution or similar provisions of such Option or Convertible Security) to provide for either (1) any increase in the number of shares of Common Stock issuable upon the exercise, conversion or exchange of any such Option or Convertible Security or (2) any decrease in the consideration payable to the Corporation upon such exercise, conversion or exchange, then such Option or Convertible Security, as so amended or adjusted, and the Additional Shares of Common Stock subject thereto (determined in the manner provided in Subsection 4.4.2(a)) shall be deemed to have been issued effective upon such increase or decrease becoming effective.

(d) Upon the expiration or termination of any unexercised Option or unconverted or unexchanged Convertible Security (or portion thereof) which resulted (either upon its original issuance or upon a revision of its terms) in an adjustment to the Conversion Price of any series of Preferred Stock pursuant to the terms of Subsection 4.4.3, the Conversion Price of such series of Preferred Stock shall be readjusted to such Conversion Price as would have obtained had such Option or Convertible Security (or portion thereof) never been issued.

(e) If the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any Option or Convertible Security, or the consideration payable to the Corporation upon such exercise, conversion and/or exchange, is calculable at the time such Option or Convertible Security is issued or amended but is subject to adjustment based upon subsequent events, any adjustment to the Conversion Price of each series of Preferred Stock provided for in this Subsection 4.4.2 shall be effected at the time of such issuance or amendment based on such number of shares or amount of consideration without regard to any provisions for subsequent adjustments (and any subsequent adjustments shall be treated as provided in clauses (b) and (c) of this Subsection 4.4.2). If the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any Option or Convertible Security, or the consideration payable to the Corporation upon such exercise, conversion and/or exchange, cannot be calculated at all at the time such Option or Convertible Security is issued or amended, any adjustment to the Conversion Price of each series of Preferred Stock that would result under the terms of this Subsection 4.4.2 at the time of such issuance or amendment shall instead be effected at the time such number of shares and/or amount of consideration is first calculable (even if subject to subsequent adjustments), assuming for purposes of calculating such adjustment to such Conversion Price that such issuance or amendment took place at the time such calculation can first be made.

4.4.3 Adjustment of Conversion Price Upon Issuance of Additional Shares of Common Stock. In the event the Corporation shall at any time after the Original Issue Date issue Additional Shares of Common Stock (including Additional Shares of Common Stock deemed to be issued pursuant to Subsection 4.4.2), without consideration or for a consideration per share less than the Conversion Price of any series of Preferred Stock in effect immediately prior to such issue, then the Conversion Price of such series of Preferred Stock shall be reduced, concurrently with such issue, to a price (calculated to the nearest one-hundredth of a cent) determined in accordance with the following formula:

$$CP_2 = CP_1 * (A + B) \div (A + C).$$

For purposes of the foregoing formula, the following definitions shall apply:

(a) “CP₂” shall mean the Conversion Price of such series of Preferred Stock in effect immediately after such issue of Additional Shares of Common Stock;

(b) “CP₁” shall mean the Conversion Price of such series of Preferred Stock in effect immediately prior to such issue of Additional Shares of Common Stock;

(c) “A” shall mean the number of shares of Common Stock outstanding immediately prior to such issue of Additional Shares of Common Stock (treating for this purpose as outstanding all shares of Common Stock issuable upon exercise of Options outstanding immediately prior to such issue or upon conversion or exchange of Convertible Securities (including the Preferred Stock) outstanding (assuming exercise of any outstanding Options therefor) immediately prior to such issue);

(d) “B” shall mean the number of shares of Common Stock that would have been issued if such Additional Shares of Common Stock had been issued at a price per share equal to CP₁ (determined by dividing the aggregate consideration received by the Corporation in respect of such issue by CP₁); and

(e) “C” shall mean the number of such Additional Shares of Common Stock issued in such transaction.

4.4.4 Determination of Consideration. For purposes of this Subsection 4.4, the consideration received by the Corporation for the issue of any Additional Shares of Common Stock shall be computed as follows:

(a) Cash and Property: Such consideration shall:

- (i) insofar as it consists of cash, be computed at the aggregate amount of cash received by the Corporation, excluding amounts paid or payable for accrued interest;
- (ii) insofar as it consists of property other than cash, be computed at the fair market value thereof at the time of such issue, as determined in good faith by the Board of Directors of the Corporation; and
- (iii) in the event Additional Shares of Common Stock are issued together with other shares or securities or other assets of the Corporation for consideration which covers both, be the proportion of such consideration so received, computed as provided in clauses (i) and (ii) above, as determined in good faith by the Board of Directors of the Corporation.

(b) Options and Convertible Securities. The consideration per share received by the Corporation for Additional Shares of Common Stock deemed to have been issued pursuant to Subsection 4.4.2, relating to Options and Convertible Securities, shall be determined by dividing:

- (i) the total amount, if any, received or receivable by the Corporation as consideration for the issue of such Options or Convertible Securities, plus the minimum aggregate amount of additional consideration (as set forth in the instruments relating thereto, without regard to any provision contained therein for a subsequent adjustment of such consideration) payable to the Corporation upon the exercise of such Options or the conversion or exchange of such
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Convertible Securities, or in the case of Options for Convertible Securities, the exercise of such Options for Convertible Securities and the conversion or exchange of such Convertible Securities, by

- (ii) the maximum number of shares of Common Stock (as set forth in the instruments relating thereto, without regard to any provision contained therein for a subsequent adjustment of such number) issuable upon the exercise of such Options or the conversion or exchange of such Convertible Securities, or in the case of Options for Convertible Securities, the exercise of such Options for Convertible Securities and the conversion or exchange of such Convertible Securities.

4.4.5 Multiple Closing Dates. In the event the Corporation shall issue on more than one date Additional Shares of Common Stock that are a part of one transaction or a series of related transactions and that would result in an adjustment to the Conversion Price of any series of Preferred Stock pursuant to the terms of Subsection 4.4.3, then, upon the final such issuance, the Conversion Price of such series of Preferred Stock shall be readjusted to give effect to all such issuances as if they occurred on the date of the first such issuance (and without giving effect to any additional adjustments as a result of any such subsequent issuances within such period).

4.5 Adjustment for Stock Splits and Combinations. If the Corporation shall at any time or from time to time after the Original Issue Date effect a subdivision of the outstanding Common Stock, the Conversion Price of each series of Preferred Stock in effect immediately before that subdivision shall be proportionately decreased so that the number of shares of Common Stock issuable on conversion of each share of such series shall be increased in proportion to such increase in the aggregate number of shares of Common Stock outstanding. If the Corporation shall at any time or from time to time after the Original Issue Date combine the outstanding shares of Common Stock, the Conversion Price of each series of Preferred Stock in effect immediately before the combination shall be proportionately increased so that the number of shares of Common Stock issuable on conversion of each share of such series shall be decreased in proportion to such decrease in the aggregate number of shares of Common Stock outstanding. Any adjustment under this subsection shall become effective at the close of business on the date the subdivision or combination becomes effective.

4.6 Adjustment for Certain Dividends and Distributions. In the event the Corporation at any time or from time to time after the Original Issue Date shall make or issue, or fix a record date for the determination of holders of Common Stock entitled to receive, a dividend or other distribution payable on the Common Stock in additional shares of Common Stock, then and in each such event the Conversion Price of each series of Preferred Stock in effect immediately before such event shall be decreased as of the time

of such issuance or, in the event such a record date shall have been fixed, as of the close of business on such record date, by multiplying the Conversion Price of such series of Preferred Stock then in effect by a fraction:

- (1) the numerator of which shall be the total number of shares of Common Stock issued and outstanding immediately prior to the time of such issuance or the close of business on such record date, and
- (2) the denominator of which shall be the total number of shares of Common Stock issued and outstanding immediately prior to the time of such issuance or the close of business on such record date plus the number of shares of Common Stock issuable in payment of such dividend or distribution.

Notwithstanding the foregoing, (a) if such record date shall have been fixed and such dividend is not fully paid or if such distribution is not fully made on the date fixed therefor, the Conversion Price of such series of Preferred Stock shall be recomputed accordingly as of the close of business on such record date and thereafter the Conversion Price of such series of Preferred Stock shall be adjusted pursuant to this subsection as of the time of actual payment of such dividends or distributions; and (b) that no such adjustment shall be made if the holders of such series of Preferred Stock simultaneously receive a dividend or other distribution of shares of Common Stock in a number equal to the number of shares of Common Stock as they would have received if all outstanding shares of such series of Preferred Stock had been converted into Common Stock on the date of such event.

4.7 Adjustments for Other Dividends and Distributions. In the event the Corporation at any time or from time to time after the Original Issue Date shall make or issue, or fix a record date for the determination of holders of Common Stock entitled to receive, a dividend or other distribution payable in securities of the Corporation (other than a distribution of shares of Common Stock in respect of outstanding shares of Common Stock) or in other property and the provisions of Section 1 do not apply to such dividend or distribution, then and in each such event the holders of each series of Preferred Stock shall receive, simultaneously with the distribution to the holders of Common Stock, a dividend or other distribution of such securities or other property in an amount equal to the amount of such securities or other property as they would have received if all outstanding shares of such series of Preferred Stock had been converted into Common Stock on the date of such event.

4.8 Adjustment for Merger or Reorganization, etc. Subject to the provisions of Subsection 2.3, if there shall occur any reorganization, recapitalization, reclassification, consolidation or merger involving the Corporation in which the Common Stock (but not any series of Preferred Stock) is converted into or exchanged for securities, cash or other

property (other than a transaction covered by Subsections 4.4, 4.6 or 4.7), then, following any such reorganization, recapitalization, reclassification, consolidation or merger, each share of such series of Preferred Stock shall thereafter be convertible in lieu of the Common Stock into which it was convertible prior to such event into the kind and amount of securities, cash or other property which a holder of the number of shares of Common Stock of the Corporation issuable upon conversion of one share of such series of Preferred Stock immediately prior to such reorganization, recapitalization, reclassification, consolidation or merger would have been entitled to receive pursuant to such transaction; and, in such case, appropriate adjustment (as determined in good faith by the Board of Directors of the Corporation) shall be made in the application of the provisions in this Section 4 with respect to the rights and interests thereafter of the holders of the such series of Preferred Stock, to the end that the provisions set forth in this Section 4 (including provisions with respect to changes in and other adjustments of the Conversion Price of such series of Preferred Stock) shall thereafter be applicable, as nearly as reasonably may be, in relation to any securities or other property thereafter deliverable upon the conversion of such series of Preferred Stock.

4.9 Certificate as to Adjustments. Upon the occurrence of each adjustment or readjustment of the Conversion Price of any series of Preferred Stock pursuant to this Section 4, the Corporation at its expense shall, as promptly as reasonably practicable but in any event not later than 10 days thereafter, compute such adjustment or readjustment in accordance with the terms hereof and furnish to each holder of such series of Preferred Stock a certificate setting forth such adjustment or readjustment (including the kind and amount of securities, cash or other property into which such series of Preferred Stock is convertible) and showing in detail the facts upon which such adjustment or readjustment is based. The Corporation shall, as promptly as reasonably practicable after the written request at any time of any holder of any series of Preferred Stock (but in any event not later than 10 days thereafter), furnish or cause to be furnished to such holder a certificate setting forth (i) the Conversion Price of such series of Preferred Stock then in effect, and (ii) the number of shares of Common Stock and the amount, if any, of other securities, cash or property which then would be received upon the conversion of such series of Preferred Stock.

4.10 Notice of Record Date. In the event:

- (a) the Corporation shall take a record of the holders of its Common Stock (or other capital stock or securities at the time issuable upon conversion of the Preferred Stock) for the purpose of entitling or enabling them to receive any dividend or other distribution, or to receive any right to subscribe for or purchase any shares of capital stock of any class or any other securities, or to receive any other security; or
 - (b) of any capital reorganization of the Corporation, any reclassification of the Common Stock of the Corporation, or any Deemed Liquidation Event; or
 - (c) of the voluntary or involuntary dissolution, liquidation or winding-up of the Corporation,
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then, and in each such case, the Corporation will send or cause to be sent to the holders of the each series of Preferred Stock a notice specifying, as the case may be, (i) the record date for such dividend, distribution or right, and the amount and character of such dividend, distribution or right, or (ii) the effective date on which such reorganization, reclassification, consolidation, merger, transfer, dissolution, liquidation or winding-up is proposed to take place, and the time, if any is to be fixed, as of which the holders of record of Common Stock (or such other capital stock or securities at the time issuable upon the conversion of the such series of Preferred Stock) shall be entitled to exchange their shares of Common Stock (or such other capital stock or securities) for securities or other property deliverable upon such reorganization, reclassification, consolidation, merger, transfer, dissolution, liquidation or winding-up, and the amount per share and character of such exchange applicable to the such series of Preferred Stock and the Common Stock. Such notice shall be sent at least 10 days prior to the record date or effective date for the event specified in such notice.

5. Mandatory Conversion.

5.1 Trigger Events. Upon either (a) the closing of the sale of shares of Common Stock to the public in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act of 1933, as amended, resulting in at least \$35,000,000 of gross proceeds to the Corporation or (b) the date and time, or the occurrence of an event, specified by vote or written consent of the Requisite Vote (the time of such closing or the date and time specified or the time of the event specified in such vote or written consent is referred to herein as the “**Mandatory Conversion Time**”), (i) all outstanding shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall automatically be converted into shares of Common Stock, at the applicable then effective conversion rate and (ii) such shares may not be reissued by the Corporation.

5.2 Procedural Requirements. All holders of record of shares of the relevant series of Preferred Stock shall be sent written notice of the Mandatory Conversion Time applicable to them and the place designated for mandatory conversion of all such shares of Preferred Stock pursuant to this Section 5. Such notice need not be sent in advance of the occurrence of the Mandatory Conversion Time. Upon receipt of such notice, each such holder of shares of Preferred Stock shall surrender his, her or its certificate or certificates for all such shares (or, if such holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate) to the Corporation at the place designated in such notice. If so required by the Corporation, certificates surrendered for conversion shall be endorsed or accompanied by written instrument or instruments of transfer, in form satisfactory to the Corporation, duly executed by the registered holder or by his, her or its attorney duly authorized in writing. All rights with respect to the Preferred Stock converted pursuant to Section 5.1, including the rights, if any, to receive notices and vote (other than as a holder of Common Stock), will terminate at the applicable Mandatory Conversion Time (notwithstanding the failure of the holder or holders thereof to

surrender the certificates at or prior to such time), except only the rights of the holders thereof, upon surrender of their certificate or certificates (or lost certificate affidavit and agreement) therefor, to receive the items provided for in the next sentence of this Subsection 5.2. As soon as practicable after the applicable Mandatory Conversion Time and the surrender of the certificate or certificates (or lost certificate affidavit and agreement) for the relevant series of the Preferred Stock, the Corporation shall issue and deliver to such holder, or to his, her or its nominees, a certificate or certificates for the number of full shares of Common Stock issuable on such conversion in accordance with the provisions hereof, together with cash as provided in Subsection 4.2 in lieu of any fraction of a share of Common Stock otherwise issuable upon such conversion and the payment of any declared but unpaid dividends on the shares of such series of Preferred Stock converted. Such converted Preferred Stock shall be retired and cancelled and may not be reissued as shares of such series, and the Corporation may thereafter take such appropriate action (without the need for stockholder action) as may be necessary to reduce the authorized number of shares of the applicable series of Preferred Stock accordingly.

6. Redemption.

6.1 Redemption. Shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall be redeemed by the Corporation on a pari passu basis out of funds lawfully available therefor at a price equal to (a) in the case of the Series A Preferred Stock, the Series A Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series A Redemption Price**”), (b) in the case of the Series B Preferred Stock, the Series B Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series B Redemption Price**”), (c) in the case of the Series B-1 Preferred Stock, the Series B-1 Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series B-1 Redemption Price**”), (d) in the case of the Series C Preferred Stock, the Series C Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series C Redemption Price**”), (e) in the case of the Series D Preferred Stock, the Series D Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series D Redemption Price**”), and (f) in the case of the Series E Preferred Stock, the Series E Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series E Redemption Price**”) in three annual installments commencing not more than 60 days after receipt by the Corporation at any time on or after the date five (5) years after the Original Issue Date, from the holders of the Requisite Vote, of written notice requesting redemption of all shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock. The date of each such installment shall be referred to as a “**Redemption Date**.” On each Redemption Date, the Corporation shall redeem, on a pro rata basis in accordance with the number of shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock owned by each holder, (A) that number of outstanding shares of Series A Preferred Stock determined by dividing (i) the total number of shares of Series A Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), (B) that

number of outstanding shares of Series B Preferred Stock determined by dividing (i) the total number of Series B Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), (C) that number of outstanding shares of Series B-1 Preferred Stock determined by dividing (i) the total number of Series B-1 Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), (D) that number of outstanding shares of Series C Preferred Stock determined by dividing (i) the total number of Series C Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), (E) that number of outstanding shares of Series D Preferred Stock determined by dividing (i) the total number of Series D Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), and (F) that number of outstanding shares of Series E Preferred Stock determined by dividing (i) the total number of Series E Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies); provided, however, that Excluded Shares (as such term is defined in Subsection 6.2) shall not be redeemed and shall be excluded from the calculations set forth in this sentence. Notwithstanding the foregoing, if the Corporation does not have sufficient funds legally available to redeem on any Redemption Date all shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to be redeemed on such Redemption Date, the Corporation shall redeem first a pro rata portion on a pari passu basis of each holder's redeemable shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock out of funds legally available therefor, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the legally available funds were sufficient to redeem all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor; and second, after all of the redeemable shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock have been redeemed, a pro rata portion on a pari passu basis of each holder's redeemable shares of Series A Preferred Stock, Series B Preferred Stock and Series B-1 Preferred Stock out of funds legally available therefor, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the legally available funds were sufficient to redeem all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor.

6.2 Redemption Notice. The Corporation shall send written notice of the mandatory redemption (the “**Redemption Notice**”) to each holder of record of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock not less than 40 days prior to each Redemption Date. Each Redemption Notice shall state:

- (a) the number of shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock held by the holder that the Corporation shall redeem on the Redemption Date specified in the Redemption Notice;
- (b) the Redemption Date, the Series A Redemption Price, the Series B Redemption Price, the Series B-1 Redemption Price, the Series C Redemption Price, the Series D Redemption Price, and the Series E Redemption Price;
- (c) the date upon which the holder's right to convert such shares terminates (as determined in accordance with Subsection 4.1); and
- (d) that the holder is to surrender to the Corporation, in the manner and at the place designated, his, her or its certificate or certificates representing the shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to be redeemed.

If the Corporation receives, on or prior to the 20th day after the date of delivery of the Redemption Notice to a holder of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, written notice from such holder that such holder elects to be excluded from the redemption provided in this Section 6, then the shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock registered on the books of the Corporation in the name of such holder at the time of the Corporation's receipt of such notice shall thereafter be "**Excluded Shares**." Excluded Shares shall not be redeemed or redeemable pursuant to this Section 6, whether on such Redemption Date or thereafter.

6.3 Surrender of Certificates; Payment. On or before the applicable Redemption Date, each holder of shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to be redeemed on such Redemption Date, unless such holder has exercised his, her or its right to convert such shares as provided in Section 4, shall surrender the certificate or certificates representing such shares (or, if such registered holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate) to the Corporation, in the manner and at the place designated in the Redemption Notice, and thereupon the Redemption Price for such shares shall be payable to the order of the person whose name appears on such certificate or certificates as the owner thereof. In the event less than all of the shares of Preferred Stock represented by a certificate are redeemed, a new

certificate representing the unredeemed shares of Preferred Stock shall promptly be issued to such holder.

6.4 Rights Subsequent to Redemption. If the Redemption Notice shall have been duly given, and if on the applicable Redemption Date the Redemption Price payable upon redemption of the shares of Preferred Stock to be redeemed on such Redemption Date is paid or tendered for payment or deposited with an independent payment agent so as to be available therefor in a timely manner, then notwithstanding that the certificates evidencing any of the shares of Preferred Stock so called for redemption shall not have been surrendered, dividends with respect to such shares of Preferred Stock shall cease to accrue after such Redemption Date and all rights with respect to such shares shall forthwith after the Redemption Date terminate, except only the right of the holders to receive the Redemption Price without interest upon surrender of their certificate or certificates therefor.

7. Redeemed or Otherwise Acquired Shares. Any shares of Preferred Stock that are redeemed or otherwise acquired by the Corporation or any of its subsidiaries shall be automatically and immediately cancelled and retired and shall not be reissued, sold or transferred. Neither the Corporation nor any of its subsidiaries may exercise any voting or other rights granted to the holders of Preferred Stock following redemption.

8. Waiver. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Preferred Stock set forth herein may be waived on behalf of all holders of Preferred Stock by the affirmative written consent or vote of the holders of a majority of the then outstanding shares of Preferred Stock, voting together as a single class on an as-converted basis. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock and/or Series D Preferred Stock set forth herein may be waived on behalf of all holders of the Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock and Series D Preferred Stock only by the affirmative written consent or vote of the holders of at least a majority of the outstanding shares of Series A Preferred Stock, Series B Preferred Stock, Series B-1 Preferred Stock and Series D Preferred Stock voting or consenting together as a single class on an as-converted basis; provided that, (a) any waiver of an adjustment to be made to the Series D Conversion Price resulting from the issuance or deemed issuance of Additional Shares of Common Stock, and (b) any waiver with respect to Section 3.3.4 of Article FOURTH Part B, in each case, may be waived on behalf of all holders of the Series D Preferred Stock only by the affirmative written consent or vote of the holders of at least a majority of the outstanding shares Series D Preferred Stock voting or consenting together as a single class. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Series C Preferred Stock set forth herein may be waived on behalf of all holders of Series C Preferred Stock only by the affirmative written consent or vote of the holders of a majority of the then outstanding shares of Series C Preferred Stock, voting separately as a single class. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Series E Preferred Stock set forth herein may be waived on behalf of all holders of Series E Preferred Stock only by the affirmative written

consent or vote of the holders of a majority of the then outstanding shares of Series E Preferred Stock, voting separately as a single class.

9. Notices. Any notice required or permitted by the provisions of this Article Fourth to be given to a holder of shares of Preferred Stock shall be mailed, postage prepaid, to the post office address last shown on the records of the Corporation, or given by electronic communication in compliance with the provisions of the General Corporation Law, and shall be deemed sent upon such mailing or electronic transmission.

AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
AXCELLA HEALTH INC.

Axcella Health Inc., a corporation organized and existing under the laws of the State of Delaware (the “Corporation”), hereby certifies as follows:

1. The name of the Corporation is Axcella Health Inc. The date of the filing of its original Certificate of Incorporation with the Secretary of State of the State of Delaware was August 27, 2008 (the “Original Certificate”). The name under which the Corporation filed the Original Certificate was Newco LS16, Inc.
2. This Amended and Restated Certificate of Incorporation (the “**Certificate**”) which restates and integrates and also further amends the provisions of the Corporation’s Certificate of Incorporation, as amended and restated, was duly adopted in accordance with the provisions of Sections 242 and 245 of the General Corporation Law of the State of Delaware (the “**DGCL**”) and by the written consent of its stockholders in accordance with Section 228 of the DGCL.
3. The text of the Certificate of the Corporation, as previously amended and restated, is hereby further amended and restated in its entirety as herein set forth in full.

ARTICLE I

The name of the Corporation is Axcella Health Inc.

ARTICLE II

The address of the Corporation’s registered office in the State of Delaware is c/o The Corporation Trust Company, 1209 Orange Street in the City of Wilmington, County of New Castle, 19801. The name of its registered agent at such address is The Corporation Trust Company.

ARTICLE III

The purpose of the Corporation is to engage in any lawful act or activity for which corporations may be organized under the DGCL.

ARTICLE IV

CAPITAL STOCK

The total number of shares of capital stock which the Corporation shall have authority to issue is one hundred eighty-two million fifty-four thousand four hundred and ninety-one

(182,054,491) of which (i) one hundred fifty million (150,000,000) shares shall be a class designated as common stock, par value \$0.001 per share (the “Common Stock”), and (ii) thirty-two million fifty-four thousand four hundred and ninety-one (32,054,491) shares shall be a class designated as preferred stock, par value \$0.001 per share (the “Preferred Stock”), of which 4,737,041 shares are designated Series B Preferred Stock, 1,084,441 shares are designated Series B-1 Preferred Stock, 6,969,044 shares are designated Series C Preferred Stock, 2,997,179 shares are designated Series D Preferred Stock, and 6,266,786 shares are designated Series E Preferred Stock (the “Designated Preferred Stock”) and ten million (10,000,000) shares shall be undesignated preferred stock (together, the “Preferred Stock”).

Except as otherwise provided in any certificate of designations of any series of Preferred Stock, the number of authorized shares of the class of Common Stock or Preferred Stock may from time to time be increased or decreased (but not below the number of shares of such class outstanding) by the affirmative vote of the holders of a majority in voting power of the outstanding shares of capital stock of the Corporation irrespective of the provisions of Section 242(b)(2) of the DGCL.

The powers, preferences and rights of, and the qualifications, limitations and restrictions upon, each class or series of stock shall be determined in accordance with, or as set forth below in, this Article IV except that the powers, preferences and rights of, and the qualifications, limitations and restrictions upon the Designated Preferred Stock are as set forth on Exhibit A. Every reference to Preferred Stock in Exhibit A means the Designated Preferred Stock. Immediately following the conversion of all outstanding Designated Preferred Stock into Common Stock upon the earlier to occur of (i) a Qualified Public Offering (as defined in Exhibit A) or (ii) a Majority Conversion (as defined in Exhibit A), the Corporation shall no longer have the authority to issue any Designated Preferred Stock.

A. COMMON STOCK

Subject to all the rights, powers and preferences of the Preferred Stock and except as provided by law or in this Certificate (or in any certificate of designations of any series of Preferred Stock):

(a) the holders of the Common Stock shall have the exclusive right to vote for the election of directors of the Corporation (the “Directors”) and on all other matters requiring stockholder action, each outstanding share entitling the holder thereof to one vote on each matter properly submitted to the stockholders of the Corporation for their vote; provided, however, that, except as otherwise required by law, holders of Common Stock, as such, shall not be entitled to vote on any amendment to this Certificate (or on any amendment to a certificate of designations of any series of Preferred Stock) that alters or changes the powers, preferences, rights or other terms of one or more outstanding series of Preferred Stock if the holders of such affected series of Preferred Stock are entitled to vote, either separately or together with the holders of one or more other such series, on such amendment pursuant to this Certificate (or pursuant to a certificate of designations of any series of Preferred Stock) or pursuant to the DGCL;

(b) dividends may be declared and paid or set apart for payment upon the Common Stock out of any assets or funds of the Corporation legally available for the payment of dividends, but only when and as declared by the Board of Directors or any authorized committee thereof; and

(c) upon the voluntary or involuntary liquidation, dissolution or winding up of the Corporation, the net assets of the Corporation shall be distributed pro rata to the holders of the Common Stock.

B. PREFERRED STOCK

The Board of Directors or any authorized committee thereof is expressly authorized, to the fullest extent permitted by law, to provide by resolution or resolutions for, out of the unissued shares of Preferred Stock, the issuance of the shares of Preferred Stock in one or more series of such stock, and by filing a certificate of designations pursuant to applicable law of the State of Delaware, to establish or change from time to time the number of shares of each such series, and to fix the designations, powers, including voting powers, full or limited, or no voting powers, preferences and the relative, participating, optional or other special rights of the shares of each series and any qualifications, limitations and restrictions thereof.

ARTICLE V

STOCKHOLDER ACTION

The following sections shall become effective immediately following the time that the Corporation has a class or series of capital stock listed on a national securities exchange (the "IPO Time").

1. Action without Meeting. Any action required or permitted to be taken by the stockholders of the Corporation at any annual or special meeting of stockholders of the Corporation must be effected at a duly called annual or special meeting of stockholders and may not be taken or effected by a written consent of stockholders in lieu thereof; *provided, however*, that any action required or permitted to be taken by the holders of Preferred Stock, voting separately as a series or separately as a class with one or more other such series, may be taken without a meeting, without prior notice and without a vote, to the extent expressly so provided by the applicable certificate of designation relating to such series of Preferred Stock. Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article V, Section 1.

2. Special Meetings. Except as otherwise required by statute and subject to the rights, if any, of the holders of any series of Preferred Stock, special meetings of the stockholders of the Corporation may be called only by the Board of Directors acting pursuant to a resolution approved by the affirmative vote of a majority of the Directors then in office, and special meetings of

stockholders may not be called by any other person or persons. Only those matters set forth in the notice of the special meeting may be considered or acted upon at a special meeting of stockholders of the Corporation.

ARTICLE VI

DIRECTORS

Sections 3, 4 and 5 of this Article VI shall become effective at the IPO Time.

1. General. The business and affairs of the Corporation shall be managed by or under the direction of the Board of Directors except as otherwise provided herein or required by law.
2. Election of Directors. Election of Directors need not be by written ballot unless the By-laws of the Corporation (the “By-laws”) shall so provide.
3. Number of Directors; Term of Office. The number of Directors of the Corporation shall be fixed solely and exclusively by resolution duly adopted from time to time by the Board of Directors. The Directors, other than those who may be elected by the holders of any series of Preferred Stock, shall be classified, with respect to the term for which they severally hold office, into three classes, as nearly equal in number as possible. The Board of Directors shall assign Directors into classes at the time the classification becomes effective. The initial Class I Directors shall serve for a term expiring at the first annual meeting of stockholders to be held after the date the Board initially became classified (the “Classification Date”), the initial Class II Directors shall serve for a term expiring at the second annual meeting of stockholders to be held after the Classification Date, and the initial Class III Directors shall serve for a term expiring at the third annual meeting of stockholders to be held after the Classification Date. At each annual meeting of stockholders, Directors elected to succeed those Directors whose terms expire shall be elected for a term of office to expire at the third succeeding annual meeting of stockholders after their election. Notwithstanding the foregoing, the Directors elected to each class shall hold office until their successors are duly elected and qualified or until their earlier resignation, death or removal.

Notwithstanding the foregoing, whenever, pursuant to the provisions of Article IV of this Certificate, the holders of any one or more series of Preferred Stock shall have the right, voting separately as a series or together with holders of other such series, to elect Directors at an annual or special meeting of stockholders, the election, term of office, filling of vacancies and other features of such directorships shall be governed by the terms of this Certificate and any certificate of designations applicable to such series.

Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article VI, Section 3.

4. Vacancies. Subject to the rights, if any, of the holders of any series of Preferred Stock to elect Directors and to fill vacancies in the Board of Directors relating thereto, any and all vacancies in the Board of Directors, however occurring, including, without limitation, by reason of an increase in the size of the Board of Directors, or the death, resignation, disqualification or removal of a Director, shall be filled solely and exclusively by the affirmative vote of a majority of the remaining Directors then in office, even if less than a quorum of the Board of Directors, and not by the stockholders. Any Director appointed in accordance with the preceding sentence shall hold office for the remainder of the full term of the class of Directors in which the new directorship was created or the vacancy occurred and until such Director's successor shall have been duly elected and qualified or until his or her earlier resignation, death or removal. Subject to the rights, if any, of the holders of any series of Preferred Stock to elect Directors, when the number of Directors is increased or decreased, the Board of Directors shall, subject to Article VI, Section 3 hereof, determine the class or classes to which the increased or decreased number of Directors shall be apportioned; *provided, however*, that no decrease in the number of Directors shall shorten the term of any incumbent Director. In the event of a vacancy in the Board of Directors, the remaining Directors, except as otherwise provided by law, shall exercise the powers of the full Board of Directors until the vacancy is filled.

5. Removal. Subject to the rights, if any, of any series of Preferred Stock to elect Directors and to remove any Director whom the holders of any such series have the right to elect, any Director (including persons elected by Directors to fill vacancies in the Board of Directors) may be removed from office (i) only with cause and (ii) only by the affirmative vote of the holders of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock then entitled to vote at an election of Directors. At least forty-five (45) days prior to any annual or special meeting of stockholders at which it is proposed that any Director be removed from office, written notice of such proposed removal and the alleged grounds thereof shall be sent to the Director whose removal will be considered at the meeting.

ARTICLE VII

LIMITATION OF LIABILITY

A Director of the Corporation shall not be personally liable to the Corporation or its stockholders for monetary damages for breach of his or her fiduciary duty as a Director, except for liability (a) for any breach of the Director's duty of loyalty to the Corporation or its stockholders, (b) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (c) under Section 174 of the DGCL or (d) for any transaction from which the Director derived an improper personal benefit. If the DGCL is amended after the effective date of this Certificate to authorize corporate action further eliminating or limiting the personal liability of Directors, then the liability of a Director of the Corporation shall be eliminated or limited to the fullest extent permitted by the DGCL, as so amended.

Any amendment, repeal or modification of this Article VII by either of (i) the stockholders of the Corporation or (ii) an amendment to the DGCL, shall not adversely affect any right or protection existing at the time of such amendment, repeal or modification with respect to any acts

or omissions occurring before such amendment, repeal or modification of a person serving as a Director at the time of such amendment, repeal or modification.

Notwithstanding anything herein to the contrary, from and after the IPO Time, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article VII.

ARTICLE VIII

AMENDMENT OF BY-LAWS

1. Amendment by Directors. Except as otherwise provided by law, the By-laws of the Corporation may be amended or repealed by the Board of Directors.

2. Amendment by Stockholders. Effective from and after the IPO Time, the By-laws of the Corporation may be amended or repealed by the stockholders at any annual meeting of stockholders, or special meeting of stockholders called for such purpose, by the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class; provided, however, that if the Board of Directors recommends that stockholders approve such amendment or repeal at such meeting of stockholders, such amendment or repeal shall only require the affirmative vote of the majority in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class.

ARTICLE IX

AMENDMENT OF CERTIFICATE OF INCORPORATION

The Corporation reserves the right to amend or repeal this Certificate in the manner now or hereafter prescribed by statute and this Certificate, and all rights conferred upon stockholders herein are granted subject to this reservation. Except as otherwise required by this Certificate or by law, whenever any vote of the holders of capital stock of the Corporation is required to amend or repeal any provision of this Certificate, such amendment or repeal shall require the affirmative vote of the majority in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of the majority in voting power of the outstanding shares of each class entitled to vote thereon as a class, at a duly constituted meeting of stockholders called expressly for such purpose; provided, however, that from and after the IPO Time, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of Article V, Article VI, Article VII, Article VIII or Article IX of this Certificate.

[End of Text]

By: _____
Name: _____
Title: _____

[Signature Page to Axcella Health Inc. Amended and Restated Certificate of Incorporation]

EXHIBIT A

1. Dividends. The Corporation shall not declare, pay or set aside any dividends on shares of any other class or series of capital stock of the Corporation (other than dividends on shares of Common Stock payable in shares of Common Stock) unless (in addition to the obtaining of any consents required elsewhere in the Certificate of Incorporation) the holders of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock and Series D Preferred Stock then outstanding on a pari passu basis, shall receive, or simultaneously receive, a dividend on each outstanding share of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock or Series D Preferred Stock as the case may be, in an amount at least equal to the greater of (i) \$0.2069 per share of the Series B Preferred Stock in the case of the Series B Preferred Stock, \$0.2213 per share of the Series B-1 Preferred Stock in the case of the Series B-1 Preferred Stock, \$0.8064 per share of the Series C Preferred Stock in the case of the Series C Preferred Stock, \$1.1344 per share of the Series D Preferred Stock in the case of the Series D Preferred Stock, and \$0.8936 per share of the Series E Preferred Stock in the case of the Series E Preferred Stock (in each case, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization affecting such shares) per year from and after the date of the issuance of any shares of Series B Preferred Stock in the case of the Series B Preferred Stock, from and after the date of the issuance of any shares of Series B-1 Preferred Stock in the case of the Series B-1 Preferred Stock (to the extent not previously paid), from and after the date of the issuance of any shares of Series C Preferred Stock in the case of the Series C Preferred Stock (to the extent not previously paid), from and after the date of the issuance of any shares of Series D Preferred Stock in the case of the Series D Preferred Stock (to the extent not previously paid), and from and after the date of the issuance of any shares of Series E Preferred Stock in the case of the Series E Preferred Stock (to the extent not previously paid) and (ii) (A) in the case of a dividend on Common Stock or any class or series that is convertible into Common Stock, that dividend per share of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock, as the case may be, as would equal the product of (1) the dividend payable on each share of such class or series determined, if applicable, as if all shares of such class or series had been converted into Common Stock and (2) the number of shares of Common Stock issuable upon conversion of a share of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock as the case may be, in each case calculated on the record date for determination of holders entitled to receive such dividend or (B) in the case of a dividend on any class or series that is not convertible into Common Stock, at a rate per share of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock, as the case may be, determined by (1) dividing the amount of the dividend payable on each share of such class or series of capital stock by the original issuance price of such class or series of capital stock (subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization affecting such shares) and (2) multiplying such fraction by an amount equal to, in the case of the Series B Preferred Stock, the Series B Original Issue Price (as defined below), in the case of the Series B-1 Preferred Stock, the Series B-1 Original Issue Price (as defined below), in the case of the Series C Preferred Stock, the Series C Original Issue Price (as defined below), in the case of the Series D Preferred Stock, the Series D Original Issue Price (as defined below), and in the case of the Series E Preferred Stock, the Series E Original Issue Price (as defined below); provided that, if the Corporation declares, pays or sets aside, on the same date, a dividend on shares of more than one class or series of capital stock of the

Corporation, the dividend payable to the holders of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock pursuant to this Section 1 shall be calculated based upon the dividend on the class or series of capital stock that would result in the highest dividend for the Series B Preferred Stock, the Series B-1 Preferred Stock, the Series C Preferred Stock, the Series D Preferred Stock, and the Series E Preferred Stock. The foregoing dividend shall not be cumulative. The “**Series B Original Issue Price**” shall mean \$4.7634 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series B Preferred Stock. The “**Series B-1 Original Issue Price**” shall mean \$5.0957 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series B-1 Preferred Stock. The “**Series C Original Issue Price**” shall mean \$18.5674 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series C Preferred Stock. The “**Series D Original Issue Price**” shall mean \$24.9591 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series D Preferred Stock. The “**Series E Original Issue Price**” shall mean \$20.5751 per share, subject to appropriate adjustment in the event of any stock dividend, stock split, combination or other similar recapitalization with respect to the Series E Preferred Stock.

2. Liquidation, Dissolution or Winding Up; Certain Mergers, Consolidations and Asset Sales.

2.1 Preferential Payments to Holders of Preferred Stock.

2.1.1 In the event of any voluntary or involuntary liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, the holders of shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock then outstanding shall be entitled on a pari passu basis to be paid out of the assets of the Corporation available for distribution to its stockholders before any payment shall be made to the holders of Series B Preferred Stock, Series B-1 Preferred Stock or Common Stock by reason of their ownership thereof, an amount per share equal to (a) in the case of the Series C Preferred Stock, the greater of (i) the Series C Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series C Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series C Liquidation Amount**”), (b) in the case of the Series D Preferred Stock, the greater of (i) the Series D Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series D Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this sentence is hereinafter referred to as the “**Series D Liquidation Amount**”), and (c) in the case of the Series E Preferred Stock, the greater of (i) the Series E Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series E Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the

amount payable pursuant to this sentence is hereinafter referred to as the “**Series E Liquidation Amount**”). If upon any such liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, the assets of the Corporation available for distribution to its stockholders shall be insufficient to pay the holders of shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock the full amount to which they shall be entitled under this Subsection 2.1.1, the holders of shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall share ratably in any distribution of the assets available for distribution in proportion to the respective amounts which would otherwise be payable in respect of the shares held by them upon such distribution if all amounts payable on or with respect to such shares were paid in full.

2.1.2 Following the payment of the Series C Liquidation Amount, the Series D Liquidation Amount, and the Series E Liquidation Amount, the holders of shares of Series B Preferred Stock and Series B-1 Preferred Stock then outstanding shall be entitled on a pari passu basis to be paid out of the assets of the Corporation available for distribution to its stockholders before any payment shall be made to the holders of Common Stock by reason of their ownership thereof, an amount per share equal to (a) in the case of the Series B Preferred Stock, the greater of (i) the Series B Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series B Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this clause (a) is hereinafter referred to as the “**Series B Liquidation Amount**”), and (b) in the case of the Series B-1 Preferred Stock, the greater of (i) the Series B-1 Original Issue Price, plus any dividends declared but unpaid thereon or (ii) such amount per share as would have been payable had all shares of Series B-1 Preferred Stock been converted into Common Stock pursuant to Section 4 immediately prior to such liquidation, dissolution, winding up or Deemed Liquidation Event (the amount payable pursuant to this clause (b) is hereinafter referred to as the “**Series B-1 Liquidation Amount**”). If upon any such liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, the assets of the Corporation available for distribution to its stockholders shall be insufficient to pay the holders of shares of Series B Preferred Stock and Series B-1 Preferred Stock the full amount to which they shall be entitled under this Subsection 2.1.2, the holders of shares of Series B Preferred Stock and Series B-1 Preferred Stock shall share ratably in any distribution of the assets available for distribution in proportion to the respective amounts which would otherwise be payable in respect of the shares held by them upon such distribution if all amounts payable on or with respect to such shares were paid in full.

2.2 Payments to Holders of Common Stock. In the event of any voluntary or involuntary liquidation, dissolution or winding up of the Corporation or Deemed Liquidation Event, after the payment of all preferential amounts required to be paid to the holders of shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, the remaining assets of the Corporation available for distribution to its stockholders shall be distributed among the holders of shares of Common Stock, pro rata based on the number of shares held by each such holder.

2.3 Deemed Liquidation Events.

2.3.1 Definition. Each of the following events shall be considered a “**Deemed Liquidation Event**” unless (A) the holders of at least a majority of the outstanding shares of Preferred Stock, voting or consenting together as a single class on an as-converted basis, and (B) the holders of at least a majority of the outstanding shares of Series C Preferred Stock, voting or consenting separately as a single class (the votes and consents described in clauses (A) and (B) together, the “**Requisite Vote**”), elect otherwise by written notice sent to the Corporation at least 20 days prior to the effective date of any such event:

- (a) a merger or consolidation in which
 - (i) the Corporation is a constituent party or
 - (ii) a subsidiary of the Corporation is a constituent party and the Corporation issues shares of its capital stock pursuant to such merger or consolidation,

except any such merger or consolidation involving the Corporation or a subsidiary in which the shares of capital stock of the Corporation outstanding immediately prior to such merger or consolidation continue to represent, or are converted into or exchanged for shares of capital stock that represent, immediately following such merger or consolidation, at least a majority, by voting power, of the capital stock of (1) the surviving or resulting corporation or (2) if the surviving or resulting corporation is a wholly owned subsidiary of another corporation immediately following such merger or consolidation, the parent corporation of such surviving or resulting corporation (provided that, for the purpose of this Subsection 2.3.1, all shares of Common Stock issuable upon exercise of Options (as defined below) outstanding immediately prior to such merger or consolidation or upon conversion of Convertible Securities (as defined below) outstanding immediately prior to such merger or consolidation shall be deemed to be outstanding immediately prior to such merger or consolidation and, if applicable, converted or exchanged in such merger or consolidation on the same terms as the actual outstanding shares of Common Stock are converted or exchanged); or

(b) the sale, lease, transfer, exclusive license or other disposition, in a single transaction or series of related transactions, by the Corporation or any subsidiary of the Corporation of all or substantially all the assets of the Corporation and its subsidiaries taken as a whole, or the sale or disposition (whether by merger, consolidation or otherwise) of one or more subsidiaries of the Corporation if all or substantially all of the assets of the Corporation and its subsidiaries taken as a whole are held by such subsidiary or subsidiaries, except where such sale, lease, transfer, exclusive license or other disposition is to a wholly-owned subsidiary of the Corporation.

2.3.2 Effecting a Deemed Liquidation Event.

- (a) The Corporation shall not have the power to effect a Deemed Liquidation Event referred to in Subsection 2.3.1(a) (i) unless the agreement or plan of merger or consolidation for such transaction (the “**Merger Agreement**”) provides that the consideration
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payable to the stockholders of the Corporation shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2.

(b) In the event of a Deemed Liquidation Event referred to in Subsection 2.3.1(a)(ii) or 2.3.1(b), if the Corporation does not effect a dissolution of the Corporation under the General Corporation Law within 90 days after such Deemed Liquidation Event, then (i) the Corporation shall send a written notice to each holder of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock no later than the 90th day after the Deemed Liquidation Event advising such holders of their right (and the requirements to be met to secure such right) pursuant to the terms of the following clause (ii) to require the redemption of such shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock and (ii) if the holders of the Requisite Vote so request in a written instrument delivered to the Corporation not later than 120 days after such Deemed Liquidation Event, the Corporation shall use the consideration received by the Corporation for such Deemed Liquidation Event (net of any retained liabilities associated with the assets sold or technology licensed, as determined in good faith by the Board of Directors of the Corporation), together with any other assets of the Corporation available for distribution to its stockholders (the “**Available Proceeds**”), to the extent legally available therefor, on or before the 150th day after such Deemed Liquidation Event, to redeem all outstanding shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock at a price per share equal to the Series B Liquidation Amount, the Series B-1 Liquidation Amount, the Series C Liquidation Amount, the Series D Liquidation Amount, and the Series E Liquidation Amount, respectively. Notwithstanding the foregoing, in the event of a redemption pursuant to the preceding sentence, if the Available Proceeds are not sufficient to redeem all outstanding shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, the Corporation shall redeem first a pro rata portion on a pari passu basis of each holder’s shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to the fullest extent of such Available Proceeds, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the Available Proceeds were sufficient to redeem all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor; and second, after all of the shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock have been redeemed, a pro rata portion on a pari passu basis of each holder’s shares of Series B Preferred Stock and Series B-1 Preferred Stock to the fullest extent of such Available Proceeds, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the Available Proceeds were sufficient to redeem all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor. The provisions of Subsections 6.2 through 6.4 shall apply, with such necessary changes in the details thereof as are necessitated by the context, to the redemption of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock pursuant to this Subsection 2.3.2(b). Prior to the distribution or redemption provided for in this Subsection 2.3.2(b), the Corporation shall not expend or dissipate the consideration received for such Deemed Liquidation Event, except to discharge expenses incurred in connection with such Deemed Liquidation Event or in the ordinary course of business.

2.3.3 Amount Deemed Paid or Distributed. If the amount deemed paid or distributed under this Subsection 2.3.3 is made in property other than in cash, the value of such distribution shall be the fair market value of such property, determined as follows:

- (a) For securities not subject to investment letters or other similar restrictions on free marketability,
 - (i) if traded on a securities exchange, the value shall be deemed to be the average of the closing prices of the securities on such exchange or market over the 30-day period ending three days prior to the closing of such transaction;
 - (ii) if actively traded over-the-counter, the value shall be deemed to be the average of the closing bid prices over the 30-day period ending three days prior to the closing of such transaction; or
 - (iii) if there is no active public market, the value shall be the fair market value thereof, as determined in good faith by the Board of Directors of the Corporation.

(b) The method of valuation of securities subject to investment letters or other similar restrictions on free marketability (other than restrictions arising solely by virtue of a stockholder's status as an affiliate or former affiliate) shall take into account an appropriate discount (as determined in good faith by the Board of Directors of the Corporation) from the market value as determined pursuant to clause (a) above so as to reflect the approximate fair market value thereof.

(c) For other assets, the value shall be the fair market value thereof, as determined in good faith by the Board of Directors of the Corporation.

2.3.4 Allocation of Escrow. In the event of a Deemed Liquidation Event pursuant to Subsections 2.3.1(a)(i) or 2.3.1(b), if any portion of the consideration payable to the stockholders of the Corporation is placed into escrow and/or is payable to the stockholders of the Corporation subject to contingencies, the Merger Agreement shall provide that (a) the portion of such consideration that is not placed in escrow and not subject to any contingencies (the "**Initial Consideration**") shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2 as if the Initial Consideration were the only consideration payable in connection with such Deemed Liquidation Event and (b) any additional consideration which becomes payable to the stockholders of the Corporation upon release from escrow or satisfaction of contingencies shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2 after taking into account the previous payment of the Initial Consideration as part of the same transaction.

3. Voting.

3.1 General. On any matter presented to the stockholders of the Corporation for their action or consideration at any meeting of stockholders of the Corporation (or by written consent of stockholders in lieu of meeting), each holder of outstanding shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall be entitled to cast the number of votes equal to the number of whole shares of Common Stock into which the shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock held by such holder are convertible as of the record date for determining stockholders entitled to vote on such matter. Except as provided by law or by the other provisions of the Certificate of Incorporation, holders of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall vote together with the holders of Common Stock as a single class.

3.2 Election of Directors. So long as any shares of Preferred Stock are outstanding, the holders of record of the shares of Preferred Stock, exclusively and voting together as a single, separate class on an as-converted to Common Stock basis, shall be entitled to elect one (1) director of the Corporation (the “**Preferred Director**”). The Preferred Director may be removed without cause by, and only by, the affirmative vote of the holders of shares of Preferred Stock, given either at a special meeting of such stockholders duly called for that purpose or pursuant to a written consent of stockholders. If the holders of shares of Preferred Stock, voting exclusively and as a separate class, fail to elect a sufficient number of directors to fill all directorships for which they are entitled to elect directors, voting exclusively and as a separate class, pursuant to the first sentence of this Subsection 3.2, then any directorship not so filled shall remain vacant until such time as the holders of the Preferred Stock elect a person to fill such directorship by vote or written consent in lieu of a meeting; and such directorship may not be filled by stockholders of the Corporation other than by the holders of shares of Preferred Stock, voting exclusively and as a separate class. The holders of record of the shares of Common Stock and of any other class or series of voting stock (including the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock), exclusively and voting together as a single class on an as-converted basis, shall be entitled to elect the balance of the total number of directors of the Corporation. At any meeting held for the purpose of electing a director, the presence in person or by proxy of the holders of a majority of the outstanding shares of the class or series entitled to elect such director shall constitute a quorum for the purpose of electing such director. Except as otherwise provided in this Subsection 3.2, a vacancy in any directorship filled by the holders of any class or series shall be filled only by vote or written consent in lieu of a meeting of the holders of such class or series or by any remaining director or directors elected by the holders of such class or series pursuant to this Subsection 3.2.

3.3 Protective Provisions.

3.3.1 Preferred Stock Protective Provisions. At any time when any shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly by amendment, merger, consolidation or otherwise, do any of the following

without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the outstanding shares of Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single class on an as-converted basis:

- (a) liquidate, dissolve or wind-up the business and affairs of the Corporation, effect any Deemed Liquidation Event, or consent to any of the foregoing;
 - (b) amend, alter or repeal any provision of the Certificate of Incorporation or Bylaws of the Corporation;
 - (c) create, or authorize the creation of, or issue or obligate itself to issue shares of, any additional class or series of capital stock unless the same ranks junior to the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock with respect to the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends and rights of redemption, or increase the authorized number of shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock or increase the authorized number of shares of any additional class or series of capital stock unless the same ranks junior to the Series B Preferred Stock, the Series B-1 Preferred Stock, the Series C Preferred Stock, the Series D Preferred Stock, and the Series E Preferred Stock with respect to the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends and rights of redemption;
 - (d) (i) reclassify, alter or amend any existing security of the Corporation that is *pari passu* with the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or *pari passu* with the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock in respect of any such right, preference or privilege;
 - (e) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases
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of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(f) create, or authorize the creation of, or issue, or authorize the issuance of any debt security, or permit any subsidiary to take any such action with respect to any debt security if the aggregate indebtedness of the Corporation and its subsidiaries for borrowed money following such action would exceed \$250,000, unless such debt security has received the prior approval of the Board of Directors of the Corporation, including the Preferred Director;

(g) create or hold capital stock in any subsidiary that is not a wholly-owned subsidiary or sell, transfer or otherwise dispose of any capital stock of any direct or indirect subsidiary of the Corporation, or permit any direct or indirect subsidiary to sell, lease, transfer, exclusively license or otherwise dispose (in a single transaction or series of related transactions) of all or substantially all of the assets of such subsidiary;

(h) increase or decrease the authorized number of directors constituting the Board of Directors of the Corporation; or

(i) create or establish any new employee stock option plan, employee stock purchase plan, employee restricted stock plan or other similar equity incentive plan or increase the number of shares of capital stock of the Corporation reserved for issuance under any current or new employee stock option plan, employee stock purchase plan, employee restricted stock plan or other similar equity incentive plan.

3.3.2 Series C Preferred Stock Protective Provisions. At any time when any shares of Series C Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series C Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class:

(a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series C Preferred Stock in a manner that is adverse to the Series C Preferred Stock;

(b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series C Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series C Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series C Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series C Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series C Preferred Stock in respect of any such right, preference or privilege; or

(d) increase or decrease the authorized number of shares of the Series C Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series C Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series C Preferred Stock that is in a manner adverse to the Series C Preferred Stock.

3.3.3 Series B/B-1 Preferred Stock Protective Provisions. At any time when any shares of Series B Preferred Stock or Series B-1 Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series B Preferred Stock and Series B-1 Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class, on an as-converted basis:

(a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series B Preferred Stock or the Series B-1 Preferred Stock in a manner that is adverse to the Series B Preferred Stock or the Series B-1 Preferred Stock;

(b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series B Preferred Stock or the Series B-1 Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series B Preferred Stock or the Series B-1 Preferred Stock

in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series B Preferred Stock or the Series B-1 Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series B Preferred Stock or the Series B-1 Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series B Preferred Stock or the Series B-1 Preferred Stock in respect of any such right, preference or privilege; or

(d) increase or decrease the authorized number of shares of the Series B Preferred Stock or the Series B-1 Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series B Preferred Stock or the Series B-1 Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series B Preferred Stock or the Series B-1 Preferred Stock that is in a manner adverse to any such series of Preferred Stock.

3.3.4 Series D Preferred Stock Protective Provisions. At any time when any shares of Series D Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series D Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class:

(a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series D Preferred Stock in a manner that is adverse to the Series D Preferred Stock;

(b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series D Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

(c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends

or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series D Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series D Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series D Preferred Stock in respect of any such right, preference or privilege; or

- (d) increase or decrease the authorized number of shares of the Series D Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series D Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series D Preferred Stock that is in a manner adverse to the Series D Preferred Stock.

3.3.5 Series E Preferred Stock Protective Provisions. At any time when any shares of Series E Preferred Stock are outstanding, the Corporation shall not, either directly or indirectly, by amendment, merger, consolidation or otherwise, do any of the following without (in addition to any other vote required by law or the Certificate of Incorporation) the written consent or affirmative vote of the holders of at least a majority of the Series E Preferred Stock, given in writing or by vote at a meeting, consenting or voting (as the case may be) as a single, separate class:

- (a) amend, alter, or repeal the rights, preferences or privileges of the shares of the Series E Preferred Stock in a manner that is adverse to the Series E Preferred Stock;

- (b) purchase or redeem (or permit any subsidiary to purchase or redeem) or pay or declare any dividend or make any distribution on, any shares of capital stock of the Corporation other than (i) redemptions of or dividends or distributions on the Series E Preferred Stock as expressly authorized herein, (ii) dividends or other distributions payable on the Common Stock solely in the form of additional shares of Common Stock and (iii) repurchases of stock from former employees, officers, directors, consultants or other persons who performed services for the Corporation or any subsidiary in connection with the cessation of such employment or service at the lower of the original purchase price or the then-current fair market value thereof;

- (c) (i) reclassify, alter or amend any existing security of the Corporation that is pari passu with the Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to the Series E Preferred Stock in respect of any such right, preference or privilege, or (ii) reclassify, alter or amend any existing security of the Corporation that is junior to the Series E Preferred Stock in respect of the distribution of assets on the liquidation, dissolution or winding

up of the Corporation, the payment of dividends or rights of redemption, if such reclassification, alteration or amendment would render such other security senior to or pari passu with the Series E Preferred Stock in respect of any such right, preference or privilege; or

(d) increase or decrease the authorized number of shares of the Series E Preferred Stock.

For the avoidance of doubt, the authorization or issuance of any other series or class of capital stock ranking junior, pari passu, or senior to the Series E Preferred Stock with respect to one or more rights, preferences or privileges shall not, in and of itself, be deemed to constitute an amendment, alteration or repeal of the rights, preferences or privileges of the Series E Preferred Stock that is in a manner adverse to the Series E Preferred Stock.

4. Optional Conversion. The holders of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall have conversion rights as follows (the “Conversion Rights”):

4.1 Right to Convert.

4.1.1 Conversion Ratio. Each share of Series B Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series B Original Issue Price by the Series B Conversion Price (as defined below) in effect at the time of conversion. The “**Series B Conversion Price**” shall initially be equal to \$2.586. Such initial Series B Conversion Price, and the rate at which shares of Series B Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series B-1 Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series B-1 Original Issue Price by the Series B-1 Conversion Price (as defined below) in effect at the time of conversion. The “**Series B-1 Conversion Price**” shall initially be equal to \$2.7664. Such initial Series B-1 Conversion Price, and the rate at which shares of Series B-1 Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series C Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series C Original Issue Price by the Series C Conversion Price (as defined below) in effect at the time of conversion. The “**Series C Conversion Price**” shall initially be equal to \$10.08. Such initial Series C Conversion Price, and the rate at which shares of Series C Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series D Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series D Original Issue Price by the Series D Conversion Price (as defined below) in effect at the time of conversion. The “**Series D Conversion**

Price” shall initially be equal to \$13.87. Such initial Series D Conversion Price, and the rate at which shares of Series D Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below. Each share of Series E Preferred Stock shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into such number of fully paid and nonassessable shares of Common Stock as is determined by dividing the Series E Original Issue Price by the Series E Conversion Price (as defined below) in effect at the time of conversion. The **“Series E Conversion Price”** shall initially be equal to \$11.17. Such initial Series E Conversion Price, and the rate at which shares of Series E Preferred Stock may be converted into shares of Common Stock, shall be subject to adjustment as provided below.

4.1.2 Termination of Conversion Rights. In the event of a notice of redemption of any shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock pursuant to Section 6, the Conversion Rights of the shares designated for redemption shall terminate at the close of business on the last full day preceding the date fixed for redemption, unless the redemption price is not fully paid on such redemption date, in which case the Conversion Rights for such shares shall continue until such price is paid in full. In the event of a liquidation, dissolution or winding up of the Corporation or a Deemed Liquidation Event, the Conversion Rights shall terminate at the close of business on the last full day preceding the date fixed for the payment of any such amounts distributable on such event to the holders of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock.

4.2 Fractional Shares. No fractional shares of Common Stock shall be issued upon conversion of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, or Series E Preferred Stock. In lieu of any fractional shares to which the holder would otherwise be entitled, the Corporation shall pay cash equal to such fraction multiplied by the fair market value of a share of Common Stock as determined in good faith by the Board of Directors of the Corporation. Whether or not fractional shares would be issuable upon such conversion shall be determined on the basis of the total number of shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, as the case may be, the holder is at the time converting into Common Stock and the aggregate number of shares of Common Stock issuable upon such conversion.

4.3 Mechanics of Conversion.

4.3.1 Notice of Conversion. In order for a holder of Preferred Stock to voluntarily convert shares of Preferred Stock into shares of Common Stock, such holder shall surrender the certificate or certificates for such shares of Preferred Stock (or, if such registered holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate), at the office of the transfer agent for the Preferred Stock (or at the principal office of the Corporation if the Corporation serves as its own transfer agent), together with written

notice that such holder elects to convert all or any number of the shares of the Preferred Stock represented by such certificate or certificates and, if applicable, any event on which such conversion is contingent. Such notice shall state such holder's name or the names of the nominees in which such holder wishes the certificate or certificates for shares of Common Stock to be issued. If required by the Corporation, certificates surrendered for conversion shall be endorsed or accompanied by a written instrument or instruments of transfer, in form satisfactory to the Corporation, duly executed by the registered holder or his, her or its attorney duly authorized in writing. The close of business on the date of receipt by the transfer agent (or by the Corporation if the Corporation serves as its own transfer agent) of such certificates (or lost certificate affidavit and agreement) and notice shall be the time of conversion (the "**Conversion Time**"), and the shares of Common Stock issuable upon conversion of the shares represented by such certificate shall be deemed to be outstanding of record as of such date. The Corporation shall, as soon as practicable after the Conversion Time, (i) issue and deliver to such holder of Preferred Stock, or to his, her or its nominees, a certificate or certificates for the number of full shares of Common Stock issuable upon such conversion in accordance with the provisions hereof and a certificate for the number (if any) of the shares of Preferred Stock represented by the surrendered certificate that were not converted into Common Stock, (ii) pay in cash such amount as provided in Subsection 4.2 in lieu of any fraction of a share of Common Stock otherwise issuable upon such conversion and (iii) pay all declared but unpaid dividends on the shares of Preferred Stock converted.

4.3.2 Reservation of Shares. The Corporation shall at all times when the Preferred Stock shall be outstanding, reserve and keep available out of its authorized but unissued capital stock, for the purpose of effecting the conversion of the Preferred Stock, such number of its duly authorized shares of Common Stock as shall from time to time be sufficient to effect the conversion of all outstanding Preferred Stock; and if at any time the number of authorized but unissued shares of Common Stock shall not be sufficient to effect the conversion of all then outstanding shares of the Preferred Stock, the Corporation shall take such corporate action as may be necessary to increase its authorized but unissued shares of Common Stock to such number of shares as shall be sufficient for such purposes, including, without limitation, engaging in best efforts to obtain the requisite stockholder approval of any necessary amendment to the Certificate of Incorporation. Before taking any action which would cause an adjustment reducing the Conversion Price below the then par value of the shares of Common Stock issuable upon conversion of the Preferred Stock, the Corporation will take any corporate action which may, in the opinion of its counsel, be necessary in order that the Corporation may validly and legally issue fully paid and nonassessable shares of Common Stock at such adjusted Conversion Price.

4.3.3 Effect of Conversion. All shares of Preferred Stock which shall have been surrendered for conversion as herein provided shall no longer be deemed to be outstanding and all rights with respect to such shares shall immediately cease and terminate at the Conversion Time, except only the right of the holders thereof to receive shares of Common Stock in exchange therefor, to receive payment in lieu of any fraction of a share otherwise issuable upon such conversion as provided in Subsection 4.2 and to receive payment of any dividends declared but unpaid thereon. Any shares of Preferred Stock so converted shall be retired and cancelled and may not be reissued as shares of such series, and the Corporation may thereafter take such appropriate

action (without the need for stockholder action) as may be necessary to reduce the authorized number of shares of Preferred Stock accordingly.

4.3.4 No Further Adjustment. Upon any such conversion, no adjustment to the Conversion Price shall be made for any declared but unpaid dividends on the Preferred Stock surrendered for conversion or on the Common Stock delivered upon conversion.

4.3.5 Taxes. The Corporation shall pay any and all issue and other similar taxes that may be payable in respect of any issuance or delivery of shares of Common Stock upon conversion of shares of Preferred Stock pursuant to this Section 4. The Corporation shall not, however, be required to pay any tax which may be payable in respect of any transfer involved in the issuance and delivery of shares of Common Stock in a name other than that in which the shares of Preferred Stock so converted were registered, and no such issuance or delivery shall be made unless and until the person or entity requesting such issuance has paid to the Corporation the amount of any such tax or has established, to the satisfaction of the Corporation, that such tax has been paid.

4.4 Adjustments to Conversion Price for Diluting Issues.

4.4.1 Special Definitions. For purposes of this Article Fourth, the following definitions shall apply:

(a) **“Option”** shall mean rights, options or warrants to subscribe for, purchase or otherwise acquire Common Stock or Convertible Securities.

(b) **“Original Issue Date”** shall mean the date on which the first share of Series E Preferred Stock was issued.

(c) **“Convertible Securities”** shall mean any evidences of indebtedness, shares or other securities directly or indirectly convertible into or exchangeable for Common Stock, but excluding Options.

(d) **“Additional Shares of Common Stock”** shall mean all shares of Common Stock issued (or, pursuant to Subsection 4.4.2 below, deemed to be issued) by the Corporation after the Original Issue Date, other than (1) the following shares of Common Stock and (2) shares of Common Stock deemed issued pursuant to the following Options and Convertible Securities (clauses (1) and (2), collectively, **“Exempted Securities”**):

(i) shares of Common Stock, Options or Convertible Securities issued upon the conversion of Preferred Stock or as a dividend or distribution on Preferred Stock;

(ii) shares of Common Stock, Options or Convertible Securities issued by reason of a dividend, stock split, split-up or other distribution on shares of Common

Stock that is covered by Subsection 4.5, 4.6, 4.7 or 4.8;

- (iii) shares of Common Stock or Options issued to employees or directors of, or consultants or advisors to, the Corporation or any of its subsidiaries pursuant to a plan, agreement or arrangement approved by the Board of Directors of the Corporation, including the Preferred Director;
 - (iv) shares of Common Stock or Convertible Securities actually issued upon the exercise of Options or shares of Common Stock actually issued upon the conversion or exchange of Convertible Securities, in each case provided such issuance is pursuant to the terms of such Option or Convertible Security;
 - (v) shares of Common Stock, Options or Convertible Securities issued to banks, equipment lessors or other financial institutions, or to real property lessors, pursuant to a debt financing, equipment leasing or real property leasing transaction approved by the Board of Directors of the Corporation, including the Preferred Director;
 - (vi) shares of Common Stock, Options or Convertible Securities issued to suppliers or third party service providers in connection with the provision of goods or services pursuant to transactions approved by the Board of Directors of the Corporation, including the Preferred Director;
 - (vii) shares of Common Stock, Options or Convertible Securities issued in connection with sponsored research, collaboration, technology license, development, marketing or other similar agreements or strategic partnerships approved by the Board of Directors of the Corporation, including the Preferred Director; or
 - (viii) shares of Common Stock issued or issuable in or in connection with an initial public offering.
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4.4.2 Deemed Issue of Additional Shares of Common Stock.

(a) If the Corporation at any time or from time to time after the Original Issue Date shall issue any Options or Convertible Securities (excluding Options or Convertible Securities which are themselves Exempted Securities) or shall fix a record date for the determination of holders of any class of securities entitled to receive any such Options or Convertible Securities, then the maximum number of shares of Common Stock (as set forth in the instrument relating thereto, assuming the satisfaction of any conditions to exercisability, convertibility or exchangeability but without regard to any provision contained therein for a subsequent adjustment of such number) issuable upon the exercise of such Options or, in the case of Convertible Securities and Options therefor, the conversion or exchange of such Convertible Securities, shall be deemed to be Additional Shares of Common Stock issued as of the time of such issue or, in case such a record date shall have been fixed, as of the close of business on such record date.

(b) If the terms of any Option or Convertible Security, the issuance of which resulted in an adjustment to the Conversion Price of any series of Preferred Stock pursuant to the terms of Subsection 4.4.3, are revised as a result of an amendment to such terms or any other adjustment pursuant to the provisions of such Option or Convertible Security (but excluding automatic adjustments to such terms pursuant to anti-dilution or similar provisions of such Option or Convertible Security) to provide for either (1) any increase or decrease in the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any such Option or Convertible Security or (2) any increase or decrease in the consideration payable to the Corporation upon such exercise, conversion and/or exchange, then, effective upon such increase or decrease becoming effective, the Conversion Price of such series of Preferred Stock computed upon the original issue of such Option or Convertible Security (or upon the occurrence of a record date with respect thereto) shall be readjusted to the Conversion Price of such series of Preferred Stock as would have obtained had such revised terms been in effect upon the original date of issuance of such Option or Convertible Security. Notwithstanding the foregoing, no readjustment pursuant to this clause (b) shall have the effect of increasing the Conversion Price of any series of Preferred Stock to an amount which exceeds the lower of (i) the Conversion Price of such series of Preferred Stock in effect immediately prior to the original adjustment made as a result of the issuance of such Option or Convertible Security, or (ii) the Conversion Price of such series of Preferred Stock that would have resulted from any issuances of Additional Shares of Common Stock (other than deemed issuances of Additional Shares of Common Stock as a result of the issuance of such Option or Convertible Security) between the original adjustment date and such readjustment date.

(c) If the terms of any Option or Convertible Security (excluding Options or Convertible Securities which are themselves Exempted Securities), the issuance of which did not result in an adjustment to the Conversion Price of any series of Preferred Stock pursuant to the terms of Subsection 4.4.3 (either because the consideration per share (determined pursuant to Subsection 4.4.4) of the Additional Shares of Common Stock subject thereto was equal to or greater than the Conversion Price of such series of Preferred Stock then in effect, or because such Option or Convertible Security was issued before the Original Issue Date), are revised after the Original Issue Date as a result of an amendment to such terms or any other adjustment pursuant to the provisions of such Option or Convertible Security (but excluding automatic adjustments to such terms pursuant to anti-dilution or similar provisions of such Option

or Convertible Security) to provide for either (1) any increase in the number of shares of Common Stock issuable upon the exercise, conversion or exchange of any such Option or Convertible Security or (2) any decrease in the consideration payable to the Corporation upon such exercise, conversion or exchange, then such Option or Convertible Security, as so amended or adjusted, and the Additional Shares of Common Stock subject thereto (determined in the manner provided in Subsection 4.4.2(a)) shall be deemed to have been issued effective upon such increase or decrease becoming effective.

(d) Upon the expiration or termination of any unexercised Option or unconverted or unexchanged Convertible Security (or portion thereof) which resulted (either upon its original issuance or upon a revision of its terms) in an adjustment to the Conversion Price of any series of Preferred Stock pursuant to the terms of Subsection 4.4.3, the Conversion Price of such series of Preferred Stock shall be readjusted to such Conversion Price as would have obtained had such Option or Convertible Security (or portion thereof) never been issued.

(e) If the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any Option or Convertible Security, or the consideration payable to the Corporation upon such exercise, conversion and/or exchange, is calculable at the time such Option or Convertible Security is issued or amended but is subject to adjustment based upon subsequent events, any adjustment to the Conversion Price of each series of Preferred Stock provided for in this Subsection 4.4.2 shall be effected at the time of such issuance or amendment based on such number of shares or amount of consideration without regard to any provisions for subsequent adjustments (and any subsequent adjustments shall be treated as provided in clauses (b) and (c) of this Subsection 4.4.2). If the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any Option or Convertible Security, or the consideration payable to the Corporation upon such exercise, conversion and/or exchange, cannot be calculated at all at the time such Option or Convertible Security is issued or amended, any adjustment to the Conversion Price of each series of Preferred Stock that would result under the terms of this Subsection 4.4.2 at the time of such issuance or amendment shall instead be effected at the time such number of shares and/or amount of consideration is first calculable (even if subject to subsequent adjustments), assuming for purposes of calculating such adjustment to such Conversion Price that such issuance or amendment took place at the time such calculation can first be made.

4.4.3 Adjustment of Conversion Price Upon Issuance of Additional Shares of Common Stock. In the event the Corporation shall at any time after the Original Issue Date issue Additional Shares of Common Stock (including Additional Shares of Common Stock deemed to be issued pursuant to Subsection 4.4.2), without consideration or for a consideration per share less than the Conversion Price of any series of Preferred Stock in effect immediately prior to such issue, then the Conversion Price of such series of Preferred Stock shall be reduced, concurrently with such issue, to a price (calculated to the nearest one-hundredth of a cent) determined in accordance with the following formula:

$$CP_2 = CP_1 * (A + B) \div (A + C).$$

For purposes of the foregoing formula, the following definitions shall apply:

(a) “CP₂” shall mean the Conversion Price of such series of Preferred Stock in effect immediately after such issue of Additional Shares of Common Stock;

(b) “CP₁” shall mean the Conversion Price of such series of Preferred Stock in effect immediately prior to such issue of Additional Shares of Common Stock;

(c) “A” shall mean the number of shares of Common Stock outstanding immediately prior to such issue of Additional Shares of Common Stock (treating for this purpose as outstanding all shares of Common Stock issuable upon exercise of Options outstanding immediately prior to such issue or upon conversion or exchange of Convertible Securities (including the Preferred Stock) outstanding (assuming exercise of any outstanding Options therefor) immediately prior to such issue);

(d) “B” shall mean the number of shares of Common Stock that would have been issued if such Additional Shares of Common Stock had been issued at a price per share equal to CP₁ (determined by dividing the aggregate consideration received by the Corporation in respect of such issue by CP₁); and

(e) “C” shall mean the number of such Additional Shares of Common Stock issued in such transaction.

4.4.4 Determination of Consideration. For purposes of this Subsection 4.4, the consideration received by the Corporation for the issue of any Additional Shares of Common Stock shall be computed as follows:

(a) Cash and Property: Such consideration shall:

- (i) insofar as it consists of cash, be computed at the aggregate amount of cash received by the Corporation, excluding amounts paid or payable for accrued interest;
 - (ii) insofar as it consists of property other than cash, be computed at the fair market value thereof at the time of such issue, as determined in good faith by the Board of Directors of the Corporation; and
 - (iii) in the event Additional Shares of Common Stock are issued together with other shares or securities or other assets of the Corporation for consideration which covers both, be the proportion of such consideration so received, computed as provided in clauses (i) and (ii) above, as determined in good faith by the Board of Directors of the Corporation.
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(b) Options and Convertible Securities. The consideration per share received by the Corporation for Additional Shares of Common Stock deemed to have been issued pursuant to Subsection 4.4.2, relating to Options and Convertible Securities, shall be determined by dividing:

- (i) the total amount, if any, received or receivable by the Corporation as consideration for the issue of such Options or Convertible Securities, plus the minimum aggregate amount of additional consideration (as set forth in the instruments relating thereto, without regard to any provision contained therein for a subsequent adjustment of such consideration) payable to the Corporation upon the exercise of such Options or the conversion or exchange of such Convertible Securities, or in the case of Options for Convertible Securities, the exercise of such Options for Convertible Securities and the conversion or exchange of such Convertible Securities, by
- (ii) the maximum number of shares of Common Stock (as set forth in the instruments relating thereto, without regard to any provision contained therein for a subsequent adjustment of such number) issuable upon the exercise of such Options or the conversion or exchange of such Convertible Securities, or in the case of Options for Convertible Securities, the exercise of such Options for Convertible Securities and the conversion or exchange of such Convertible Securities.

4.4.5 Multiple Closing Dates. In the event the Corporation shall issue on more than one date Additional Shares of Common Stock that are a part of one transaction or a series of related transactions and that would result in an adjustment to the Conversion Price of any series of Preferred Stock pursuant to the terms of Subsection 4.4.3, then, upon the final such issuance, the Conversion Price of such series of Preferred Stock shall be readjusted to give effect to all such issuances as if they occurred on the date of the first such issuance (and without giving effect to any additional adjustments as a result of any such subsequent issuances within such period).

4.5 Adjustment for Stock Splits and Combinations. If the Corporation shall at any time or from time to time after the Original Issue Date effect a subdivision of the outstanding Common Stock, the Conversion Price of each series of Preferred Stock in effect immediately before that subdivision shall be proportionately decreased so that the number of shares of Common Stock issuable on conversion of each share of such series shall be increased in proportion to such increase in the aggregate number of shares of Common Stock outstanding. If the Corporation shall at any time or from time to time

after the Original Issue Date combine the outstanding shares of Common Stock, the Conversion Price of each series of Preferred Stock in effect immediately before the combination shall be proportionately increased so that the number of shares of Common Stock issuable on conversion of each share of such series shall be decreased in proportion to such decrease in the aggregate number of shares of Common Stock outstanding. Any adjustment under this subsection shall become effective at the close of business on the date the subdivision or combination becomes effective.

4.6 Adjustment for Certain Dividends and Distributions. In the event the Corporation at any time or from time to time after the Original Issue Date shall make or issue, or fix a record date for the determination of holders of Common Stock entitled to receive, a dividend or other distribution payable on the Common Stock in additional shares of Common Stock, then and in each such event the Conversion Price of each series of Preferred Stock in effect immediately before such event shall be decreased as of the time of such issuance or, in the event such a record date shall have been fixed, as of the close of business on such record date, by multiplying the Conversion Price of such series of Preferred Stock then in effect by a fraction:

- (1) the numerator of which shall be the total number of shares of Common Stock issued and outstanding immediately prior to the time of such issuance or the close of business on such record date, and
- (2) the denominator of which shall be the total number of shares of Common Stock issued and outstanding immediately prior to the time of such issuance or the close of business on such record date plus the number of shares of Common Stock issuable in payment of such dividend or distribution.

Notwithstanding the foregoing, (a) if such record date shall have been fixed and such dividend is not fully paid or if such distribution is not fully made on the date fixed therefor, the Conversion Price of such series of Preferred Stock shall be recomputed accordingly as of the close of business on such record date and thereafter the Conversion Price of such series of Preferred Stock shall be adjusted pursuant to this subsection as of the time of actual payment of such dividends or distributions; and (b) that no such adjustment shall be made if the holders of such series of Preferred Stock simultaneously receive a dividend or other distribution of shares of Common Stock in a number equal to the number of shares of Common Stock as they would have received if all outstanding shares of such series of Preferred Stock had been converted into Common Stock on the date of such event.

4.7 Adjustments for Other Dividends and Distributions. In the event the Corporation at any time or from time to time after the Original Issue Date shall make or issue, or fix a record date for the determination of holders of Common Stock entitled to

receive, a dividend or other distribution payable in securities of the Corporation (other than a distribution of shares of Common Stock in respect of outstanding shares of Common Stock) or in other property and the provisions of Section 1 do not apply to such dividend or distribution, then and in each such event the holders of each series of Preferred Stock shall receive, simultaneously with the distribution to the holders of Common Stock, a dividend or other distribution of such securities or other property in an amount equal to the amount of such securities or other property as they would have received if all outstanding shares of such series of Preferred Stock had been converted into Common Stock on the date of such event.

4.8 Adjustment for Merger or Reorganization, etc. Subject to the provisions of Subsection 2.3, if there shall occur any reorganization, recapitalization, reclassification, consolidation or merger involving the Corporation in which the Common Stock (but not any series of Preferred Stock) is converted into or exchanged for securities, cash or other property (other than a transaction covered by Subsections 4.4, 4.6 or 4.7), then, following any such reorganization, recapitalization, reclassification, consolidation or merger, each share of such series of Preferred Stock shall thereafter be convertible in lieu of the Common Stock into which it was convertible prior to such event into the kind and amount of securities, cash or other property which a holder of the number of shares of Common Stock of the Corporation issuable upon conversion of one share of such series of Preferred Stock immediately prior to such reorganization, recapitalization, reclassification, consolidation or merger would have been entitled to receive pursuant to such transaction; and, in such case, appropriate adjustment (as determined in good faith by the Board of Directors of the Corporation) shall be made in the application of the provisions in this Section 4 with respect to the rights and interests thereafter of the holders of the such series of Preferred Stock, to the end that the provisions set forth in this Section 4 (including provisions with respect to changes in and other adjustments of the Conversion Price of such series of Preferred Stock) shall thereafter be applicable, as nearly as reasonably may be, in relation to any securities or other property thereafter deliverable upon the conversion of such series of Preferred Stock.

4.9 Certificate as to Adjustments. Upon the occurrence of each adjustment or readjustment of the Conversion Price of any series of Preferred Stock pursuant to this Section 4, the Corporation at its expense shall, as promptly as reasonably practicable but in any event not later than 10 days thereafter, compute such adjustment or readjustment in accordance with the terms hereof and furnish to each holder of such series of Preferred Stock a certificate setting forth such adjustment or readjustment (including the kind and amount of securities, cash or other property into which such series of Preferred Stock is convertible) and showing in detail the facts upon which such adjustment or readjustment is based. The Corporation shall, as promptly as reasonably practicable after the written request at any time of any holder of any series of Preferred Stock (but in any event not later than 10 days thereafter), furnish or cause to be furnished to such holder a certificate setting forth (i) the Conversion Price of such series of Preferred Stock then in effect, and (ii) the number of shares of Common Stock and the amount, if any, of other securities, cash or

property which then would be received upon the conversion of such series of Preferred Stock.

4.10 Notice of Record Date. In the event:

- (a) the Corporation shall take a record of the holders of its Common Stock (or other capital stock or securities at the time issuable upon conversion of the Preferred Stock) for the purpose of entitling or enabling them to receive any dividend or other distribution, or to receive any right to subscribe for or purchase any shares of capital stock of any class or any other securities, or to receive any other security; or
- (b) of any capital reorganization of the Corporation, any reclassification of the Common Stock of the Corporation, or any Deemed Liquidation Event; or
- (c) of the voluntary or involuntary dissolution, liquidation or winding-up of the Corporation,

then, and in each such case, the Corporation will send or cause to be sent to the holders of the each series of Preferred Stock a notice specifying, as the case may be, (i) the record date for such dividend, distribution or right, and the amount and character of such dividend, distribution or right, or (ii) the effective date on which such reorganization, reclassification, consolidation, merger, transfer, dissolution, liquidation or winding-up is proposed to take place, and the time, if any is to be fixed, as of which the holders of record of Common Stock (or such other capital stock or securities at the time issuable upon the conversion of the such series of Preferred Stock) shall be entitled to exchange their shares of Common Stock (or such other capital stock or securities) for securities or other property deliverable upon such reorganization, reclassification, consolidation, merger, transfer, dissolution, liquidation or winding-up, and the amount per share and character of such exchange applicable to the such series of Preferred Stock and the Common Stock. Such notice shall be sent at least 10 days prior to the record date or effective date for the event specified in such notice.

5. Mandatory Conversion.

5.1 Trigger Events. Upon either (a) the closing of the sale of shares of Common Stock to the public in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act of 1933, as amended, resulting in at least \$35,000,000 of gross proceeds to the Corporation or (b) the date and time, or the occurrence of an event, specified by vote or written consent of the Requisite Vote (the time of such closing or the date and time specified or the time of the event specified in such vote or written consent is referred to herein as the “**Mandatory Conversion Time**”), (i) all outstanding shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall automatically be converted into shares of Common Stock, at the

applicable then effective conversion rate and (ii) such shares may not be reissued by the Corporation.

5.2 Procedural Requirements. All holders of record of shares of the relevant series of Preferred Stock shall be sent written notice of the Mandatory Conversion Time applicable to them and the place designated for mandatory conversion of all such shares of Preferred Stock pursuant to this Section 5. Such notice need not be sent in advance of the occurrence of the Mandatory Conversion Time. Upon receipt of such notice, each such holder of shares of Preferred Stock shall surrender his, her or its certificate or certificates for all such shares (or, if such holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate) to the Corporation at the place designated in such notice. If so required by the Corporation, certificates surrendered for conversion shall be endorsed or accompanied by written instrument or instruments of transfer, in form satisfactory to the Corporation, duly executed by the registered holder or by his, her or its attorney duly authorized in writing. All rights with respect to the Preferred Stock converted pursuant to Section 5.1, including the rights, if any, to receive notices and vote (other than as a holder of Common Stock), will terminate at the applicable Mandatory Conversion Time (notwithstanding the failure of the holder or holders thereof to surrender the certificates at or prior to such time), except only the rights of the holders thereof, upon surrender of their certificate or certificates (or lost certificate affidavit and agreement) therefor, to receive the items provided for in the next sentence of this Subsection 5.2. As soon as practicable after the applicable Mandatory Conversion Time and the surrender of the certificate or certificates (or lost certificate affidavit and agreement) for the relevant series of the Preferred Stock, the Corporation shall issue and deliver to such holder, or to his, her or its nominees, a certificate or certificates for the number of full shares of Common Stock issuable on such conversion in accordance with the provisions hereof, together with cash as provided in Subsection 4.2 in lieu of any fraction of a share of Common Stock otherwise issuable upon such conversion and the payment of any declared but unpaid dividends on the shares of such series of Preferred Stock converted. Such converted Preferred Stock shall be retired and cancelled and may not be reissued as shares of such series, and the Corporation may thereafter take such appropriate action (without the need for stockholder action) as may be necessary to reduce the authorized number of shares of the applicable series of Preferred Stock accordingly.

6. Redemption.

6.1 Redemption. Shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock shall be redeemed by the Corporation on a pari passu basis out of funds lawfully available therefor at a price equal to (a) in the case of the Series B Preferred Stock, the Series B Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series B Redemption Price**”), (b) in the case of the Series B-1 Preferred Stock, the Series B-1 Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series B-1 Redemption Price**”), (c) in the case of the Series C Preferred Stock, the Series C Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series C Redemption Price**”), (d) in the case of the Series D Preferred Stock, the

Series D Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series D Redemption Price**”), and (e) in the case of the Series E Preferred Stock, the Series E Original Issue Price per share, plus all declared but unpaid dividends thereon (the “**Series E Redemption Price**”) in three annual installments commencing not more than 60 days after receipt by the Corporation at any time on or after the date five (5) years after the Original Issue Date, from the holders of the Requisite Vote, of written notice requesting redemption of all shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock. The date of each such installment shall be referred to as a “**Redemption Date**.” On each Redemption Date, the Corporation shall redeem, on a pro rata basis in accordance with the number of shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock owned by each holder, (A) that number of outstanding shares of Series B Preferred Stock determined by dividing (i) the total number of Series B Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), (B) that number of outstanding shares of Series B-1 Preferred Stock determined by dividing (i) the total number of Series B-1 Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), (C) that number of outstanding shares of Series C Preferred Stock determined by dividing (i) the total number of Series C Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), (D) that number of outstanding shares of Series D Preferred Stock determined by dividing (i) the total number of Series D Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies), and (E) that number of outstanding shares of Series E Preferred Stock determined by dividing (i) the total number of Series E Preferred Stock outstanding immediately prior to such Redemption Date by (ii) the number of remaining Redemption Dates (including the Redemption Date to which such calculation applies); provided, however, that Excluded Shares (as such term is defined in Subsection 6.2) shall not be redeemed and shall be excluded from the calculations set forth in this sentence. Notwithstanding the foregoing, if the Corporation does not have sufficient funds legally available to redeem on any Redemption Date all shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to be redeemed on such Redemption Date, the Corporation shall redeem first a pro rata portion on a pari passu basis of each holder’s redeemable shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock out of funds legally available therefor, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the legally available funds were sufficient to redeem all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor; and second, after all of the redeemable shares of Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock have been redeemed, a pro rata portion on a pari passu basis of each holder’s redeemable shares of Series B Preferred Stock and Series B-1 Preferred Stock out of funds legally available

therefor, based on the respective amounts which would otherwise be payable in respect of the shares to be redeemed if the legally available funds were sufficient to redeem all such shares, and shall redeem the remaining shares to have been redeemed as soon as practicable after the Corporation has funds legally available therefor.

6.2 Redemption Notice. The Corporation shall send written notice of the mandatory redemption (the “**Redemption Notice**”) to each holder of record of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock not less than 40 days prior to each Redemption Date. Each Redemption Notice shall state:

- (a) the number of shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock held by the holder that the Corporation shall redeem on the Redemption Date specified in the Redemption Notice;
- (b) the Redemption Date, the Series B Redemption Price, the Series B-1 Redemption Price, the Series C Redemption Price, the Series D Redemption Price, and the Series E Redemption Price;
- (c) the date upon which the holder’s right to convert such shares terminates (as determined in accordance with Subsection 4.1); and
- (d) that the holder is to surrender to the Corporation, in the manner and at the place designated, his, her or its certificate or certificates representing the shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to be redeemed.

If the Corporation receives, on or prior to the 20th day after the date of delivery of the Redemption Notice to a holder of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock, written notice from such holder that such holder elects to be excluded from the redemption provided in this Section 6, then the shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock registered on the books of the Corporation in the name of such holder at the time of the Corporation’s receipt of such notice shall thereafter be “**Excluded Shares**.” Excluded Shares shall not be redeemed or redeemable pursuant to this Section 6, whether on such Redemption Date or thereafter.

6.3 Surrender of Certificates; Payment. On or before the applicable Redemption Date, each holder of shares of Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock, and Series E Preferred Stock to be redeemed on such Redemption Date, unless such holder has exercised his, her or its right to convert such shares as provided in Section 4, shall surrender the certificate or certificates representing such shares (or, if such registered holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim

that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate) to the Corporation, in the manner and at the place designated in the Redemption Notice, and thereupon the Redemption Price for such shares shall be payable to the order of the person whose name appears on such certificate or certificates as the owner thereof. In the event less than all of the shares of Preferred Stock represented by a certificate are redeemed, a new certificate representing the unredeemed shares of Preferred Stock shall promptly be issued to such holder.

6.4 Rights Subsequent to Redemption. If the Redemption Notice shall have been duly given, and if on the applicable Redemption Date the Redemption Price payable upon redemption of the shares of Preferred Stock to be redeemed on such Redemption Date is paid or tendered for payment or deposited with an independent payment agent so as to be available therefor in a timely manner, then notwithstanding that the certificates evidencing any of the shares of Preferred Stock so called for redemption shall not have been surrendered, dividends with respect to such shares of Preferred Stock shall cease to accrue after such Redemption Date and all rights with respect to such shares shall forthwith after the Redemption Date terminate, except only the right of the holders to receive the Redemption Price without interest upon surrender of their certificate or certificates therefor.

7. Redeemed or Otherwise Acquired Shares. Any shares of Preferred Stock that are redeemed or otherwise acquired by the Corporation or any of its subsidiaries shall be automatically and immediately cancelled and retired and shall not be reissued, sold or transferred. Neither the Corporation nor any of its subsidiaries may exercise any voting or other rights granted to the holders of Preferred Stock following redemption.

8. Waiver. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Preferred Stock set forth herein may be waived on behalf of all holders of Preferred Stock by the affirmative written consent or vote of the holders of a majority of the then outstanding shares of Preferred Stock, voting together as a single class on an as-converted basis. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Series B Preferred Stock, Series B-1 Preferred Stock and/or Series D Preferred Stock set forth herein may be waived on behalf of all holders of the Series B Preferred Stock, Series B-1 Preferred Stock and Series D Preferred Stock only by the affirmative written consent or vote of the holders of at least a majority of the outstanding shares of Series B Preferred Stock, Series B-1 Preferred Stock and Series D Preferred Stock voting or consenting together as a single class on an as-converted basis; provided that, (a) any waiver of an adjustment to be made to the Series D Conversion Price resulting from the issuance or deemed issuance of Additional Shares of Common Stock, and (b) any waiver with respect to Section 3.3.4 of Article FOURTH Part B, in each case, may be waived on behalf of all holders of the Series D Preferred Stock only by the affirmative written consent or vote of the holders of at least a majority of the outstanding shares Series D Preferred Stock voting or consenting together as a single class. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Series C Preferred Stock set forth herein may be waived on behalf of all holders of Series C Preferred Stock only by the affirmative written consent or vote of the holders of a majority of the then outstanding shares of Series C

Preferred Stock, voting separately as a single class. Except as required by law or as otherwise provided herein, any of the rights, powers, preferences and other terms of the Series E Preferred Stock set forth herein may be waived on behalf of all holders of Series E Preferred Stock only by the affirmative written consent or vote of the holders of a majority of the then outstanding shares of Series E Preferred Stock, voting separately as a single class.

9. Notices. Any notice required or permitted by the provisions of this Article Fourth to be given to a holder of shares of Preferred Stock shall be mailed, postage prepaid, to the post office address last shown on the records of the Corporation, or given by electronic communication in compliance with the provisions of the General Corporation Law, and shall be deemed sent upon such mailing or electronic transmission.

**CERTIFICATE OF RETIREMENT
OF
SERIES B CONVERTIBLE PREFERRED STOCK
SERIES B-1 CONVERTIBLE PREFERRED STOCK
SERIES C CONVERTIBLE PREFERRED STOCK
SERIES D CONVERTIBLE PREFERRED STOCK
AND
SERIES E CONVERTIBLE PREFERRED STOCK
OF
AXCELLA HEALTH INC.**

Pursuant to Section 243(b)
of the General Corporation Law
of the State of Delaware

Axcella Health Inc., a corporation organized and existing under the laws of the State of Delaware (the “Corporation”), HEREBY CERTIFIES as follows:

1. The Certificate of Incorporation of the Corporation authorizes 4,737,041 shares of Series B Convertible Preferred Stock, par value \$0.001 per share, (the “Series B Preferred Stock”), 1,084,441 shares of Series B-1 Convertible Preferred Stock, par value \$0.001 per share, (the “Series B-1 Preferred Stock”), 6,969,044 shares of Series C Convertible Preferred Stock, par value \$0.001 per share, (the “Series C Preferred Stock”), 2,997,179 shares of Series D Convertible Preferred Stock, par value \$0.001 per share, (the “Series D Preferred Stock”) and 6,266,786 shares of Series E Convertible Preferred Stock, par value \$0.001 per share, (the “Series E Preferred Stock”) of the Corporation.
 2. All of the authorized shares of each of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock and Series E Preferred Stock were issued and all such shares have been converted into shares of Common Stock, par value \$0.001 per share, of the Corporation (“Common Stock”). As a result of the conversion to Common Stock, there are no shares of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock or Series E Preferred Stock outstanding.
 3. The Restated Certificate of Incorporation provides that any shares of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock and Series E Preferred Stock that are converted shall be retired and cancelled and may not be reissued as shares of such series and the Corporation may take action (without the need for stockholder action) as may be necessary to reduce the authorized number of shares of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock and Series E Preferred Stock.
 4. The Board of Directors of the Corporation has adopted resolutions retiring all previously outstanding shares of the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock and Series E Preferred Stock immediately
-

upon their conversion into shares of Common Stock and authorizing the filing of this Certificate of Retirement.

5. Accordingly, pursuant to the provisions of Section 243(b) of the General Corporation Law of the State of Delaware, upon the effective time of this Certificate of Retirement, the Certificate of Incorporation of the Corporation shall be amended so as to reduce the total authorized number of shares of the capital stock of the Corporation by 22,054,491 shares, such that the total number of authorized shares of the Corporation shall be 160,000,000, such shares consisting of (a) 150,000,000 shares of Common Stock, par value \$0.001 per share and (b) 10,000,000 shares of Preferred Stock, par value \$0.001 per share, all of which shall be designated as undesignated Preferred Stock. In addition, upon the effective time of this Certificate of Retirement, the Certificate of Incorporation shall be amended to eliminate therefrom all references to the Series B Preferred Stock, Series B-1 Preferred Stock, Series C Preferred Stock, Series D Preferred Stock and Series E Preferred Stock.

[Signature Page Follows]

IN WITNESS WHEREOF, the Corporation has caused this Certificate of Retirement to be signed by its duly authorized officer, this day
of , 2019.

Axcella Health Inc.

By: _____

RESTATED
CERTIFICATE OF INCORPORATION
OF
AXCELLA HEALTH INC.

Axcella Health Inc., a corporation organized and existing under the laws of the State of Delaware (the “Corporation”), hereby certifies as follows:

1. The name of the Corporation is Axcella Health Inc. The date of the filing of its original Certificate of Incorporation with the Secretary of State of the State of Delaware was August 27, 2008 (the “Original Certificate”). The name under which the Corporation filed the Original Certificate was Newco LS16, Inc.
2. This Restated Certificate of Incorporation (the “Certificate”) only restates and integrates and does not further amend the provisions of the Certificate of Incorporation as amended and restated (the “Amended and Restated Certificate”) and there is no discrepancy between the provisions of the Amended and Restated Certificate and the provisions of this Restated Certificate of Incorporation, and this Restated Certificate of Incorporation was duly adopted in accordance with the provisions of Section 245 of the General Corporation Law of the State of Delaware (the “DGCL”).
3. The text of the Amended and Restated Certificate is hereby integrated and restated in its entirety to provide as herein set forth in full.

ARTICLE I

The name of the Corporation is Axcella Health Inc.

ARTICLE II

The address of the Corporation’s registered office in the State of Delaware is c/o The Corporation Trust Company, 1209 Orange Street in the City of Wilmington, County of New Castle, 19801. The name of its registered agent at such address is The Corporation Trust Company.

ARTICLE III

The purpose of the Corporation is to engage in any lawful act or activity for which corporations may be organized under the DGCL.

ARTICLE IV

CAPITAL STOCK

The total number of shares of capital stock which the Corporation shall have authority to issue is one hundred sixty million (160,000,000) of which (i) one hundred fifty million (150,000,000) shares shall be a class designated as common stock, par value \$0.001 per share (the “Common Stock”), and (ii) ten million (10,000,000) shares shall be a class designated as undesignated preferred stock, par value \$0.001 per share (the “Preferred Stock”).

Except as otherwise provided in any certificate of designations of any series of Preferred Stock, the number of authorized shares of the class of Common Stock or Preferred Stock may from time to time be increased or decreased (but not below the number of shares of such class outstanding) by the affirmative vote of the holders of a majority in voting power of the outstanding shares of capital stock of the Corporation irrespective of the provisions of Section 242(b)(2) of the DGCL.

The powers, preferences and rights of, and the qualifications, limitations and restrictions upon, each class or series of stock shall be determined in accordance with, or as set forth below in, this Article IV.

A. COMMON STOCK

Subject to all the rights, powers and preferences of the Preferred Stock and except as provided by law or in this Certificate (or in any certificate of designations of any series of Preferred Stock):

(a) the holders of the Common Stock shall have the exclusive right to vote for the election of directors of the Corporation (the “Directors”) and on all other matters requiring stockholder action, each outstanding share entitling the holder thereof to one vote on each matter properly submitted to the stockholders of the Corporation for their vote; provided, however, that, except as otherwise required by law, holders of Common Stock, as such, shall not be entitled to vote on any amendment to this Certificate (or on any amendment to a certificate of designations of any series of Preferred Stock) that alters or changes the powers, preferences, rights or other terms of one or more outstanding series of Preferred Stock if the holders of such affected series of Preferred Stock are entitled to vote, either separately or together with the holders of one or more other such series, on such amendment pursuant to this Certificate (or pursuant to a certificate of designations of any series of Preferred Stock) or pursuant to the DGCL;

(b) dividends may be declared and paid or set apart for payment upon the Common Stock out of any assets or funds of the Corporation legally available for the payment of dividends, but only when and as declared by the Board of Directors or any authorized committee thereof; and

(c) upon the voluntary or involuntary liquidation, dissolution or winding up of the Corporation, the net assets of the Corporation shall be distributed pro rata to the holders of the Common Stock.

B. PREFERRED STOCK

The Board of Directors or any authorized committee thereof is expressly authorized, to the fullest extent permitted by law, to provide by resolution or resolutions for, out of the unissued shares of Preferred Stock, the issuance of the shares of Preferred Stock in one or more series of such stock, and by filing a certificate of designations pursuant to applicable law of the State of Delaware, to establish or change from time to time the number of shares of each such series, and to fix the designations, powers, including voting powers, full or limited, or no voting powers, preferences and the relative, participating, optional or other special rights of the shares of each series and any qualifications, limitations and restrictions thereof.

ARTICLE V

STOCKHOLDER ACTION

The following sections shall become effective immediately following the time that the Corporation has a class or series of capital stock listed on a national securities exchange (the "IPO Time").

1. **Action without Meeting.** Any action required or permitted to be taken by the stockholders of the Corporation at any annual or special meeting of stockholders of the Corporation must be effected at a duly called annual or special meeting of stockholders and may not be taken or effected by a written consent of stockholders in lieu thereof; *provided, however*, that any action required or permitted to be taken by the holders of Preferred Stock, voting separately as a series or separately as a class with one or more other such series, may be taken without a meeting, without prior notice and without a vote, to the extent expressly so provided by the applicable certificate of designation relating to such series of Preferred Stock. Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article V, Section 1.

2. **Special Meetings.** Except as otherwise required by statute and subject to the rights, if any, of the holders of any series of Preferred Stock, special meetings of the stockholders of the Corporation may be called only by the Board of Directors acting pursuant to a resolution approved by the affirmative vote of a majority of the Directors then in office, and special meetings of stockholders may not be called by any other person or persons. Only those matters set forth in the notice of the special meeting may be considered or acted upon at a special meeting of stockholders of the Corporation.

ARTICLE VI

DIRECTORS

Sections 3, 4 and 5 of this Article VI shall become effective at the IPO Time.

1. General. The business and affairs of the Corporation shall be managed by or under the direction of the Board of Directors except as otherwise provided herein or required by law.
2. Election of Directors. Election of Directors need not be by written ballot unless the By-laws of the Corporation (the “By-laws”) shall so provide.
3. Number of Directors; Term of Office. The number of Directors of the Corporation shall be fixed solely and exclusively by resolution duly adopted from time to time by the Board of Directors. The Directors, other than those who may be elected by the holders of any series of Preferred Stock, shall be classified, with respect to the term for which they severally hold office, into three classes, as nearly equal in number as possible. The Board of Directors shall assign Directors into classes at the time the classification becomes effective. The initial Class I Directors shall serve for a term expiring at the first annual meeting of stockholders to be held after the date the Board initially became classified (the “Classification Date”), the initial Class II Directors shall serve for a term expiring at the second annual meeting of stockholders to be held after the Classification Date, and the initial Class III Directors shall serve for a term expiring at the third annual meeting of stockholders to be held after the Classification Date. At each annual meeting of stockholders, Directors elected to succeed those Directors whose terms expire shall be elected for a term of office to expire at the third succeeding annual meeting of stockholders after their election. Notwithstanding the foregoing, the Directors elected to each class shall hold office until their successors are duly elected and qualified or until their earlier resignation, death or removal.

Notwithstanding the foregoing, whenever, pursuant to the provisions of Article IV of this Certificate, the holders of any one or more series of Preferred Stock shall have the right, voting separately as a series or together with holders of other such series, to elect Directors at an annual or special meeting of stockholders, the election, term of office, filling of vacancies and other features of such directorships shall be governed by the terms of this Certificate and any certificate of designations applicable to such series.

Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article VI, Section 3.

4. Vacancies. Subject to the rights, if any, of the holders of any series of Preferred Stock to elect Directors and to fill vacancies in the Board of Directors relating thereto, any and all vacancies in the Board of Directors, however occurring, including, without limitation, by

reason of an increase in the size of the Board of Directors, or the death, resignation, disqualification or removal of a Director, shall be filled solely and exclusively by the affirmative vote of a majority of the remaining Directors then in office, even if less than a quorum of the Board of Directors, and not by the stockholders. Any Director appointed in accordance with the preceding sentence shall hold office for the remainder of the full term of the class of Directors in which the new directorship was created or the vacancy occurred and until such Director's successor shall have been duly elected and qualified or until his or her earlier resignation, death or removal. Subject to the rights, if any, of the holders of any series of Preferred Stock to elect Directors, when the number of Directors is increased or decreased, the Board of Directors shall, subject to Article VI, Section 3 hereof, determine the class or classes to which the increased or decreased number of Directors shall be apportioned; provided, however, that no decrease in the number of Directors shall shorten the term of any incumbent Director. In the event of a vacancy in the Board of Directors, the remaining Directors, except as otherwise provided by law, shall exercise the powers of the full Board of Directors until the vacancy is filled.

5. Removal. Subject to the rights, if any, of any series of Preferred Stock to elect Directors and to remove any Director whom the holders of any such series have the right to elect, any Director (including persons elected by Directors to fill vacancies in the Board of Directors) may be removed from office (i) only with cause and (ii) only by the affirmative vote of the holders of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock then entitled to vote at an election of Directors. At least forty-five (45) days prior to any annual or special meeting of stockholders at which it is proposed that any Director be removed from office, written notice of such proposed removal and the alleged grounds thereof shall be sent to the Director whose removal will be considered at the meeting.

ARTICLE VII

LIMITATION OF LIABILITY

A Director of the Corporation shall not be personally liable to the Corporation or its stockholders for monetary damages for breach of his or her fiduciary duty as a Director, except for liability (a) for any breach of the Director's duty of loyalty to the Corporation or its stockholders, (b) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (c) under Section 174 of the DGCL or (d) for any transaction from which the Director derived an improper personal benefit. If the DGCL is amended after the effective date of this Certificate to authorize corporate action further eliminating or limiting the personal liability of Directors, then the liability of a Director of the Corporation shall be eliminated or limited to the fullest extent permitted by the DGCL, as so amended.

Any amendment, repeal or modification of this Article VII by either of (i) the stockholders of the Corporation or (ii) an amendment to the DGCL, shall not adversely affect any right or protection existing at the time of such amendment, repeal or modification with respect to any acts or omissions occurring before such amendment, repeal or modification of a person serving as a Director at the time of such amendment, repeal or modification.

Notwithstanding anything herein to the contrary, from and after the IPO Time, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article VII.

ARTICLE VIII

AMENDMENT OF BY-LAWS

1. Amendment by Directors. Except as otherwise provided by law, the By-laws of the Corporation may be amended or repealed by the Board of Directors.

2. Amendment by Stockholders. Effective from and after the IPO Time, the By-laws of the Corporation may be amended or repealed by the stockholders at any annual meeting of stockholders, or special meeting of stockholders called for such purpose, by the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class; provided, however, that if the Board of Directors recommends that stockholders approve such amendment or repeal at such meeting of stockholders, such amendment or repeal shall only require the affirmative vote of the majority in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, voting together as a single class.

ARTICLE IX

AMENDMENT OF CERTIFICATE OF INCORPORATION

The Corporation reserves the right to amend or repeal this Certificate in the manner now or hereafter prescribed by statute and this Certificate, and all rights conferred upon stockholders herein are granted subject to this reservation. Except as otherwise required by this Certificate or by law, whenever any vote of the holders of capital stock of the Corporation is required to amend or repeal any provision of this Certificate, such amendment or repeal shall require the affirmative vote of the majority in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of the majority in voting power of the outstanding shares of each class entitled to vote thereon as a class, at a duly constituted meeting of stockholders called expressly for such purpose; *provided, however*, that from and after the IPO Time, the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of capital stock entitled to vote on such amendment or repeal, and the affirmative vote of not less than two thirds (2/3) in voting power of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of Article V, Article VI, Article VII, Article VIII or Article IX of this Certificate.

[End of Text]

THIS RESTATED CERTIFICATE OF INCORPORATION is executed as of this day of , 2019.

By: _____
Name:
Title:

[Signature Page to Axcella Health Inc. Restated Certificate of Incorporation]

AMENDED AND RESTATED

BY-LAWS

OF

AXCELLA HEALTH INC.

(the “Corporation”)

ARTICLE IStockholders

SECTION 1. Annual Meeting. The annual meeting of stockholders (any such meeting being referred to in these By-laws as an “Annual Meeting”) shall be held at the hour, date and place within or without the United States which is fixed by the Board of Directors, which time, date and place may subsequently be changed at any time by vote of the Board of Directors. If no Annual Meeting has been held for a period of thirteen (13) months after the Corporation’s last Annual Meeting, a special meeting in lieu thereof may be held, and such special meeting shall have, for the purposes of these By-laws or otherwise, all the force and effect of an Annual Meeting. Any and all references hereafter in these By-laws to an Annual Meeting or Annual Meetings also shall be deemed to refer to any special meeting(s) in lieu thereof.

SECTION 2. Notice of Stockholder Business and Nominations.

(a) Annual Meetings of Stockholders.

(1) Nominations of persons for election to the Board of Directors of the Corporation and the proposal of other business to be considered by the stockholders may be brought before an Annual Meeting (i) by or at the direction of the Board of Directors or (ii) by any stockholder of the Corporation who was a stockholder of record at the time of giving of notice provided for in this By-law, who is entitled to vote at the meeting, who is present (in person or by proxy) at the meeting and who complies with the notice procedures set forth in this By-law as to such nomination or business. For the avoidance of doubt, the foregoing clause (ii) shall be the exclusive means for a stockholder to bring nominations or business properly before an Annual Meeting (other than matters properly brought under Rule 14a-8 (or any successor rule) under the Securities Exchange Act of 1934, as amended (the “Exchange Act”)), and such stockholder must comply with the notice and other procedures set forth in Article I, Section 2(a)(2) and (3) of this By-law to bring such nominations or business properly before an Annual Meeting. In addition to the other requirements set forth in this By-law, for any proposal of business to be

considered at an Annual Meeting, it must be a proper subject for action by stockholders of the Corporation under Delaware law.

(2) For nominations or other business to be properly brought before an Annual Meeting by a stockholder pursuant to clause (ii) of Article I, Section 2(a)(1) of this By-law, the stockholder must (i) have given Timely Notice (as defined below) thereof in writing to the Secretary of the Corporation, (ii) have provided any updates or supplements to such notice at the times and in the forms required by this By-law and (iii) together with the beneficial owner(s), if any, on whose behalf the nomination or business proposal is made, have acted in accordance with the representations set forth in the Solicitation Statement (as defined below) required by this By-law. To be timely, a stockholder's written notice shall be received by the Secretary at the principal executive offices of the Corporation not later than the close of business on the ninetieth (90th) day nor earlier than the close of business on the one hundred twentieth (120th) day prior to the one-year anniversary of the preceding year's Annual Meeting; provided, however, that in the event the Annual Meeting is first convened more than thirty (30) days before or more than sixty (60) days after such anniversary date, or if no Annual Meeting were held in the preceding year, notice by the stockholder to be timely must be received by the Secretary of the Corporation not later than the close of business on the later of the ninetieth (90th) day prior to the scheduled date of such Annual Meeting or the tenth (10th) day following the day on which public announcement of the date of such meeting is first made (such notice within such time periods shall be referred to as "Timely Notice"). Notwithstanding anything to the contrary provided herein, for the first Annual Meeting following the initial public offering of common stock of the Corporation, a stockholder's notice shall be timely if received by the Secretary at the principal executive offices of the Corporation not later than the close of business on the later of the ninetieth (90th) day prior to the scheduled date of such Annual Meeting or the tenth (10th) day following the day on which public announcement of the date of such Annual Meeting is first made or sent by the Corporation. Such stockholder's Timely Notice shall set forth:

(A) as to each person whom the stockholder proposes to nominate for election or reelection as a director, (i) the name, age, business address and residence address of the nominee, (ii) the principal occupation or employment of the nominee, (iii) the class and number of shares of the Corporation that are held of record or are beneficially owned by the nominee and any derivative positions held or beneficially held by the nominee, (iv) whether and the extent to which any hedging or other transaction or series of transactions has been entered into by or on behalf of the nominee with respect to any securities of the Corporation, and a description of any other agreement, arrangement or understanding (including any short position or any borrowing or lending of shares), the effect or intent of which is to mitigate loss to, or to manage the risk or benefit of share price changes for, or to increase or decrease the voting power of the nominee, (v) a description of all arrangements or understandings between or among the stockholder and each nominee and any other person or persons (naming such person or persons) pursuant to which the nominations are to be made by the stockholder or concerning the nominee's potential service on the Board of Directors, (vi) a written statement executed by the nominee acknowledging that as a director of the

corporation, the nominee will owe fiduciary duties under Delaware law with respect to the Corporation and its stockholders, and (vii) all information relating to such person that is required to be disclosed in solicitations of proxies for election of directors in an election contest, or is otherwise required, in each case pursuant to Regulation 14A under the Exchange Act (including such person's written consent to being named in the proxy statement as a nominee and to serving as a director if elected);

(B) as to any other business that the stockholder proposes to bring before the meeting, a brief description of the business desired to be brought before the meeting, the reasons for conducting such business at the meeting, the text, if any, of any resolutions or By-law amendment proposed for adoption, and any material interest in such business of each Proposing Person (as defined below);

(C) (i) the name and address of the stockholder giving the notice, as they appear on the Corporation's books, and the names and addresses of the other Proposing Persons (if any) and (ii) as to each Proposing Person, the following information: (a) the class or series and number of all shares of capital stock of the Corporation which are, directly or indirectly, owned beneficially or of record by such Proposing Person or any of its affiliates or associates (as such terms are defined in Rule 12b-2 promulgated under the Exchange Act), including any shares of any class or series of capital stock of the Corporation as to which such Proposing Person or any of its affiliates or associates has a right to acquire beneficial ownership at any time in the future, (b) all Synthetic Equity Interests (as defined below) in which such Proposing Person or any of its affiliates or associates, directly or indirectly, holds an interest including a description of the material terms of each such Synthetic Equity Interest, including without limitation, identification of the counterparty to each such Synthetic Equity Interest and disclosure, for each such Synthetic Equity Interest, as to (x) whether or not such Synthetic Equity Interest conveys any voting rights, directly or indirectly, in such shares to such Proposing Person, (y) whether or not such Synthetic Equity Interest is required to be, or is capable of being, settled through delivery of such shares and (z) whether or not such Proposing Person and/or, to the extent known, the counterparty to such Synthetic Equity Interest has entered into other transactions that hedge or mitigate the economic effect of such Synthetic Equity Interest, (c) any proxy (other than a revocable proxy given in response to a public proxy solicitation made pursuant to, and in accordance with, the Exchange Act), agreement, arrangement, understanding or relationship pursuant to which such Proposing Person has or shares a right to, directly or indirectly, vote any shares of any class or series of capital stock of the Corporation, (d) any rights to dividends or other distributions on the shares of any class or series of capital stock of the Corporation, directly or indirectly, owned beneficially by such Proposing Person that are separated or separable from the underlying shares of the Corporation, and (e) any performance-related fees (other than an asset based fee) that such Proposing Person, directly or indirectly, is entitled to based on any increase or decrease in the value of shares of any class or series of capital stock of the Corporation or any Synthetic Equity Interests (the disclosures to be made

pursuant to the foregoing clauses (a) through (e) are referred to, collectively, as “Material Ownership Interests”) and (iii) a description of the material terms of all agreements, arrangements or understandings (whether or not in writing) entered into by any Proposing Person or any of its affiliates or associates with any other person for the purpose of acquiring, holding, disposing or voting of any shares of any class or series of capital stock of the Corporation;

(D) (i) a description of all agreements, arrangements or understandings by and among any of the Proposing Persons, or by and among any Proposing Persons and any other person (including with any proposed nominee(s)), pertaining to the nomination(s), or other business proposed to be brought before the meeting of stockholders (which description shall identify the name of each other person who is party to such an agreement, arrangement or understanding), and (ii) identification of the names and addresses of other stockholders (including beneficial owners) known by any of the Proposing Persons to support such nominations or other business proposal(s), and to the extent known the class and number of all shares of the Corporation’s capital stock owned beneficially or of record by such other stockholder(s) or other beneficial owner(s); and

(E) a statement whether or not the stockholder giving the notice and/or the other Proposing Person(s), if any, will deliver a proxy statement and form of proxy to holders of, in the case of a business proposal, at least the percentage of voting power of all of the shares of capital stock of the Corporation required under applicable law to approve the proposal or, in the case of a nomination or nominations, at least the percentage of voting power of all of the shares of capital stock of the Corporation reasonably believed by such Proposing Person to be sufficient to elect the nominee or nominees proposed to be nominated by such stockholder (such statement, the “Solicitation Statement”).

For purposes of this Article I of these By-laws, the term “Proposing Person” shall mean the following persons: (i) the stockholder of record providing the notice of nominations or business proposed to be brought before a stockholders’ meeting, and (ii) the beneficial owner(s), if different, on whose behalf the nominations or business proposed to be brought before a stockholders’ meeting is made. For purposes of this Section 2 of Article I of these By-laws, the term “Synthetic Equity Interest” shall mean any transaction, agreement or arrangement (or series of transactions, agreements or arrangements), including, without limitation, any derivative, swap, hedge, repurchase or so-called “stock borrowing” agreement or arrangement, the purpose or effect of which is to, directly or indirectly: (a) give a person or entity economic benefit and/or risk similar to ownership of shares of any class or series of capital stock of the Corporation, in whole or in part, including due to the fact that such transaction, agreement or arrangement provides, directly or indirectly, the opportunity to profit or avoid a loss from any increase or decrease in the value of any shares of any class or series of capital stock of the Corporation, (b) mitigate loss to, reduce the economic risk of or manage the risk of share price changes for, any person or entity with respect to any shares of any class or series of capital stock of the Corporation, (c) otherwise provide in any manner the opportunity to profit or avoid a loss from any decrease in the value of any shares of any class or series of

capital stock of the Corporation, or (d) increase or decrease the voting power of any person or entity with respect to any shares of any class or series of capital stock of the Corporation.

(3) A stockholder providing Timely Notice of nominations or business proposed to be brought before an Annual Meeting shall further update and supplement such notice, if necessary, so that the information (including, without limitation, the Material Ownership Interests information) provided or required to be provided in such notice pursuant to this By-law shall be true and correct as of the record date for the meeting and as of the date that is ten (10) business days prior to such Annual Meeting, and such update and supplement shall be received by the Secretary at the principal executive offices of the Corporation not later than the close of business on the fifth (5th) business day after the record date for the Annual Meeting (in the case of the update and supplement required to be made as of the record date), and not later than the close of business on the eighth (8th) business day prior to the date of the Annual Meeting (in the case of the update and supplement required to be made as of ten (10) business days prior to the meeting).

(4) Notwithstanding anything in the second sentence of Article I, Section 2(a)(2) of this By-law to the contrary, in the event that the number of directors to be elected to the Board of Directors of the Corporation is increased and there is no public announcement naming all of the nominees for director or specifying the size of the increased Board of Directors made by the Corporation at least ten (10) days before the last day a stockholder may deliver a notice of nomination in accordance with the second sentence of Article I, Section 2(a)(2), a stockholder's notice required by this By-law shall also be considered timely, but only with respect to nominees for any new positions created by such increase, if it shall be received by the Secretary of the Corporation not later than the close of business on the tenth (10th) day following the day on which such public announcement is first made by the Corporation.

(b) General.

(1) Only such persons who are nominated in accordance with the provisions of this By-law shall be eligible for election and to serve as directors and only such business shall be conducted at an Annual Meeting as shall have been brought before the meeting in accordance with the provisions of this By-law or in accordance with Rule 14a-8 under the Exchange Act. The Board of Directors or a designated committee thereof shall have the power to determine whether a nomination or any business proposed to be brought before the meeting was made in accordance with the provisions of this By-law. If neither the Board of Directors nor such designated committee makes a determination as to whether any stockholder proposal or nomination was made in accordance with the provisions of this By-law, the presiding officer of the Annual Meeting shall have the power and duty to determine whether the stockholder proposal or nomination was made in accordance with the provisions of this By-law. If the Board of Directors or a designated committee thereof or the presiding officer, as applicable, determines that any stockholder proposal or nomination was not made in accordance with the provisions of

this By-law, such proposal or nomination shall be disregarded and shall not be presented for action at the Annual Meeting.

(2) Except as otherwise required by law, nothing in this Article I, Section 2 shall obligate the Corporation or the Board of Directors to include in any proxy statement or other stockholder communication distributed on behalf of the Corporation or the Board of Directors information with respect to any nominee for director or any other matter of business submitted by a stockholder.

(3) Notwithstanding the foregoing provisions of this Article I, Section 2, if the nominating or proposing stockholder (or a qualified representative of the stockholder) does not appear at the Annual Meeting to present a nomination or any business, such nomination or business shall be disregarded, notwithstanding that proxies in respect of such vote may have been received by the Corporation. For purposes of this Article I, Section 2, to be considered a qualified representative of the proposing stockholder, a person must be authorized by a written instrument executed by such stockholder or an electronic transmission delivered by such stockholder to act for such stockholder as proxy at the meeting of stockholders and such person must produce such written instrument or electronic transmission, or a reliable reproduction of the written instrument or electronic transmission, to the presiding officer at the meeting of stockholders.

(4) For purposes of this By-law, “public announcement” shall mean disclosure in a press release reported by the Dow Jones News Service, Associated Press or comparable national news service or in a document publicly filed by the Corporation with the Securities and Exchange Commission pursuant to Section 13, 14 or 15(d) of the Exchange Act.

(5) Notwithstanding the foregoing provisions of this By-law, a stockholder shall also comply with all applicable requirements of the Exchange Act and the rules and regulations thereunder with respect to the matters set forth in this By-law. Nothing in this By-law shall be deemed to affect any rights of (i) stockholders to have proposals included in the Corporation’s proxy statement pursuant to Rule 14a-8 (or any successor rule), as applicable, under the Exchange Act and, to the extent required by such rule, have such proposals considered and voted on at an Annual Meeting or (ii) the holders of any series of Undesignated Preferred Stock to elect directors under specified circumstances.

(c) Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article I, Section 2; provided, however, that if the Board of Directors recommends that stockholders approve such amendment or repeal at such meeting of stockholders, such amendment or repeal shall only require the affirmative vote of a majority of the outstanding shares entitled to vote on such amendment or repeal, voting together as a single class.

SECTION 3. Special Meetings. Except as otherwise required by statute and subject to the rights, if any, of the holders of any series of Undesignated Preferred Stock, special meetings

of the stockholders of the Corporation may be called only by the Board of Directors acting pursuant to a resolution approved by the affirmative vote of a majority of the Directors then in office. The Board of Directors may postpone or reschedule any previously scheduled special meeting of stockholders. Only those matters set forth in the notice of the special meeting may be considered or acted upon at a special meeting of stockholders of the Corporation. Nominations of persons for election to the Board of Directors of the Corporation and stockholder proposals of other business shall not be brought before a special meeting of stockholders to be considered by the stockholders unless such special meeting is held in lieu of an annual meeting of stockholders in accordance with Article I, Section 1 of these By-laws, in which case such special meeting in lieu thereof shall be deemed an Annual Meeting for purposes of these By-laws and the provisions of Article I, Section 2 of these By-laws shall govern such special meeting.

Notwithstanding anything herein to the contrary, the affirmative vote of not less than two thirds (2/3) of the outstanding shares of capital stock entitled to vote thereon, and the affirmative vote of not less than two thirds (2/3) of the outstanding shares of each class entitled to vote thereon as a class, shall be required to amend or repeal any provision of this Article I, Section 3; provided, however, that if the Board of Directors recommends that stockholders approve such amendment or repeal at such meeting of stockholders, such amendment or repeal shall only require the affirmative vote of a majority of the outstanding shares entitled to vote on such amendment or repeal, voting together as a single class.

SECTION 4. Notice of Meetings; Adjournments.

(a) A notice of each Annual Meeting stating the hour, date and place, if any, of such Annual Meeting and the means of remote communication, if any, by which stockholders and proxyholders may be deemed to be present in person and vote at such meeting, shall be given not less than ten (10) days nor more than sixty (60) days before the Annual Meeting, to each stockholder entitled to vote thereat by delivering such notice to such stockholder or by mailing it, postage prepaid, addressed to such stockholder at the address of such stockholder as it appears on the Corporation's stock transfer books. Without limiting the manner by which notice may otherwise be given to stockholders, any notice to stockholders may be given by electronic transmission in the manner provided in Section 232 of the Delaware General Corporation Law ("DGCL").

(b) Unless otherwise required by the DGCL, notice of all special meetings of stockholders shall be given in the same manner as provided for Annual Meetings, except that the notice of all special meetings shall state the purpose or purposes for which the meeting has been called.

(c) Notice of an Annual Meeting or special meeting of stockholders need not be given to a stockholder if a waiver of notice is executed, or waiver of notice by electronic transmission is provided, before or after such meeting by such stockholder or if such stockholder attends such meeting, unless such attendance is for the express purpose of objecting at the beginning of the meeting to the transaction of any business because the meeting was not lawfully called or convened.

(d) The Board of Directors may postpone and reschedule any previously scheduled Annual Meeting or special meeting of stockholders and any record date with respect thereto, regardless of whether any notice or public disclosure with respect to any such meeting has been sent or made pursuant to Section 2 of this Article I of these By-laws or otherwise. In no event shall the public announcement of an adjournment, postponement or rescheduling of any previously scheduled meeting of stockholders commence a new time period for the giving of a stockholder's notice under this Article I of these By-laws.

(e) When any meeting is convened, the presiding officer may adjourn the meeting if (i) no quorum is present for the transaction of business, (ii) the Board of Directors determines that adjournment is necessary or appropriate to enable the stockholders to consider fully information which the Board of Directors determines has not been made sufficiently or timely available to stockholders, or (iii) the Board of Directors determines that adjournment is otherwise in the best interests of the Corporation. When any Annual Meeting or special meeting of stockholders is adjourned to another hour, date or place, notice need not be given of the adjourned meeting other than an announcement at the meeting at which the adjournment is taken of the hour, date and place, if any, to which the meeting is adjourned and the means of remote communications, if any, by which stockholders and proxyholders may be deemed to be present in person and vote at such adjourned meeting; provided, however, that if the adjournment is for more than thirty (30) days from the meeting date, or if after the adjournment a new record date is fixed for the adjourned meeting, notice of the adjourned meeting and the means of remote communications, if any, by which stockholders and proxyholders may be deemed to be present in person and vote at such adjourned meeting shall be given to each stockholder of record entitled to vote thereat and each stockholder who, by law or under the Certificate of Incorporation of the Corporation (as the same may hereafter be amended and/or restated, the "Certificate") or these By-laws, is entitled to such notice.

SECTION 5. Quorum. A majority of the outstanding shares entitled to vote, present in person or represented by proxy, shall constitute a quorum at any meeting of stockholders. If less than a quorum is present at a meeting, the holders of voting stock representing a majority of the voting power present at the meeting or the presiding officer may adjourn the meeting from time to time, and the meeting may be held as adjourned without further notice, except as provided in Section 4 of this Article I. At such adjourned meeting at which a quorum is present, any business may be transacted which might have been transacted at the original meeting. The stockholders present at a duly constituted meeting may continue to transact business until adjournment, notwithstanding the withdrawal of enough stockholders to leave less than a quorum.

SECTION 6. Voting and Proxies. Stockholders shall have one vote for each share of stock entitled to vote owned by them of record according to the stock ledger of the Corporation as of the record date, unless otherwise provided by law or by the Certificate. Stockholders may vote either (i) in person, (ii) by written proxy or (iii) by a transmission permitted by Section 212(c) of the DGCL. Any copy, facsimile telecommunication or other reliable reproduction of the writing or transmission permitted by Section 212(c) of the DGCL may be substituted for or used in lieu of the original writing or transmission for any and all purposes for which the original writing or transmission could be used, provided that such copy, facsimile telecommunication or other reproduction shall be a complete reproduction of the entire original

writing or transmission. Proxies shall be filed in accordance with the procedures established for the meeting of stockholders. Except as otherwise limited therein or as otherwise provided by law, proxies authorizing a person to vote at a specific meeting shall entitle the persons authorized thereby to vote at any adjournment of such meeting, but they shall not be valid after final adjournment of such meeting. A proxy with respect to stock held in the name of two or more persons shall be valid if executed by or on behalf of any one of them unless at or prior to the exercise of the proxy the Corporation receives a specific written notice to the contrary from any one of them.

SECTION 7. Action at Meeting. When a quorum is present at any meeting of stockholders, any matter before any such meeting (other than an election of a director or directors) shall be decided by a majority of the votes properly cast for and against such matter, except where a larger vote is required by law, by the Certificate or by these By-laws. Any election of directors by stockholders shall be determined by a plurality of the votes properly cast on the election of directors.

SECTION 8. Stockholder Lists. The Secretary or an Assistant Secretary (or the Corporation's transfer agent or other person authorized by these By-laws or by law) shall prepare and make, at least ten (10) days before every Annual Meeting or special meeting of stockholders, a complete list of the stockholders entitled to vote at the meeting, arranged in alphabetical order, and showing the address of each stockholder and the number of shares registered in the name of each stockholder. Such list shall be open to the examination of any stockholder, for a period of at least ten (10) days prior to the meeting as provided in the manner, and subject to the terms, set forth in Section 219 of the DGCL (or any successor provision). The list shall also be open to the examination of any stockholder during the whole time of the meeting as provided by law.

SECTION 9. Presiding Officer. The Board of Directors shall designate a representative to preside over all Annual Meetings or special meetings of stockholders, provided that if the Board of Directors does not so designate such a presiding officer, then the Chairman of the Board, if one is elected, shall preside over such meetings. If the Board of Directors does not so designate such a presiding officer and there is no Chairman of the Board or the Chairman of the Board is unable to so preside or is absent, then the Chief Executive Officer, if one is elected, shall preside over such meetings, provided further that if there is no Chief Executive Officer or the Chief Executive Officer is unable to so preside or is absent, then the President shall preside over such meetings. The presiding officer at any Annual Meeting or special meeting of stockholders shall have the power, among other things, to adjourn such meeting at any time and from time to time, subject to Sections 4 and 5 of this Article I. The order of business and all other matters of procedure at any meeting of the stockholders shall be determined by the presiding officer.

SECTION 10. Inspectors of Elections. The Corporation shall, in advance of any meeting of stockholders, appoint one or more inspectors to act at the meeting and make a written report thereof. The Corporation may designate one or more persons as alternate inspectors to replace any inspector who fails to act. If no inspector or alternate is able to act at a meeting of stockholders, the presiding officer shall appoint one or more inspectors to act at the meeting. Any inspector may, but need not, be an officer, employee or agent of the Corporation. Each inspector, before entering upon the discharge of his or her duties, shall take and sign an oath

faithfully to execute the duties of inspector with strict impartiality and according to the best of his or her ability. The inspectors shall perform such duties as are required by the DGCL, including the counting of all votes and ballots. The inspectors may appoint or retain other persons or entities to assist the inspectors in the performance of the duties of the inspectors. The presiding officer may review all determinations made by the inspectors, and in so doing the presiding officer shall be entitled to exercise his or her sole judgment and discretion and he or she shall not be bound by any determinations made by the inspectors. All determinations by the inspectors and, if applicable, the presiding officer, shall be subject to further review by any court of competent jurisdiction.

ARTICLE II

Directors

SECTION 1. Powers. The business and affairs of the Corporation shall be managed by or under the direction of the Board of Directors except as otherwise provided by the Certificate or required by law.

SECTION 2. Number and Terms. The number of directors of the Corporation shall be fixed solely and exclusively by resolution duly adopted from time to time by the Board of Directors. The directors shall hold office in the manner provided in the Certificate.

SECTION 3. Qualification. No director need be a stockholder of the Corporation.

SECTION 4. Vacancies. Vacancies in the Board of Directors shall be filled in the manner provided in the Certificate.

SECTION 5. Removal. Directors may be removed from office only in the manner provided in the Certificate.

SECTION 6. Resignation. A director may resign at any time by electronic transmission or by giving written notice to the Chairman of the Board, if one is elected, the President or the Secretary. A resignation shall be effective upon receipt, unless the resignation otherwise provides.

SECTION 7. Regular Meetings. The regular annual meeting of the Board of Directors shall be held, without notice other than this Section 7, on the same date and at the same place as the Annual Meeting following the close of such meeting of stockholders. Other regular meetings of the Board of Directors may be held at such hour, date and place as the Board of Directors may by resolution from time to time determine and publicize by means of reasonable notice given to any director who is not present at the meeting at which such resolution is adopted.

SECTION 8. Special Meetings. Special meetings of the Board of Directors may be called, orally or in writing, by or at the request of a majority of the directors, the Chairman of the Board, if one is elected, or the President. The person calling any such special meeting of the Board of Directors may fix the hour, date and place thereof.

SECTION 9. Notice of Meetings. Notice of the hour, date and place of all special meetings of the Board of Directors shall be given to each director by the Secretary or an Assistant Secretary, or in case of the death, absence, incapacity or refusal of such persons, by the Chairman of the Board, if one is elected, or the President or such other officer designated by the Chairman of the Board, if one is elected, or the President. Notice of any special meeting of the Board of Directors shall be given to each director in person, by telephone, or by facsimile, electronic mail or other form of electronic communication, sent to his or her business or home address, at least twenty-four (24) hours in advance of the meeting, or by written notice mailed to his or her business or home address, at least forty-eight (48) hours in advance of the meeting. Such notice shall be deemed to be delivered when hand-delivered to such address, read to such director by telephone, deposited in the mail so addressed, with postage thereon prepaid if mailed, dispatched or transmitted if sent by facsimile transmission or by electronic mail or other form of electronic communications. A written waiver of notice signed or electronically transmitted before or after a meeting by a director and filed with the records of the meeting shall be deemed to be equivalent to notice of the meeting. The attendance of a director at a meeting shall constitute a waiver of notice of such meeting, except where a director attends a meeting for the express purpose of objecting at the beginning of the meeting to the transaction of any business because such meeting is not lawfully called or convened. Except as otherwise required by law, by the Certificate or by these By-laws, neither the business to be transacted at, nor the purpose of, any meeting of the Board of Directors need be specified in the notice or waiver of notice of such meeting.

SECTION 10. Quorum. At any meeting of the Board of Directors, a majority of the total number of directors shall constitute a quorum for the transaction of business, but if less than a quorum is present at a meeting, a majority of the directors present may adjourn the meeting from time to time, and the meeting may be held as adjourned without further notice. Any business which might have been transacted at the meeting as originally noticed may be transacted at such adjourned meeting at which a quorum is present. For purposes of this section, the total number of directors includes any unfilled vacancies on the Board of Directors.

SECTION 11. Action at Meeting. At any meeting of the Board of Directors at which a quorum is present, the vote of a majority of the directors present shall constitute action by the Board of Directors, unless otherwise required by law, by the Certificate or by these By-laws.

SECTION 12. Action by Consent. Any action required or permitted to be taken at any meeting of the Board of Directors may be taken without a meeting if all members of the Board of Directors consent thereto in writing or by electronic transmission and the writing or writings or electronic transmission or transmissions are filed with the records of the meetings of the Board of Directors. Such filing shall be in paper form if the minutes are maintained in paper form and shall be in electronic form if the minutes are maintained in electronic form. Such consent shall be treated as a resolution of the Board of Directors for all purposes.

SECTION 13. Manner of Participation. Directors may participate in meetings of the Board of Directors by means of conference telephone or other communications equipment by means of which all directors participating in the meeting can hear each other, and participation in a meeting in accordance herewith shall constitute presence in person at such meeting for purposes of these By-laws.

SECTION 14. Presiding Director. The Board of Directors shall designate a representative to preside over all meetings of the Board of Directors, provided that if the Board of Directors does not so designate such a presiding director or such designated presiding director is unable to so preside or is absent, then the Chairman of the Board, if one is elected, shall preside over all meetings of the Board of Directors. If both the designated presiding director, if one is so designated, and the Chairman of the Board, if one is elected, are unable to preside or are absent, the Board of Directors shall designate an alternate representative to preside over a meeting of the Board of Directors.

SECTION 15. Committees. The Board of Directors, by vote of a majority of the directors then in office, may elect one or more committees, including, without limitation, a Compensation Committee, a Nominating & Corporate Governance Committee and an Audit Committee, and may delegate thereto some or all of its powers except those which by law, by the Certificate or by these By-laws may not be delegated. Except as the Board of Directors may otherwise determine, any such committee may make rules for the conduct of its business, but unless otherwise provided by the Board of Directors or in such rules, its business shall be conducted so far as possible in the same manner as is provided by these By-laws for the Board of Directors. All members of such committees shall hold such offices at the pleasure of the Board of Directors. The Board of Directors may abolish any such committee at any time. Any committee to which the Board of Directors delegates any of its powers or duties shall keep records of its meetings and shall report its action to the Board of Directors.

SECTION 16. Compensation of Directors. Directors shall receive such compensation for their services as shall be determined by a majority of the Board of Directors, or a designated committee thereof, provided that directors who are serving the Corporation as employees and who receive compensation for their services as such, shall not receive any salary or other compensation for their services as directors of the Corporation.

ARTICLE III

Officers

SECTION 1. Enumeration. The officers of the Corporation shall consist of a President, a Treasurer, a Secretary and such other officers, including, without limitation, a Chairman of the Board of Directors, a Chief Executive Officer and one or more Vice Presidents (including Executive Vice Presidents or Senior Vice Presidents), Assistant Vice Presidents, Assistant Treasurers and Assistant Secretaries, as the Board of Directors may determine.

SECTION 2. Election. At the regular annual meeting of the Board of Directors following the Annual Meeting, the Board of Directors shall elect the President, the Treasurer and the Secretary. Other officers may be elected by the Board of Directors at such regular annual meeting of the Board of Directors or at any other regular or special meeting.

SECTION 3. Qualification. No officer need be a stockholder or a director. Any person may occupy more than one office of the Corporation at any time.

SECTION 4. Tenure. Except as otherwise provided by the Certificate or by these By-laws, each of the officers of the Corporation shall hold office until the regular annual meeting of

the Board of Directors following the next Annual Meeting and until his or her successor is elected and qualified or until his or her earlier resignation or removal.

SECTION 5. Resignation. Any officer may resign by delivering his or her written or electronically transmitted resignation to the Corporation addressed to the President or the Secretary, and such resignation shall be effective upon receipt, unless the resignation otherwise provides.

SECTION 6. Removal. Except as otherwise provided by law or by resolution of the Board of Directors, the Board of Directors may remove any officer with or without cause by the affirmative vote of a majority of the directors then in office.

SECTION 7. Absence or Disability. In the event of the absence or disability of any officer, the Board of Directors may designate another officer to act temporarily in place of such absent or disabled officer.

SECTION 8. Vacancies. Any vacancy in any office may be filled for the unexpired portion of the term by the Board of Directors.

SECTION 9. President. The President shall, subject to the direction of the Board of Directors, have such powers and shall perform such duties as the Board of Directors may from time to time designate.

SECTION 10. Chairman of the Board. The Chairman of the Board, if one is elected, shall have such powers and shall perform such duties as the Board of Directors may from time to time designate.

SECTION 11. Chief Executive Officer. The Chief Executive Officer, if one is elected, shall have such powers and shall perform such duties as the Board of Directors may from time to time designate.

SECTION 12. Vice Presidents and Assistant Vice Presidents. Any Vice President (including any Executive Vice President or Senior Vice President) and any Assistant Vice President shall have such powers and shall perform such duties as the Board of Directors or the Chief Executive Officer may from time to time designate.

SECTION 13. Treasurer and Assistant Treasurers. The Treasurer shall, subject to the direction of the Board of Directors and except as the Board of Directors or the Chief Executive Officer may otherwise provide, have general charge of the financial affairs of the Corporation and shall cause to be kept accurate books of account. The Treasurer shall have custody of all funds, securities, and valuable documents of the Corporation. He or she shall have such other duties and powers as may be designated from time to time by the Board of Directors or the Chief Executive Officer. Any Assistant Treasurer shall have such powers and perform such duties as the Board of Directors or the Chief Executive Officer may from time to time designate.

SECTION 14. Secretary and Assistant Secretaries. The Secretary shall record all the proceedings of the meetings of the stockholders and the Board of Directors (including committees of the Board of Directors) in books kept for that purpose. In his or her absence from

any such meeting, a temporary secretary chosen at the meeting shall record the proceedings thereof. The Secretary shall have charge of the stock ledger (which may, however, be kept by any transfer or other agent of the Corporation). The Secretary shall have custody of the seal of the Corporation, and the Secretary, or an Assistant Secretary shall have authority to affix it to any instrument requiring it, and, when so affixed, the seal may be attested by his or her signature or that of an Assistant Secretary. The Secretary shall have such other duties and powers as may be designated from time to time by the Board of Directors or the Chief Executive Officer. In the absence of the Secretary, any Assistant Secretary may perform his or her duties and responsibilities. Any Assistant Secretary shall have such powers and perform such duties as the Board of Directors or the Chief Executive Officer may from time to time designate.

SECTION 15. Other Powers and Duties. Subject to these By-laws and to such limitations as the Board of Directors may from time to time prescribe, the officers of the Corporation shall each have such powers and duties as generally pertain to their respective offices, as well as such powers and duties as from time to time may be conferred by the Board of Directors or the Chief Executive Officer.

ARTICLE IV

Capital Stock

SECTION 1. Certificates of Stock. Each stockholder shall be entitled to a certificate of the capital stock of the Corporation in such form as may from time to time be prescribed by the Board of Directors. Such certificate shall be signed by any two authorized officers of the Corporation. The Corporation seal and the signatures by the Corporation's officers, the transfer agent or the registrar may be facsimiles. In case any officer, transfer agent or registrar who has signed or whose facsimile signature has been placed on such certificate shall have ceased to be such officer, transfer agent or registrar before such certificate is issued, it may be issued by the Corporation with the same effect as if he or she were such officer, transfer agent or registrar at the time of its issue. Every certificate for shares of stock which are subject to any restriction on transfer and every certificate issued when the Corporation is authorized to issue more than one class or series of stock shall contain such legend with respect thereto as is required by law. Notwithstanding anything to the contrary provided in these Bylaws, the Board of Directors of the Corporation may provide by resolution or resolutions that some or all of any or all classes or series of its stock shall be uncertificated shares (except that the foregoing shall not apply to shares represented by a certificate until such certificate is surrendered to the Corporation), and by the approval and adoption of these Bylaws the Board of Directors has determined that all classes or series of the Corporation's stock may be uncertificated, whether upon original issuance, re-issuance, or subsequent transfer.

SECTION 2. Transfers. Subject to any restrictions on transfer and unless otherwise provided by the Board of Directors, shares of stock that are represented by a certificate may be transferred on the books of the Corporation by the surrender to the Corporation or its transfer agent of the certificate theretofore properly endorsed or accompanied by a written assignment or power of attorney properly executed, with transfer stamps (if necessary) affixed, and with such proof of the authenticity of signature as the Corporation or its transfer agent may reasonably require. Shares of stock that are not represented by a certificate may be transferred on the books

of the Corporation by submitting to the Corporation or its transfer agent such evidence of transfer and following such other procedures as the Corporation or its transfer agent may require.

SECTION 3. Record Holders. Except as may otherwise be required by law, by the Certificate or by these By-laws, the Corporation shall be entitled to treat the record holder of stock as shown on its books as the owner of such stock for all purposes, including the payment of dividends and the right to vote with respect thereto, regardless of any transfer, pledge or other disposition of such stock, until the shares have been transferred on the books of the Corporation in accordance with the requirements of these By-laws.

SECTION 4. Record Date. In order that the Corporation may determine the stockholders entitled to notice of or to vote at any meeting of stockholders or any adjournment thereof or entitled to receive payment of any dividend or other distribution or allotment of any rights, or entitled to exercise any rights in respect of any change, conversion or exchange of stock or for the purpose of any other lawful action, the Board of Directors may fix a record date, which record date shall not precede the date upon which the resolution fixing the record date is adopted by the Board of Directors, and which record date: (a) in the case of determination of stockholders entitled to vote at any meeting of stockholders, shall, unless otherwise required by law, not be more than sixty (60) nor less than ten (10) days before the date of such meeting and (b) in the case of any other action, shall not be more than sixty (60) days prior to such other action. If no record date is fixed: (i) the record date for determining stockholders entitled to notice of or to vote at a meeting of stockholders shall be at the close of business on the day next preceding the day on which notice is given, or, if notice is waived, at the close of business on the day next preceding the day on which the meeting is held; and (ii) the record date for determining stockholders for any other purpose shall be at the close of business on the day on which the Board of Directors adopts the resolution relating thereto.

SECTION 5. Replacement of Certificates. In case of the alleged loss, destruction or mutilation of a certificate of stock of the Corporation, a duplicate certificate may be issued in place thereof, upon such terms as the Board of Directors may prescribe.

ARTICLE V

Indemnification

SECTION 1. Definitions. For purposes of this Article:

(a) "Corporate Status" describes the status of a person who is serving or has served (i) as a Director of the Corporation, (ii) as an Officer of the Corporation, (iii) as a Non-Officer Employee of the Corporation, or (iv) as a director, partner, trustee, officer, employee or agent of any other corporation, partnership, limited liability company, joint venture, trust, employee benefit plan, foundation, association, organization or other legal entity which such person is or was serving at the request of the Corporation. For purposes of this Section 1(a), a Director, Officer or Non-Officer Employee of the Corporation who is serving or has served as a director, partner, trustee, officer, employee or agent of a Subsidiary shall be deemed to be serving at the request of the Corporation. Notwithstanding the foregoing, "Corporate Status" shall not include the status of a person who is serving or has served as a director, officer, employee or agent of a

constituent corporation absorbed in a merger or consolidation transaction with the Corporation with respect to such person's activities prior to said transaction, unless specifically authorized by the Board of Directors or the stockholders of the Corporation;

(b) "Director" means any person who serves or has served the Corporation as a director on the Board of Directors of the Corporation;

(c) "Disinterested Director" means, with respect to each Proceeding in respect of which indemnification is sought hereunder, a Director of the Corporation who is not and was not a party to such Proceeding;

(d) "Expenses" means all attorneys' fees, retainers, court costs, transcript costs, fees of expert witnesses, private investigators and professional advisors (including, without limitation, accountants and investment bankers), travel expenses, duplicating costs, printing and binding costs, costs of preparation of demonstrative evidence and other courtroom presentation aids and devices, costs incurred in connection with document review, organization, imaging and computerization, telephone charges, postage, delivery service fees, and all other disbursements, costs or expenses of the type customarily incurred in connection with prosecuting, defending, preparing to prosecute or defend, investigating, being or preparing to be a witness in, settling or otherwise participating in, a Proceeding;

(e) "Liabilities" means judgments, damages, liabilities, losses, penalties, excise taxes, fines and amounts paid in settlement;

(f) "Non-Officer Employee" means any person who serves or has served as an employee or agent of the Corporation, but who is not or was not a Director or Officer;

(g) "Officer" means any person who serves or has served the Corporation as an officer of the Corporation appointed by the Board of Directors of the Corporation;

(h) "Proceeding" means any threatened, pending or completed action, suit, arbitration, alternate dispute resolution mechanism, inquiry, investigation, administrative hearing or other proceeding, whether civil, criminal, administrative, arbitral or investigative; and

(i) "Subsidiary" shall mean any corporation, partnership, limited liability company, joint venture, trust or other entity of which the Corporation owns (either directly or through or together with another Subsidiary of the Corporation) either (i) a general partner, managing member or other similar interest or (ii) (A) fifty percent (50%) or more of the voting power of the voting capital equity interests of such corporation, partnership, limited liability company, joint venture or other entity, or (B) fifty percent (50%) or more of the outstanding voting capital stock or other voting equity interests of such corporation, partnership, limited liability company, joint venture or other entity.

SECTION 2. Indemnification of Directors and Officers.

(a) Subject to the operation of Section 4 of this Article V of these By-laws, each Director and Officer shall be indemnified and held harmless by the Corporation to the fullest extent authorized by the DGCL, as the same exists or may hereafter be amended (but, in the case

of any such amendment, only to the extent that such amendment permits the Corporation to provide broader indemnification rights than such law permitted the Corporation to provide prior to such amendment), and to the extent authorized in this Section 2.

(1) Actions, Suits and Proceedings Other than By or In the Right of the Corporation. Each Director and Officer shall be indemnified and held harmless by the Corporation against any and all Expenses and Liabilities that are incurred or paid by such Director or Officer or on such Director's or Officer's behalf in connection with any Proceeding or any claim, issue or matter therein (other than an action by or in the right of the Corporation), which such Director or Officer is, or is threatened to be made, a party to or participant in by reason of such Director's or Officer's Corporate Status, if such Director or Officer acted in good faith and in a manner such Director or Officer reasonably believed to be in or not opposed to the best interests of the Corporation and, with respect to any criminal proceeding, had no reasonable cause to believe his or her conduct was unlawful.

(2) Actions, Suits and Proceedings By or In the Right of the Corporation. Each Director and Officer shall be indemnified and held harmless by the Corporation against any and all Expenses that are incurred by such Director or Officer or on such Director's or Officer's behalf in connection with any Proceeding or any claim, issue or matter therein by or in the right of the Corporation, which such Director or Officer is, or is threatened to be made, a party to or participant in by reason of such Director's or Officer's Corporate Status, if such Director or Officer acted in good faith and in a manner such Director or Officer reasonably believed to be in or not opposed to the best interests of the Corporation; provided, however, that no indemnification shall be made under this Section 2(a)(2) in respect of any claim, issue or matter as to which such Director or Officer shall have been finally adjudged by a court of competent jurisdiction to be liable to the Corporation, unless, and only to the extent that, the Court of Chancery or another court in which such Proceeding was brought shall determine upon application that, despite adjudication of liability, but in view of all the circumstances of the case, such Director or Officer is fairly and reasonably entitled to indemnification for such Expenses that such court deems proper.

(3) Survival of Rights. The rights of indemnification provided by this Section 2 shall continue as to a Director or Officer after he or she has ceased to be a Director or Officer and shall inure to the benefit of his or her heirs, executors, administrators and personal representatives.

(4) Actions by Directors or Officers. Notwithstanding the foregoing, the Corporation shall indemnify any Director or Officer seeking indemnification in connection with a Proceeding initiated by such Director or Officer only if such Proceeding (including any parts of such Proceeding not initiated by such Director or Officer) was authorized in advance by the Board of Directors of the Corporation, unless such Proceeding was brought to enforce such Officer's or Director's rights to indemnification or, in the case of Directors, advancement of Expenses under these By-laws in accordance with the provisions set forth herein.

SECTION 3. Indemnification of Non-Officer Employees. Subject to the operation of Section 4 of this Article V of these By-laws, each Non-Officer Employee may, in the discretion of the Board of Directors of the Corporation, be indemnified by the Corporation to the fullest extent authorized by the DGCL, as the same exists or may hereafter be amended, against any or all Expenses and Liabilities that are incurred by such Non-Officer Employee or on such Non-Officer Employee's behalf in connection with any threatened, pending or completed Proceeding, or any claim, issue or matter therein, which such Non-Officer Employee is, or is threatened to be made, a party to or participant in by reason of such Non-Officer Employee's Corporate Status, if such Non-Officer Employee acted in good faith and in a manner such Non-Officer Employee reasonably believed to be in or not opposed to the best interests of the Corporation and, with respect to any criminal proceeding, had no reasonable cause to believe his or her conduct was unlawful. The rights of indemnification provided by this Section 3 shall exist as to a Non-Officer Employee after he or she has ceased to be a Non-Officer Employee and shall inure to the benefit of his or her heirs, personal representatives, executors and administrators. Notwithstanding the foregoing, the Corporation may indemnify any Non-Officer Employee seeking indemnification in connection with a Proceeding initiated by such Non-Officer Employee only if such Proceeding was authorized in advance by the Board of Directors of the Corporation.

SECTION 4. Determination. Unless ordered by a court, no indemnification shall be provided pursuant to this Article V to a Director, to an Officer or to a Non-Officer Employee unless a determination shall have been made that such person acted in good faith and in a manner such person reasonably believed to be in or not opposed to the best interests of the Corporation and, with respect to any criminal Proceeding, such person had no reasonable cause to believe his or her conduct was unlawful. Such determination shall be made by (a) a majority vote of the Disinterested Directors, even though less than a quorum of the Board of Directors, (b) a committee comprised of Disinterested Directors, such committee having been designated by a majority vote of the Disinterested Directors (even though less than a quorum), (c) if there are no such Disinterested Directors, or if a majority of Disinterested Directors so directs, by independent legal counsel in a written opinion, or (d) by the stockholders of the Corporation.

SECTION 5. Advancement of Expenses to Directors Prior to Final Disposition.

(a) The Corporation shall advance all Expenses incurred by or on behalf of any Director in connection with any Proceeding in which such Director is involved by reason of such Director's Corporate Status within thirty (30) days after the receipt by the Corporation of a written statement from such Director requesting such advance or advances from time to time, whether prior to or after final disposition of such Proceeding. Such statement or statements shall reasonably evidence the Expenses incurred by such Director and shall be preceded or accompanied by an undertaking by or on behalf of such Director to repay any Expenses so advanced if it shall ultimately be determined that such Director is not entitled to be indemnified against such Expenses. Notwithstanding the foregoing, the Corporation shall advance all Expenses incurred by or on behalf of any Director seeking advancement of expenses hereunder in connection with a Proceeding initiated by such Director only if such Proceeding (including any parts of such Proceeding not initiated by such Director) was (i) authorized by the Board of Directors of the Corporation, or (ii) brought to enforce such Director's rights to indemnification or advancement of Expenses under these By-laws.

(b) If a claim for advancement of Expenses hereunder by a Director is not paid in full by the Corporation within thirty (30) days after receipt by the Corporation of documentation of Expenses and the required undertaking, such Director may at any time thereafter bring suit against the Corporation to recover the unpaid amount of the claim and if successful in whole or in part, such Director shall also be entitled to be paid the expenses of prosecuting such claim. The failure of the Corporation (including its Board of Directors or any committee thereof, independent legal counsel, or stockholders) to make a determination concerning the permissibility of such advancement of Expenses under this Article V shall not be a defense to an action brought by a Director for recovery of the unpaid amount of an advancement claim and shall not create a presumption that such advancement is not permissible. The burden of proving that a Director is not entitled to an advancement of expenses shall be on the Corporation.

(c) In any suit brought by the Corporation to recover an advancement of expenses pursuant to the terms of an undertaking, the Corporation shall be entitled to recover such expenses upon a final adjudication that the Director has not met any applicable standard for indemnification set forth in the DGCL.

SECTION 6. Advancement of Expenses to Officers and Non-Officer Employees Prior to Final Disposition.

(a) The Corporation may, at the discretion of the Board of Directors of the Corporation, advance any or all Expenses incurred by or on behalf of any Officer or any Non-Officer Employee in connection with any Proceeding in which such person is involved by reason of his or her Corporate Status as an Officer or Non-Officer Employee upon the receipt by the Corporation of a statement or statements from such Officer or Non-Officer Employee requesting such advance or advances from time to time, whether prior to or after final disposition of such Proceeding. Such statement or statements shall reasonably evidence the Expenses incurred by such Officer or Non-Officer Employee and shall be preceded or accompanied by an undertaking by or on behalf of such person to repay any Expenses so advanced if it shall ultimately be determined that such Officer or Non-Officer Employee is not entitled to be indemnified against such Expenses.

(b) In any suit brought by the Corporation to recover an advancement of expenses pursuant to the terms of an undertaking, the Corporation shall be entitled to recover such expenses upon a final adjudication that the Officer or Non-Officer Employee has not met any applicable standard for indemnification set forth in the DGCL.

SECTION 7. Contractual Nature of Rights.

(a) The provisions of this Article V shall be deemed to be a contract between the Corporation and each Director and Officer entitled to the benefits hereof at any time while this Article V is in effect, in consideration of such person's past or current and any future performance of services for the Corporation. Neither amendment, repeal or modification of any provision of this Article V nor the adoption of any provision of the Certificate of Incorporation inconsistent with this Article V shall eliminate or reduce any right conferred by this Article V in respect of any act or omission occurring, or any cause of action or claim that accrues or arises or any state of facts existing, at the time of or before such amendment, repeal, modification or

adoption of an inconsistent provision (even in the case of a proceeding based on such a state of facts that is commenced after such time), and all rights to indemnification and advancement of Expenses granted herein or arising out of any act or omission shall vest at the time of the act or omission in question, regardless of when or if any proceeding with respect to such act or omission is commenced. The rights to indemnification and to advancement of expenses provided by, or granted pursuant to, this Article V shall continue notwithstanding that the person has ceased to be a director or officer of the Corporation and shall inure to the benefit of the estate, heirs, executors, administrators, legatees and distributees of such person.

(b) If a claim for indemnification hereunder by a Director or Officer is not paid in full by the Corporation within sixty (60) days after receipt by the Corporation of a written claim for indemnification, such Director or Officer may at any time thereafter bring suit against the Corporation to recover the unpaid amount of the claim, and if successful in whole or in part, such Director or Officer shall also be entitled to be paid the expenses of prosecuting such claim. The failure of the Corporation (including its Board of Directors or any committee thereof, independent legal counsel, or stockholders) to make a determination concerning the permissibility of such indemnification under this Article V shall not be a defense to an action brought by a Director or Officer for recovery of the unpaid amount of an indemnification claim and shall not create a presumption that such indemnification is not permissible. The burden of proving that a Director or Officer is not entitled to indemnification shall be on the Corporation.

(c) In any suit brought by a Director or Officer to enforce a right to indemnification hereunder, it shall be a defense that such Director or Officer has not met any applicable standard for indemnification set forth in the DGCL.

SECTION 8. Non-Exclusivity of Rights. The rights to indemnification and to advancement of Expenses set forth in this Article V shall not be exclusive of any other right which any Director, Officer, or Non-Officer Employee may have or hereafter acquire under any statute, provision of the Certificate or these By-laws, agreement, vote of stockholders or Disinterested Directors or otherwise.

SECTION 9. Insurance. The Corporation may maintain insurance, at its expense, to protect itself and any Director, Officer or Non-Officer Employee against any liability of any character asserted against or incurred by the Corporation or any such Director, Officer or Non-Officer Employee, or arising out of any such person's Corporate Status, whether or not the Corporation would have the power to indemnify such person against such liability under the DGCL or the provisions of this Article V.

SECTION 10. Other Indemnification. The Corporation's obligation, if any, to indemnify or provide advancement of Expenses to any person under this Article V as a result of such person serving, at the request of the Corporation, as a director, partner, trustee, officer, employee or agent of another corporation, partnership, joint venture, trust, employee benefit plan or other enterprise shall be reduced by any amount such person may collect as indemnification or advancement of Expenses from such other corporation, partnership, joint venture, trust, employee benefit plan or enterprise (the "Primary Indemnitor"). Any indemnification or advancement of Expenses under this Article V owed by the Corporation as a result of a person serving, at the request of the Corporation, as a director, partner, trustee, officer, employee or

agent of another corporation, partnership, joint venture, trust, employee benefit plan or other enterprise shall only be in excess of, and shall be secondary to, the indemnification or advancement of Expenses available from the applicable Primary Indemnitor(s) and any applicable insurance policies.

ARTICLE VI

Miscellaneous Provisions

SECTION 1. Fiscal Year. The fiscal year of the Corporation shall be determined by the Board of Directors.

SECTION 2. Seal. The Board of Directors shall have power to adopt and alter the seal of the Corporation.

SECTION 3. Execution of Instruments. All deeds, leases, transfers, contracts, bonds, notes and other obligations to be entered into by the Corporation in the ordinary course of its business without director action may be executed on behalf of the Corporation by the Chairman of the Board, if one is elected, the President or the Treasurer or any other officer, employee or agent of the Corporation as the Board of Directors or the executive committee of the Board may authorize.

SECTION 4. Voting of Securities. Unless the Board of Directors otherwise provides, the Chairman of the Board, if one is elected, the President or the Treasurer may waive notice of and act on behalf of the Corporation (including with regard to voting and actions by written consent), or appoint another person or persons to act as proxy or attorney in fact for the Corporation with or without discretionary power and/or power of substitution, at any meeting of stockholders or shareholders of any other corporation or organization, any of whose securities are held by the Corporation.

SECTION 5. Resident Agent. The Board of Directors may appoint a resident agent upon whom legal process may be served in any action or proceeding against the Corporation.

SECTION 6. Corporate Records. The original or attested copies of the Certificate, By-laws and records of all meetings of the incorporators, stockholders and the Board of Directors and the stock transfer books, which shall contain the names of all stockholders, their record addresses and the amount of stock held by each, may be kept outside the State of Delaware and shall be kept at the principal office of the Corporation, at an office of its counsel, at an office of its transfer agent or at such other place or places as may be designated from time to time by the Board of Directors.

SECTION 7. Certificate. All references in these By-laws to the Certificate shall be deemed to refer to the Amended and Restated Certificate of Incorporation of the Corporation, as amended and/or restated and in effect from time to time.

SECTION 8. Exclusive Jurisdiction. Unless the Corporation consents in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware shall be the sole and exclusive forum for (i) any derivative action or proceeding brought on behalf of the

Corporation, (ii) any action asserting a claim of breach of a fiduciary duty owed by any director, officer or other employee of the Corporation to the Corporation or the Corporation's stockholders, (iii) any action asserting a claim arising pursuant to any provision of the Delaware General Corporation Law or the Certificate or By-laws, (iv) any action to interpret, apply, enforce or determine the validity of the Certificate or By-laws, or (v) any action asserting a claim against the Corporation governed by the internal affairs doctrine. Unless the Corporation consents in writing to the selection of an alternative forum, the United States District Court for the District of Massachusetts shall be the sole and exclusive forum for resolving any complaint asserting a cause of action arising under the Securities Act of 1933, as amended. Any person or entity purchasing or otherwise acquiring any interest in shares of capital stock of the Corporation shall be deemed to have notice of and consented to the provisions of this Section 8.

SECTION 9. Amendment of By-laws.

(a) Amendment by Directors. Except as provided otherwise by law, these By-laws may be amended or repealed by the Board of Directors by the affirmative vote of a majority of the directors then in office.




(b) Amendment by Stockholders. Except as otherwise required by these By-laws or by law, these By-laws may be amended or repealed at any Annual Meeting, or special meeting of stockholders called for such purpose in accordance with these By-Laws, by the affirmative vote of a majority of the outstanding shares entitled to vote on such amendment or repeal, voting together as a single class. Notwithstanding the foregoing, stockholder approval shall not be required unless mandated by the Certificate, these By-laws, or other applicable law.

SECTION 10. Notices. If mailed, notice to stockholders shall be deemed given when deposited in the mail, postage prepaid, directed to the stockholder at such stockholder's address as it appears on the records of the Corporation. Without limiting the manner by which notice otherwise may be given to stockholders, any notice to stockholders may be given by electronic transmission in the manner provided in Section 232 of the DGCL.

SECTION 11. Waivers. A written waiver of any notice, signed by a stockholder or director, or waiver by electronic transmission by such person, whether given before or after the time of the event for which notice is to be given, shall be deemed equivalent to the notice required to be given to such person. Neither the business to be transacted at, nor the purpose of, any meeting need be specified in such a waiver.

Adopted April 29, 2019, subject to and effective upon the effectiveness of the Corporation's Registration Statement on Form S-1 for its initial public offering.

CASE#INWTR	XXXXXX.XX
Member ID	XXXXXXXXXX
Insurance Value	1,000,000.00
Number of Shares	123456
Certificate Numbers	12345678 123456789012345
12345678901234567890	1
12345678901234567890	2
12345678901234567890	3
12345678901234567890	4
12345678901234567890	5
12345678901234567890	6
12345678901234567890	7

COMMON STOCK		COMMON STOCK	
Certificate Number ZC00000000	 AXCELLA HEALTH INCORPORATED UNDER THE LAWS OF THE STATE OF DELAWARE		
THIS CERTIFIES THAT	MR. SAMPLE & MRS. SAMPLE & MR. SAMPLE & MRS. SAMPLE	SEE REVERSE FOR OTHER DESIGNATIONS	
is the owner of	***ZERO HUNDRED THOUSAND ZERO HUNDRED AND ZERO***	CUSIP 05454010 5	
FULLY-PAID AND NON-ASSESSABLE SHARES OF COMMON STOCK OF			
<p>Axcella Health (hereinafter called the "Company"), transferable on the books of the Company in person or by duly authorized attorney, upon surrender of this Certificate properly endorsed. This Certificate and the shares represented hereby, are issued and shall be held subject to all of the provisions of the Articles of Incorporation, as amended, and the By-Laws, as amended, of the Company (copies of which are on file with the Company and with the Transfer Agent), to all of which each holder, by acceptance hereof, assents. This Certificate is not valid unless countersigned and registered by the Transfer Agent and Registrar.</p> <p>Witness the facsimile seal of the Company and the facsimile signatures of its duly authorized officers.</p>			
FACSIMILE SIGNATURE TO COME President		DATED 03-MMM-YYYY COUNTERSIGNED AND REGISTERED: COMPUTERSHARE TRUST COMPANY, N.A. TRANSFER AGENT AND REGISTRAR	
FACSIMILE SIGNATURE TO COME Secretary		By _____ AUTHORIZED SIGNATURE	

1234567

AXCELLA HEALTH

THE COMPANY WILL FURNISH WITHOUT CHARGE TO EACH SHAREHOLDER WHO SO REQUESTS, A SUMMARY OF THE POWERS, DESIGNATIONS, PREFERENCES AND RELATIVE, PARTICIPATING, OPTIONAL OR OTHER SPECIAL RIGHTS OF EACH CLASS OF STOCK OF THE COMPANY AND THE QUALIFICATIONS, LIMITATIONS OR RESTRICTIONS OF SUCH PREFERENCES AND RIGHTS, AND THE VARIATIONS IN RIGHTS, PREFERENCES AND LIMITATIONS DETERMINED FOR EACH SERIES, WHICH ARE FIXED BY THE ARTICLES OF INCORPORATION OF THE COMPANY, AS AMENDED, AND THE RESOLUTIONS OF THE BOARD OF DIRECTORS OF THE COMPANY, AND THE AUTHORITY OF THE BOARD OF DIRECTORS TO DETERMINE VARIATIONS FOR FUTURE SERIES. SUCH REQUEST MAY BE MADE TO THE OFFICE OF THE SECRETARY OF THE COMPANY OR TO THE TRANSFER AGENT. THE BOARD OF DIRECTORS MAY REQUIRE THE OWNER OF A LOST OR DESTROYED STOCK CERTIFICATE, OR HIS LEGAL REPRESENTATIVES, TO GIVE THE COMPANY A BOND TO INDEMNIFY IT AND ITS TRANSFER AGENTS AND REGISTRARS AGAINST ANY CLAIM THAT MAY BE MADE AGAINST THEM ON ACCOUNT OF THE ALLEGED LOSS OR DESTRUCTION OF ANY SUCH CERTIFICATE.

The following abbreviations, when used in the inscription on the face of this certificate, shall be construed as though they were written out in full according to applicable laws or regulations:

TEN COM - as tenants in common

TEN ENT - as tenants by the entireties

JT TEN - as joint tenants with right of survivorship
and not as tenants in common

UNIF GIFT MIN ACT - Custodian
(Cust) (Minor)

under Uniform Gifts to Minors Act
(State)

UNIF TRF MIN ACT - Custodian (until age)
(Cust) (Minor) (State)

under Uniform Transfers to Minors Act
(State)

Additional abbreviations may also be used though not in the above list.

For value received, _____ hereby sell, assign and transfer unto

PLEASE INSERT SOCIAL SECURITY OR OTHER IDENTIFYING NUMBER OF ASSIGNEE

(PLEASE PRINT OR TYPEWRITE NAME AND ADDRESS, INCLUDING POSTAL ZIP CODE, OF ASSIGNEE)

_____ Shares
of the common stock represented by the within Certificate, and do hereby irrevocably constitute and appoint

_____ Attorney
to transfer the said stock on the books of the within-named Company with full power of substitution in the premises.

Dated: _____ 20_____

Signature: _____

Signature: _____

Notice: The signature to this assignment must correspond with the name
as written upon the face of the certificate, in every particular,
without alteration or enlargement, or any change whatever.

Signature(s) Guaranteed: Medallion Guarantee Stamp

THE SIGNATURE(S) SHOULD BE GUARANTEED BY AN ELIGIBLE GUARANTOR INSTITUTION (Banks, Stockbrokers, Savings and Loan Associations and Credit Unions) WITH MEMBERSHIP IN AN APPROVED SIGNATURE GUARANTEE MEDALLION PROGRAM, PURSUANT TO S.E.C. RULE 17Ad-15.

SECURITY INSTRUCTIONS

THIS IS WATERMARKED PAPER. DO NOT ACCEPT WITHOUT NOTING
WATERMARK. HOLD TO LIGHT TO VERIFY WATERMARK.



The IRS requires that the named transfer agent ("we") report the cost basis of certain shares or units acquired after January 1, 2011. If your shares or units are covered by the legislation, and you requested to sell or transfer the shares or units using a specific cost basis calculation method, then we have processed as you requested. If you did not specify a cost basis calculation method, then we have defaulted to the first in, first out (FIFO) method. Please consult your tax advisor if you need additional information about cost basis.

If you do not keep in contact with the issuer or do not have any activity in your account for the time period specified by state law, your property may become subject to state unclaimed property laws and transferred to the appropriate state.

1534201

April 30, 2019

Axcella Health Inc.
840 Memorial Drive
Cambridge, MA 02139

Re: Securities Registered under Registration Statement on Form S-1

Ladies and Gentlemen:

We have acted as counsel to you in connection with your filing of a Registration Statement on Form S-1 (File No. 333-230822) (as amended or supplemented, the "Registration Statement") pursuant to the Securities Act of 1933, as amended (the "Securities Act"), relating to the registration of the offering by Axcella Health Inc., a Delaware corporation (the "Company") of up to \$90,357,128 of shares (the "Shares") of the Company's Common Stock, \$0.001 par value per share, including Shares purchasable by the underwriters upon their exercise of an over-allotment option granted to the underwriters by the Company. The Shares are being sold to the several underwriters named in, and pursuant to, an underwriting agreement among the Company and such underwriters (the "Underwriting Agreement").

We have reviewed such documents and made such examination of law as we have deemed appropriate to give the opinions set forth below. We have relied, without independent verification, on certificates of public officials and, as to matters of fact material to the opinions set forth below, on certificates of officers of the Company.

The opinion set forth below is limited to the Delaware General Corporation Law.

Based on the foregoing, we are of the opinion that the Company Shares have been duly authorized and, upon issuance and delivery against payment therefor in accordance with the terms of the Underwriting Agreement, the Company Shares will be validly issued, fully paid and non-assessable.

We hereby consent to the inclusion of this opinion as Exhibit 5.1 to the Registration Statement and to the references to our firm under the caption "Legal Matters" in the Registration Statement. In giving our consent, we do not admit that we are in the category of persons whose consent is required under Section 7 of the Securities Act or the rules and regulations thereunder.

Very truly yours,

/s/ Goodwin Procter LLP

GOODWIN PROCTER LLP

ESSENTIENT, INC.
2010 STOCK OPTION AND GRANT PLAN

SECTION 1. GENERAL PURPOSE OF THE PLAN; DEFINITIONS

The name of the plan is the Essentient, Inc. 2010 Stock Option and Grant Plan (the “Plan”). The purpose of the Plan is to encourage and enable the officers, employees, directors, Consultants and other key persons (including prospective employees, but conditioned on their employment) of Essentient, Inc., a Delaware corporation (including any successor entity, the “Company”), and any Subsidiary, upon whose judgment, initiative and efforts the Company largely depends for the successful conduct of its business, to acquire a proprietary interest in the Company.

The following terms shall be defined as set forth below:

“Affiliate” of any Person means a Person that directly or indirectly, through one or more intermediaries, controls, is controlled by or is under common control with the first mentioned Person. A Person shall be deemed to control another Person if such first Person possesses directly or indirectly the power to direct, or cause the direction of, the management and policies of the second Person, whether through the ownership of voting securities, by contract or otherwise.

“Award” or “Awards,” except where referring to a particular category of grant under the Plan, shall include Incentive Stock Options, Non-Qualified Stock Options, Restricted Stock Awards, Unrestricted Stock Awards, Restricted Stock Units or any combination of the foregoing.

“Award Agreement” means a written or electronic agreement setting forth the terms and provisions applicable to an Award granted under the Plan. Each Award Agreement may contain terms and conditions in addition to those set forth in the Plan; *provided, however*, that except to the extent explicitly provided to the contrary, in the event of any conflict in the terms of the Plan and the Award Agreement, the terms of the Plan shall govern.

“Bankruptcy” shall mean (i) the filing of a voluntary petition under any bankruptcy or insolvency law, or a petition for the appointment of a receiver or the making of an assignment for the benefit of creditors, with respect to the Holder, (ii) the Holder being subjected involuntarily to such a petition or assignment or to an attachment or other legal or equitable interest with respect to the Holder’s assets, which involuntary petition or assignment or attachment is not discharged within 60 days after its date, or (iii) the Holder being subject to a transfer of its Issued Shares or Award(s) by operation of law (including by divorce, even if not insolvent), except by reason of death.

“Board” means the Board of Directors of the Company.

“Cause” shall have the meaning as set forth in the Award Agreement(s). In the case that any Award Agreement does not contain a definition of “Cause,” it shall mean (i) the grantee’s dishonest statements or acts with respect to the Company or any Affiliate of the Company, or

any of the Company's current or prospective customers, suppliers, vendors or other third parties with which such entity does business; (ii) the grantee's commission of (A) a felony or (B) any misdemeanor involving moral turpitude, deceit, dishonesty or fraud; (iii) the grantee's failure to perform his or her assigned duties and responsibilities to the reasonable satisfaction of the Company which failure continues, in the reasonable judgment of the Company, after written notice given to the grantee by the Company; (iv) the grantee's gross negligence, willful misconduct or insubordination with respect to the Company or any Affiliate of the Company; or (v) the grantee's violation of any provision of any agreement(s) between the grantee and the Company relating to noncompetition, nondisclosure and/or assignment of inventions.

"Code" means the Internal Revenue Code of 1986, as amended, and any successor Code, and related rules, regulations and interpretations.

"Committee" means the Committee of the Board referred to in Section 2.

"Consultant" means any natural person that provides bona fide services to the Company (including a Subsidiary), and such services are not in connection with the offer or sale of securities in a capital-raising transaction and do not directly or indirectly promote or maintain a market for the Company's securities.

"Effective Date" means the date on which the Plan is adopted as set forth on the final page of the Plan.

"Exchange Act" means the Securities Exchange Act of 1934, as amended, and the rules and regulations thereunder.

"Fair Market Value" of the Stock on any given date means the fair market value of the Stock determined in good faith by the Committee based on the reasonable application of a reasonable valuation method not inconsistent with Section 409A of the Code. If the Stock is admitted to trade on a national securities exchange, the determination shall be made by reference to the closing price. If the date for which Fair Market Value is determined is the first day when trading prices for the Stock are reported on a national securities exchange, the Fair Market Value shall be the "Price to the Public" (or equivalent) set forth on the cover page for the final prospectus relating to the Company's Initial Public Offering.

"Good Reason" shall have the meaning as set forth in the Award Agreement(s). In the case that any Award Agreement does not contain a definition of "Good Reason," it shall mean (i) a material diminution in the grantee's base salary except for across-the-board salary reductions based on the Company's financial performance similarly affecting all or substantially all senior management employees of the Company or (ii) a change of more than 50 miles in the geographic location at which the grantee provides services to the Company.

"Grant Date" means the date that the Committee designates in its approval of an Award in accordance with applicable law as the date on which the Award is granted, which date may not precede the date of such Committee approval.

"Holder" means, with respect to an Award or any Issued Shares, the Person holding such Award or Issued Shares, including the initial recipient of the Award or any Permitted Transferee.

“Incentive Stock Option” means any Stock Option designated and qualified as an “incentive stock option” as defined in Section 422 of the Code.

“Initial Public Offering” means the consummation of the first firm commitment underwritten public offering pursuant to an effective registration statement under the Securities Act covering the offer and sale by the Company of its equity securities, as a result of or following which the Stock shall be publicly held.

“Issued Shares” means, collectively, all outstanding Shares issued pursuant to Restricted Stock Awards, Unrestricted Stock Awards and Restricted Stock Units and all Option Shares.

“NASDAQ” means the NASDAQ Stock Market LLC.

“Non-Qualified Stock Option” means any Stock Option that is not an Incentive Stock Option.

“Option” or “Stock Option” means any option to purchase shares of Stock granted pursuant to Section 5.

“Option Shares” means outstanding shares of Stock that were issued to a Holder upon the exercise of a Stock Option.

“Permitted Transferees” shall mean any of the following to whom a Holder may transfer Issued Shares hereunder (as set forth in Section 9(a)(ii)(A)): the Holder’s child, stepchild, grandchild, parent, stepparent, grandparent, spouse, former spouse, sibling, niece, nephew, mother-in-law, father-in-law, son-in-law, daughter-in-law, brother-in-law, or sister-in-law, including adoptive relationships, any person sharing the Holder’s household (other than a tenant or employee), a trust in which these persons have more than fifty percent of the beneficial interest, a foundation in which these persons control the management of assets, and any other entity in which these persons own more than fifty percent of the voting interests; *provided, however*, that any such trust does not require or permit distribution of any Issued Shares during the term of the Award Agreement unless subject to its terms. Upon the death of the Holder, the term Permitted Transferees shall also include such deceased Holder’s estate, executors, administrators, personal representatives, heirs, legatees and distributees, as the case may be.

“Person” shall mean any individual, corporation, partnership (limited or general), limited liability company, limited liability partnership, association, trust, joint venture, unincorporated organization or any similar entity.

“Repurchase Event” means (i) a Termination Event in which an Award Recipient’s Service Relationship with the Company or its Subsidiaries is terminated for Cause, (ii) a Sale Event or (iii) the Holder’s Bankruptcy.

“Restricted Stock Award” means Awards granted pursuant to Section 6 and “*Restricted Stock*” means Shares granted pursuant to such Awards.

“Restricted Stock Unit” means an Award of phantom stock units to a grantee, which may be settled in cash or stock as determined by the Committee, pursuant to Section 8.

“Sale Event” means the consummation of (i) the dissolution or liquidation of the Company, (ii) the sale of all or substantially all of the assets of the Company on a consolidated basis to an unrelated person or entity, (iii) a merger, reorganization or consolidation involving the Company in which the shares of voting stock of the Company outstanding immediately prior to such transaction represent or are converted into or exchanged for securities of the surviving or resulting entity immediately upon completion of such transaction which represent less than 50 percent of the outstanding voting power of such surviving or resulting entity, (iv) the acquisition of all or a majority of the outstanding voting stock of the Company in a single transaction or a series of related transactions by a Person or group of Persons, or (v) any other acquisition of the business of the Company, as determined by the Board; *provided, however*, that the Company’s Initial Public Offering, any subsequent public offering or another capital raising event, or a merger effected solely to change the Company’s domicile shall not constitute a “Sale Event.”

“Section 409A” means Section 409A of the Code and the regulations and other guidance promulgated thereunder.

“Securities Act” means the Securities Act of 1933, as amended, and the rules and regulations thereunder.

“Service Relationship” means any relationship as a full-time employee, part-time employee, director or other key person (including Consultants) of the Company or any Subsidiary or any successor entity (e.g., a Service Relationship shall be deemed to continue without interruption in the event an individual’s status changes from full-time employee to part-time employee or Consultant).

“Shares” means shares of Stock.

“Stock” means the Common Stock, par value \$0.001 per share, of the Company. “Subsidiary” means any corporation or other entity (other than the Company) in which the Company has more than a 50 percent interest, either directly or indirectly.

“Ten Percent Owner” means an employee who owns or is deemed to own (by reason of the attribution rules of Section 424(d) of the Code) more than 10 percent of the combined voting power of all classes of stock of the Company or any parent of the Company or any Subsidiary.

“Termination Event” means the termination of the Award recipient’s Service Relationship with the Company and its Subsidiaries for any reason whatsoever, regardless of the circumstances thereof, and including, without limitation, upon death, disability, retirement, discharge or resignation for any reason, whether voluntarily or involuntarily. The following shall not constitute a Termination Event: (i) a transfer to the service of the Company from a Subsidiary or from the Company to a Subsidiary, or from one Subsidiary to another Subsidiary or (ii) an approved leave of absence for military service or sickness, or for any other purpose approved by the Committee, if the individual’s right to re-employment is guaranteed either by a statute or by contract or under the policy pursuant to which the leave of absence was granted or if the Committee otherwise so provides in writing.

“Unrestricted Stock Award” means any Award granted pursuant to Section 7 and

“Unrestricted Stock” means Shares granted pursuant to such Awards.

SECTION 2. ADMINISTRATION OF PLAN; COMMITTEE AUTHORITY TO SELECT GRANTEES AND DETERMINE AWARDS

(a) Administration of Plan. The Plan shall be administered by the Board, or at the discretion of the Board, by a committee of the Board, comprised of not less than two Directors. All references herein to the “Committee” shall be deemed to refer to the group then responsible for administration of the Plan at the relevant time (i.e., either the Board of Directors or a committee or committees of the Board, as applicable).

(b) Powers of Committee. The Committee shall have the power and authority to grant Awards consistent with the terms of the Plan, including the power and authority:

(i) to select the individuals to whom Awards may from time to time be granted;

(ii) to determine the time or times of grant, and the amount, if any, of Incentive Stock Options, Non-Qualified Stock Options, Restricted Stock Awards, Unrestricted Stock Awards, Restricted Stock Units, or any combination of the foregoing, granted to any one or more grantees;

(iii) to determine the number of shares of Stock to be covered by any Award and, subject to the provisions of Section 5(a)(i) below, the price, exercise price, conversion ratio or other price relating thereto;

(iv) to determine and, subject to Section 12, to modify from time to time the terms and conditions, including restrictions, not inconsistent with the terms of the Plan, of any Award, which terms and conditions may differ among individual Awards and grantees, and to approve the form of Award Agreements;

(v) to accelerate at any time the exercisability or vesting of all or any portion of any Award;

(vi) to impose any limitations on Awards granted under the Plan, including limitations on transfers, repurchase provisions and the like, and to exercise repurchase rights or obligations;

(vii) subject to any restrictions imposed by Section 409A, to extend at any time the period in which Stock Options may be exercised; and

(viii) at any time to adopt, alter and repeal such rules, guidelines and practices for administration of the Plan and for its own acts and proceedings as it shall deem advisable; to interpret the terms and provisions of the Plan and any Award (including related written instruments); to make all determinations it deems advisable for the administration of the Plan; to decide all disputes arising in connection with the Plan; and to otherwise supervise the administration of the Plan.

All decisions and interpretations of the Committee shall be binding on all persons, including the Company and Plan grantees.

(c) Award Agreement. Awards under the Plan shall be evidenced by Award Agreements that set forth the terms, conditions and limitations for each Award. To the extent permitted by the Committee, Award Agreements may be executed electronically by the Award recipient.

(d) Indemnification. Neither the Board nor the Committee, nor any member of either or any delegate thereof, shall be liable for any act, omission, interpretation, construction or determination made in good faith in connection with the Plan, and the members of the Board and the Committee (and any delegate thereof) shall be entitled in all cases to indemnification and reimbursement by the Company in respect of any claim, loss, damage or expense (including, without limitation, reasonable attorneys' fees) arising or resulting therefrom to the fullest extent permitted by law and/or under the Company's governing documents, including its certificate of incorporation or bylaws (each, as may be amended or restated in the future), or any directors' and officers' liability insurance coverage which may be in effect from time to time and/or any indemnification agreement between such individual and the Company.

(e) Foreign Award Recipients. Notwithstanding any provision of the Plan to the contrary, in order to comply with the laws in other countries in which the Company and any Subsidiary operate or have employees or other individuals eligible for Awards, the Committee, in its sole discretion, shall have the power and authority to: (i) determine which Subsidiaries, if any, shall be covered by the Plan; (ii) determine which individuals, if any, outside the United States are eligible to participate in the Plan; (iii) modify the terms and conditions of any Award granted to individuals outside the United States to comply with applicable foreign laws; (iv) establish subplans and modify exercise procedures and other terms and procedures, to the extent the Committee determines such actions to be necessary or advisable (and such subplans and/or modifications shall be attached to the Plan as appendices); provided, however, that no such subplans and/or modifications shall increase the share limitation contained in Section 3(a) hereof; and (v) take any action, before or after an Award is made, that the Committee determines to be necessary or advisable to obtain approval or comply with any local governmental regulatory exemptions or approvals.

SECTION 3. STOCK ISSUABLE UNDER THE PLAN; MERGERS AND OTHER TRANSACTIONS; SUBSTITUTION

(a) Stock Issuable. The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 250,000 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.

(b) Changes in Stock. Subject to Section 3(c) hereof, if, as a result of any reorganization, recapitalization, reclassification, stock dividend, stock split, reverse stock split or other similar change in the Company's capital stock, the outstanding shares of Stock are increased or decreased or are exchanged for a different number or kind of shares or other securities of the Company, or additional shares or new or different shares or other securities of the Company or other non-cash assets are distributed with respect to such shares of Stock or other securities, or, if, as a result of any merger or consolidation, or sale of all or substantially all of the assets of the Company, the outstanding shares of Stock are converted into or exchanged for securities of the Company or any successor entity (or a parent or subsidiary thereof), the Committee shall make an appropriate and equitable or proportionate adjustment in (i) the maximum number of shares reserved for issuance under the Plan, (ii) the number and kind of shares or other securities subject to any then outstanding Awards under the Plan, (iii) the repurchase price, if any, per share subject to each outstanding Award, and (iv) the exercise price for each share subject to any then outstanding Stock Options under the Plan, without changing the aggregate exercise price (i.e., the exercise price multiplied by the number of Stock Options) as to which such Stock Options remain exercisable. The adjustment by the Committee shall be final, binding and conclusive. No fractional shares of Stock shall be issued under the Plan resulting from any such adjustment, but the Committee in its discretion may make a cash payment in lieu of fractional shares.

(c) Sale Events.

(i) Options.

(A) In the case of and subject to the consummation of a Sale Event, the Plan and all Options issued hereunder shall terminate upon the effective time of any such Sale Event unless provision is made in connection with the Sale Event for the assumption or continuation of Options theretofore granted by the successor entity, or the substitution of such Options with new Options of the successor entity or parent thereof, with an equitable or proportionate adjustment as to the number and kind of shares and, if appropriate, the per share exercise prices, as such parties shall agree (after taking into account any acceleration hereunder and/or pursuant to the terms of any Award Agreement).

(B) In the event of the termination of the Plan and all Options issued hereunder pursuant to Section 3(c), each Holder of Options shall be permitted, within a specified period of time prior to the consummation of the Sale Event as determined by the Committee, to exercise all such Options which are then exercisable or will become exercisable as of the effective time of the Sale Event; *provided, however*, that the exercise of Options not exercisable prior to the Sale Event shall be subject to the consummation of the Sale Event.

(C) Notwithstanding anything to the contrary in Section 3(c)(i)(A), in the event of a Sale Event, the Company shall have the right, but not the obligation, to make or provide for a cash payment to the grantees holding Options in exchange for the cancellation thereof, in an amount equal to the difference between (A) the value as determined by the Committee of the consideration payable per share of Stock pursuant to

the Sale Event (the “Sale Price”) times the number of shares of Stock subject to outstanding Options (to the extent then vested and exercisable, including by reason of acceleration in connection with such Sale Event, at prices not in excess of the Sale Price) and (B) the aggregate exercise price of all such outstanding vested Options.

(ii) Option Shares. Unless otherwise provided in an Award Agreement, in the case of and subject to the consummation of a Sale Event, Option Shares shall be subject to the repurchase right set forth in Section 9(c)(i).

(iii) Restricted Stock and Restricted Stock Unit Awards.

(A) In the case of and subject to the consummation of a Sale Event, all Restricted Stock and Restricted Stock Unit Awards issued hereunder shall be forfeited immediately prior to the effective time of any such Sale Event unless provision is made in connection with the Sale Event for the assumption or continuation of such Awards by the successor entity, or the substitution of such Awards with new Awards of the successor entity or parent thereof, with an equitable or proportionate adjustment as to the number and kind of shares subject to such Awards as such parties shall agree (after taking into account any acceleration hereunder and/or pursuant to the terms of any Award Agreement).

(B) In the event of the forfeiture of shares of Restricted Stock issued hereunder pursuant to Section 3(c)(iii)(A), such shares of Restricted Stock shall be repurchased from the Holder thereof at a price per share equal to the lower of the original per share purchase price paid by the recipient (subject to adjustment as provided in Section 3(b)) or the current Fair Market Value of such shares, determined immediately prior to the effective time of the Sale Event.

(C) Notwithstanding anything to the contrary in Section 3(c)(iii)(A), in the event of a Sale Event, the Company shall have the right, but not the obligation, to make or provide for a cash payment to the grantees holding Restricted Stock or Restricted Stock Unit Awards in exchange for the cancellation thereof, in an amount equal to the Sale Price times the number of shares of Stock subject to such Awards, to be paid at the time of such Sale Event or upon the later vesting of such Awards.

(iv) Unrestricted Stock Awards. Unless otherwise provided in an Award Agreement, any shares of Unrestricted Stock shall be treated in a Sale Event the same as all other Shares then outstanding.

SECTION 4. ELIGIBILITY

Grantees under the Plan will be such full or part-time officers and other employees, directors, Consultants and key persons (including prospective employees, but conditioned on their employment) of the Company and any Subsidiary who are selected from time to time by the Committee in its sole discretion; provided, however, that an Incentive Stock Option may be granted only to a person who, at the time the Incentive Stock Option is granted, is an employee of the Company or any Subsidiary.

SECTION 5. STOCK OPTIONS

Upon the grant of a Stock Option, the Company and the grantee shall enter into a Stock Option Award Agreement. The terms and conditions of each such Stock Option Award Agreement shall be determined by the Committee, and such terms and conditions may differ among individual Awards and grantees, all of whom must be eligible persons under Section 4 hereof.

Stock Options granted under the Plan may be either Incentive Stock Options or Non- Qualified Stock Options. Incentive Stock Options may be granted only to employees of the Company or any Subsidiary that is a “subsidiary corporation” within the meaning of Section 424(f) of the Code. To the extent that any Option does not qualify as an Incentive Stock Option, it shall be deemed a Non-Qualified Stock Option.

(a) Terms of Stock Options. The Committee in its discretion may grant Stock Options to eligible officers, employees, directors, Consultants and key persons of the Company or any Subsidiary. Stock Options granted pursuant to this Section 5(a) shall be subject to the following terms and conditions and shall contain such additional terms and conditions, not inconsistent with the terms of the Plan, as the Committee shall deem desirable.

(i) Exercise Price. The exercise price per share for the Stock covered by a Stock Option granted pursuant to Section 5(a) shall be determined by the Committee at the time of grant but shall not be less than 100 percent of the Fair Market Value on the Grant Date. In the case of an Incentive Stock Option that is granted to a Ten Percent Owner, the option price of such Incentive Stock Option shall not be less than 110 percent of the Fair Market Value on the Grant Date.

(ii) Option Term. The term of each Stock Option shall be fixed by the Committee, but no Stock Option shall be exercisable more than ten years after the date the Stock Option is granted. In the case of an Incentive Stock Option that is granted to a Ten Percent Owner, the term of such Stock Option shall be no more than five years from the Grant Date.

(iii) Exercisability; Rights of a Stockholder. Stock Options shall become exercisable and/or vested at such time or times, whether or not in installments, as shall be determined by the Committee at or after the Grant Date. The Award Agreement may permit an optionee to exercise all or a portion of a Stock Option immediately at grant; provided that the Option Shares issued upon such exercise shall be subject to restrictions and a vesting schedule identical to the vesting schedule of the related Stock Option and the optionee shall be required to enter into a Restricted Stock Award Agreement and any other similar documentation required by the Company as a condition to exercise of such Stock Option. An optionee shall have the rights of a stockholder only as to shares acquired upon the exercise of a Stock Option and not as to unexercised Stock Options. An optionee shall not be deemed to have acquired any such shares unless and until a Stock Option shall have been exercised pursuant to the terms hereof and the optionee’s name shall have been entered on the books of the Company as a stockholder.

(iv) Method of Exercise. Stock Options may be exercised by an optionee in whole or in part, by the optionee giving written notice of exercise to the Company, specifying the

number of shares to be purchased. Payment of the purchase price may be made by one or more of the following methods (or any combination thereof) to the extent provided in the Option Award Agreement:

- (A) In cash, by certified or bank check, by wire transfer of immediately available funds, or other instrument acceptable to the Committee;
- (B) If permitted by the Committee and the Initial Public Offering has occurred (or the Stock otherwise becomes publicly-traded), through the delivery (or attestation to the ownership) of shares of Stock that have been purchased by the optionee on the open market or that are beneficially owned by the optionee and are not then subject to restrictions under any Company plan. To the extent required to avoid variable accounting treatment under FAS 123R or other applicable accounting rules, such surrendered shares if originally purchased from the Company shall have been owned by the optionee for at least six months. Such surrendered shares shall be valued at Fair Market Value on the exercise date;
- (C) If permitted by the Committee and the Initial Public Offering has occurred (or the Stock otherwise becomes publicly-traded), by the optionee delivering to the Company a properly executed exercise notice together with irrevocable instructions to a broker to promptly deliver to the Company cash or a check payable and acceptable to the Company for the purchase price; provided that in the event the optionee chooses to pay the purchase price as so provided, the optionee and the broker shall comply with such procedures and enter into such agreements of indemnity and other agreements as the Committee shall prescribe as a condition of such payment procedure; and
- (D) If permitted by the Committee, with respect to Stock Options that are not Incentive Stock Options, by a “net exercise” arrangement pursuant to which the Company will reduce the number of shares of Stock issuable upon exercise by the largest whole number of shares with a Fair Market Value that does not exceed the aggregate exercise price.

Payment instruments will be received subject to collection. No certificates for shares of Stock so purchased will be issued to the optionee or, with respect to uncertificated Stock, no transfer to the optionee on the records of the Company will take place, until the Company has completed all steps required by law to be taken in connection with the issuance and sale of the shares, which steps may include, without limitation, (i) receipt of a representation from the optionee at the time of exercise of the Option that the optionee is purchasing the shares for the optionee’s own account and not with a view to any sale or distribution thereof, (ii) the legending of any certificate (or notation on any book entry) representing the shares to evidence the foregoing restrictions, (iii) obtaining from optionee payment or provision for all withholding taxes due as a result of the exercise of the Option, and (iv) if required by the Company, the optionee shall have entered into any stockholders’ agreements or other agreements with the Company and/or certain other stockholders of the Company relating to shares of the Stock. The delivery of certificates representing the shares of Stock (or the transfer to the optionee on the records of the Company with respect to uncertificated Stock) to be purchased pursuant to the exercise of a Stock Option will be contingent upon receipt from the optionee (or a purchaser

acting in his or her stead in accordance with the provisions of the Stock Option) by the Company of the full purchase price for such shares and the fulfillment of any other requirements contained in the Option Award Agreement or applicable provisions of laws. In the event an optionee chooses to pay the purchase price by previously-owned shares of Stock through the attestation method, the number of shares of Stock transferred to the optionee upon the exercise of the Stock Option shall be net of the number of shares attested to.

(b) Annual Limit on Incentive Stock Options. To the extent required for “incentive stock option” treatment under Section 422 of the Code, the aggregate Fair Market Value (determined as of the time of grant) of the shares of Stock with respect to which Incentive Stock Options granted under the Plan and any other plan of the Company or its parent and any Subsidiary that become exercisable for the first time by an optionee during any calendar year shall not exceed \$100,000 or such other limit as may be in effect from time to time under Section 422 of the Code. To the extent that any Stock Option exceeds this limit, it shall constitute a Non-Qualified Stock Option.

SECTION 6. RESTRICTED STOCK AWARDS

(a) Nature of Restricted Stock Awards. The Committee may, in its sole discretion, grant (or sell at par value or such higher purchase price determined by the Committee) to an eligible person under Section 4 hereof a Restricted Stock Award under the Plan. The Committee shall determine the restrictions and conditions applicable to each Restricted Stock Award at the time of grant. Conditions may be based on continuing employment (or other Service Relationship), achievement of pre-established performance goals and objectives and/or such other criteria as the Committee may determine. The grant of a Restricted Stock Award is contingent on the grantee executing a Restricted Stock Award Agreement. The terms and conditions of each such Award Agreement shall be determined by the Committee, and such terms and conditions may differ among individual Awards and grantees, all of whom must be eligible persons under Section 4 hereof.

(b) Rights as a Stockholder. Upon execution of a Restricted Stock Award Agreement and payment of any applicable purchase price, a grantee of Restricted Stock shall be considered the record owner of and shall be entitled to vote the Shares of Restricted Stock if, and to the extent, such Shares are entitled to voting rights, subject to such conditions contained in the Restricted Stock Award Agreement. The grantee shall be entitled to receive all dividends and any other distributions declared on the Shares; provided, however, that the Company is under no duty to declare any such dividends or to make any such distribution. The Restricted Stock Award Agreement may require or permit the immediate payment, waiver, deferral or investment of dividends paid on the Restricted Stock. Unless the Committee shall otherwise determine, certificates evidencing the Restricted Stock shall remain in the possession of the Company until such Restricted Stock is vested as provided in subsection (d) below of this Section, and the grantee shall be required, as a condition of the grant, to deliver to the Company a stock power endorsed in blank and such other instruments of transfer as the Committee may prescribe.

(c) Restrictions. Restricted Stock may not be sold, assigned, transferred, pledged or otherwise encumbered or disposed of except as specifically provided herein or in the Restricted Stock Award Agreement. Except as may otherwise be provided by the Committee either in the

Award Agreement or, subject to Section 12 below, in writing after the Award Agreement is issued, if any, if a grantee's employment (or other Service Relationship) with the Company and any Subsidiary terminates, the Company or its assigns shall have the right, as may be specified in the relevant instrument, to repurchase some or all of the Shares subject to the Award at such purchase price as is set forth in the Restricted Stock Award Agreement.

(d) Vesting of Restricted Stock. The Committee at the time of grant shall specify the date or dates and/or the attainment of pre-established performance goals, objectives and other conditions on which the substantial risk of forfeiture imposed shall lapse and the Restricted Stock shall become vested, subject to such further rights of the Company or its assigns as may be specified in the Restricted Stock Award Agreement.

SECTION 7. UNRESTRICTED STOCK AWARDS.

The Committee may, in its sole discretion, grant (or sell at par value or such higher purchase price determined by the Committee) to an eligible person under Section 4 hereof an Unrestricted Stock Award under the Plan. Unrestricted Stock Awards may be granted in respect of past services or other valid consideration, or in lieu of cash compensation due to such grantee.

SECTION 8. RESTRICTED STOCK UNITS

(a) Nature of Restricted Stock Units. The Committee shall determine the restrictions and conditions applicable to each Restricted Stock Unit at the time of grant. Vesting conditions may be based on continuing employment (or other Service Relationship), achievement of pre-established performance goals and objectives and/or other such criteria as the Committee may determine. The grant of Restricted Stock Unit(s) is contingent on the grantee executing a Restricted Stock Unit Award Agreement. The terms and conditions of each such Award Agreement shall be determined by the Committee and may differ among individual Awards and grantees. On or promptly following the vesting date or dates applicable to any Restricted Stock Unit, but in no event later than March 15 of the year following the year in which such vesting occurs, such Restricted Stock Unit(s), shall be settled in the form of cash or shares of Stock, as specified in the Award Agreement.

(b) Rights as a Stockholder. A grantee shall have the rights of a stockholder only as to shares of Stock, if any, acquired upon settlement of a Restricted Stock Unit. A grantee shall not be deemed to have acquired any such shares unless and until a Restricted Stock Unit shall have been settled in Stock pursuant to the terms hereof, the Company shall have issued and delivered a certificate representing the shares to the grantee, and the grantee's name shall have been entered in the books of the Company as a stockholder.

(c) Termination. Except as may otherwise be provided by the Committee either in the Award Agreement or in writing after the Award Agreement is issued, a grantee's right in all Restricted Stock Units that have not vested shall automatically terminate upon the grantee's termination of employment (or cessation of Service Relationship) with the Company and any Subsidiary for any reason.

12

SECTION 9. TRANSFER RESTRICTIONS; COMPANY RIGHT OF FIRST REFUSAL; COMPANY REPURCHASE RIGHTS

(a) Restrictions on Transfer.

(i) Non-Transferability of Stock Options. No Stock Option shall be transferable by the optionee otherwise than by will or by the laws of descent and distribution and all Stock Options shall be exercisable, during the optionee's lifetime, only by the optionee, or by the optionee's legal representative or guardian in the event of the optionee's incapacity. Notwithstanding the foregoing, the Committee, in its sole discretion, may provide in the Award Agreement regarding a given Stock Option that the optionee may transfer, without consideration for the transfer, his or her Non-Qualified Stock Options to members of his or her immediate family, to trusts for the benefit of such family members, or to partnerships in which such family members are the only partners, provided that the transferee agrees in writing with the Company to be bound by all of the terms and conditions of this Plan and the applicable Option.

(ii) Issued Shares. No Issued Shares shall be sold, assigned, transferred, pledged, hypothecated, given away or in any other manner disposed of or encumbered, whether voluntarily or by operation of law, unless (i) such transfer is in compliance with the terms of the applicable Award Agreement, all applicable securities laws (including, without limitation, the Securities Act), and with the terms and conditions of this Section 9, (ii) such transfer does not cause the Company to become subject to the reporting requirements of the Exchange Act, and (iii) the transferee consents in writing to be bound by the provisions of the Plan, including this Section 9. In connection with any proposed transfer, the Committee may require the transferor to provide at the transferor's own expense an opinion of counsel to the transferor, satisfactory to the Committee, that such transfer is in compliance with all foreign, federal and state securities laws (including, without limitation, the Securities Act). Any attempted disposition of Issued Shares not in accordance with the terms and conditions of this Section 9 shall be null and void, and the Company shall not reflect on its records any change in record ownership of any Issued Shares as a result of any such disposition, shall otherwise refuse to recognize any such disposition and shall not in any way give effect to any such disposition of Issued Shares. Subject to the foregoing general provisions, and unless otherwise provided in the applicable Award Agreement, Issued Shares may be transferred pursuant to the following specific terms and conditions (provided that with respect to any transfer of Restricted Stock, all vesting and forfeiture provisions shall continue to apply only with respect to the original recipient):

(A) Transfers to Permitted Transferees. The Holder may sell, assign, transfer or give away any or all of the Issued Shares to Permitted Transferees; *provided, however*, that following such sale, assignment, transfer or gift, such Issued Shares shall continue to be subject to the terms of this Plan (including this Section 9) and such Permitted Transferee(s) shall, as a condition to any such transfer, deliver a written acknowledgment to that effect to the Company. Notwithstanding the foregoing, the Holder may not sell, assign, transfer or give any or all of the Issued Shares to any Person whom the Company reasonably determines is a direct competitor or a potential competitor of the Company or any of its Subsidiaries.

13

(B) Transfers Upon Death. Upon the death of the Holder, any Issued Shares then held by the Holder at the time of such death and any Issued Shares acquired thereafter by the Holder's legal representative shall be subject to the provisions of this Plan, and the Holder's estate, executors, administrators, personal representatives, heirs, legatees and distributees shall be obligated to convey such Issued Shares to the Company or its assigns under the terms contemplated hereby.

(b) Right of First Refusal. In the event that a Holder desires at any time to sell or otherwise transfer all or any part of such Holder's Issued Shares (other than shares of Restricted Stock which by their terms are not transferrable), the Holder first shall give written notice to the Company of the Holder's intention to make such transfer. Such notice shall state the number of Issued Shares which the Holder proposes to sell (the "Offered Shares"), the price and the terms at which the proposed sale is to be made and the name and address of the proposed transferee. At any time within 30 days after the receipt of such notice by the Company, the Company or its assigns may elect to purchase all or any portion of the Offered Shares at the price and on the terms offered by the proposed transferee and specified in the notice. The Company or its assigns shall exercise this right by mailing or delivering written notice to the Holder within the foregoing 30-day period. If the Company or its assigns elect to exercise its purchase rights under this Section 9(b), the closing for such purchase shall, in any event, take place within 45 days after the receipt by the Company of the initial notice from the Holder. In the event that the Company or its assigns do not elect to exercise such purchase right, or in the event that the Company or its assigns do not pay the full purchase price within such 45-day period, the Holder may, within 60 days thereafter, sell the Offered Shares to the proposed transferee and at the same price and on the same terms as specified in the Holder's notice. Any Shares purchased by such proposed transferee shall no longer be subject to the terms of the Plan. Any Shares not sold to the proposed transferee shall remain subject to the Plan. If the Holder is a party to any stockholders' agreements or other agreements with the Company and/or certain other of the Company's stockholders relating to shares of the Stock, (i) the transferring Holder shall comply with the requirements of such stockholders' agreements or other agreements relating to any proposed transfer of the Offered Shares, and (ii) any proposed transferee that purchases Offered Shares shall enter into such stockholders' agreements or other agreements with the Company and/or certain other of the Company's stockholders relating to the Offered Shares on the same terms and in the same capacity as the transferring Holder.

(c) Company's Right of Repurchase.

(i) Right of Repurchase for Option Shares. The Company or its assigns shall have the right and option upon a Repurchase Event to repurchase from a Holder of Option Shares some or all (as determined by the Company) of the Option Shares held or subsequently acquired upon exercise of a Stock Option by such Holder at the price per share specified below. Such repurchase right may be exercised by the Company within the later of (A) six months following the date of such Repurchase Event or (B) seven months after the acquisition of such Option Shares upon exercise of a Stock Option (the "Option Shares Repurchase Period"). The "Option Shares Repurchase Price" shall be equal to the Fair Market Value of the Option Shares, determined as of the date the Committee elects to exercise its repurchase rights in connection with a Repurchase Event.

(ii) Right of Repurchase With Respect to Restricted Stock and Shares issued pursuant to an Unrestricted Stock Award or Restricted Stock Unit Award. Unless otherwise set forth in the agreement entered into by the recipient and the Company in connection with a Restricted Stock Award, Unrestricted Stock Award or Restricted Stock Unit Award, the Company or its assigns shall have the right and option upon a Repurchase Event to repurchase from a Holder of Issued Shares received pursuant to a Restricted Stock Award, Unrestricted Stock Award or Restricted Stock Unit Award some or all (as determined by the Company) of such Issued Shares at the price per share specified below. In addition, upon a Termination Event, the Company or its assigns shall have the right and option to repurchase from a Holder of Issued Shares received pursuant to a Restricted Stock Award any Issued Shares which have not vested as of the Termination Event. Such repurchase right may be exercised by the Company within six months following the date of such Repurchase Event or Termination Event as applicable (the “Non-Option Shares Repurchase Period”). The “Non-Option Shares Repurchase Price” shall be (i) in the case of Issued Shares which are vested as of the date of the Repurchase Event, the Fair Market Value of such Issued Shares as of the date the Company elects to exercise its repurchase rights in connection with a Repurchase Event and (ii) in the case of Issued Shares which have not vested as of the date of the Repurchase Event or Termination Event (as applicable), the lower of the original per share purchase price paid by the recipient subject to adjustment as provided in Section 3(b) or the current Fair Market Value of such Issued Shares as of the date the Company elects to exercise its repurchase rights in connection with a Repurchase Event or Termination Event (as applicable).

(iii) Procedure. Any repurchase right of the Company shall be exercised by the Company or its assigns by giving the Holder written notice on or before the last day of the Option Shares Repurchase Period or Non-Option Shares Repurchase Period, as applicable, of its intention to exercise such repurchase right. Upon such notification, the Holder shall promptly surrender to the Company, free and clear of any liens or encumbrances, any certificates representing the Shares being purchased, together with a duly executed stock power for the transfer of such Shares to the Company or the Company’s assignee or assignees. Upon the Company’s or its assignee’s receipt of the certificates from the Holder, the Company or its assignee or assignees shall deliver to him, her or them a check for the Option Shares Repurchase Price or the Non-Option Shares Repurchase Price, as applicable; *provided, however*, that the Company may pay the Option Shares Repurchase Price or Non-Option Shares Repurchase Price, as applicable, by offsetting and canceling any indebtedness then owed by the Holder to the Company.

(d) Drag Along Right. In the event the holders of a majority of the Company’s equity securities then outstanding (the “Majority Shareholders”) determine to enter into a Sale Event in a *bona fide* negotiated transaction (a “Sale”), with any non-Affiliate of the Company or any majority stockholder (in each case, the “Buyer”), a Holder of Issued Shares, including any Permitted Transferees, shall be obligated to and shall upon the written request of the Company or the Majority Shareholders: (i) sell, transfer and deliver, or cause to be sold, transferred and delivered, to the Buyer, his or her Issued Shares (including for this purpose all of such Holder’s or his or her Permitted Transferee’s Issued Shares that presently or as a result of any such transaction may be acquired upon the exercise of an Option (following the payment of the exercise price therefor)) on substantially the same terms applicable to the Majority Shareholders (with appropriate adjustments to reflect the conversion of convertible securities, the redemption

of redeemable securities and the exercise of exercisable securities as well as the relative preferences and priorities of preferred stock); and (ii) execute and deliver such instruments of conveyance and transfer and take such other action, including voting such Issued Shares in favor of any Sale proposed by the Majority Shareholders and executing any purchase agreements, merger agreements, indemnity agreements, escrow agreements or related documents as the Company, the Majority Shareholders or the Buyer may reasonably require in order to carry out the terms and provisions of this Section 9(d).

(e) Escrow Arrangement.

(i) Escrow. In order to carry out the provisions of Sections 9(b), (c) and (d) of this Agreement more effectively, the Company shall hold any Issued Shares in escrow together with separate stock powers executed by the Holder in blank for transfer, and any Permitted Transferee shall, as an additional condition to any transfer of Issued Shares, execute a like stock power as to such Issued Shares. The Company shall not dispose of the Issued Shares except as otherwise provided in this Agreement. In the event of any repurchase by the Company (or any of its assigns), the Company is hereby authorized by the Holder and any Permitted Transferee, as the Holder's and each such Permitted Transferee's attorney-in-fact, to date and complete the stock powers necessary for the transfer of the Issued Shares being purchased and to transfer such Issued Shares in accordance with the terms hereof. At such time as any Issued Shares are no longer subject to the Company's repurchase, first refusal and drag along rights, the Company shall, at the written request of the Holder, deliver to the Holder (or the relevant Permitted Transferee) a certificate representing such Issued Shares with the balance of the Issued Shares to be held in escrow pursuant to this Section 9(e).

(ii) Remedy. Without limitation of any other provision of this Agreement or other rights, in the event that a Holder, any Permitted Transferees or any other Person is required to sell a Holder's Issued Shares pursuant to the provisions of Sections 9(b), (c), or (d) hereof and in the further event that he or she refuses or for any reason fails to deliver to the Company or its designated purchaser of such Issued Shares the certificate or certificates evidencing such Issued Shares together with a related stock power, the Company or such designated purchaser may deposit the applicable purchase price for such Issued Shares with a bank designated by the Company, or with the Company's independent public accounting firm, as agent or trustee, or in escrow, for such Holder, any Permitted Transferees or other Person, to be held by such bank or accounting firm for the benefit of and for delivery to him, her, them or it, and/or, in its discretion, pay such purchase price by offsetting any indebtedness then owed by such Holder as provided above. Upon any such deposit and/or offset by the Company or its designated purchaser of such amount and upon notice to the Person who was required to sell the Issued Shares to be sold pursuant to the provisions of Sections 9(b), (c) or (d), such Issued Shares shall at such time be deemed to have been sold, assigned, transferred and conveyed to such purchaser, such Holder shall have no further rights thereto (other than the right to withdraw the payment thereof held in escrow, if applicable), and the Company shall record such transfer in its stock transfer book or in any appropriate manner.

(f) Lockup Provision. A Holder agrees, if requested by the Company and any underwriter engaged by the Company, not to sell or otherwise transfer or dispose of any Issued Shares (including, without limitation, pursuant to Rule 144 under the Securities Act) held by him

or her for such period following the effective date of any registration statement of the Company filed under the Securities Act as the Company or such underwriter shall specify reasonably and in good faith. If requested by the underwriter engaged by the Company, each Holder shall execute a separate letter reflecting the agreement set forth in this Section 9(f).

(g) Adjustments for Changes in Capital Structure. If, as a result of any reorganization, recapitalization, reclassification, stock dividend, stock split, reverse stock split or other similar change in the Common Stock, the outstanding shares of Common Stock are increased or decreased or are exchanged for a different number or kind of shares of the Company's Stock, the restrictions contained in this Section 9 shall apply with equal force to additional and/or substitute securities, if any, received by Holder in exchange for, or by virtue of his or her ownership of, Issued Shares.

(h) Termination. The terms and provisions of Section 9(b), Section 9(c) (except for the Company's right to repurchase unvested Restricted Stock Awards upon a Termination Event) and Section 9(d) shall terminate upon the closing of the Company's Initial Public Offering or upon consummation of any Sale Event, in either case as a result of which shares of the Company (or a successor entity) of the same class as the Issued Shares are registered under Section 12 of the Exchange Act and publicly traded on any national security exchange.

SECTION 10. TAX WITHHOLDING

(a) Payment by Grantee. Each grantee shall, no later than the date as of which the value of an Award or of any Stock or other amounts received thereunder first becomes includable in the gross income of the grantee for Federal income tax purposes, pay to the Company, or make arrangements satisfactory to the Committee regarding payment of, any Federal, state, or local taxes of any kind required by law to be withheld by the Company with respect to such income. The Company and any Subsidiary shall, to the extent permitted by law, have the right to deduct any such taxes from any payment of any kind otherwise due to the grantee. The Company's obligation to deliver stock certificates (or evidence of book entry) to any grantee is subject to and conditioned on any such tax withholding obligations being satisfied by the grantee.

(b) Payment in Stock. Subject to approval by the Committee, the Company's minimum required tax withholding obligation may be satisfied, in whole or in part, by the Company withholding from shares of Stock to be issued pursuant to any Award a number of shares with an aggregate Fair Market Value (as of the date the withholding is effected) that would satisfy the minimum withholding amount due.

SECTION 11. SECTION 409A AWARDS.

To the extent that any Award is determined to constitute "nonqualified deferred compensation" within the meaning of Section 409A (a "409A Award"), the Award shall be subject to such additional rules and requirements as specified by the Committee from time to time in order to comply with Section 409A. In this regard, if any amount under a 409A Award is payable upon a "separation from service" (within the meaning of Section 409A) to a grantee who is considered a "specified employee" (within the meaning of Section 409A), then no such

payment shall be made prior to the date that is the earlier of (i) six months and one day after the grantee's separation from service, or (ii) the grantee's death, but only to the extent such delay is necessary to prevent such payment from being subject to interest, penalties and/or additional tax imposed pursuant to Section 409A.

SECTION 12. AMENDMENTS AND TERMINATION

The Board may, at any time, amend or discontinue the Plan and the Committee may, at any time, amend or cancel any outstanding Award for the purpose of satisfying changes in law or for any other lawful purpose, but no such action shall adversely affect rights under any outstanding Award without the consent of the holder of the Award. The Committee may exercise its discretion to reduce the exercise price of outstanding Stock Options or effect repricing through cancellation of outstanding Awards and by granting such holders new Awards in replacement of the cancelled Awards. To the extent determined by the Committee to be required either by the Code to ensure that Incentive Stock Options granted under the Plan are qualified under Section 422 of the Code or otherwise, Plan amendments shall be subject to approval by the Company stockholders entitled to vote at a meeting of stockholders. Nothing in this Section 12 shall limit the Board's or Committee's authority to take any action permitted pursuant to Section 3(c).

SECTION 13. STATUS OF PLAN

With respect to the portion of any Award that has not been exercised and any payments in cash, Stock or other consideration not received by a grantee, a grantee shall have no rights greater than those of a general creditor of the Company unless the Committee shall otherwise expressly so determine in connection with any Award or Awards.

SECTION 14. GENERAL PROVISIONS

(a) No Distribution; Compliance with Legal Requirements. The Committee may require each person acquiring Stock pursuant to an Award to represent to and agree with the Company in writing that such person is acquiring the shares of Stock without a view to distribution thereof. No shares of Stock shall be issued pursuant to an Award until all applicable securities law and other legal and stock exchange or similar requirements have been satisfied. The Committee may require the placing of such stop-orders and restrictive legends on certificates for Stock and Awards as it deems appropriate.

(b) Delivery of Stock Certificates. Stock certificates to grantees under the Plan shall be deemed delivered for all purposes when the Company or a stock transfer agent of the Company shall have mailed such certificates in the United States mail, addressed to the grantee, at the grantee's last known address on file with the Company; provided, that stock certificates to be held in escrow pursuant to Section 9(e) of the Plan shall be deemed delivered when the Company shall have recorded the issuance in its records. Uncertificated Stock shall be deemed delivered for all purposes when the Company or a Stock transfer agent of the Company shall have given to the grantee by electronic mail (with proof of receipt) or by United States mail, addressed to the grantee, at the grantee's last known address on file with the Company, notice of

issuance and recorded the issuance in its records (which may include electronic “book entry” records).

(c) No Employment Rights. The adoption of the Plan and the grant of Awards do not confer upon any Person any right to continued employment or Service Relationship with the Company or any Subsidiary.

(d) Trading Policy Restrictions. Option exercises and other Awards under the Plan shall be subject to the Company’s insider trading policy-related restrictions, terms and conditions as may be established by the Committee, or in accordance with policies set by the Committee, from time to time.

(e) Designation of Beneficiary. Each grantee to whom an Award has been made under the Plan may designate a beneficiary or beneficiaries to exercise any Award on or after the grantee’s death or receive any payment under any Award payable on or after the grantee’s death. Any such designation shall be on a form provided for that purpose by the Committee and shall not be effective until received by the Committee. If no beneficiary has been designated by a deceased grantee, or if the designated beneficiaries have predeceased the grantee, the beneficiary shall be the grantee’s estate.

(f) Legend. Any certificate(s) representing the Issued Shares shall carry substantially the following legend (and with respect to uncertificated Stock, the book entries evidencing such shares shall contain the following notation):

The transferability of this certificate and the shares of stock represented hereby are subject to the restrictions, terms and conditions (including repurchase and restrictions against transfers) contained in the Essentient, Inc. 2010 Stock Option and Grant Plan and any agreement entered into thereunder by and between the company and the holder of this certificate (a copy of which is available at the offices of the company for examination).

SECTION 15. EFFECTIVE DATE OF PLAN

The Plan shall become effective upon adoption by the Board and shall be approved by the stockholders in accordance with applicable state law, and the Company’s certificate of incorporation and bylaws (each, as may be amended or restated in the future) within 12 months thereafter. Subject to such approval by the stockholders and to the requirement that no Stock may be issued hereunder prior to such approval, Stock Options and other Awards may be granted hereunder on and after adoption of the Plan by the Board. No grants of Stock Options and other Awards may be made hereunder after the tenth anniversary of the Effective Date and no grants of Incentive Stock Options may be made hereunder after the tenth anniversary of the date the Plan is approved by the Board.

SECTION 16. GOVERNING LAW

This Plan, all Awards and any controversy arising out of or relating to this Plan and all Awards shall be governed by and construed in accordance with the General Corporation Law of

the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to conflict of law principles that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

DATE APPROVED BY THE BOARD OF DIRECTORS: December 23, 2010

DATE APPROVED BY THE STOCKHOLDERS: April 8, 2011

20

ESSENTIENT, INC.

AMENDMENT NO. 1 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Essentient, Inc. (the "Corporation") approved and adopted the 2010 Stock Option and Grant Plan (the "Plan") of the Corporation on December 23, 2010; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

"The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 2,250,000 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company."

2. Miscellaneous.

2.01. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: April 8, 2011

APPROVED BY STOCKHOLDERS: April 8, 2011

ESSENTIENT, INC.

AMENDMENT NO. 2 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Essentient, Inc. (the "Corporation") approved and adopted the 2010 Stock Option and Grant Plan (the "Plan") of the Corporation on December 23, 2010 and approved an Amendment No.1 thereof on April 8, 2011; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No.2.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

"The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 2,254,713 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company."

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: March 2, 2012

APPROVED BY STOCKHOLDERS: December 13, 2012

PRONUTRIA, INC. (f/k/a ESSENTIENT, INC.)

AMENDMENT NO. 3 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Pronutria, Inc. (f/k/a Essentient, Inc.) (the "Corporation") approved and adopted the 2010 Stock Option and Grant Plan (the "Plan") of the Corporation on December 23, 2010 and approved an Amendment No.1 thereof on April 8, 2011;

WHEREAS, the Board of Directors approved an Amendment No.2 thereof on March 2, 2012; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No.3.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

"The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 2,354,713 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company."

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: 11/6/2012

APPROVED BY STOCKHOLDERS: 12/13/2012

AMENDMENT NO. 4 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Essentient, Inc. (the "Corporation") approved and adopted the 2010 Stock Option and Grant Plan (the "Plan") of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, and Amendment No. 3 thereof on November 6, 2012; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No.4.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

"The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 2,563,971 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company."

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: June 26, 2013

APPROVED BY STOCKHOLDERS: October 1, 2013

AMENDMENT NO. 5 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Essentient, Inc. (the "Corporation") approved and adopted the 2010 Stock Option and Grant Plan (the "Plan") of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, and Amendment No. 4 thereof on June 26, 2013; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 5.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

"The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 2,354,713 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company."

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: 10/2/2013

APPROVED BY STOCKHOLDERS: 10/2/2013

AMENDMENT NO. 6 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Essentient, Inc. (the "Corporation") approved and adopted the 2010 Stock Option and Grant Plan (the "Plan") of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, and Amendment No. 5 thereof on October 2, 2013; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 6.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

"The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 2,754,713 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company."

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: March 7, 2014

APPROVED BY STOCKHOLDERS: March 7, 2014

AMENDMENT NO. 7 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Essentient, Inc. (the "Corporation") approved and adopted the 2010 Stock Option and Grant Plan (the "Plan") of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, and Amendment No. 6 thereof on March 7, 2014; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 7.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

"The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 3,154,713 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company."

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: June 18, 2014

APPROVED BY STOCKHOLDERS: June 18, 2014

AMENDMENT NO. 8 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Pronutria, Inc. (f/k/a Essentient, Inc., the “Corporation”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 on June 18, 2014; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 8.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 3,889,713 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: October 3, 2014

APPROVED BY STOCKHOLDERS: October 3, 2014

AMENDMENT NO. 9 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Pronutria, Biosciences, Inc. (f/k/a Pronutria, Inc. and Essentient, Inc., the “Corporation”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 on June 18, 2014, and Amendment No. 8 on October 3, 2014; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 9.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 4,878,071 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: October 29, 2015

APPROVED BY STOCKHOLDERS: October 29, 2015

AMENDMENT NO. 10 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Pronutria, Biosciences, Inc. (f/k/a Pronutria, Inc. and Essentient, Inc., the “Corporation”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 thereof on June 18, 2014, Amendment No. 8 thereof on October 3, 2014 and Amendment 9 thereof on October 29, 2015; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 10.

NOW, THEREFORE, the Plan is amended as follows:

1. **Amendment of the Plan**

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 5,278,071 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. **Miscellaneous.**

2.01. **Effect.** Except as amended hereby, the Plan shall remain in full force and effect.

2.02. **Defined Terms.** All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. **Governing Law.** This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: March 29, 2016

APPROVED BY STOCKHOLDERS: February 23, 2017

AMENDMENT NO. 11 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Axcella Health Inc. (f/k/a Pronutria Biosciences, Inc., Pronutria, Inc. and Essentient, Inc., the “Corporation”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 thereof on June 18, 2014, Amendment No. 8 thereof on October 3, 2014, Amendment No. 9 thereof on October 29, 2015 and Amendment No. 10 thereof on February 23, 2017; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 11.

NOW, THEREFORE, the Plan is amended as follows:

1. **Amendment of the Plan**

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 5,828,071 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. **Miscellaneous.**

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: August 10, 2017

APPROVED BY STOCKHOLDERS: September 7, 2017

AMENDMENT NO. 12 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Axcella Health Inc. (f/k/a Pronutria Biosciences, Inc., Pronutria, Inc. and Essentient, Inc., the “Corporation”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 thereof on June 18, 2014, Amendment No. 8 thereof on October 3, 2014, Amendment No. 9 thereof on October 29, 2015, Amendment No. 10 thereof on February 23, 2017, and Amendment No. 11 thereof on September 7, 2017; and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 12.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 7,418,071 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: December 21, 2017

APPROVED BY STOCKHOLDERS: February 6, 2018

AMENDMENT NO. 13 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Axcella Health Inc. (f/k/a Pronutria Biosciences, Inc., Pronutria, Inc. and Essentient, Inc., the “Corporation”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Corporation on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 thereof on June 18, 2014, Amendment No. 8 thereof on October 3, 2014, Amendment No. 9 thereof on October 29, 2015, Amendment No. 10 thereof on February 23, 2017, and Amendment No. 11 thereof on September 7, 2017; Amendment No. 12 on December 21, 2017 and

WHEREAS, the Board of Directors and the stockholders of the Corporation have determined that it is in the best interest of the Corporation to amend the Plan as set forth in this Amendment No. 13.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 9,147,762 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: June 22, 2018

APPROVED BY STOCKHOLDERS: June 27, 2018

AMENDMENT NO. 14 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Axcella Health Inc. (f/k/a Pronutria Biosciences, Inc., Pronutria, Inc. and Essentient, Inc., the “Company”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Company on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 thereof on June 18, 2014, Amendment No. 8 thereof on October 3, 2014, Amendment No. 9 thereof on October 29, 2015, Amendment No. 10 thereof on February 23, 2017, and Amendment No. 11 thereof on September 7, 2017; Amendment No. 12 on December 21, 2017, Amendment No. 13 on June 22, 2018 and

WHEREAS, the Board of Directors and the stockholders of the Company have determined that it is in the best interest of the Company to amend the Plan as set forth in this Amendment No. 14.

NOW, THEREFORE, the Plan is amended as follows:

1. Amendment of the Plan

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 9,587,762 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. Miscellaneous.

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: October 2, 2018

APPROVED BY STOCKHOLDERS: October 24, 2018

AMENDMENT NO. 15 TO

2010 STOCK OPTION AND GRANT PLAN

WHEREAS, the Board of Directors and the stockholders of Axcella Health Inc. (f/k/a Pronutria Biosciences, Inc., Pronutria, Inc. and Essentient, Inc., the “Company”) approved and adopted the 2010 Stock Option and Grant Plan (the “Plan”) of the Company on December 23, 2010, and approved Amendment No.1 thereof on April 8, 2011, Amendment No. 2 thereof on March 2, 2012, Amendment No. 3 thereof on November 6, 2012, Amendment No. 4 thereof on June 26, 2013, Amendment No. 5 thereof on October 2, 2013, Amendment No. 6 thereof on March 7, 2014, Amendment No. 7 thereof on June 18, 2014, Amendment No. 8 thereof on October 3, 2014, Amendment No. 9 thereof on October 29, 2015, Amendment No. 10 thereof on February 23, 2017, and Amendment No. 11 thereof on September 7, 2017; Amendment No. 12 on December 21, 2017, Amendment No. 13 on June 22, 2018, Amendment No. 14 on October 24, 2018 and

WHEREAS, the Board of Directors and the stockholders of the Company have determined that it is in the best interest of the Company to amend the Plan as set forth in this Amendment No. 15.

NOW, THEREFORE, the Plan is amended as follows:

1. **Amendment of the Plan**

1.01. Section 3(a) of the Plan is hereby amended and restated in its entirety to read as follows:

“The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 11,087,762 shares, subject to adjustment as provided in Section 3(b). For purposes of this limitation, the shares of Stock underlying any Awards that are forfeited, canceled, withheld upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise), in each case shall be added back to the shares of Stock available for issuance under the Plan. Subject to such overall limitations, shares of Stock may be issued up to such maximum number pursuant to any type or types of Award. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.”

2. **Miscellaneous.**

2.01. Effect. Except as amended hereby, the Plan shall remain in full force and effect.

2.02. Defined Terms. All capitalized terms used but not specifically defined herein shall have the same meanings given such terms in the Plan unless the context clearly indicates or dictates a contrary meaning.

2.03. Governing Law. This Agreement shall be governed by and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, without regard to its principles of conflicts of laws that would result in the application of any law other than the law of the Commonwealth of Massachusetts.

ADOPTED BY BOARD OF DIRECTORS: March 11, 2019

APPROVED BY STOCKHOLDERS: March 11, 2019

AXCELLA HEALTH INC.

2019 STOCK OPTION AND INCENTIVE PLAN

SECTION 1. GENERAL PURPOSE OF THE PLAN; DEFINITIONS

The name of the plan is the Axcella Health Inc. 2019 Stock Option and Incentive Plan (the “Plan”). The purpose of the Plan is to encourage and enable the officers, employees, Non-Employee Directors and Consultants of Axcella Health Inc. (the “Company”) and its Affiliates upon whose judgment, initiative and efforts the Company largely depends for the successful conduct of its businesses to acquire a proprietary interest in the Company. It is anticipated that providing such persons with a direct stake in the Company’s welfare will assure a closer identification of their interests with those of the Company and its stockholders, thereby stimulating their efforts on the Company’s behalf and strengthening their desire to remain with the Company.

The following terms shall be defined as set forth below:

“Act” means the Securities Act of 1933, as amended, and the rules and regulations thereunder.

“Administrator” means either the Board or the compensation committee of the Board or a similar committee performing the functions of the compensation committee and which is comprised of not less than two Non-Employee Directors who are independent.

“Affiliate” means, at the time of determination, any “parent” or “subsidiary” of the Company as such terms are defined in Rule 405 of the Act. The Board will have the authority to determine the time or times at which “parent” or “subsidiary” status is determined within the foregoing definition.

“Award” or “Awards,” except where referring to a particular category of grant under the Plan, shall include Incentive Stock Options, Non-Qualified Stock Options, Stock Appreciation Rights, Restricted Stock Awards, Restricted Stock Units, Unrestricted Stock Awards, Cash-Based Awards, and Dividend Equivalent Rights.

“Award Certificate” means a written or electronic document setting forth the terms and provisions applicable to an Award granted under the Plan. Each Award Certificate is subject to the terms and conditions of the Plan.

“Board” means the Board of Directors of the Company.

“Cash-Based Award” means an Award entitling the recipient to receive a cash-denominated payment.

“Code” means the Internal Revenue Code of 1986, as amended, and any successor Code, and related rules, regulations and interpretations.

“Consultant” means a consultant or adviser who provides *bona fide* services to the Company or an Affiliate as an independent contractor and who qualifies as a consultant or advisor under Instruction A.1.(a)(1) of Form S-8 under the Act.

“Dividend Equivalent Right” means an Award entitling the grantee to receive credits based on cash dividends that would have been paid on the shares of Stock specified in the Dividend Equivalent Right (or other award to which it relates) if such shares had been issued to and held by the grantee.

“Effective Date” means the date on which the Plan becomes effective as set forth in Section 19.

“Exchange Act” means the Securities Exchange Act of 1934, as amended, and the rules and regulations thereunder.

“Fair Market Value” of the Stock on any given date means the fair market value of the Stock determined in good faith by the Administrator; provided, however, that if the Stock is listed on the National Association of Securities Dealers Automated Quotation System (“Nasdaq”), Nasdaq Global Market, The New York Stock Exchange or another national securities exchange or traded on any established market, the determination shall be made by reference to the closing sales price. If there is no closing sales price for such date, the determination shall be made by reference to the last date preceding such date for which there is a closing sales price; provided further, however, that if the date for which Fair Market Value is determined is the Registration Date, the Fair Market Value shall be the “Price to the Public” (or equivalent) set forth on the cover page for the final prospectus relating to the Company’s initial public offering.

“Incentive Stock Option” means any Stock Option designated and qualified as an “incentive stock option” as defined in Section 422 of the Code.

“Non-Employee Director” means a member of the Board who is not also an employee of the Company or any Subsidiary.

“Non-Qualified Stock Option” means any Stock Option that is not an Incentive Stock Option.

“Option” or “Stock Option” means any option to purchase shares of Stock granted pursuant to Section 5.

“Registration Date” means the date upon which the registration statement on Form S-1 that is filed by the Company with respect to its initial public offering is declared effective by the Securities and Exchange Commission.

“Restricted Shares” means the shares of Stock underlying a Restricted Stock Award that remain subject to a risk of forfeiture or the Company’s right of repurchase.

“Restricted Stock Award” means an Award of Restricted Shares subject to such restrictions and conditions as the Administrator may determine at the time of grant.

“Restricted Stock Units” means an Award of stock units subject to such restrictions and conditions as the Administrator may determine at the time of grant.

“Sale Event” means (i) the sale of all or substantially all of the assets of the Company on a consolidated basis to an unrelated person or entity, (ii) a merger, reorganization or consolidation pursuant to which the holders of the Company’s outstanding voting power and outstanding stock immediately prior to such transaction do not own a majority of the outstanding voting power and outstanding stock or other equity interests of the resulting or successor entity (or its ultimate parent, if applicable) immediately upon completion of such transaction, (iii) the sale of all of the Stock of the Company to an unrelated person, entity or group thereof acting in concert, or (iv) any other transaction in which the owners of the Company’s outstanding voting power immediately prior to such transaction do not own at least a majority of the outstanding voting power of the Company or any successor entity immediately upon completion of the transaction other than as a result of the acquisition of securities directly from the Company.

“Sale Price” means the value as determined by the Administrator of the consideration payable, or otherwise to be received by stockholders, per share of Stock pursuant to a Sale Event.

“Section 409A” means Section 409A of the Code and the regulations and other guidance promulgated thereunder.

“Service Relationship” means any relationship as an employee, director or Consultant of the Company or any Affiliate (e.g., a Service Relationship shall be deemed to continue without interruption in the event an individual’s status changes from full-time employee to part-time employee or Consultant).

“Stock” means the Common Stock, par value \$0.001 per share, of the Company, subject to adjustments pursuant to Section 3.

“Stock Appreciation Right” means an Award entitling the recipient to receive shares of Stock (or cash, to the extent explicitly provided for in the applicable Award Certificate) having a value equal to the excess of the Fair Market Value of the Stock on the date of exercise over the exercise price of the Stock Appreciation Right multiplied by the number of shares of Stock with respect to which the Stock Appreciation Right shall have been exercised.

“Subsidiary” means any corporation or other entity (other than the Company) in which the Company has at least a 50 percent interest, either directly or indirectly.

“Ten Percent Owner” means an employee who owns or is deemed to own (by reason of the attribution rules of Section 424(d) of the Code) more than 10 percent of the combined voting power of all classes of stock of the Company or any parent or subsidiary corporation.

“Unrestricted Stock Award” means an Award of shares of Stock free of any restrictions.

SECTION 2. ADMINISTRATION OF PLAN; ADMINISTRATOR AUTHORITY TO SELECT GRANTEES AND DETERMINE AWARDS

(a) Administration of Plan. The Plan shall be administered by the Administrator.

(b) Powers of Administrator. The Administrator shall have the power and authority to grant Awards consistent with the terms of the Plan, including the power and authority:

(i) to select the individuals to whom Awards may from time to time be granted;

(ii) to determine the time or times of grant, and the extent, if any, of Incentive Stock Options, Non-Qualified Stock Options, Stock Appreciation Rights, Restricted Stock Awards, Restricted Stock Units, Unrestricted Stock Awards, Cash-Based Awards, and Dividend Equivalent Rights, or any combination of the foregoing, granted to any one or more grantees;

(iii) to determine the number of shares of Stock to be covered by any Award;

(iv) to determine and modify from time to time the terms and conditions, including restrictions, not inconsistent with the terms of the Plan, of any Award, which terms and conditions may differ among individual Awards and grantees, and to approve the forms of Award Certificates;

(v) to accelerate at any time the exercisability or vesting of all or any portion of any Award;

(vi) subject to the provisions of Section 5(c), to extend at any time the period in which Stock Options may be exercised; and

(vii) at any time to adopt, alter and repeal such rules, guidelines and practices for administration of the Plan and for its own acts and proceedings as it shall deem advisable; to interpret the terms and provisions of the Plan and any Award (including related written instruments); to make all determinations it deems advisable for the administration of the Plan; to decide all disputes arising in connection with the Plan; and to otherwise supervise the administration of the Plan.

All decisions and interpretations of the Administrator shall be binding on all persons, including the Company and Plan grantees.

(c) Delegation of Authority to Grant Awards. Subject to applicable law, the Administrator, in its discretion, may delegate to a committee consisting of one or more officers of the Company including the Chief Executive Officer of the Company all or part of the Administrator's authority and duties with respect to the granting of Awards to individuals who are (i) not subject to the reporting and other provisions of Section 16 of the Exchange Act and (ii) not members of the delegated committee. Any such delegation by the Administrator shall include a limitation as to the amount of Stock underlying Awards that may be granted during the period of the delegation and shall contain guidelines as to the determination of the exercise price and the vesting criteria. The Administrator may revoke or amend the terms of a delegation at

any time but such action shall not invalidate any prior actions of the Administrator's delegate or delegates that were consistent with the terms of the Plan.

(d) Award Certificate. Awards under the Plan shall be evidenced by Award Certificates that set forth the terms, conditions and limitations for each Award which may include, without limitation, the term of an Award and the provisions applicable in the event employment or service terminates.

(e) Indemnification. Neither the Board nor the Administrator, nor any member of either or any delegate thereof, shall be liable for any act, omission, interpretation, construction or determination made in good faith in connection with the Plan, and the members of the Board and the Administrator (and any delegate thereof) shall be entitled in all cases to indemnification and reimbursement by the Company in respect of any claim, loss, damage or expense (including, without limitation, reasonable attorneys' fees) arising or resulting therefrom to the fullest extent permitted by law and/or under the Company's articles or bylaws or any directors' and officers' liability insurance coverage which may be in effect from time to time and/or any indemnification agreement between such individual and the Company.

(f) Foreign Award Recipients. Notwithstanding any provision of the Plan to the contrary, in order to comply with the laws in other countries in which the Company and its Subsidiaries operate or have employees or other individuals eligible for Awards, the Administrator, in its sole discretion, shall have the power and authority to: (i) determine which Subsidiaries shall be covered by the Plan; (ii) determine which individuals outside the United States are eligible to participate in the Plan; (iii) modify the terms and conditions of any Award granted to individuals outside the United States to comply with applicable foreign laws; (iv) establish subplans and modify exercise procedures and other terms and procedures, to the extent the Administrator determines such actions to be necessary or advisable (and such subplans and/or modifications shall be attached to this Plan as appendices); provided, however, that no such subplans and/or modifications shall increase the share limitations contained in Section 3(a) hereof; and (v) take any action, before or after an Award is made, that the Administrator determines to be necessary or advisable to obtain approval or comply with any local governmental regulatory exemptions or approvals. Notwithstanding the foregoing, the Administrator may not take any actions hereunder, and no Awards shall be granted, that would violate the Exchange Act or any other applicable United States securities law, the Code, or any other applicable United States governing statute or law.

SECTION 3. STOCK ISSUABLE UNDER THE PLAN; MERGERS; SUBSTITUTION

(a) Stock Issuable. The maximum number of shares of Stock reserved and available for issuance under the Plan shall be 6,671,662 (the "Initial Limit"), subject to adjustment as provided in Section 3(c), plus on January 1, 2020 and each January 1 thereafter, the number of shares of Stock reserved and available for issuance under the Plan shall be cumulatively increased by four percent of the number of shares of Stock issued and outstanding on the immediately preceding December 31 or such lesser number of shares of Stock as determined by the Administrator (the "Annual Increase"). Subject to such overall limitation, the maximum aggregate number of shares of Stock that may be issued in the form of Incentive Stock Options shall not exceed the Initial Limit cumulatively increased on January 1, 2020 and on each January

1 thereafter by the lesser of the Annual Increase for such year or 6,671,662 shares of Stock, subject in all cases to adjustment as provided in Section 3(c). Shares of Stock underlying any awards under the Plan and under the Company's 2010 Stock Option and Grant Plan that are forfeited, canceled, held back upon exercise of an Option or settlement of an Award to cover the exercise price or tax withholding, reacquired by the Company prior to vesting, satisfied without the issuance of Stock or otherwise terminated (other than by exercise) shall be added back to the shares of Stock available for issuance under the Plan and, to the extent permitted under Section 422 of the Code and the regulations promulgated thereunder, the shares of Stock that may be issued as Incentive Stock Options. In the event the Company repurchases shares of Stock on the open market, such shares shall not be added to the shares of Stock available for issuance under the Plan. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company.

(b) Changes in Stock. Subject to Section 3(d) hereof, if, as a result of any reorganization, recapitalization, reclassification, stock dividend, stock split, reverse stock split or other similar change in the Company's capital stock, the outstanding shares of Stock are increased or decreased or are exchanged for a different number or kind of shares or other securities of the Company, or additional shares or new or different shares or other securities of the Company or other non-cash assets are distributed with respect to such shares of Stock or other securities, or, if, as a result of any merger or consolidation, sale of all or substantially all of the assets of the Company, the outstanding shares of Stock are converted into or exchanged for securities of the Company or any successor entity (or a parent or subsidiary thereof), the Administrator shall make an appropriate or proportionate adjustment in (i) the maximum number of shares reserved for issuance under the Plan, including the maximum number of shares that may be issued in the form of Incentive Stock Options, (ii) the number and kind of shares or other securities subject to any then outstanding Awards under the Plan, (iii) the repurchase price, if any, per share subject to each outstanding Restricted Stock Award, and (iv) the exercise price for each share subject to any then outstanding Stock Options and Stock Appreciation Rights under the Plan, without changing the aggregate exercise price (i.e., the exercise price multiplied by the number of shares subject to Stock Options and Stock Appreciation Rights) as to which such Stock Options and Stock Appreciation Rights remain exercisable. The Administrator shall also make equitable or proportionate adjustments in the number of shares subject to outstanding Awards and the exercise price and the terms of outstanding Awards to take into consideration cash dividends paid other than in the ordinary course or any other extraordinary corporate event. The adjustment by the Administrator shall be final, binding and conclusive. No fractional shares of Stock shall be issued under the Plan resulting from any such adjustment, but the Administrator in its discretion may make a cash payment in lieu of fractional shares.

(c) Mergers and Other Transactions. In the case of and subject to the consummation of a Sale Event, the parties thereto may cause the assumption or continuation of Awards theretofore granted by the successor entity, or the substitution of such Awards with new Awards of the successor entity or parent thereof, with appropriate adjustment as to the number and kind of shares and, if appropriate, the per share exercise prices, as such parties shall agree. To the extent the parties to such Sale Event do not provide for the assumption, continuation or substitution of Awards, upon the effective time of the Sale Event, the Plan and all outstanding Awards granted hereunder shall terminate. In such case, except as may be otherwise provided in the relevant Award Certificate, all Awards with time-based vesting, conditions or restrictions

shall become fully vested and nonforfeitable as of the effective time of the Sale Event, and all Awards with conditions and restrictions relating to the attainment of performance goals may become vested and nonforfeitable in connection with a Sale Event in the Administrator's discretion or to the extent specified in the relevant Award Certificate. In the event of such termination, (i) the Company shall have the option (in its sole discretion) to make or provide for a payment, in cash or in kind, to the grantees holding Options and Stock Appreciation Rights, in exchange for the cancellation thereof, in an amount equal to the difference between (A) the Sale Price multiplied by the number of shares of Stock subject to outstanding Options and Stock Appreciation Rights (to the extent then exercisable at prices not in excess of the Sale Price) and (B) the aggregate exercise price of all such outstanding Options and Stock Appreciation Rights (provided that, in the case of an Option or Stock Appreciation Right with an exercise price equal to or less than the Sale Price, such Option or Stock Appreciation Right shall be cancelled for no consideration); or (ii) each grantee shall be permitted, within a specified period of time prior to the consummation of the Sale Event as determined by the Administrator, to exercise all outstanding Options and Stock Appreciation Rights (to the extent then exercisable) held by such grantee. The Company shall also have the option (in its sole discretion) to make or provide for a payment, in cash or in kind, to the grantees holding other Awards in an amount equal to the Sale Price multiplied by the number of vested shares of Stock under such Awards.

SECTION 4. ELIGIBILITY

Grantees under the Plan will be such employees, Non-Employee Directors and Consultants of the Company and its Affiliates as are selected from time to time by the Administrator in its sole discretion; provided that Awards may not be granted to employees, Directors or Consultants who are providing services only to any "parent" of the Company, as such term is defined in Rule 405 of the Act, unless (i) the stock underlying the Awards is treated as "service recipient stock" under Section 409A or (ii) the Company, in consultation with its legal counsel, has determined that such Awards are exempt from or otherwise comply with Section 409A.

SECTION 5. STOCK OPTIONS

(a) Award of Stock Options. The Administrator may grant Stock Options under the Plan. Any Stock Option granted under the Plan shall be in such form as the Administrator may from time to time approve.

Stock Options granted under the Plan may be either Incentive Stock Options or Non-Qualified Stock Options. Incentive Stock Options may be granted only to employees of the Company or any Subsidiary that is a "subsidiary corporation" within the meaning of Section 424(f) of the Code. To the extent that any Option does not qualify as an Incentive Stock Option, it shall be deemed a Non-Qualified Stock Option.

Stock Options granted pursuant to this Section 5 shall be subject to the following terms and conditions and shall contain such additional terms and conditions, not inconsistent with the terms of the Plan, as the Administrator shall deem desirable. If the Administrator so determines, Stock Options may be granted in lieu of cash compensation at the optionee's election, subject to such terms and conditions as the Administrator may establish.

(b) Exercise Price. The exercise price per share for the Stock covered by a Stock Option granted pursuant to this Section 5 shall be determined by the Administrator at the time of grant but shall not be less than 100 percent of the Fair Market Value on the date of grant. In the case of an Incentive Stock Option that is granted to a Ten Percent Owner, the exercise price of such Incentive Stock Option shall be not less than 110 percent of the Fair Market Value on the grant date. Notwithstanding the foregoing, Stock Options may be granted with an exercise price per share that is less than 100 percent of the Fair Market Value on the date of grant (i) pursuant to a transaction described in, and in a manner consistent with, Section 424(a) of the Code.

(c) Option Term. The term of each Stock Option shall be fixed by the Administrator, but no Stock Option shall be exercisable more than ten years after the date the Stock Option is granted. In the case of an Incentive Stock Option that is granted to a Ten Percent Owner, the term of such Stock Option shall be no more than five years from the date of grant.

(d) Exercisability; Rights of a Stockholder. Stock Options shall become exercisable at such time or times, whether or not in installments, as shall be determined by the Administrator at or after the grant date. The Administrator may at any time accelerate the exercisability of all or any portion of any Stock Option. An optionee shall have the rights of a stockholder only as to shares acquired upon the exercise of a Stock Option and not as to unexercised Stock Options.

(e) Method of Exercise. Stock Options may be exercised in whole or in part, by giving written or electronic notice of exercise to the Company, specifying the number of shares to be purchased. Payment of the purchase price may be made by one or more of the following methods except to the extent otherwise provided in the Option Award Certificate:

(i) In cash, by certified or bank check or other instrument acceptable to the Administrator;

(ii) Through the delivery (or attestation to the ownership following such procedures as the Company may prescribe) of shares of Stock that are not then subject to restrictions under any Company plan. Such surrendered shares shall be valued at Fair Market Value on the exercise date;

(iii) By the optionee delivering to the Company a properly executed exercise notice together with irrevocable instructions to a broker to promptly deliver to the Company cash or a check payable and acceptable to the Company for the purchase price; provided that in the event the optionee chooses to pay the purchase price as so provided, the optionee and the broker shall comply with such procedures and enter into such agreements of indemnity and other agreements as the Company shall prescribe as a condition of such payment procedure; or

(iv) With respect to Stock Options that are not Incentive Stock Options, by a “net exercise” arrangement pursuant to which the Company will reduce the number of shares of Stock issuable upon exercise by the largest whole number of shares with a Fair Market Value that does not exceed the aggregate exercise price.

Payment instruments will be received subject to collection. The transfer to the optionee on the records of the Company or of the transfer agent of the shares of Stock to be purchased pursuant to the exercise of a Stock Option will be contingent upon receipt from the optionee (or a

8

purchaser acting in his stead in accordance with the provisions of the Stock Option) by the Company of the full purchase price for such shares and the fulfillment of any other requirements contained in the Option Award Certificate or applicable provisions of laws (including the satisfaction of any withholding taxes that the Company is obligated to withhold with respect to the optionee). In the event an optionee chooses to pay the purchase price by previously-owned shares of Stock through the attestation method, the number of shares of Stock transferred to the optionee upon the exercise of the Stock Option shall be net of the number of attested shares. In the event that the Company establishes, for itself or using the services of a third party, an automated system for the exercise of Stock Options, such as a system using an internet website or interactive voice response, then the paperless exercise of Stock Options may be permitted through the use of such an automated system.

(f) Annual Limit on Incentive Stock Options. To the extent required for “incentive stock option” treatment under Section 422 of the Code, the aggregate Fair Market Value (determined as of the time of grant) of the shares of Stock with respect to which Incentive Stock Options granted under this Plan and any other plan of the Company or its parent and subsidiary corporations become exercisable for the first time by an optionee during any calendar year shall not exceed \$100,000. To the extent that any Stock Option exceeds this limit, it shall constitute a Non-Qualified Stock Option.

SECTION 6. STOCK APPRECIATION RIGHTS

(a) Award of Stock Appreciation Rights. The Administrator may grant Stock Appreciation Rights under the Plan. A Stock Appreciation Right is an Award entitling the recipient to receive shares of Stock (or cash, to the extent explicitly provided for in the applicable Award Certificate) having a value equal to the excess of the Fair Market Value of a share of Stock on the date of exercise over the exercise price of the Stock Appreciation Right multiplied by the number of shares of Stock with respect to which the Stock Appreciation Right shall have been exercised.

(b) Exercise Price of Stock Appreciation Rights. The exercise price of a Stock Appreciation Right shall not be less than 100 percent of the Fair Market Value of the Stock on the date of grant.

(c) Grant and Exercise of Stock Appreciation Rights. Stock Appreciation Rights may be granted by the Administrator independently of any Stock Option granted pursuant to Section 5 of the Plan.

(d) Terms and Conditions of Stock Appreciation Rights. Stock Appreciation Rights shall be subject to such terms and conditions as shall be determined on the date of grant by the Administrator. The term of a Stock Appreciation Right may not exceed ten years. The terms and conditions of each such Award shall be determined by the Administrator, and such terms and conditions may differ among individual Awards and grantees.

SECTION 7. RESTRICTED STOCK AWARDS

(a) Nature of Restricted Stock Awards. The Administrator may grant Restricted Stock Awards under the Plan. A Restricted Stock Award is any Award of Restricted Shares

subject to such restrictions and conditions as the Administrator may determine at the time of grant. Conditions may be based on continuing employment (or other Service Relationship) and/or achievement of pre-established performance goals and objectives.

(b) Rights as a Stockholder. Upon the grant of the Restricted Stock Award and payment of any applicable purchase price, a grantee shall have the rights of a stockholder with respect to the voting of the Restricted Shares and receipt of dividends; provided that if the lapse of restrictions with respect to the Restricted Stock Award is tied to the attainment of performance goals, any dividends paid by the Company during the performance period shall accrue and shall not be paid to the grantee until and to the extent the performance goals are met with respect to the Restricted Stock Award. Unless the Administrator shall otherwise determine, (i) uncertificated Restricted Shares shall be accompanied by a notation on the records of the Company or the transfer agent to the effect that they are subject to forfeiture until such Restricted Shares are vested as provided in Section 7(d) below, and (ii) certificated Restricted Shares shall remain in the possession of the Company until such Restricted Shares are vested as provided in Section 7(d) below, and the grantee shall be required, as a condition of the grant, to deliver to the Company such instruments of transfer as the Administrator may prescribe.

(c) Restrictions. Restricted Shares may not be sold, assigned, transferred, pledged or otherwise encumbered or disposed of except as specifically provided herein or in the Restricted Stock Award Certificate. Except as may otherwise be provided by the Administrator either in the Award Certificate or, subject to Section 16 below, in writing after the Award is issued, if a grantee's employment (or other Service Relationship) with the Company and its Subsidiaries terminates for any reason, any Restricted Shares that have not vested at the time of termination shall automatically and without any requirement of notice to such grantee from or other action by or on behalf of, the Company be deemed to have been reacquired by the Company at its original purchase price (if any) from such grantee or such grantee's legal representative simultaneously with such termination of employment (or other Service Relationship), and thereafter shall cease to represent any ownership of the Company by the grantee or rights of the grantee as a stockholder. Following such deemed reacquisition of Restricted Shares that are represented by physical certificates, a grantee shall surrender such certificates to the Company upon request without consideration.

(d) Vesting of Restricted Shares. The Administrator at the time of grant shall specify the date or dates and/or the attainment of pre-established performance goals, objectives and other conditions on which the non-transferability of the Restricted Shares and the Company's right of repurchase or forfeiture shall lapse. Subsequent to such date or dates and/or the attainment of such pre-established performance goals, objectives and other conditions, the shares on which all restrictions have lapsed shall no longer be Restricted Shares and shall be deemed "vested."

SECTION 8. RESTRICTED STOCK UNITS

(a) Nature of Restricted Stock Units. The Administrator may grant Restricted Stock Units under the Plan. A Restricted Stock Unit is an Award of stock units that may be settled in shares of Stock (or cash, to the extent explicitly provided for in the Award Certificate) upon the satisfaction of such restrictions and conditions at the time of grant. Conditions may be based on continuing employment (or other Service Relationship) and/or achievement of pre-established

performance goals and objectives. The terms and conditions of each such Award shall be determined by the Administrator, and such terms and conditions may differ among individual Awards and grantees. Except in the case of Restricted Stock Units with a deferred settlement date that complies with Section 409A, at the end of the vesting period, the Restricted Stock Units, to the extent vested, shall be settled in the form of shares of Stock. Restricted Stock Units with deferred settlement dates are subject to Section 409A and shall contain such additional terms and conditions as the Administrator shall determine in its sole discretion in order to comply with the requirements of Section 409A.

(b) Election to Receive Restricted Stock Units in Lieu of Compensation. The Administrator may, in its sole discretion, permit a grantee to elect to receive a portion of future cash compensation otherwise due to such grantee in the form of an award of Restricted Stock Units. Any such election shall be made in writing and shall be delivered to the Company no later than the date specified by the Administrator and in accordance with Section 409A and such other rules and procedures established by the Administrator. Any such future cash compensation that the grantee elects to defer shall be converted to a fixed number of Restricted Stock Units based on the Fair Market Value of Stock on the date the compensation would otherwise have been paid to the grantee if such payment had not been deferred as provided herein. The Administrator shall have the sole right to determine whether and under what circumstances to permit such elections and to impose such limitations and other terms and conditions thereon as the Administrator deems appropriate. Any Restricted Stock Units that are elected to be received in lieu of cash compensation shall be fully vested, unless otherwise provided in the Award Certificate.

(c) Rights as a Stockholder. A grantee shall have the rights as a stockholder only as to shares of Stock acquired by the grantee upon settlement of Restricted Stock Units; provided, however, that the grantee may be credited with Dividend Equivalent Rights with respect to the stock units underlying his Restricted Stock Units, subject to the provisions of Section 11 and such terms and conditions as the Administrator may determine.

(d) Termination. Except as may otherwise be provided by the Administrator either in the Award Certificate or, subject to Section 16 below, in writing after the Award is issued, a grantee's right in all Restricted Stock Units that have not vested shall automatically terminate upon the grantee's termination of employment (or cessation of Service Relationship) with the Company and its Subsidiaries for any reason.

SECTION 9. UNRESTRICTED STOCK AWARDS

Grant or Sale of Unrestricted Stock. The Administrator may grant (or sell at par value or such higher purchase price determined by the Administrator) an Unrestricted Stock Award under the Plan. An Unrestricted Stock Award is an Award pursuant to which the grantee may receive shares of Stock free of any restrictions under the Plan. Unrestricted Stock Awards may be granted in respect of past services or other valid consideration, or in lieu of cash compensation due to such grantee.

SECTION 10. CASH-BASED AWARDS

Grant of Cash-Based Awards. The Administrator may grant Cash-Based Awards under the Plan. A Cash-Based Award is an Award that entitles the grantee to a payment in cash upon the attainment of specified performance goals. The Administrator shall determine the maximum duration of the Cash-Based Award, the amount of cash to which the Cash-Based Award pertains, the conditions upon which the Cash-Based Award shall become vested or payable, and such other provisions as the Administrator shall determine. Each Cash-Based Award shall specify a cash-denominated payment amount, formula or payment ranges as determined by the Administrator. Payment, if any, with respect to a Cash-Based Award shall be made in accordance with the terms of the Award and may be made in cash.

SECTION 11. DIVIDEND EQUIVALENT RIGHTS

(a) Dividend Equivalent Rights. The Administrator may grant Dividend Equivalent Rights under the Plan. A Dividend Equivalent Right is an Award entitling the grantee to receive credits based on cash dividends that would have been paid on the shares of Stock specified in the Dividend Equivalent Right (or other Award to which it relates) if such shares had been issued to the grantee. A Dividend Equivalent Right may be granted hereunder to any grantee as a component of an award of Restricted Stock Units or as a freestanding award. The terms and conditions of Dividend Equivalent Rights shall be specified in the Award Certificate. Dividend equivalents credited to the holder of a Dividend Equivalent Right may be paid currently or may be deemed to be reinvested in additional shares of Stock, which may thereafter accrue additional equivalents. Any such reinvestment shall be at Fair Market Value on the date of reinvestment or such other price as may then apply under a dividend reinvestment plan sponsored by the Company, if any. Dividend Equivalent Rights may be settled in cash or shares of Stock or a combination thereof, in a single installment or installments. A Dividend Equivalent Right granted as a component of an Award of Restricted Stock Units shall provide that such Dividend Equivalent Right shall be settled only upon settlement or payment of, or lapse of restrictions on, such other Award, and that such Dividend Equivalent Right shall expire or be forfeited or annulled under the same conditions as such other Award.

(b) Termination. Except as may otherwise be provided by the Administrator either in the Award Certificate or, subject to Section 16 below, in writing after the Award is issued, a grantee's rights in all Dividend Equivalent Rights shall automatically terminate upon the grantee's termination of employment (or cessation of Service Relationship) with the Company and its Subsidiaries for any reason.

SECTION 12. TRANSFERABILITY OF AWARDS

(a) Transferability. Except as provided in Section 12(b) below, during a grantee's lifetime, his or her Awards shall be exercisable only by the grantee, or by the grantee's legal representative or guardian in the event of the grantee's incapacity. No Awards shall be sold, assigned, transferred or otherwise encumbered or disposed of by a grantee other than by will or by the laws of descent and distribution or pursuant to a domestic relations order. No Awards shall be subject, in whole or in part, to attachment, execution, or levy of any kind, and any purported transfer in violation hereof shall be null and void.

(b) Administrator Action. Notwithstanding Section 12(a), the Administrator, in its discretion, may provide either in the Award Certificate regarding a given Award or by subsequent written approval that the grantee (who is an employee or director) may transfer his or her Non-Qualified Stock Options to his or her immediate family members, to trusts for the benefit of such family members, or to partnerships in which such family members are the only partners, provided that the transferee agrees in writing with the Company to be bound by all of the terms and conditions of this Plan and the applicable Award. In no event may an Award be transferred by a grantee for value.

(c) Family Member. For purposes of Section 12(b), “family member” shall mean a grantee’s child, stepchild, grandchild, parent, stepparent, grandparent, spouse, former spouse, sibling, niece, nephew, mother-in-law, father-in-law, son-in-law, daughter-in-law, brother-in-law, or sister-in-law, including adoptive relationships, any person sharing the grantee’s household (other than a tenant of the grantee), a trust in which these persons (or the grantee) have more than 50 percent of the beneficial interest, a foundation in which these persons (or the grantee) control the management of assets, and any other entity in which these persons (or the grantee) own more than 50 percent of the voting interests.

(d) Designation of Beneficiary. To the extent permitted by the Company, each grantee to whom an Award has been made under the Plan may designate a beneficiary or beneficiaries to exercise any Award or receive any payment under any Award payable on or after the grantee’s death. Any such designation shall be on a form provided for that purpose by the Administrator and shall not be effective until received by the Administrator. If no beneficiary has been designated by a deceased grantee, or if the designated beneficiaries have predeceased the grantee, the beneficiary shall be the grantee’s estate.

SECTION 13. TAX WITHHOLDING

(a) Payment by Grantee. Each grantee shall, no later than the date as of which the value of an Award or of any Stock or other amounts received thereunder first becomes includable in the gross income of the grantee for Federal income tax purposes, pay to the Company, or make arrangements satisfactory to the Administrator regarding payment of, any Federal, state, or local taxes of any kind required by law to be withheld by the Company with respect to such income. The Company and its Subsidiaries shall, to the extent permitted by law, have the right to deduct any such taxes from any payment of any kind otherwise due to the grantee. The Company’s obligation to deliver evidence of book entry (or stock certificates) to any grantee is subject to and conditioned on tax withholding obligations being satisfied by the grantee.

(b) Payment in Stock. Subject to approval by the Administrator, a grantee may elect to have the Company’s required tax withholding obligation satisfied, in whole or in part, by authorizing the Company to withhold from shares of Stock to be issued pursuant to any Award a number of shares with an aggregate Fair Market Value (as of the date the withholding is effected) that would satisfy the withholding amount due; provided, however, that the amount withheld does not exceed the maximum statutory tax rate or such lesser amount as is necessary to avoid liability accounting treatment. The Administrator may also require Awards to be subject to mandatory share withholding up to the required withholding amount. For purposes of share

withholding, the Fair Market Value of withheld shares shall be determined in the same manner as the value of Stock includible in income of the Participants. The required tax withholding obligation may also be satisfied, in whole or in part, by an arrangement whereby a certain number of shares of Stock issued pursuant to any Award are immediately sold and proceeds from such sale are remitted to the Company in an amount that would satisfy the withholding amount due.

SECTION 14. SECTION 409A AWARDS

To the extent that any Award is determined to constitute “nonqualified deferred compensation” within the meaning of Section 409A (a “409A Award”), the Award shall be subject to such additional rules and requirements as specified by the Administrator from time to time in order to comply with Section 409A. In this regard, if any amount under a 409A Award is payable upon a “separation from service” (within the meaning of Section 409A) to a grantee who is then considered a “specified employee” (within the meaning of Section 409A), then no such payment shall be made prior to the date that is the earlier of (i) six months and one day after the grantee’s separation from service, or (ii) the grantee’s death, but only to the extent such delay is necessary to prevent such payment from being subject to interest, penalties and/or additional tax imposed pursuant to Section 409A. Further, the settlement of any 409A Award may not be accelerated except to the extent permitted by Section 409A.

SECTION 15. TERMINATION OF SERVICE RELATIONSHIP, TRANSFER, LEAVE OF ABSENCE, ETC.

(a) Termination of Service Relationship. If the grantee’s Service Relationship is with an Affiliate and such Affiliate ceases to be an Affiliate, the grantee shall be deemed to have terminated his or her Service Relationship for purposes of the Plan.

(b) For purposes of the Plan, the following events shall not be deemed a termination of employment:

(i) a transfer to the employment of the Company from an Affiliate or from the Company to an Affiliate, or from one Affiliate to another; or

(ii) an approved leave of absence for military service or sickness, or for any other purpose approved by the Company, if the employee’s right to re-employment is guaranteed either by a statute or by contract or under the policy pursuant to which the leave of absence was granted or if the Administrator otherwise so provides in writing.

SECTION 16. AMENDMENTS AND TERMINATION

The Board may, at any time, amend or discontinue the Plan and the Administrator may, at any time, amend or cancel any outstanding Award for the purpose of satisfying changes in law or for any other lawful purpose, but no such action shall adversely affect rights under any outstanding Award without the holder’s consent. Except as provided in Section 3(c) or 3(d), without prior stockholder approval, in no event may the Administrator exercise its discretion to reduce the exercise price of outstanding Stock Options or Stock Appreciation Rights or effect repricing through cancellation and re-grants or cancellation of Stock Options or Stock

Appreciation Rights in exchange for cash or other Awards. To the extent required under the rules of any securities exchange or market system on which the Stock is listed, to the extent determined by the Administrator to be required by the Code to ensure that Incentive Stock Options granted under the Plan are qualified under Section 422 of the Code, Plan amendments shall be subject to approval by the Company stockholders entitled to vote at a meeting of stockholders. Nothing in this Section 16 shall limit the Administrator's authority to take any action permitted pursuant to Section 3(c) or 3(d).

SECTION 17. STATUS OF PLAN

With respect to the portion of any Award that has not been exercised and any payments in cash, Stock or other consideration not received by a grantee, a grantee shall have no rights greater than those of a general creditor of the Company unless the Administrator shall otherwise expressly determine in connection with any Award or Awards. In its sole discretion, the Administrator may authorize the creation of trusts or other arrangements to meet the Company's obligations to deliver Stock or make payments with respect to Awards hereunder, provided that the existence of such trusts or other arrangements is consistent with the foregoing sentence.

SECTION 18. GENERAL PROVISIONS

(a) No Distribution. The Administrator may require each person acquiring Stock pursuant to an Award to represent to and agree with the Company in writing that such person is acquiring the shares without a view to distribution thereof.

(b) Issuance of Stock. To the extent certificated, stock certificates to grantees under this Plan shall be deemed delivered for all purposes when the Company or a stock transfer agent of the Company shall have mailed such certificates in the United States mail, addressed to the grantee, at the grantee's last known address on file with the Company. Uncertificated Stock shall be deemed delivered for all purposes when the Company or a Stock transfer agent of the Company shall have given to the grantee by electronic mail (with proof of receipt) or by United States mail, addressed to the grantee, at the grantee's last known address on file with the Company, notice of issuance and recorded the issuance in its records (which may include electronic "book entry" records). Notwithstanding anything herein to the contrary, the Company shall not be required to issue or deliver any evidence of book entry or certificates evidencing shares of Stock pursuant to the exercise or settlement of any Award, unless and until the Administrator has determined, with advice of counsel (to the extent the Administrator deems such advice necessary or advisable), that the issuance and delivery is in compliance with all applicable laws, regulations of governmental authorities and, if applicable, the requirements of any exchange on which the shares of Stock are listed, quoted or traded. Any Stock issued pursuant to the Plan shall be subject to any stop-transfer orders and other restrictions as the Administrator deems necessary or advisable to comply with federal, state or foreign jurisdiction, securities or other laws, rules and quotation system on which the Stock is listed, quoted or traded. The Administrator may place legends on any Stock certificate or notations on any book entry to reference restrictions applicable to the Stock. In addition to the terms and conditions provided herein, the Administrator may require that an individual make such reasonable covenants, agreements, and representations as the Administrator, in its discretion, deems necessary or advisable in order to comply with any such laws, regulations, or requirements. The

Administrator shall have the right to require any individual to comply with any timing or other restrictions with respect to the settlement or exercise of any Award, including a window-period limitation, as may be imposed in the discretion of the Administrator.

(c) Stockholder Rights. Until Stock is deemed delivered in accordance with Section 18(b), no right to vote or receive dividends or any other rights of a stockholder will exist with respect to shares of Stock to be issued in connection with an Award, notwithstanding the exercise of a Stock Option or any other action by the grantee with respect to an Award.

(d) Other Compensation Arrangements; No Employment Rights. Nothing contained in this Plan shall prevent the Board from adopting other or additional compensation arrangements, including trusts, and such arrangements may be either generally applicable or applicable only in specific cases. The adoption of this Plan and the grant of Awards do not confer upon any employee any right to continued employment with the Company or any Subsidiary.

(e) Trading Policy Restrictions. Option exercises and other Awards under the Plan shall be subject to the Company's insider trading policies and procedures, as in effect from time to time.

(f) Clawback Policy. Awards under the Plan shall be subject to the Company's clawback policy, as in effect from time to time.

SECTION 19. EFFECTIVE DATE OF PLAN

This Plan shall become effective upon the date immediately preceding the Registration Date following stockholder approval in accordance with applicable state law, the Company's bylaws and articles of incorporation, and applicable stock exchange rules. No grants of Stock Options and other Awards may be made hereunder after the tenth anniversary of the Effective Date and no grants of Incentive Stock Options may be made hereunder after the tenth anniversary of the date the Plan is approved by the Board.

SECTION 20. GOVERNING LAW

This Plan and all Awards and actions taken thereunder shall be governed by, and construed in accordance with the General Corporation Law of the State of Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, applied without regard to conflict of law principles.

DATE APPROVED BY BOARD OF DIRECTORS: April 29, 2019

DATE APPROVED BY STOCKHOLDERS: April 29, 2019

16

INCENTIVE STOCK OPTION AGREEMENT UNDER THE AXCELLA HEALTH INC. 2019 STOCK OPTION AND INCENTIVE PLAN

Name of Optionee:

No. of Option Shares:

Option Exercise Price per Share: \$

Grant Date:

Expiration Date:

Pursuant to the Axcella Health Inc. 2019 Stock Option and Incentive Plan as amended through the date hereof (the "Plan"), Axcella Health Inc. (the "Company") hereby grants to the Optionee named above an option (the "Stock Option") to purchase on or prior to the Expiration Date specified above all or part of the number of shares of Common Stock, par value \$0.001 per share (the "Stock"), of the Company specified above at the Option Exercise Price per Share specified above subject to the terms and conditions set forth herein and in the Plan.

1. Exercisability Schedule. No portion of this Stock Option may be exercised until such portion shall have become exercisable. Except as set forth below, and subject to the discretion of the Administrator (as defined in Section 2 of the Plan) to accelerate the exercisability schedule hereunder, this Stock Option shall be exercisable with respect to the following number of Option Shares on the dates indicated so long as the Optionee remains in continued service of the Company or a Subsidiary on such dates:

Incremental Number of Option Shares Exercisable*	Exercisability Date
()%	
()%	
()%	
()%	
()%	

* Max. of \$100,000 per yr.

Once exercisable, this Stock Option shall continue to be exercisable at any time or times prior to the close of business on the Expiration Date, subject to the provisions hereof and of the Plan.

2. Manner of Exercise.

(a) The Optionee may exercise this Stock Option only in the following manner: from time to time on or prior to the Expiration Date of this Stock Option, the Optionee may give written notice to the Administrator of his or her election to purchase some or all of the Option Shares purchasable at the time of such notice. This notice shall specify the number of Option Shares to be purchased.

Payment of the purchase price for the Option Shares may be made by one or more of the following methods: (i) in cash, by certified or bank check or other instrument acceptable to the Administrator; (ii) through the delivery (or attestation to the ownership) of shares of Stock that have been purchased by the Optionee on the open market or that are beneficially owned by the Optionee and are not then subject to any restrictions under any Company plan and that otherwise satisfy any holding periods as may be required by the Administrator; or (iii) by the Optionee delivering to the Company a properly executed exercise notice together with irrevocable instructions to a broker to promptly deliver to the Company cash or a check payable and acceptable to the Company to pay the option purchase price, provided that in the event the Optionee chooses to pay the option purchase price as so provided, the Optionee and the broker shall comply with such procedures and enter into such agreements of indemnity and other agreements as the Administrator shall prescribe as a condition of such payment procedure; or (iv) a combination of (i), (ii) and (iii) above. Payment instruments will be received subject to collection.

The transfer to the Optionee on the records of the Company or of the transfer agent of the Option Shares will be contingent upon (i) the Company's receipt from the Optionee of the full purchase price for the Option Shares, as set forth above, (ii) the fulfillment of any other requirements contained herein or in the Plan or in any other agreement or provision of laws, and (iii) the receipt by the Company of any agreement, statement or other evidence that the Company may require to satisfy itself that the issuance of Stock to be purchased pursuant to the exercise of Stock Options under the Plan and any subsequent resale of the shares of Stock will be in compliance with applicable laws and regulations. In the event the Optionee chooses to pay the purchase price by previously-owned shares of Stock through the attestation method, the number of shares of Stock transferred to the Optionee upon the exercise of the Stock Option shall be net of the Shares attested to.

(b) The shares of Stock purchased upon exercise of this Stock Option shall be transferred to the Optionee on the records of the Company or of the transfer agent upon compliance to the satisfaction of the Administrator with all requirements under applicable laws or regulations in connection with such transfer and with the requirements hereof and of the Plan. The determination of the Administrator as to such compliance shall be final and binding on the Optionee. The Optionee shall not be deemed to be the holder of, or to have any of the rights of a holder with respect to, any shares of Stock subject to this Stock Option unless and until this Stock Option shall have been exercised pursuant to the terms hereof, the Company or the transfer agent shall have transferred the shares to the Optionee, and the Optionee's name shall have been entered as the stockholder of record on the books of the Company. Thereupon, the Optionee shall have full voting, dividend and other ownership rights with respect to such shares of Stock.

(c) The minimum number of shares with respect to which this Stock Option may be exercised at any one time shall be 100 shares, unless the number of shares with respect to which this Stock Option is being exercised is the total number of shares subject to exercise under this Stock Option at the time.

(d) Notwithstanding any other provision hereof or of the Plan, no portion of this Stock Option shall be exercisable after the Expiration Date hereof.

3. Termination of Employment. If the Optionee's employment by the Company or a Subsidiary (as defined in the Plan) is terminated, the period within which to exercise the Stock Option may be subject to earlier termination as set forth below.

(a) Termination Due to Death. If the Optionee's employment terminates by reason of the Optionee's death, any portion of this Stock Option outstanding on such date, to the extent exercisable on the date of death, may thereafter be exercised by the Optionee's legal representative or legatee for a period of 12 months from the date of death or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date of death shall terminate immediately and be of no further force or effect.

(b) Termination Due to Disability. If the Optionee's employment terminates by reason of the Optionee's disability (as determined by the Administrator), any portion of this Stock Option outstanding on such date, to the extent exercisable on the date of such termination of employment, may thereafter be exercised by the Optionee for a period of 12 months from the date of disability or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date of disability shall terminate immediately and be of no further force or effect.

(c) Termination for Cause. If the Optionee's employment terminates for Cause, any portion of this Stock Option outstanding on such date shall terminate immediately and be of no further force and effect. For purposes hereof, "Cause" shall mean, unless otherwise provided in an employment agreement between the Company and the Optionee, a determination by the Administrator that the Optionee shall be dismissed as a result of (i) any material breach by the Optionee of any agreement between the Optionee and the Company; (ii) the conviction of, indictment for or plea of nolo contendere by the Optionee to a felony or a crime involving moral turpitude; or (iii) any material misconduct or willful and deliberate non-performance (other than by reason of disability) by the Optionee of the Optionee's duties to the Company.

(d) Other Termination. If the Optionee's employment terminates for any reason other than the Optionee's death, the Optionee's disability, or Cause, and unless otherwise determined by the Administrator, any portion of this Stock Option outstanding on such date may be exercised, to the extent exercisable on the date of termination, for a period of three months from the date of termination or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date of termination shall terminate immediately and be of no further force or effect.

The Administrator's determination of the reason for termination of the Optionee's employment shall be conclusive and binding on the Optionee and his or her representatives or legatees.

4. **Incorporation of Plan.** Notwithstanding anything herein to the contrary, this Stock Option shall be subject to and governed by all the terms and conditions of the Plan, including the powers of the Administrator set forth in Section 2(b) of the Plan. Capitalized terms in this Agreement shall have the meaning specified in the Plan, unless a different meaning is specified herein.

5. **Transferability.** This Agreement is personal to the Optionee, is non-assignable and is not transferable in any manner, by operation of law or otherwise, other than by will or the laws of descent and distribution. This Stock Option is exercisable, during the Optionee's lifetime, only by the Optionee, and thereafter, only by the Optionee's legal representative or legatee.

6. **Status of the Stock Option.** This Stock Option is intended to qualify as an "incentive stock option" under Section 422 of the Internal Revenue Code of 1986, as amended (the "Code"), but the Company does not represent or warrant that this Stock Option qualifies as such. The Optionee should consult with his or her own tax advisors regarding the tax effects of this Stock Option and the requirements necessary to obtain favorable income tax treatment under Section 422 of the Code, including, but not limited to, holding period requirements. To the extent any portion of this Stock Option does not so qualify as an "incentive stock option," such portion shall be deemed to be a non-qualified stock option. If the Optionee intends to dispose or does dispose (whether by sale, gift, transfer or otherwise) of any Option Shares within the one-year period beginning on the date after the transfer of such shares to him or her, or within the two-year period beginning on the day after the grant of this Stock Option, he or she will so notify the Company within 30 days after such disposition.

7. **Tax Withholding.** The Optionee shall, not later than the date as of which the exercise of this Stock Option becomes a taxable event for Federal income tax purposes, pay to the Company or make arrangements satisfactory to the Administrator for payment of any Federal, state, and local taxes required by law to be withheld on account of such taxable event. The Company shall have the authority to cause the required tax withholding obligation to be satisfied, in whole or in part, by withholding from shares of Stock to be issued to the Optionee a number of shares of Stock with an aggregate Fair Market Value that would satisfy the withholding amount due.

8. **No Obligation to Continue Employment.** Neither the Company nor any Subsidiary is obligated by or as a result of the Plan or this Agreement to continue the Optionee in employment and neither the Plan nor this Agreement shall interfere in any way with the right of the Company or any Subsidiary to terminate the employment of the Optionee at any time.

9. **Integration.** This Agreement constitutes the entire agreement between the parties with respect to this Stock Option and supersedes all prior agreements and discussions between the parties concerning such subject matter.

10. Data Privacy Consent. In order to administer the Plan and this Agreement and to implement or structure future equity grants, the Company, its subsidiaries and affiliates and certain agents thereof (together, the “Relevant Companies”) may process any and all personal or professional data, including but not limited to Social Security or other identification number, home address and telephone number, date of birth and other information that is necessary or desirable for the administration of the Plan and/or this Agreement (the “Relevant Information”). By entering into this Agreement, the Optionee (i) authorizes the Company to collect, process, register and transfer to the Relevant Companies all Relevant Information; (ii) waives any privacy rights the Optionee may have with respect to the Relevant Information; (iii) authorizes the Relevant Companies to store and transmit such information in electronic form; and (iv) authorizes the transfer of the Relevant Information to any jurisdiction in which the Relevant Companies consider appropriate. The Optionee shall have access to, and the right to change, the Relevant Information. Relevant Information will only be used in accordance with applicable law.

11. Notices. Notices hereunder shall be mailed or delivered to the Company at its principal place of business and shall be mailed or delivered to the Optionee at the address on file with the Company or, in either case, at such other address as one party may subsequently furnish to the other party in writing.

AXCELLA HEALTH INC.

By: _____
Title: _____

The foregoing Agreement is hereby accepted and the terms and conditions thereof hereby agreed to by the undersigned. Electronic acceptance of this Agreement pursuant to the Company’s instructions to the Optionee (including through an online acceptance process) is acceptable.

Dated: _____
Optionee’s Signature
Optionee’s name and address:

5

**NON-QUALIFIED STOCK OPTION AGREEMENT
FOR COMPANY EMPLOYEES
UNDER THE AXCELLA HEALTH INC.
2019 STOCK OPTION AND INCENTIVE PLAN**

Name of Optionee:

No. of Option Shares:

Option Exercise Price per Share: \$

Grant Date:

Expiration Date:

Pursuant to the Axcella Health Inc. 2019 Stock Option and Incentive Plan as amended through the date hereof (the “Plan”), Axcella Health Inc. (the “Company”) hereby grants to the Optionee named above an option (the “Stock Option”) to purchase on or prior to the Expiration Date specified above all or part of the number of shares of Common Stock, par value \$0.001 per share (the “Stock”) of the Company specified above at the Option Exercise Price per Share specified above subject to the terms and conditions set forth herein and in the Plan. This Stock Option is not intended to be an “incentive stock option” under Section 422 of the Internal Revenue Code of 1986, as amended.

1. Exercisability Schedule. No portion of this Stock Option may be exercised until such portion shall have become exercisable. Except as set forth below, and subject to the discretion of the Administrator (as defined in Section 2 of the Plan) to accelerate the exercisability schedule hereunder, this Stock Option shall be exercisable with respect to the following number of Option Shares on the dates indicated so long as Optionee remains in continued service of the Company or a Subsidiary on such dates:

Incremental Number of Option Shares Exercisable	Exercisability Date
()%	
()%	
()%	
()%	
()%	

Once exercisable, this Stock Option shall continue to be exercisable at any time or times prior to the close of business on the Expiration Date, subject to the provisions hereof and of the Plan.

2. Manner of Exercise.

(a) The Optionee may exercise this Stock Option only in the following manner: from time to time on or prior to the Expiration Date of this Stock Option, the Optionee may give written notice to the Administrator of his or her election to purchase some or all of the Option Shares purchasable at the time of such notice. This notice shall specify the number of Option Shares to be purchased.

Payment of the purchase price for the Option Shares may be made by one or more of the following methods: (i) in cash, by certified or bank check or other instrument acceptable to the Administrator; (ii) through the delivery (or attestation to the ownership) of shares of Stock that have been purchased by the Optionee on the open market or that are beneficially owned by the Optionee and are not then subject to any restrictions under any Company plan and that otherwise satisfy any holding periods as may be required by the Administrator; (iii) by the Optionee delivering to the Company a properly executed exercise notice together with irrevocable instructions to a broker to promptly deliver to the Company cash or a check payable and acceptable to the Company to pay the option purchase price, provided that in the event the Optionee chooses to pay the option purchase price as so provided, the Optionee and the broker shall comply with such procedures and enter into such agreements of indemnity and other agreements as the Administrator shall prescribe as a condition of such payment procedure; (iv) by a "net exercise" arrangement pursuant to which the Company will reduce the number of shares of Stock issuable upon exercise by the largest whole number of shares with a Fair Market Value that does not exceed the aggregate exercise price; or (v) a combination of (i), (ii), (iii) and (iv) above. Payment instruments will be received subject to collection.

The transfer to the Optionee on the records of the Company or of the transfer agent of the Option Shares will be contingent upon (i) the Company's receipt from the Optionee of the full purchase price for the Option Shares, as set forth above, (ii) the fulfillment of any other requirements contained herein or in the Plan or in any other agreement or provision of laws, and (iii) the receipt by the Company of any agreement, statement or other evidence that the Company may require to satisfy itself that the issuance of Stock to be purchased pursuant to the exercise of Stock Options under the Plan and any subsequent resale of the shares of Stock will be in compliance with applicable laws and regulations. In the event the Optionee chooses to pay the purchase price by previously-owned shares of Stock through the attestation method, the number of shares of Stock transferred to the Optionee upon the exercise of the Stock Option shall be net of the Shares attested to.

(b) The shares of Stock purchased upon exercise of this Stock Option shall be transferred to the Optionee on the records of the Company or of the transfer agent upon compliance to the satisfaction of the Administrator with all requirements under applicable laws or regulations in connection with such transfer and with the requirements hereof and of the Plan. The determination of the Administrator as to such compliance shall be final and binding on the Optionee. The Optionee shall not be deemed to be the holder of, or to have any of the rights of a holder with respect to, any shares of Stock subject to this Stock Option unless and until this Stock Option shall have been exercised pursuant to the terms hereof, the Company or the transfer agent shall have transferred the shares to the Optionee, and the Optionee's name shall have been

entered as the stockholder of record on the books of the Company. Thereupon, the Optionee shall have full voting, dividend and other ownership rights with respect to such shares of Stock.

(c) The minimum number of shares with respect to which this Stock Option may be exercised at any one time shall be 100 shares, unless the number of shares with respect to which this Stock Option is being exercised is the total number of shares subject to exercise under this Stock Option at the time.

(d) Notwithstanding any other provision hereof or of the Plan, no portion of this Stock Option shall be exercisable after the Expiration Date hereof.

3. Termination of Employment. If the Optionee's employment the Company or a Subsidiary (as defined in the Plan) is terminated, the period within which to exercise the Stock Option may be subject to earlier termination as set forth below.

(a) Termination Due to Death. If the Optionee's employment terminates by reason of the Optionee's death, any portion of this Stock Option outstanding on such date, to the extent exercisable on the date of death, may thereafter be exercised by the Optionee's legal representative or legatee for a period of 12 months from the date of death or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date of death shall terminate immediately and be of no further force or effect.

(b) Termination Due to Disability. If the Optionee's employment terminates by reason of the Optionee's disability (as determined by the Administrator), any portion of this Stock Option outstanding on such date, to the extent exercisable on the date of such termination of employment, may thereafter be exercised by the Optionee for a period of 12 months from the date of disability or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date of disability shall terminate immediately and be of no further force or effect.

(c) Termination for Cause. If the Optionee's employment terminates for Cause, any portion of this Stock Option outstanding on such date shall terminate immediately and be of no further force and effect. For purposes hereof, "Cause" shall mean, unless otherwise provided in an employment agreement between the Company and the Optionee, a determination by the Administrator that the Optionee shall be dismissed as a result of (i) any material breach by the Optionee of any agreement between the Optionee and the Company; (ii) the conviction of, indictment for or plea of nolo contendere by the Optionee to a felony or a crime involving moral turpitude; or (iii) any material misconduct or willful and deliberate non-performance (other than by reason of disability) by the Optionee of the Optionee's duties to the Company.

(d) Other Termination. If the Optionee's employment terminates for any reason other than the Optionee's death, the Optionee's disability or Cause, and unless otherwise determined by the Administrator, any portion of this Stock Option outstanding on such date may be exercised, to the extent exercisable on the date of termination, for a period of three months from the date of termination or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date of termination shall terminate immediately and be of no further force or effect.

The Administrator's determination of the reason for termination of the Optionee's employment shall be conclusive and binding on the Optionee and his or her representatives or legatees.

4. **Incorporation of Plan.** Notwithstanding anything herein to the contrary, this Stock Option shall be subject to and governed by all the terms and conditions of the Plan, including the powers of the Administrator set forth in Section 2(b) of the Plan. Capitalized terms in this Agreement shall have the meaning specified in the Plan, unless a different meaning is specified herein.

5. **Transferability.** This Agreement is personal to the Optionee, is non-assignable and is not transferable in any manner, by operation of law or otherwise, other than by will or the laws of descent and distribution. This Stock Option is exercisable, during the Optionee's lifetime, only by the Optionee, and thereafter, only by the Optionee's legal representative or legatee.

6. **Tax Withholding.** The Optionee shall, not later than the date as of which the exercise of this Stock Option becomes a taxable event for Federal income tax purposes, pay to the Company or make arrangements satisfactory to the Administrator for payment of any Federal, state, and local taxes required by law to be withheld on account of such taxable event. The Company shall have the authority to cause the required tax withholding obligation to be satisfied, in whole or in part, by withholding from shares of Stock to be issued to the Optionee a number of shares of Stock with an aggregate Fair Market Value that would satisfy the withholding amount due.

7. **No Obligation to Continue Employment.** Neither the Company nor any Subsidiary is obligated by or as a result of the Plan or this Agreement to continue the Optionee in employment and neither the Plan nor this Agreement shall interfere in any way with the right of the Company or any Subsidiary to terminate the employment of the Optionee at any time.

8. **Integration.** This Agreement constitutes the entire agreement between the parties with respect to this Stock Option and supersedes all prior agreements and discussions between the parties concerning such subject matter.

9. **Data Privacy Consent.** In order to administer the Plan and this Agreement and to implement or structure future equity grants, the Company, its subsidiaries and affiliates and certain agents thereof (together, the "Relevant Companies") may process any and all personal or professional data, including but not limited to Social Security or other identification number, home address and telephone number, date of birth and other information that is necessary or desirable for the administration of the Plan and/or this Agreement (the "Relevant Information"). By entering into this Agreement, the Optionee (i) authorizes the Company to collect, process, register and transfer to the Relevant Companies all Relevant Information; (ii) waives any privacy rights the Optionee may have with respect to the Relevant Information; (iii) authorizes the Relevant Companies to store and transmit such information in electronic form; and (iv) authorizes the transfer of the Relevant Information to any jurisdiction in which the Relevant Companies consider appropriate. The Optionee shall have access to, and the right to change, the

Relevant Information. Relevant Information will only be used in accordance with applicable law.

10. Notices. Notices hereunder shall be mailed or delivered to the Company at its principal place of business and shall be mailed or delivered to the Optionee at the address on file with the Company or, in either case, at such other address as one party may subsequently furnish to the other party in writing.

AXCELLA HEALTH INC.

By: _____
Title: _____

The foregoing Agreement is hereby accepted and the terms and conditions thereof hereby agreed to by the undersigned. Electronic acceptance of this Agreement pursuant to the Company’s instructions to the Optionee (including through an online acceptance process) is acceptable.

Dated: _____
Optionee’s Signature
Optionee’s name and address:

**NON-QUALIFIED STOCK OPTION AGREEMENT
FOR NON-EMPLOYEE DIRECTORS
UNDER THE AXCELLA HEALTH INC.
2019 STOCK OPTION AND INCENTIVE PLAN**

Name of Optionee:

No. of Option Shares:

Option Exercise Price per Share: \$

Grant Date:

Expiration Date:

Pursuant to the Axcella Health Inc. 2019 Stock Option and Incentive Plan as amended through the date hereof (the “Plan”), Axcella Health Inc. (the “Company”) hereby grants to the Optionee named above, who is a Director of the Company but is not an employee of the Company, an option (the “Stock Option”) to purchase on or prior to the Expiration Date specified above all or part of the number of shares of Common Stock, par value \$0.001 per share (the “Stock”), of the Company specified above at the Option Exercise Price per Share specified above subject to the terms and conditions set forth herein and in the Plan. This Stock Option is not intended to be an “incentive stock option” under Section 422 of the Internal Revenue Code of 1986, as amended.

1. Exercisability Schedule. No portion of this Stock Option may be exercised until such portion shall have become exercisable. Except as set forth below, and subject to the discretion of the Administrator (as defined in Section 2 of the Plan) to accelerate the exercisability schedule hereunder, this Stock Option shall be exercisable with respect to the following number of Option Shares on the dates indicated so long as the Optionee remains in continued service of the Company on such dates:

Incremental Number of Option Shares Exercisable	Exercisability Date
()%	
()%	
()%	
()%	
()%	

Once exercisable, this Stock Option shall continue to be exercisable at any time or times prior to the close of business on the Expiration Date, subject to the provisions hereof and of the Plan. Notwithstanding the foregoing, 100% of the Option Shares shall immediately become exercisable upon (i) termination of the Optionee's service as a Director by reason of the Optionee's death or disability and (ii) a Sale Event, provided that the Grantee continues to provide services as a Director through the date of such Sale Event.

2. Manner of Exercise.

(a) The Optionee may exercise this Stock Option only in the following manner: from time to time on or prior to the Expiration Date of this Stock Option, the Optionee may give written notice to the Administrator of his or her election to purchase some or all of the Option Shares purchasable at the time of such notice. This notice shall specify the number of Option Shares to be purchased.

Payment of the purchase price for the Option Shares may be made by one or more of the following methods: (i) in cash, by certified or bank check or other instrument acceptable to the Administrator; (ii) through the delivery (or attestation to the ownership) of shares of Stock that have been purchased by the Optionee on the open market or that are beneficially owned by the Optionee and are not then subject to any restrictions under any Company plan and that otherwise satisfy any holding periods as may be required by the Administrator; (iii) by the Optionee delivering to the Company a properly executed exercise notice together with irrevocable instructions to a broker to promptly deliver to the Company cash or a check payable and acceptable to the Company to pay the option purchase price, provided that in the event the Optionee chooses to pay the option purchase price as so provided, the Optionee and the broker shall comply with such procedures and enter into such agreements of indemnity and other agreements as the Administrator shall prescribe as a condition of such payment procedure; (iv) by a "net exercise" arrangement pursuant to which the Company will reduce the number of shares of Stock issuable upon exercise by the largest whole number of shares with a Fair Market Value that does not exceed the aggregate exercise price; or (v) a combination of (i), (ii), (iii) and (iv) above. Payment instruments will be received subject to collection.

The transfer to the Optionee on the records of the Company or of the transfer agent of the Option Shares will be contingent upon (i) the Company's receipt from the Optionee of the full purchase price for the Option Shares, as set forth above, (ii) the fulfillment of any other requirements contained herein or in the Plan or in any other agreement or provision of laws, and (iii) the receipt by the Company of any agreement, statement or other evidence that the Company may require to satisfy itself that the issuance of Stock to be purchased pursuant to the exercise of Stock Options under the Plan and any subsequent resale of the shares of Stock will be in compliance with applicable laws and regulations. In the event the Optionee chooses to pay the purchase price by previously-owned shares of Stock through the attestation method, the number of shares of Stock transferred to the Optionee upon the exercise of the Stock Option shall be net of the Shares attested to.

(b) The shares of Stock purchased upon exercise of this Stock Option shall be transferred to the Optionee on the records of the Company or of the transfer agent upon compliance to the satisfaction of the Administrator with all requirements under applicable laws

or regulations in connection with such transfer and with the requirements hereof and of the Plan. The determination of the Administrator as to such compliance shall be final and binding on the Optionee. The Optionee shall not be deemed to be the holder of, or to have any of the rights of a holder with respect to, any shares of Stock subject to this Stock Option unless and until this Stock Option shall have been exercised pursuant to the terms hereof, the Company or the transfer agent shall have transferred the shares to the Optionee, and the Optionee's name shall have been entered as the stockholder of record on the books of the Company. Thereupon, the Optionee shall have full voting, dividend and other ownership rights with respect to such shares of Stock.

(c) The minimum number of shares with respect to which this Stock Option may be exercised at any one time shall be 100 shares, unless the number of shares with respect to which this Stock Option is being exercised is the total number of shares subject to exercise under this Stock Option at the time.

(d) Notwithstanding any other provision hereof or of the Plan, no portion of this Stock Option shall be exercisable after the Expiration Date hereof.

3. Termination as Director. If the Optionee ceases to be a Director of the Company, the period within which to exercise the Stock Option may be subject to earlier termination as set forth below.

(a) Termination Due to Death. If the Optionee's service as a Director terminates by reason of the Optionee's death, any portion of this Stock Option outstanding on such date, to the extent exercisable on the date of death, may thereafter be exercised by the Optionee's legal representative or legatee for a period of 12 months from the date of death or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date of death shall terminate immediately and be of no further force or effect.

(b) Other Termination. If the Optionee ceases to be a Director for any reason other than the Optionee's death, any portion of this Stock Option outstanding on such date may be exercised, to the extent exercisable on the date the Optionee ceased to be a Director, for a period of 12 months from the date the Optionee ceased to be a Director or until the Expiration Date, if earlier. Any portion of this Stock Option that is not exercisable on the date the Optionee ceases to be a Director shall terminate immediately and be of no further force or effect.

4. Incorporation of Plan. Notwithstanding anything herein to the contrary, this Stock Option shall be subject to and governed by all the terms and conditions of the Plan, including the powers of the Administrator set forth in Section 2(b) of the Plan. Capitalized terms in this Agreement shall have the meaning specified in the Plan, unless a different meaning is specified herein.

5. Transferability. This Agreement is personal to the Optionee, is non-assignable and is not transferable in any manner, by operation of law or otherwise, other than by will or the laws of descent and distribution. This Stock Option is exercisable, during the Optionee's lifetime, only by the Optionee, and thereafter, only by the Optionee's legal representative or legatee.

6. No Obligation to Continue as a Director. Neither the Plan nor this Stock Option confers upon the Optionee any rights with respect to continuance as a Director.

7. Integration. This Agreement constitutes the entire agreement between the parties with respect to this Stock Option and supersedes all prior agreements and discussions between the parties concerning such subject matter.

8. Data Privacy Consent. In order to administer the Plan and this Agreement and to implement or structure future equity grants, the Company, its subsidiaries and affiliates and certain agents thereof (together, the “Relevant Companies”) may process any and all personal or professional data, including but not limited to Social Security or other identification number, home address and telephone number, date of birth and other information that is necessary or desirable for the administration of the Plan and/or this Agreement (the “Relevant Information”). By entering into this Agreement, the Optionee (i) authorizes the Company to collect, process, register and transfer to the Relevant Companies all Relevant Information; (ii) waives any privacy rights the Optionee may have with respect to the Relevant Information; (iii) authorizes the Relevant Companies to store and transmit such information in electronic form; and (iv) authorizes the transfer of the Relevant Information to any jurisdiction in which the Relevant Companies consider appropriate. The Optionee shall have access to, and the right to change, the Relevant Information. Relevant Information will only be used in accordance with applicable law.

9. Notices. Notices hereunder shall be mailed or delivered to the Company at its principal place of business and shall be mailed or delivered to the Optionee at the address on file with the Company or, in either case, at such other address as one party may subsequently furnish to the other party in writing.

AXCELLA HEALTH INC.

By: _____
Title:

The foregoing Agreement is hereby accepted and the terms and conditions thereof hereby agreed to by the undersigned. Electronic acceptance of this Agreement pursuant to the Company's instructions to the Optionee (including through an online acceptance process) is acceptable.

Dated: _____
Optionee's Signature
Optionee's name and address:

**RESTRICTED STOCK AWARD AGREEMENT
UNDER THE AXCELLA HEALTH INC.
2019 STOCK OPTION AND INCENTIVE PLAN**

Name of Grantee:

No. of Shares:

Grant Date:

Pursuant to the Axcella Health Inc. 2019 Stock Option and Incentive Plan (the "Plan") as amended through the date hereof, Axcella Health Inc. (the "Company") hereby grants a Restricted Stock Award (an "Award") to the Grantee named above. Upon acceptance of this Award, the Grantee shall receive the number of shares of Common Stock, par value \$0.001 per share (the "Stock") of the Company specified above, subject to the restrictions and conditions set forth herein and in the Plan. The Company acknowledges the receipt from the Grantee of consideration with respect to the par value of the Stock in the form of cash, past or future services rendered to the Company by the Grantee or such other form of consideration as is acceptable to the Administrator.

1. Award. The shares of Restricted Stock awarded hereunder shall be issued and held by the Company's transfer agent in book entry form, and the Grantee's name shall be entered as the stockholder of record on the books of the Company. Thereupon, the Grantee shall have all the rights of a stockholder with respect to such shares, including voting and dividend rights, subject, however, to the restrictions and conditions specified in Paragraph 2 below. The Grantee shall (i) sign and deliver to the Company a copy of this Award Agreement and (ii) deliver to the Company a stock power endorsed in blank.

2. Restrictions and Conditions.

(a) Any book entries for the shares of Restricted Stock granted herein shall bear an appropriate legend, as determined by the Administrator in its sole discretion, to the effect that such shares are subject to restrictions as set forth herein and in the Plan.

(b) Shares of Restricted Stock granted herein may not be sold, assigned, transferred, pledged or otherwise encumbered or disposed of by the Grantee prior to vesting.

(c) If the Grantee's employment(1) with the Company and its Subsidiaries is voluntarily or involuntarily terminated for any reason (including death) prior to vesting of shares of Restricted Stock granted herein, all shares of Restricted Stock shall immediately and automatically be forfeited and returned to the Company.

3. Vesting of Restricted Stock. The restrictions and conditions in Paragraph 2 of this Agreement shall lapse on the Vesting Date or Dates specified in the following schedule so long as the Grantee remains in continued service of the Company or a Subsidiary on such Dates. If a series of Vesting Dates is specified, then the restrictions and conditions in Paragraph 2 shall

lapse only with respect to the number of shares of Restricted Stock specified as vested on such date.

<u>Incremental Number of Shares Vested</u>	<u>Vesting Date</u>
()%	
()%	
()%	
()%	
()%	

Subsequent to such Vesting Date or Dates, the shares of Stock on which all restrictions and conditions have lapsed shall no longer be deemed Restricted Stock. The Administrator may at any time accelerate the vesting schedule specified in this Paragraph 3.

4. Dividends. Dividends on shares of Restricted Stock shall be paid currently to the Grantee.

5. Incorporation of Plan. Notwithstanding anything herein to the contrary, this Award shall be subject to and governed by all the terms and conditions of the Plan, including the powers of the Administrator set forth in Section 2(b) of the Plan. Capitalized terms in this Agreement shall have the meaning specified in the Plan, unless a different meaning is specified herein.

6. Transferability. This Agreement is personal to the Grantee, is non-assignable and is not transferable in any manner, by operation of law or otherwise, other than by will or the laws of descent and distribution.

7. Tax Withholding. The Grantee shall, not later than the date as of which the receipt of this Award becomes a taxable event for Federal income tax purposes, pay to the Company or make arrangements satisfactory to the Administrator for payment of any Federal, state, and local taxes required by law to be withheld on account of such taxable event. Except in the case where an election is made pursuant to Paragraph 8 below, the Company shall have the authority to cause the required tax withholding obligation to be satisfied, in whole or in part, by withholding from shares of Stock to be issued or released by the transfer agent a number of shares of Stock with an aggregate Fair Market Value that would satisfy the withholding amount due.

8. Election Under Section 83(b). The Grantee and the Company hereby agree that the Grantee may, within 30 days following the Grant Date of this Award, file with the Internal Revenue Service and the Company an election under Section 83(b) of the Internal Revenue Code. In the event the Grantee makes such an election, he or she agrees to provide a copy of the election to the Company. The Grantee acknowledges that he or she is responsible for obtaining the advice of his or her tax advisors with regard to the Section 83(b) election and that he or she is relying solely on such advisors and not on any statements or representations of the Company or any of its agents with regard to such election.

9. No Obligation to Continue Employment. Neither the Company nor any Subsidiary is obligated by or as a result of the Plan or this Agreement to continue the Grantee in employment and neither the Plan nor this Agreement shall interfere in any way with the right of the Company or any Subsidiary to terminate the employment of the Grantee at any time.

10. Integration. This Agreement constitutes the entire agreement between the parties with respect to this Award and supersedes all prior agreements and discussions between the parties concerning such subject matter.

11. Data Privacy Consent. In order to administer the Plan and this Agreement and to implement or structure future equity grants, the Company, its subsidiaries and affiliates and certain agents thereof (together, the “Relevant Companies”) may process any and all personal or professional data, including but not limited to Social Security or other identification number, home address and telephone number, date of birth and other information that is necessary or desirable for the administration of the Plan and/or this Agreement (the “Relevant Information”). By entering into this Agreement, the Grantee (i) authorizes the Company to collect, process, register and transfer to the Relevant Companies all Relevant Information; (ii) waives any privacy rights the Grantee may have with respect to the Relevant Information; (iii) authorizes the Relevant Companies to store and transmit such information in electronic form; and (iv) authorizes the transfer of the Relevant Information to any jurisdiction in which the Relevant Companies consider appropriate. The Grantee shall have access to, and the right to change, the Relevant Information. Relevant Information will only be used in accordance with applicable law.

12. Notices. Notices hereunder shall be mailed or delivered to the Company at its principal place of business and shall be mailed or delivered to the Grantee at the address on file with the Company or, in either case, at such other address as one party may subsequently furnish to the other party in writing.

AXCELLA HEALTH INC.

By: _____
Title: _____

The foregoing Agreement is hereby accepted and the terms and conditions thereof hereby agreed to by the undersigned. Electronic acceptance of this Agreement pursuant to the Company's instructions to the Grantee (including through an online acceptance process) is acceptable.

Dated: _____
Grantee's Signature

Grantee's name and address:

4

**RESTRICTED STOCK UNIT AWARD AGREEMENT
FOR COMPANY EMPLOYEES
UNDER THE AXCELLA HEALTH INC.
2019 STOCK OPTION AND INCENTIVE PLAN**

Name of Grantee:

No. of Restricted Stock Units:

Grant Date:

Pursuant to the Axcella Health Inc. 2019 Stock Option and Incentive Plan as amended through the date hereof (the "Plan"), Axcella Health Inc. (the "Company") hereby grants an award of the number of Restricted Stock Units listed above (an "Award") to the Grantee named above. Each Restricted Stock Unit shall relate to one share of Common Stock, par value \$0.001 per share (the "Stock") of the Company.

1. Restrictions on Transfer of Award. This Award may not be sold, transferred, pledged, assigned or otherwise encumbered or disposed of by the Grantee, and any shares of Stock issuable with respect to the Award may not be sold, transferred, pledged, assigned or otherwise encumbered or disposed of until (i) the Restricted Stock Units have vested as provided in Paragraph 2 of this Agreement and (ii) shares of Stock have been issued to the Grantee in accordance with the terms of the Plan and this Agreement.

2. Vesting of Restricted Stock Units. The restrictions and conditions of Paragraph 1 of this Agreement shall lapse on the Vesting Date or Dates specified in the following schedule so long as the Grantee remains in continued service of the Company or a Subsidiary on such Dates. If a series of Vesting Dates is specified, then the restrictions and conditions in Paragraph 1 shall lapse only with respect to the number of Restricted Stock Units specified as vested on such date.

<u>Incremental Number of Restricted Stock Units Vested</u>	<u>Vesting Date</u>
()%	
()%	
()%	
()%	

The Administrator may at any time accelerate the vesting schedule specified in this Paragraph 2.

3. Termination of Employment. If the Grantee's employment with the Company and its Subsidiaries terminates for any reason (including death or disability) prior to the satisfaction of the vesting conditions set forth in Paragraph 2 above, any Restricted Stock Units that have not vested as of such date shall automatically and without notice terminate and be forfeited, and neither the Grantee nor any of his or her successors, heirs, assigns, or personal

representatives will thereafter have any further rights or interests in such unvested Restricted Stock Units.

4. Issuance of Shares of Stock. As soon as practicable following each Vesting Date (but in no event later than two and one-half months after the end of the year in which the Vesting Date occurs), the Company shall issue to the Grantee the number of shares of Stock equal to the aggregate number of Restricted Stock Units that have vested pursuant to Paragraph 2 of this Agreement on such date and the Grantee shall thereafter have all the rights of a stockholder of the Company with respect to such shares.

5. Incorporation of Plan. Notwithstanding anything herein to the contrary, this Agreement shall be subject to and governed by all the terms and conditions of the Plan, including the powers of the Administrator set forth in Section 2(b) of the Plan. Capitalized terms in this Agreement shall have the meaning specified in the Plan, unless a different meaning is specified herein.

6. Tax Withholding. The Grantee shall, not later than the date as of which the receipt of this Award becomes a taxable event for Federal income tax purposes, pay to the Company or make arrangements satisfactory to the Administrator for payment of any Federal, state, and local taxes required by law to be withheld on account of such taxable event. The Company shall have the authority to cause the required tax withholding obligation to be satisfied, in whole or in part, by withholding from shares of Stock to be issued to the Grantee a number of shares of Stock with an aggregate Fair Market Value that would satisfy the withholding amount due.

7. Section 409A of the Code. This Agreement shall be interpreted in such a manner that all provisions relating to the settlement of the Award are exempt from the requirements of Section 409A of the Code as “short-term deferrals” as described in Section 409A of the Code.

8. No Obligation to Continue Employment. Neither the Company nor any Subsidiary is obligated by or as a result of the Plan or this Agreement to continue the Grantee in employment and neither the Plan nor this Agreement shall interfere in any way with the right of the Company or any Subsidiary to terminate the employment of the Grantee at any time.

9. Integration. This Agreement constitutes the entire agreement between the parties with respect to this Award and supersedes all prior agreements and discussions between the parties concerning such subject matter.

10. Data Privacy Consent. In order to administer the Plan and this Agreement and to implement or structure future equity grants, the Company, its subsidiaries and affiliates and certain agents thereof (together, the “Relevant Companies”) may process any and all personal or professional data, including but not limited to Social Security or other identification number, home address and telephone number, date of birth and other information that is necessary or desirable for the administration of the Plan and/or this Agreement (the “Relevant Information”). By entering into this Agreement, the Grantee (i) authorizes the Company to collect, process, register and transfer to the Relevant Companies all Relevant Information; (ii) waives any privacy rights the Grantee may have with respect to the Relevant Information; (iii) authorizes the Relevant Companies to store and transmit such information in electronic form; and (iv)

authorizes the transfer of the Relevant Information to any jurisdiction in which the Relevant Companies consider appropriate. The Grantee shall have access to, and the right to change, the Relevant Information. Relevant Information will only be used in accordance with applicable law.

11. Notices. Notices hereunder shall be mailed or delivered to the Company at its principal place of business and shall be mailed or delivered to the Grantee at the address on file with the Company or, in either case, at such other address as one party may subsequently furnish to the other party in writing.

AXCELLA HEALTH INC.

By: _____
Title: _____

The foregoing Agreement is hereby accepted and the terms and conditions thereof hereby agreed to by the undersigned. Electronic acceptance of this Agreement pursuant to the Company’s instructions to the Grantee (including through an online acceptance process) is acceptable.

Dated: _____
Grantee’s Signature

Grantee’s name and address:

**RESTRICTED STOCK UNIT AWARD AGREEMENT
FOR NON-EMPLOYEE DIRECTORS
UNDER THE AXCELLA HEALTH INC.
2019 STOCK OPTION AND INCENTIVE PLAN**

Name of Grantee:

No. of Restricted Stock Units:

Grant Date:

Pursuant to the Axcella Health Inc. 2019 Stock Option and Incentive Plan as amended through the date hereof (the “Plan”), Axcella Health Inc. (the “Company”) hereby grants an award of the number of Restricted Stock Units listed above (an “Award”) to the Grantee named above. Each Restricted Stock Unit shall relate to one share of Common Stock, par value \$0.001 per share (the “Stock”) of the Company.

1. Restrictions on Transfer of Award. This Award may not be sold, transferred, pledged, assigned or otherwise encumbered or disposed of by the Grantee, and any shares of Stock issuable with respect to the Award may not be sold, transferred, pledged, assigned or otherwise encumbered or disposed of until (i) the Restricted Stock Units have vested as provided in Paragraph 2 of this Agreement and (ii) shares of Stock have been issued to the Grantee in accordance with the terms of the Plan and this Agreement.

2. Vesting of Restricted Stock Units. The restrictions and conditions of Paragraph 1 of this Agreement shall lapse on the Vesting Date or Dates specified in the following schedule so long as the Grantee remains in continued service of the Company on such Dates. If a series of Vesting Dates is specified, then the restrictions and conditions in Paragraph 1 shall lapse only with respect to the number of Restricted Stock Units specified as vested on such date.

<u>Incremental Number of Restricted Stock Units Vested</u>	<u>Vesting Date</u>
()%	
()%	
()%	
()%	

Notwithstanding the foregoing, 100% of the Option Shares shall immediately become exercisable upon (i) termination of the Grantee’s service as a Director by reason of the Grantee’s death or disability and (ii) a Sale Event, provided that the Grantee continues to provide services as a Director through the date of such Sale Event. The Administrator may at any time accelerate the vesting schedule specified in this Paragraph 2.

3. Termination of Service. If the Grantee’s service as a Director terminates for any reason (other than death or disability) prior to the satisfaction of the vesting conditions set forth

in Paragraph 2 above, any Restricted Stock Units that have not vested as of such date shall automatically and without notice terminate and be forfeited, and neither the Grantee nor any of his or her successors, heirs, assigns, or personal representatives will thereafter have any further rights or interests in such unvested Restricted Stock Units.

4. Issuance of Shares of Stock. As soon as practicable following each Vesting Date (but in no event later than two and one-half months after the end of the year in which the Vesting Date occurs), the Company shall issue to the Grantee the number of shares of Stock equal to the aggregate number of Restricted Stock Units that have vested pursuant to Paragraph 2 of this Agreement on such date and the Grantee shall thereafter have all the rights of a stockholder of the Company with respect to such shares.

5. Incorporation of Plan. Notwithstanding anything herein to the contrary, this Agreement shall be subject to and governed by all the terms and conditions of the Plan, including the powers of the Administrator set forth in Section 2(b) of the Plan. Capitalized terms in this Agreement shall have the meaning specified in the Plan, unless a different meaning is specified herein.

6. Section 409A of the Code. This Agreement shall be interpreted in such a manner that all provisions relating to the settlement of the Award are exempt from the requirements of Section 409A of the Code as “short-term deferrals” as described in Section 409A of the Code.

7. No Obligation to Continue as a Director. Neither the Plan nor this Award confers upon the Grantee any rights with respect to continuance as a Director.

8. Integration. This Agreement constitutes the entire agreement between the parties with respect to this Award and supersedes all prior agreements and discussions between the parties concerning such subject matter.

9. Data Privacy Consent. In order to administer the Plan and this Agreement and to implement or structure future equity grants, the Company, its subsidiaries and affiliates and certain agents thereof (together, the “Relevant Companies”) may process any and all personal or professional data, including but not limited to Social Security or other identification number, home address and telephone number, date of birth and other information that is necessary or desirable for the administration of the Plan and/or this Agreement (the “Relevant Information”). By entering into this Agreement, the Grantee (i) authorizes the Company to collect, process, register and transfer to the Relevant Companies all Relevant Information; (ii) waives any privacy rights the Grantee may have with respect to the Relevant Information; (iii) authorizes the Relevant Companies to store and transmit such information in electronic form; and (iv) authorizes the transfer of the Relevant Information to any jurisdiction in which the Relevant Companies consider appropriate. The Grantee shall have access to, and the right to change, the Relevant Information. Relevant Information will only be used in accordance with applicable law.

10. Notices. Notices hereunder shall be mailed or delivered to the Company at its principal place of business and shall be mailed or delivered to the Grantee at the address on file with the Company or, in either case, at such other address as one party may subsequently furnish to the other party in writing.

AXCELLA HEALTH INC.

By: _____
Title:

The foregoing Agreement is hereby accepted and the terms and conditions thereof hereby agreed to by the undersigned. Electronic acceptance of this Agreement pursuant to the Company's instructions to the Grantee (including through an online acceptance process) is acceptable.

Dated: _____
Grantee's Signature

Grantee's name and address:

AXCELLA HEALTH INC.

2019 EMPLOYEE STOCK PURCHASE PLAN

The purpose of the Axcella Health Inc. 2019 Employee Stock Purchase Plan (“the Plan”) is to provide eligible employees of Axcella Health Inc. (the “Company”) and each Designated Subsidiary (as defined in Section 11) with opportunities to purchase shares of the Company’s common stock, par value \$0.001 per share (the “Common Stock”). An aggregate of 237,181 shares of Common Stock in the aggregate have been approved and reserved for this purpose, plus on January 1, 2020, and each January 1 thereafter through January 1, 2029, the number of shares of Common Stock reserved and available for issuance under the Plan shall be cumulatively increased by the least of (i) one percent (1%) percent of the number of shares of Common Stock issued and outstanding on the immediately preceding December 31st, (ii) 237,181 shares of Common Stock or (iii) such number of shares of Common Stock as determined by the Administrator. The Plan is intended to constitute an “employee stock purchase plan” within the meaning of Section 423(b) of the Internal Revenue Code of 1986, as amended (the “Code”), and shall be interpreted in accordance with that intent.

1. Administration. The Plan will be administered by the person or persons (the “Administrator”) appointed by the Company’s Board of Directors (the “Board”) for such purpose. The Administrator has authority at any time to: (i) adopt, alter and repeal such rules, guidelines and practices for the administration of the Plan and for its own acts and proceedings as it shall deem advisable; (ii) interpret the terms and provisions of the Plan; (iii) make all determinations it deems advisable for the administration of the Plan; (iv) decide all disputes arising in connection with the Plan; and (v) otherwise supervise the administration of the Plan.

All interpretations and decisions of the Administrator shall be binding on all persons, including the Company and the Participants. No member of the Board or individual exercising administrative authority with respect to the Plan shall be liable for any action or determination made in good faith with respect to the Plan or any option granted hereunder.

2. Offerings. The Company may make one or more offerings to eligible employees to purchase Common Stock under the Plan (“Offerings”). Unless otherwise determined by the Administrator, an Offering will begin on the first business day occurring on or after each May 1 and November 1 and will end on the last business day occurring on or before the following October 31 and April 30 respectively. The Administrator may, in its discretion, designate a different period for any Offering, provided that no Offering shall exceed one year in duration or overlap any other Offering.

3. Eligibility. All individuals classified as employees on the payroll records of the Company and each Designated Subsidiary are eligible to participate in any one or more of the Offerings under the Plan, provided that as of the first day of the applicable Offering (the “Offering Date”) they are customarily employed by the Company or a Designated Subsidiary for more than 20 hours a week and have completed at least three months of employment. Notwithstanding any other provision herein, individuals who are not contemporaneously classified as employees of the Company or a Designated Subsidiary for purposes of the Company’s or applicable Designated Subsidiary’s payroll system are not considered to be eligible employees of the Company or any Designated Subsidiary and shall not be eligible to participate in the Plan. In the event any such individuals are reclassified as employees of the Company or a Designated Subsidiary for any purpose, including, without limitation, common law or statutory employees, by any action of any third party, including, without limitation, any

government agency, or as a result of any private lawsuit, action or administrative proceeding, such individuals shall, notwithstanding such reclassification, remain ineligible for participation. Notwithstanding the foregoing, the exclusive means for individuals who are not contemporaneously classified as employees of the Company or a Designated Subsidiary on the Company's or Designated Subsidiary's payroll system to become eligible to participate in this Plan is through an amendment to this Plan, duly executed by the Company, which specifically renders such individuals eligible to participate herein.

4. Participation.

(a) **Participants.** An eligible employee who is not a Participant in any prior Offering may participate in a subsequent Offering by submitting an enrollment form to his or her appropriate payroll location at least 15 business days before the Offering Date (or by such other deadline as shall be established by the Administrator for the Offering).

(b) **Enrollment.** The enrollment form will (a) state a whole percentage to be deducted from an eligible employee's Compensation (as defined in Section 11) per pay period, (b) authorize the purchase of Common Stock in each Offering in accordance with the terms of the Plan and (c) specify the exact name or names in which shares of Common Stock purchased for such individual are to be issued pursuant to Section 10. An employee who does not enroll in accordance with these procedures will be deemed to have waived the right to participate. Unless a Participant files a new enrollment form or withdraws from the Plan, such Participant's deductions and purchases will continue at the same percentage of Compensation for future Offerings, provided he or she remains eligible.

(c) Notwithstanding the foregoing, participation in the Plan will neither be permitted nor be denied contrary to the requirements of the Code.

5. Employee Contributions. Each eligible employee may authorize payroll deductions at a minimum of one percent up to a maximum of 15 percent of such employee's Compensation for each pay period. The Company will maintain book accounts showing the amount of payroll deductions made by each Participant for each Offering. No interest will accrue or be paid on payroll deductions.

6. Deduction Changes. Except as may be determined by the Administrator in advance of an Offering, a Participant may not increase or decrease his or her payroll deduction during any Offering, but may increase or decrease his or her payroll deduction with respect to the next Offering (subject to the limitations of Section 5) by filing a new enrollment form at least 15 business days before the next Offering Date (or by such other deadline as shall be established by the Administrator for the Offering). The Administrator may, in advance of any Offering, establish rules permitting a Participant to increase, decrease or terminate his or her payroll deduction during an Offering.

7. Withdrawal. A Participant may withdraw from participation in the Plan by delivering a written notice of withdrawal to his or her appropriate payroll location. The Participant's withdrawal will be effective as of the next business day. Following a Participant's withdrawal, the Company will promptly refund such individual's entire account balance under the Plan to him or her (after payment for any Common Stock purchased before the effective date of withdrawal). Partial withdrawals are not permitted. Such an employee may not begin participation again during the remainder of the Offering, but may enroll in a subsequent Offering in accordance with Section 4.

8. Grant of Options. On each Offering Date, the Company will grant to each eligible employee who is then a Participant in the Plan an option ("Option") to purchase on the last day

of such Offering (the “Exercise Date”), at the Option Price hereinafter provided for, the lowest of (a) a number of shares of Common Stock determined by dividing such Participant’s accumulated payroll deductions on such Exercise Date by the Option Price (as defined herein), (b) the number of shares determined by dividing \$25,000 by the Fair Market Value of the Common Stock on the Offering Date for such Offering; or (c) such other lesser maximum number of shares as shall have been established by the Administrator in advance of the Offering; provided, however, that such Option shall be subject to the limitations set forth below. Each Participant’s Option shall be exercisable only to the extent of such Participant’s accumulated payroll deductions on the Exercise Date. The purchase price for each share purchased under each Option (the “Option Price”) will be 85 percent of the Fair Market Value of the Common Stock on the Offering Date or the Exercise Date, whichever is less.

Notwithstanding the foregoing, no Participant may be granted an option hereunder if such Participant, immediately after the option was granted, would be treated as owning stock possessing five percent or more of the total combined voting power or value of all classes of stock of the Company or any Parent or Subsidiary (as defined in Section 11). For purposes of the preceding sentence, the attribution rules of Section 424(d) of the Code shall apply in determining the stock ownership of a Participant, and all stock which the Participant has a contractual right to purchase shall be treated as stock owned by the Participant. In addition, no Participant may be granted an Option which permits his or her rights to purchase stock under the Plan, and any other employee stock purchase plan of the Company and its Parents and Subsidiaries, to accrue at a rate which exceeds \$25,000 of the fair market value of such stock (determined on the option grant date or dates) for each calendar year in which the Option is outstanding at any time. The purpose of the limitation in the preceding sentence is to comply

with Section 423(b)(8) of the Code and shall be applied taking Options into account in the order in which they were granted.

9. Exercise of Option and Purchase of Shares. Each employee who continues to be a Participant in the Plan on the Exercise Date shall be deemed to have exercised his or her Option on such date and shall acquire from the Company such number of whole shares of Common Stock reserved for the purpose of the Plan as his or her accumulated payroll deductions on such date will purchase at the Option Price, subject to any other limitations contained in the Plan. Any amount remaining in a Participant's account at the end of an Offering solely by reason of the inability to purchase a fractional share will be carried forward to the next Offering; any other balance remaining in a Participant's account at the end of an Offering will be refunded to the Participant promptly.

10. Issuance of Certificates. Certificates or book-entries at the Company's transfer agent representing shares of Common Stock purchased under the Plan may be issued only in the name of the employee, in the name of the employee and another person of legal age as joint tenants with rights of survivorship, or in the name of a broker authorized by the employee to be his, her or their, nominee for such purpose.

11. Definitions.

The term "Compensation" means the regular or basic rate of compensation.

The term "Designated Subsidiary" means any present or future Subsidiary (as defined below) that has been designated by the Board to participate in the Plan. The Board may so designate any Subsidiary, or revoke any such designation, at any time and from time to time, either before or after the Plan is approved by the stockholders. The current list of Designated Subsidiaries is attached hereto as Appendix A.

The term “Fair Market Value of the Common Stock” on any given date means the fair market value of the Common Stock determined in good faith by the Administrator; provided, however, that if the Common Stock is admitted to quotation on the National Association of Securities Dealers Automated Quotation System (“NASDAQ”), the NASDAQ Global Market, The New York Stock Exchange or another national securities exchange, the determination shall be made by reference to the closing price on such date. If there is no closing price for such date, the determination shall be made by reference to the last date preceding such date for which there is a closing price.

The term “Parent” means a “parent corporation” with respect to the Company, as defined in Section 424(e) of the Code.

The term “Participant” means an individual who is eligible as determined in Section 3 and who has complied with the provisions of Section 4.

The term “Subsidiary” means a “subsidiary corporation” with respect to the Company, as defined in Section 424(f) of the Code.

12. Rights on Termination of Employment. If a Participant’s employment terminates for any reason before the Exercise Date for any Offering, no payroll deduction will be taken from any pay due and owing to the Participant and the balance in the Participant’s account will be paid to such Participant or, in the case of such Participant’s death, to his or her designated beneficiary as if such Participant had withdrawn from the Plan under Section 7. An employee will be deemed to have terminated employment, for this purpose, if the corporation that employs him or her, having been a Designated Subsidiary, ceases to be a Subsidiary, or if the employee is transferred to any corporation other than the Company or a Designated Subsidiary. An employee will not be deemed to have terminated employment for this purpose, if the employee is on an

approved leave of absence for military service or sickness or for any other purpose approved by the Company, if the employee’s right to reemployment is guaranteed either by a statute or by contract or under the policy pursuant to which the leave of absence was granted or if the Administrator otherwise provides in writing.

13. Special Rules. Notwithstanding anything herein to the contrary, the Administrator may adopt special rules applicable to the employees of a particular Designated Subsidiary, whenever the Administrator determines that such rules are necessary or appropriate for the implementation of the Plan in a jurisdiction where such Designated Subsidiary has employees; provided that such rules are consistent with the requirements of Section 423(b) of the Code. Any special rules established pursuant to this Section 13 shall, to the extent possible, result in the employees subject to such rules having substantially the same rights as other Participants in the Plan.

14. Optionees Not Stockholders. Neither the granting of an Option to a Participant nor the deductions from his or her pay shall constitute such Participant a holder of the shares of Common Stock covered by an Option under the Plan until such shares have been purchased by and issued to him or her.

15. Rights Not Transferable. Rights under the Plan are not transferable by a Participant other than by will or the laws of descent and distribution, and are exercisable during the Participant’s lifetime only by the Participant.

16. Application of Funds. All funds received or held by the Company under the Plan may be combined with other corporate funds and may be used for any corporate purpose.

17. Adjustment in Case of Changes Affecting Common Stock. In the event of a subdivision of outstanding shares of Common Stock, the payment of a dividend in Common

Stock or any other change affecting the Common Stock, the number of shares approved for the Plan and the share limitation set forth in Section 8 shall be equitably or proportionately adjusted to give proper effect to such event.

18. Amendment of the Plan. The Board may at any time and from time to time amend the Plan in any respect, except that without the approval within 12 months of such Board action by the stockholders, no amendment shall be made increasing the number of shares approved for the Plan or making any other change that would require stockholder approval in order for the Plan, as amended, to qualify as an “employee stock purchase plan” under Section 423(b) of the Code.

19. Insufficient Shares. If the total number of shares of Common Stock that would otherwise be purchased on any Exercise Date plus the number of shares purchased under previous Offerings under the Plan exceeds the maximum number of shares issuable under the Plan, the shares then available shall be apportioned among Participants in proportion to the amount of payroll deductions accumulated on behalf of each Participant that would otherwise be used to purchase Common Stock on such Exercise Date.

20. Termination of the Plan. The Plan may be terminated at any time by the Board. Upon termination of the Plan, all amounts in the accounts of Participants shall be promptly refunded.

21. Governmental Regulations. The Company’s obligation to sell and deliver Common Stock under the Plan is subject to obtaining all governmental approvals required in connection with the authorization, issuance, or sale of such stock.

22. Governing Law. This Plan and all Options and actions taken thereunder shall be governed by, and construed in accordance with the General Corporation Law of the State of

Delaware as to matters within the scope thereof, and as to all other matters shall be governed by and construed in accordance with the internal laws of the Commonwealth of Massachusetts, applied without regard to conflict of law principles.

23. Issuance of Shares. Shares may be issued upon exercise of an Option from authorized but unissued Common Stock, from shares held in the treasury of the Company, or from any other proper source.

24. Tax Withholding. Participation in the Plan is subject to any minimum required tax withholding on income of the Participant in connection with the Plan. Each Participant agrees, by entering the Plan, that the Company and its Subsidiaries shall have the right to deduct any such taxes from any payment of any kind otherwise due to the Participant, including shares issuable under the Plan.

25. Notification Upon Sale of Shares. Each Participant agrees, by entering the Plan, to give the Company prompt notice of any disposition of shares purchased under the Plan where such disposition occurs within two years after the date of grant of the Option pursuant to which such shares were purchased or within one year after the date such shares were purchased.

26. Effective Date. This Plan shall become effective upon the date immediately preceding the date upon which the registration statement on Form S-1 that is filed by the Company with respect to its initial public offering is declared effective by the Securities and Exchange Commission following stockholder approval in accordance with applicable state law, the Company's bylaws and articles of incorporation, each as amended, and applicable stock exchange rules.

APPENDIX A

Designated Subsidiaries

None.

**AXCELLA HEALTH INC.
SENIOR EXECUTIVE CASH INCENTIVE BONUS PLAN**

1. Purpose

This Senior Executive Cash Incentive Bonus Plan (the “Incentive Plan”) is intended to provide an incentive for superior work and to motivate eligible executives of Axcella Health Inc. (the “Company”) and its subsidiaries toward even higher achievement and business results, to tie their goals and interests to those of the Company and its stockholders and to enable the Company to attract and retain highly qualified executives. The Incentive Plan is for the benefit of Covered Executives (as defined below).

2. Covered Executives

From time to time, the Compensation Committee of the Board of Directors of the Company (the “Compensation Committee”) may select certain key executives (the “Covered Executives”) to be eligible to receive bonuses hereunder. Participation in this Plan does not change the “at will” nature of a Covered Executive’s employment with the Company.

3. Administration

The Compensation Committee shall have the sole discretion and authority to administer and interpret the Incentive Plan.

4. Bonus Determinations

(a) Corporate Performance Goals. A Covered Executive may receive a bonus payment under the Incentive Plan based upon the attainment of one or more performance objectives that are established by the Compensation Committee and relate to financial and operational metrics with respect to the Company or any of its subsidiaries (the “Corporate Performance Goals”), including the following: developmental, clinical or regulatory milestones; cash flow (including, but not limited to, operating cash flow and free cash flow); revenue; corporate revenue; earnings before interest, taxes, depreciation and amortization; net income (loss) (either before or after interest, taxes, depreciation and/or amortization); changes in the market price of the Company’s common stock; economic value-added; acquisitions or strategic transactions; operating income (loss); return on capital, assets, equity, or investment; stockholder returns; return on sales; gross or net profit levels; productivity; expense efficiency; margins; operating efficiency; customer satisfaction; working capital; earnings (loss) per share of the Company’s common stock; bookings, new bookings or renewals; sales or market shares; number of customers, number of new customers or customer references; operating income and/or net annual recurring revenue, any of which may be (A) measured in absolute terms or compared to any incremental increase, (B) measured in terms of growth, (C) compared to another company or companies or to results of a peer group, (D) measured against the market as a whole and/or as compared to applicable market indices and/or (E) measured on a pre-tax or post-tax basis (if applicable). Further, any Corporate Performance Goals may be used to measure the performance of the Company as a whole or a business unit or other segment of the Company, or one or more

product lines or specific markets. The Corporate Performance Goals may differ from Covered Executive to Covered Executive.

(b) Calculation of Corporate Performance Goals. At the beginning of each applicable performance period, the Compensation Committee will determine whether any significant element(s) will be included in or excluded from the calculation of any Corporate Performance Goal with respect to any Covered Executive. In all other respects, Corporate Performance Goals will be calculated in accordance with the Company's financial statements, generally accepted accounting principles, or under a methodology established by the Compensation Committee at the beginning of the performance period and which is consistently applied with respect to a Corporate Performance Goal in the relevant performance period.

(c) Target; Minimum; Maximum. Each Corporate Performance Goal shall have a "target" (100 percent attainment of the Corporate Performance Goal) and may also have a "minimum" hurdle and/or a "maximum" amount.

(d) Bonus Requirements; Individual Goals. Except as otherwise set forth in this Section 4(d): (i) any bonuses paid to Covered Executives under the Incentive Plan shall be based upon objectively determinable bonus formulas that tie such bonuses to one or more performance targets relating to the Corporate Performance Goals, (ii) bonus formulas for Covered Executives shall be adopted in each performance period by the Compensation Committee and communicated to each Covered Executive at the beginning of each performance period and (iii) no bonuses shall be paid to Covered Executives unless and until the Compensation Committee makes a determination with respect to the attainment of the performance targets relating to the Corporate Performance Goals. Notwithstanding the foregoing, the Compensation Committee may adjust bonuses payable under the Incentive Plan based on achievement of one or more individual performance objectives or pay bonuses (including, without limitation, discretionary bonuses) to Covered Executives under the Incentive Plan based on individual performance goals and/or upon such other terms and conditions as the Compensation Committee may in its discretion determine.

(e) Individual Target Bonuses. The Compensation Committee shall establish a target bonus opportunity for each Covered Executive for each performance period. For each Covered Executive, the Compensation Committee shall have the authority to apportion the target award so that a portion of the target award shall be tied to attainment of Corporate Performance Goals and a portion of the target award shall be tied to attainment of individual performance objectives.

(f) Employment Requirement. Subject to any additional terms contained in a written agreement between the Covered Executive and the Company, the payment of a bonus to a Covered Executive with respect to a performance period shall be conditioned upon the Covered Executive's employment by the Company on the bonus payment date. If a Covered Executive was not employed for an entire performance period, the Compensation Committee may pro rate the bonus based on the number of days employed during such period.

5. Timing of Payment

(a) With respect to Corporate Performance Goals established and measured on a basis more frequently than annually (e.g., quarterly or semi-annually), the Corporate Performance

Goals will be measured at the end of each performance period after the Company's financial reports with respect to such period(s) have been published. If the Corporate Performance Goals and/or individual goals for such period are met, payments will be made as soon as practicable following the end of such period, but not later 74 days after the end of the fiscal year in which such performance period ends.

(b) With respect to Corporate Performance Goals established and measured on an annual or multi-year basis, Corporate Performance Goals will be measured as of the end of each such performance period (e.g., the end of each fiscal year) after the Company's financial reports with respect to such period(s) have been published. If the Corporate Performance Goals and/or individual goals for any such period are met, bonus payments will be made as soon as practicable, but not later than 74 days after the end of the relevant fiscal year.

(c) For the avoidance of doubt, bonuses earned at any time in a fiscal year must be paid no later than 74 days after the last day of such fiscal year.

6. Amendment and Termination

The Company reserves the right to amend or terminate the Incentive Plan at any time in its sole discretion.

INDENTURE OF LEASE

by and between

RIVERTECH ASSOCIATES EE, LLC

("LESSOR")

and

ESSENTIENT, INC.

("LESSEE")

RIVERSIDE TECHNOLOGY CENTER

840 Memorial Drive
Cambridge, Massachusetts

RIVERSIDE TECHNOLOGY CENTER

COMMERCIAL LEASE

BETWEEN RIVERTECH ASSOCIATES H, LLC

AND

ESSENTBENT, INC.

Agreement entered into this 28th day of December, 2010 in consideration of the covenants and other benefits herein contained the receipt and sufficiency of said consideration being hereby acknowledged.

Rivertech Associates II, LLC, a Massachusetts limited liability corporation, c/o The Abbey Group, 575 Boylston Street, Boston, MA 02116 (herein “LESSOR”), does hereby lease to and Essentient, Inc., a Delaware limited liability company duly qualified to conduct business in Massachusetts, having its current principal place of business at c/o Flagship Ventures, One memorial Drive Cambridge, Massachusetts (herein “LESSEE”), does hereby lease from said LESSOR, certain space located at 840 Memorial Drive, Cambridge, Massachusetts (herein “Building”) being that portion of the third (3rd) floor of the Building consisting of approximately 10,500 rentable square feet of space, and that portion of the garage level of the Building consisting of approximately 25 rentable square feet of space, for a combination of approximately 10,525 rentable square feet of space, all as shown on Exhibit A attached hereto (herein, “Lease Plan”) and all comprising the “Leased Premises” or “Premises” hereunder; with the right in common with others in the Building to use such common areas of the Building and the property on which the Building is located as are designated by the LESSOR, from time to time including but not limited to the third floor common lavatories; shared loading dock; shared passenger and freight elevators; and common stairways, corridors, walkways, driveways and lobbies and shared conduits, chases, and mechanical, electrical and telecommunications closets.

1. Lease Term. LESSOR shall deliver the Leased Premises to the LESSEE vacant but with LESSOR’s Build-Out (as defined in Section 32) substantially completed in a turnkey condition as set forth in Section 32 hereof, and with prior delivery of an environmental exit report to LESSEE as contemplated in Section 26 hereof Delivery of the Leased Premises to the LESSEE is targeted for that date which is forty five (45) days from the date this Lease is fully executed by both parties (the “Lease Execution Date”) subject to the provisions below. The actual date of delivery is referred to herein as the “Delivery Date”.

LESSEE leases the Leased Premises for an original Term consisting of an “Interim Period (as defined below) and thereafter running thirty six (36) consecutive months (herein, “Lease Term”). The Term of the Lease shall begin on the Delivery Date.

LESSEE shall have the right of early access to the intended laboratory portion of the Leased Premises to perform LESSEE’S work therein as set forth in Section 32, approximately twenty one (21) days prior to the actual Delivery Date, upon written notice from LESSOR. The portion

of the calendar month between the beginning of the Term and the first day of the next calendar month (if the beginning of the Term occurs other than on the 1st of a month) is referred to herein as the "Interim Period", with the first day of said next calendar month being the "Commencement Date". Therefore, with Interim Period, the Term shall end on the last day of the calendar month which is thirty six (36) full months from the Commencement Date, referred to herein as the "Termination Date". The first Lease Year shall begin on the Commencement Date, and each successive Lease Year shall be the next twelve full month period after the end of the First Lease Year. By way of illustration, if the Interim Period starts on the Delivery Date of January 15, 2011 then: (i) the Commencement Date shall be February 1, 2011; (iii) the First Lease Year shall begin on February 1, 2011 and shall conclude on January 31, 2012; the Second Lease Year shall begin on February 1, 2012 and conclude on January 31, 2013; the Third Lease Year shall begin on February 1, 2013 and conclude on January 31, 2014; and the Termination Date would be January 31, 2014.

LESSOR agrees to use commercially reasonable efforts to substantially complete LESSOR'S Build-Out on or before that date which is 45 days from the Lease Execution Date, but LESSOR shall incur no liability, nor shall there be any abatement of Annual Base Rent or other payments due hereunder, if the Delivery Date occurs subsequent to said target date; provided, however, that in the event that the Delivery Date (as defined in Section 32) has not occurred for whatever reason on or before that date which is ninety (90) days from the Lease Execution Date, (the "Outside Termination Date"), then LESSEE shall have the right to terminate this Lease by written notice to LESSOR delivered within 15 business days after the Outside Termination Date, and in such event the Lease shall be deemed to be terminated if the Delivery Date has not occurred by the end of that fifteen (15) day period (absent separate written agreement of the parties). Notwithstanding the Delivery Date or subsequent Commencement Date as contemplated in Section 1 hereof, this Lease shall take effect and be binding upon the parties hereto as of its execution.

The Term may be extended as contemplated by Section 33 hereof.

2. Annual Base Rent and Additional Rent. Subject to the provisions hereof, commencing on the Delivery Date, LESSEE shall pay to LESSOR an Annual Base Rent pursuant to the schedule below during each Lease Year (or portion thereof as the case may be) of the Term hereof, (herein, "Annual Base Rent"). Annual Base Rent shall be payable in advance, in equal monthly installments, due on the first day of each calendar month, pursuant to the schedule below.

LESSEE'S first payment of Annual Base Rent for the first month of the First Lease Year and LESSEE'S payment of Annual Base Rent for the Interim Period (if any), which shall be calculated by multiplying the number of days in the Interim Period (i.e. starting with the beginning of the Term through the last day of the month prior to the Commencement Date by an applicable per diem rate (reflecting Annual Base Rent for the First Lease Year on an annualized basis) shall both be due on the Delivery Date.

All payments of Annual Base Rent (and any Additional Rent or other sums due LESSOR) shall be made to LESSOR at 575 Boylston Street, Boston, Massachusetts 02116 or to such other agent or at such other place as LESSOR may designate in writing. The covenants to pay all Annual

Base Rent and all Additional Rent hereunder (collectively, “Rent”) shall be independent from any and all other covenants of LESSOR to LESSEE hereunder; and all Rent shall be promptly paid when due stated hereunder.

LESSEE shall pay interest from the date due, at annual rate of twelve (12%) percent of any installments of Annual Base Rent, or Additional Rent or other payments which are not received by LESSOR within ten days after written notice from LESSOR that any such Rent was not received.

SCHEDULE OF ANNUAL BASE RENT

<u>Lease Year</u>	<u>Annual Base Rent</u>		<u>Monthly Installment</u>	
First Lease Year	\$	373,637.50	\$	31,136.46
Second Lease Year	\$	442,050.00	\$	36,837.50
Third Lease Year	\$	457,837.50	\$	38,153.13

This Lease is intended to be a triple net lease, and as such LESSEE shall also be responsible for payment of its pro rata share of Operating Expenses (see Section 3 herein), real estate taxes (see Section 4 herein) and utilities (see Section 7 herein), all in accordance with the terms and conditions herein. All payments due to LESSOR hereunder in addition to those under Section 2 shall be deemed to be “Additional Rent”. All LESSEE’S obligations to pay any Annual Base Rent or Additional Rent hereunder shall be independent covenants from any other obligations under this Lease.

LESSEE’S allocable pro rata share is 8.13% (the LESSEE’S “Allocable Percentage”) as that concept is applicable and used herein, which figure is derived by dividing the rentable area of the Leased Premises (10,525) by the total rentable area of the Building (129,470)

3. Additional Rent (Operating Expenses). LESSEE, in addition to the sums payable to LESSOR as Annual Base Rent as determined in Section 2 hereof shall pay to LESSOR for each year (or portion thereof, as applicable) of the Lease Term, as Additional Rent, LESSEE’S Allocable Percentage of any and all Operating Expenses attributable to the

Building for said year of the Lease Term (herein, “Additional Operating Expense Rent”). Operating Expenses as set forth in Exhibit B hereto (provided for illustration) are the unaudited expenses for calendar year 2009. Actual Operating Expenses will be subject to change based on actual costs and expenses incurred for each of the categorized Exhibit B costs and expenses actually incurred in 2010 and for each subsequent calendar year during the Lease Term and through any Extended Term.

“Operating Expenses” means the costs incurred by the LESSOR in connection with the operation, management and maintenance of the Building.” Operating Expenses” shall not include the following: the costs of LESSEE’S or any other tenant’s improvements and services for which LESSEE or any tenant directly reimburses LESSOR, or pays third persons at

LESSOR'S directions; Taxes and any income, excise, transfer or franchise taxes of the LESSOR; the costs incurred in any rehabilitation, reconstruction or other work occasioned by any insured casualty (i.e. as to which LESSOR is required to carry insurance hereunder), or by the exercise of the right of eminent domain (except to the extent of any so-called "deductible" amount under policies of insurance or any costs actually incurred for which any insurance company does not reimburse or compensate LESSOR or Owner); depreciation or interest payments on the Building; general corporate overhead of the LESSOR entity; expenses incurred in any direct dispute with any particular tenant (other than those incurred which are of benefit to or protect the rights of other tenants in the Building, generally); costs of renovations to vacant or other tenants' spaces; costs of capital improvements to the Building its systems and appurtenances (but this exclusion shall not be deemed to cover maintenance, repairs or replacements other than to cure any outstanding present building code violations which shall be excluded), and any rental payments for equipment which, if purchased, would be excluded as a capital improvement under generally accepted accounting standards in LESSOR'S reasonable judgment; brokerage and advertising costs in seeking or leasing to new tenants; and penalties incurred due to LESSOR'S violation or any violation of any government order; any ground or underlying lease rental; bad debt expenses and interest, principal, points and fees on debts or amortization on any mortgage or other debt instrument encumbering the Building or the property; costs arising from LESSOR'S charitable or political contributions; costs of selling, syndicating, financing, mortgaging or hypothecating any of LESSOR'S interest in the Building; management fees paid or charged by LESSOR in connection with the management of the Building other than a management fee based on five (5%) percent of income which is the management fee uniformly and customarily charged to other tenants in the Building by LESSOR; costs and expenses (including taxes) to operate the parking garage, valet and other parking services for the Building, and any replacement garages or parking facilities and any shuttle services as may be placed in service, including any capital improvements to the parking areas; and remediation of hazardous materials in the Building or on the land parcels on which it is located.

LESSEE shall pay its Allocable Percentage of Additional Operating Expense Rent to LESSOR based on a prospective annual schedule prepared by the LESSOR, in monthly increments based on said schedule, with each monthly payment of Annual Base Rent due hereunder. LESSOR, at its discretion, may assess LESSEE for any extraordinary item of cost or expense "which may actually occur as a direct result of LESSEE'S own distinct uses or activities which shall be itemized, invoiced separately, and paid by LESSEE within thirty (30) days of its receipt of the invoice. Within one hundred twenty (120) days of the close of each calendar year, LESSOR shall adjust the prior year's schedule of Additional Operating Expense Rent to account for actual and properly accrued costs, expenses, and liabilities, and shall issue LESSEE a refund or deficiency statement for that year, as appropriate (the "Operating Statement"). LESSEE shall pay any deficiency shown thereon within thirty (30) days of its receipt of said Operating Statement. Any rebates due LESSEE (not contested by LESSOR) shall, in LESSOR'S reasonable discretion, be credited toward current monthly Additional Operating Expense Rent or paid to LESSEE within thirty (30) days.

4. Additional Rent (Real Estate Taxes). LESSEE, in addition to the sums payable to LESSOR as Annual Base Rent as determined in Section 2 hereof, shall pay to LESSOR for each year (or portion thereof, as applicable) of the Lease Term, as Additional Rent, LESSEE'S Allocable Percentage of all sums attributable to the municipal real estate taxes on the Building

and land on which it is situated ("Taxes) allocable to said year) (herein the "Additional Real Estate Tax Rent".

Notwithstanding the foregoing, LESSOR shall be under no obligation to file for any abatement of taxes for FY 2011 or any other fiscal year, and LESSEE shall pay all amounts as invoiced by LESSOR, receiving a rebate based on its Allocable Percentage only if an abatement is sought and received by LESSOR.

LESSEE shall pay its Allocable Percentage of Additional Real Estate Tax Rent to LESSOR based on a prospective annual schedule prepared by the LESSOR, in monthly increments based on said schedule, with each monthly payment of Annual Base Rent due hereunder. Within one hundred twenty (120) days of the close of each tax year, LESSOR shall adjust the prior year's schedule of Additional Real Estate Tax Rent to account for actual and properly accrued costs, expenses, and liabilities, and shall issue LESSEE a refund or deficiency statement for that year, as appropriate. LESSEE shall pay any deficiency shown thereon within thirty (30) days of its receipt of said Operating Statement. Any rebates due LESSEE (not contested by LESSOR) shall, in LESSOR'S reasonable discretion, be credited toward current monthly Additional Real Estate Tax Rent or paid to LESSEE within thirty (30) days.

LESSOR shall keep complete books and records regarding Operating Expenses and Taxes at LESSOR'S principal offices, as to which LESSEE shall be given access as contemplated below during LESSOR'S normal business hours for the purpose of reviewing and copying (at LESSEE'S expense). LESSOR shall retain all records of Operating Expenses and Taxes for at least three (3) years. LESSEE shall have the right to audit the applicable records of LESSOR to confirm that the charges billed to LESSEE under Sections 3 and 4 above are proper and conform to the provisions of such Sections. Such right shall be exercisable by LESSEE within three (3) months after LESSEE'S receipt of LESSOR'S Operating Statement for the subject Lease Year. LESSOR shall cooperate with LESSEE in providing LESSEE reasonable access to LESSOR'S books and records during normal business hours to enable LESSEE to audit LESSOR'S books and records as they relate to any costs or expenses passed through to LESSEE pursuant to any provisions of this Lease. If the audit discloses any overpayment on the part of LESSEE, then LESSEE shall be entitled to a credit on the next succeeding installment of Rent for an amount equal to the overcharge plus interest on the amount of such overcharge from the date on which same was paid by LESSEE until the date refunded by LESSOR at the prime rate then published in The Wall Street Journal, and such credit shall be extended to succeeding installments of Rent in the event such overcharge exceeds the amount of the next succeeding such installment and, in the event the term of this Lease has expired or been earlier terminated, then LESSEE shall be entitled to a refund of such excess from LESSOR within thirty (30) days after such date or expiration or earlier termination. If the audit discloses any undercharge or underpayment on the part of LESSEE, then LESSOR shall be entitled payment of that difference, to be paid with the next succeeding installment of Rent, in the amount equal to the undercharge or underpayment.

5. Security Deposit. Within three (3) business days after full execution and delivery of this Lease by both parties hereof, LESSEE shall post with LESSOR (and maintain at all times during the Original and Extended term, if any), a Security Deposit in the amount of One Hundred Forty One Thousand Five Hundred Two and 66/100 (\$ 141,502.66) Dollars (the "Security Deposit Amount") as described below; which shall be held as security for LESSEE'S performance as

herein provided, to be returned to LESSEE at the end of this Lease Term (as maybe earlier terminated or extended), unless applied by LESSOR prior thereto in the event of any uncured default by LESSEE hereunder beyond applicable notice and cure periods. Failure to deliver the Security Deposit shall result in automatic termination of this Lease, time being of the essence.

The Security Deposit Amount shall be delivered to LESSOR, as set form above, either by:

- (a) bank check (which sum, plus any interest thereon, LESSOR shall be entitled to commingle and use with LESSOR'S own funds); or
- (b) irrevocable stand-by Letter of Credit, substantially in the form attached hereto as Exhibit C from a commercial bank in Massachusetts reasonably acceptable to LESSOR

If available to LESSEE, the Letter of Credit shall be the full term of this Lease. However, the Letter of Credit may be written on an annual basis with a provision that it may be drawn upon if LESSEE fails to provide a renewal or replacement therefor forty-five (45) days prior to the expiration of the then existing Letter of Credit.

The Letter of Credit shall: (i) name LESSOR as beneficiary; (ii) be cancelable only with a minimum 30 days prior notice to LESSOR; and (iii) be substantially in the form attached hereto as Exhibit C and in all respects in form and substance reasonably satisfactory to LESSOR

LESSOR, reserves the right, at any time at which the LESSOR has reasonable grounds to question the economic viability of the bank issuing the then existing Letter of Credit to require that the original Letter of Credit be replaced by another Letter of Credit issued by another commercial bank reasonably acceptable to LESSOR LESSEE shall be required to make its substitution within fifteen (15) days from receipt of LESSOR'S notice. Failure to provide said replacement Letter of Credit shall entitle LESSOR to draw on the existing Letter of Credit and hold the cash proceeds thereof as the Security Deposit hereunder.

LESSOR agrees that it shall not draw on the Security Deposit Amount hereunder except to the extent necessary to cure a default beyond applicable notice and cure periods of LESSEE hereunder, or upon failure to LESSEE to tender a replacement or renewal Letter of Credit as contemplated above. LESSOR agrees that it shall deliver the Security Deposit to any successor in interest to LESSOR'S rights hereunder.

Provided LESSEE has not previously defaulted during the Term, then on the first anniversary of the Commencement Date, the Security Deposit Amount shall be reduced for the remainder of the Term to One Hundred Six Thousand One Hundred Twenty Six 98/100 (\$ 106,126.98) Dollars and LESSEE will either receive a remittance from the LESSOR (if the Security Deposit Amount is held in cash) or LESSEE shall deliver a replacement Letter of Credit in that amount (if the Security Deposit is held in that form).

6. Use of Leased Premises. LESSEE shall use the leased premises for general office, research and development and laboratory use, and any other use ancillary thereto only (the "Permitted Uses"), which uses LESSOR warrants and represents are currently allowed under local zoning regulations (subject to compliance with federal, state and municipal safety, healthy,

building, and sanitary codes), and any encumbrance and restrictive instruments and agreements affecting the Building. Notwithstanding the foregoing, the portion of the Leased Premises located in the garage level will be used only for LESSEE'S acid neutralization room. LESSEE will use the Leased Premises in a safe manner and will not do or permit any act or thing which is contrary to any legal or insurance requirement referred to in Section 17 hereof or which constitutes a risk to the safety, health or well-being of other lessees in the Building, or the community, or creates a public or private nuisance or waste.

LESSEE shall not be entitled, for research or testing purposes, to bring any animals (including without limitation laboratory mice, rats or other mammals or primates, reptiles or aquatic life); micro-organisms; or bacteriological, biological, or pathological agents; (collectively, 'biological Items") into the Building or the Leased Premises without prior written notice to LESSOR and LESSOR'S express written consent; which consent shall not be unreasonably withheld, conditioned or delayed. LESSEE, at its sole cost and expense, shall comply with all applicable local, state and federal governmental statutes, regulations, rulings and orders applicable thereto (including procuring any required permits or authorizations) as to any of the foregoing Biological Items allowed under this Section 6. LESSOR may condition its consent to the presence of such animals based on quantity, type, arrangements for storage, sanitation, transportation, and other physical and logistical considerations as LESSOR may reasonably determine in each instance and from time to time as circumstances may require. Notwithstanding any provision to the contrary herein, LESSOR hereby consents and agrees that LESSEE may keep the 'Permitted Items" described on Exhibit E hereto at the Leased Premises and utilize them for the Permitted Uses hereunder, provided however, such consent by LESSOR does not relieve LESSEE, from identifying, procuring in advance, and maintaining any and all municipal, state and federal permits or authorizations therefor (including without limitation the transport, storage and handling thereof), which shall be LESSEE'S sole responsibility and the absence of which shall not in manner abrogate this Lease or reduce any of LESSEE'S obligations to pay all Rent due hereunder or otherwise perform hereunder. Any material additions or changes to the Permitted Items shown on Exhibit E shall require LESSOR'S further consent per the standards set forth above in this Section 6 and upon the giving of such further consent Exhibit E shall be deemed to be amended accordingly. LESSEE hereby indemnifies and holds harmless LESSOR from and against any and all damages, liabilities, claims, demands, actions or other losses arising from LESSEE'S non-compliance with this clause, except to the extent the same results or arises from the negligence or willful misconduct of LESSOR.

To the extent LESSEE requires additional space for the proper handling of its hazardous materials, then upon LESSEE'S request LESSOR shall provide LESSEE with the option to occupy such separately demised space in the basement of the Building for such purpose, in and AS/IS condition and without representation or warranty by LESSOR of any kind or nature, whereupon an amendment will be executed to this Lease adding the rentable square footage of such additional space to this Lease with adjustment for Annual Base Rent and all Additional Rent at the rates hereunder, and all other calculations (e.g. Percentage Interest) hereunder, to reflect the addition of such space. LESSEE shall be under no obligation to accept such space, and LESSOR shall be under no obligation to offer such space more than once. If LESSEE requests such space, LESSOR shall provide LESSEE with the keys or access cards for such space.

LESSEE shall have access to the Leased Premises for LESSEE'S use seven days per week and twenty four hours per day for each day of the Term, subject to the provisions of Section 7 hereof relative to overtime heat and air-conditioning. LESSEE shall keep the Leased Premises and adjacent areas in a clean and good condition equivalent to the standards reasonably set by LESSOR for the Building, reasonable wear and tear and casualty excepted. LESSEE shall be solely responsible to provide its own cleaning and janitorial services to the Leased Premises, at its sole cost and expense.

LESSEE shall be responsible for its own cleaning of the Leased Premises, and the prompt and proper disposal of all garbage, refuse, debris and other waste as mandated by reasonable and uniform Building regulations. LESSOR shall provide and maintain a trash dumpster and/or compactor at the Building loading dock, for the non-exclusive use of all tenants for disposal of non-hazardous/non controlled materials and substances. LESSEE may, but shall not be obligated to implement a recycling program, but its implementation, maintenance, or operation shall be without any cost or expense to

LESSOR or any other tenants of the Building. LESSOR is not obligated to coordinate any such program in any respect

7. Utilities. LESSOR shall provide to the Leased Premises and also to the common areas and facilities which LESSEE enjoys the right to use in accordance with standards reasonably determined by LESSOR for the Building and set forth herein, the following services: (1) hot and cold running water from points of supply to the water faucets or taps in the Leased Premises for use by LESSEE, the cost of which shall be paid by LESSEE per the readings of the existing submeter for the Leased Premises; (2) heat and air conditioning (as applicable) during Normal Business Hours (and at such other times requested by LESSEE in accordance with the provisions of this Section 7 set forth below), as to which LESSEE controls and maintains the system servicing its laboratory space within the Leased Premises, and LESSOR controls and maintains the system servicing the office space within the Leased Premises; (3) ventilation and exhaust, and electricity (payable by LESSEE), sufficient for the Permitted Uses as they are generally stated; (4) maintenance and repair of the Building, Premises and Common Areas as set forth in Section 11 below; and (5) elevator service; (items (1) through (5) above are collectively referred to herein as "Services"). "Normal Business Hours" shall mean 8 AM to 6 PM Monday through Friday, except for the following holidays, only: Thanksgiving Day, Christmas Day, New Years Day, Memorial Day, Fourth of July Day, and Labor Day.

Electrical service to the Premises consists of 250 Amp 480/277V power, of which there is 150 Amp 120/208v transformed power. These are supplied via one 480/277v panel and three 120/208v panels in the electrical room within the Premises. In addition, there is a 50 Amp 120/208v gas powered backup generator on the roof which supplies emergency power to several locations within the Premises. There is approximately 3,200 square feet in the main lab area with 8 foot 9 inch ceiling height, which is approximately 28,000 cubic feet. Three air changes per hour (ACH) would necessitate 84,000 cfh (cubic feet per hour) / 60 minutes = 1,400 cfm (cubic feet per minute). This system provides approximately 800 cfm exhaust to the fume hood and approximately 600 cfm of additional general exhaust to the main lab as part of the Landlord's balancing.

Notwithstanding the foregoing, LESSEE shall pay all charges for electricity used on the Leased Premises per the existing submeter for the Leased Premises as set forth below. LESSOR shall provide monthly estimates of use that are based upon actual use for the prior year (i.e. the estimates to be reset annually), to be confirmed by periodic check meter readings for the Leased Premises itself (with the actual numbers to be “trued-up” at least annually). LESSEE shall pay for such electrical charges upon receipt of its monthly invoice from LESSOR, to be rendered and paid based on those estimates within thirty (30) days of LESSEE’S receipt of the invoice. Within one hundred twenty (120) days of the close of each calendar year, LESSOR shall adjust the LESSEE’S prior year’s electrical payments to account for the actual and properly accrued charges reflective of the actual check meter readings for such year, and shall issue LESSEE a refund or deficiency statement for that year, as appropriate. LESSEE shall pay any deficiency shown thereon within thirty (30) days of its receipt of said invoice. Any rebates due

LESSEE (not contested by LESSOR) shall be credited toward then current monthly electrical charge invoices or paid to LESSEE within thirty (30) days.

LESSOR shall maintain (a) an average temperature in the useable common areas of the Building generally between 60 degrees Fahrenheit and 80 degrees Fahrenheit at all times, and (b) an average temperature in the office portions of the Leased Premises generally between 65 degrees Fahrenheit and 75 degree Fahrenheit during Normal Business Hours (the “HVAC Criteria”). LESSEE hereby acknowledges mat LESSEE controls the temperature in its own laboratory spaces; there shall be no requirement for LESSOR to maintain the foregoing standards with respect thereto; and LESSOR shall not be responsible for coordination of the relative temperatures within the Leased Premises or the balancing of the HVAC systems servicing the Leased Premises, given LESSEE’S control over such laboratory spaces; provided, however, that LESSOR shall be responsible for providing electricity and water to the HVAC equipment serving the laboratory spaces 24-hours per day, 7 days per week, such usual and customary electrical capacity and water volume to be in same quantities as are sufficient for the average office/laboratory tenant in the building without regard to any special requirements or specialized equipment (it being LESSEE’S responsibility to make separate arrangements with LESSOR, at LESSEE’S cost and expense, for any greater or more intense requirements). At any time, upon no less than forty eight (48) hours prior notice by LESSEE, LESSOR shall make available overtime heat and air-conditioning to LESSEE at the Premises in accordance with clause (b) of the HVAC criteria, and LESSEE shall pay as additional rent, overtime heat and air-conditioning for the office portions of the Leased Premises as maybe requested by LESSEE for the Leased Premises on the basis of \$ 150.00 per zone per hour (subject to increase by the same percentage amount by which the standard electric rates are increased), as billed by LESSOR. LESSEE shall give LESSOR forty eight (48) hours prior notice of any requirements for specialized overtime heating and air-conditioning. LESSOR shall not be liable to LESSEE for any interruption, interference, damage or loss to LESSEE’S research or experimentation occasioned as a result of any failure in the heating, ventilation, air conditioning, or electrical services or other utilities servicing the Building or the Leased Premises. No plumbing or electrical work of any type shall be done without LESSOR’S approval which approval shall not be unreasonably withheld or delayed, and, if applicable, the appropriate municipal permit and/or inspector’s approval. Water for domestic type sanitary purposes (only) shall be supplied at LESSOR’S expense. There shall be separately metered and separately paid for by LESSEE, non-potable laboratory water and water for other particularized uses in the Leased Premises.

10

An “Abatement Event” shall be defined as an event or circumstance (other than those addressed in Section 18, and subject to Section 27 herein) that prevents LESSEE from using the Premises or any portion thereof, as a result of any failure to provide Services or access to the Premises. LESSEE shall give LESSOR notice (“Abatement Notice”) of any such Abatement Event, and if such Abatement Event continues beyond the “Eligibility Period” (as that term is defined below), then the Annual Base Rent and LESSEE’S other monetary obligations to LESSOR hereunder shall be abated entirely or reduced, as the case may be, after expiration of the Eligibility Period for such time that LESSEE continues to be so prevented from using, and does not use, the Premises or a portion thereof, in the proportion that the rentable area of the portion of the Premises that LESSEE is prevented from using, and does not use, bears to the total rentable area of the Premises; provided, however, in the event that LESSEE is prevented from using, and does not use, a portion of the Premises for a period of time in excess of the Eligibility Period and the remaining portion of the Premises is not sufficient to allow LESSEE to effectively conduct its business therein, and if LESSEE does not conduct its business from such remaining portion, then for such time after expiration of the Eligibility Period during which LESSEE is so prevented from effectively conducting its business therein, Annual Base Rent and LESSEE’S other monetary obligations to LESSOR hereunder shall be abated entirely for such time as LESSEE continues to be so prevented from using, and does not use, the Premises. The term “Eligibility Period” shall mean a period of three (3) consecutive days after LESSOR’S receipt of any Abatement Notice(s). In addition, if an Abatement Event continues for sixty (60) consecutive days after any Abatement Notice, LESSEE may terminate this Lease by written notice to LESSOR at any time prior to the date such Abatement Event is cured by LESSOR.

8. Compliance with Laws. LESSEE acknowledges that no trade, occupation, or activity shall be conducted in the Leased Premises or use made thereof which will be unlawful, improper, noisy or offensive, or contrary to any federal or state law or administrative regulations, or any municipal ordinance or regulations in force at any time in Cambridge. LESSEE shall keep all employees working in the Leased Premises covered with Worker’s Compensation Insurance, as applicable. Specifically, LESSEE shall be responsible for causing the Premises and any work conducted therein to be in full compliance with the Occupational Safety and Health Act of 1970 and any amendments thereto. LESSEE shall strictly adhere to any and all federal, state, and municipal laws, ordinances, and regulations governing the use of LESSEE’S laboratory scientific experimentation. LESSEE shall be solely responsible for procuring and complying at all times with any and all necessary permits directly relating or incident to: the conduct of its office and research activities on the Premises; its scientific experimentation on the Premises; any transportation; storage; handling; use and disposal of any low level radioactive or bacteriological or pathological substances or organisms or other hazardous wastes or environmentally dangerous substances or materials. LESSEE shall immediately give notice to LESSOR of any warnings or violations relative to the above received from any federal, state, or municipal agency or by any Court of Law, and shall immediately cure the conditions causing any such violations; and LESSOR shall permit LESSEE to cure said harm or hazard prior to any active intervention by LESSOR (except where such intervention is necessitated by the emergency nature of the harm or hazard; or where the harm or hazard impairs the value of the Building, (directly or as collateral on any debt); interests with any other tenant’s rights; or is required by any governmental agency or authority.

11

LESSEE shall fully indemnify and hold harmless in all respects LESSOR from any and all claims, demands, losses, liabilities, and damages (including all necessary and reasonable expenses for contractors, consultants, environmental engineers, attorneys, and other professionals utilized by LESSOR to evaluate and remediate any hazard or harm caused by LESSEE and which LESSEE has failed to cure; and further including any and all fines or fees assessed by any governmental agency relative to any hazard or harm), directly arising from the conduct of its research on the Leased Premises (especially relating to research involving hazardous substances), or LESSEE'S obligations and responsibilities as set forth above and herein, and excepting liability for any claims and damages resulting from the acts or negligence of LESSOR or its agents or employees.

Notwithstanding the foregoing or any other provision of this Lease, however, LESSEE shall not be responsible for compliance with any such laws, regulations, or the like requiring (i) structural repairs or modifications or (ii) repairs or modifications to the base Building utilities running to the Leased Premises or (iii) installation of new Building service equipment, such as fire detection or suppression equipment, unless such repairs, modifications, or installations shall be due to LESSEE'S particular manner or intensity of use of the Leased Premises (in contrast to the general office/laboratory use allowed under the Permitted Uses), or LESSEE'S negligence or willful misconduct or that of its employees, agents or independent contractors.

9. Fire and General Insurance Requirements. LESSEE shall not permit any use of the Leased Premises which will make voidable, increase any premium, or decrease any insurance on the Building and property of which the Leased Premises are a part, or on the contents of said Building, or which shall be contrary to any law, regulation, or order from time to time to established or issued by the local Fire Department, or any similar body, or any restriction contained in any of LESSOR'S insurance policies as to the Building and property provided, however that LESSOR hereby represents and warrants that the Permitted Uses contemplated hereunder shall not violate any of the foregoing regulations or restrictions as of the Delivery Date. LESSEE shall, on demand, reimburse LESSOR all extra insurance premiums caused by LESSEE'S particular use of the Leased Premises (as opposed to Permitted Uses generally). LESSEE shall pay LESSOR if LESSOR incurs any extraordinary costs or expenses to maintain the Leased Premises or any Building equipment servicing the same incurred as a direct result of LESSEE'S vacating the Leased Premises or allowing the same to remain unoccupied for any extended periods of time during the Lease Term.

10. Maintenance of Leased Premises. LESSOR shall be responsible for all exterior and structural maintenance of the Leased Premises (including without limitation exterior plate glass), the maintenance and repair of the Building, including without limitation the roof and foundation of the Building of which the Leased Premises are a part, and for the maintenance, repair and replacement of all common areas serving the Premises and LESSOR'S heating and cooling equipment, doors, locks, plumbing, and electrical wiring, and other Building systems serving the Premises and common areas of the Building; except for damage caused by the malicious, willful, or negligent acts of LESSEE, and chemical, water or corrosion damage from any source within the control of LESSEE (subject to the last paragraph of Section 17). LESSEE agrees to maintain at its expense all other elements and components of the Leased Premises in the same condition as they are at the Delivery Date, normal wear and tear and damage by fire or casualty only excepted, and whenever necessary, to replace light bulbs (after the first six months of the term),

interior plate glass and other glass therein, acknowledging that the Leased Premises upon delivery and acceptance by LESSEE on the Delivery Date (except for latent defects and Punch List Items) are in good order and the light bulbs and glass whole. LESSEE shall be responsible for the periodic inspection and maintenance of all laboratory specific mechanical equipment in the Leased Premises throughout the Lease Term, and shall (at its sole cost and expense) retain the services of an outside third party maintenance contractor toward this end). LESSEE will properly control or vent all solvents, degreasers, and the like and shall not cause the area surrounding the Leased Premises to be in anything other than a neat and clean condition, depositing all waste in appropriate receptacles. LESSEE shall not permit the Leased Premises to be overloaded, damaged, stripped or defaced, suffer any waste of the Leased Premises. "Any maintenance which is the responsibility of LESSOR and which is necessitated by some specific aspect of LESSEE'S negligent or reckless use of the Leased Premises shall be at LESSEE'S expense (subject to the last paragraph of Section 17). All maintenance provided by LESSOR shall be performed as reasonably required at LESSOR'S discretion and except for emergencies, during LESSOR'S normal business hours. Except as otherwise permitted herein, LESSEE may not keep any animals on the Leased Premises without prior written notice to and approval from LESSOR in each instance, which approval may be denied or conditioned in LESSOR'S discretion. LESSEE shall be solely responsible for maintenance and operation of any and all of its systems installed by the LESSEE and shall waive any and all claims against LESSOR for any damage, impairment, or loss relative to these systems unless such damage is caused by the acts or negligent or reckless acts of LESSOR. Specifically, LESSEE shall maintain, at its sole expense, and pay all charges for electrical service and use of all LESSEE'S equipment associated with its operation.

LESSOR shall provide: (a) for maintenance, repair and upkeep for the landscaping on the property; (b) janitorial services in the common areas; (c) hot and cold water for lavatories, restrooms, kitchenettes and potable water; (d) its standard security system into the Building (LESSEE to be responsible for installation, monitoring, maintenance and repair of its own security system into the Leased Premises from the adjacent common areas, and to coordinate the means of emergency access into the Leased Premises with LESSOR; LESSOR to reasonably cooperate with LESSEE to the extent reasonably possible (without additional cost to LESSOR)).

11. Delivery to Lessee - Lessee's Alterations to Leased Premises -Emergency Generator Alternatives - Shared Systems Alternatives - Lessee's Additional HVAC and Other Equipment - Lessee's Acid Neutralization System

The Leased Premises are to be delivered to LESSEE on the Delivery Date in the condition set forth in this Section 11 and Sections 8 and 32 hereof.

LESSEE may make its initial improvements to the Premises at LESSEE'S sole cost and expense as set forth in Section 32.

Other than the initial improvements made by LESSEE in accordance with Section 32, LESSEE shall not make structural alterations or additions of any kind to the Leased Premises, but may make nonstructural alterations provided LESSOR consents thereto in writing, said consent not to be unreasonably withheld, conditioned or delayed. Plans and specifications for any of LESSEE'S potential improvements shall be submitted by LESSEE to LESSOR in each instance,

in advance of any proposed work, in sufficient detail and scope to enable LESSOR to make a reasonable determination thereon. All such allowed alterations shall be at LESSEE'S expense and shall be in quality at least equal to the present construction. If LESSOR performs any services for LESSEE in connection with such alterations or otherwise, LESSEE shall reimburse LESSOR for LESSOR'S actual and reasonable out-of-pocket costs for such services and any invoice therefor will be promptly paid. LESSEE shall be responsible to use such contractors as will ensure harmonious labor relations in the Building and on the site; and to prevent strikes, work stoppages, picketing and other labor actions. LESSEE shall submit a list of its contractors to LESSOR in advance. LESSEE shall provide LESSOR with acceptable general liability and builder's risk insurance certificates naming LESSOR and its lender as additional named insureds prior to the commencement of any work by LESSEE. LESSEE shall not permit any mechanics liens, or similar liens, to remain upon the Leased Premises in connection with work of any character performed or claimed to have been performed at the direction of LESSEE and shall cause any such lien to be released, removed or bonded forthwith without cost to LESSOR. Any alterations completed by LESSEE, including, without limitation, window blinds or other window treatment, shall be building standard unless LESSOR expressly agrees otherwise. Any and all installations by LESSEE shall become a part of the Leased Premises and LESSEE shall not remove the same either during the Term or at the expiration or earlier termination of this Lease, unless directed to do so by LESSOR at the time such Alterations are approved; except that LESSEE shall have the right to remove any hard-wired or hard-plumbed equipment purchased, paid for and installed by LESSEE itself, such as chemical fume hoods, as long as LESSEE restores the Leased Premises to the condition that it was in prior to the installation of such equipment. Notwithstanding the foregoing or any provision to the contrary contained herein, (i) LESSEE shall retain title to and be entitled to remove any movable office furniture, equipment, trade fixtures, portable bio hoods, and other personal property at the Premises, provided the Leased Premises and any common areas impacted thereby are restored to their original condition prior to such installations; (ii) LESSEE shall retain title to and be entitled to remove its emergency generator, provided the Leased Premises and any common areas impacted thereby are restored to their original condition prior to such installation; (iii) LESSEE shall not be required to remove from the Premises any portion of the LESSOR'S Build-Out; and (iv) LESSEE shall be entitled to receive from LESSOR, a statement at the time LESSEE makes any improvements to the Leased Premises as to whether the item or items being installed will be required to be removed by LESSEE at the expiration or earlier termination of the Lease. LESSOR shall have the right at any time to change the arrangement of parking areas, stairs, walkways or other common areas of the Building of which the Leased Premises are apart, provided such changes do not interfere with LESSEE'S use of the Leased Premises or access to such areas and facilities (including, without limitation, the Building and the Premises), or any other right of LESSEE hereunder.

During the Lease Term LESSEE shall have the option to (a) share use of the existing emergency generator (owned by LESSOR) currently servicing the tenant(s) on the third floor ("Landlord's Generator"), in which case LESSEE shall be responsible to share in the costs and expenses of repairs, maintenance, servicing and operation thereof, pro rata with other actual users, and enter into LESSOR'S standard side agreement with respect thereto (attached hereto as Exhibit H); or, (b) provide its own emergency generator, at its sole cost and expense (including installation and connection), in a location to be mutually agreed upon between LESSOR and LESSEE; with all costs and expenses of repairs, maintenance, servicing and operation to be borne solely by

LESSEE; or (c) if the existing emergency generator (as currently located, "Existing Generator") on the Leased Premises is transferred to LESSOR by the current tenant at the end of its occupancy, use said Existing Generator surrendered to LESSOR, at LESSEE'S sole cost and expense for connection thereto and with all costs and expenses of repairs, maintenance, servicing and operation to be borne solely by LESSEE. LESSOR does not provide any representations or warranties relative to any of the options selected by the LESSEE above, nor shall LESSOR be responsible, directly or indirectly, for any consequences arising from LESSEE'S election of any of said options or the suitability or performance of the emergency generator under any of the above scenarios; LESSEE to be solely responsible therefor at its sole risk. Under any of the three scenarios above, LESSEE shall be responsible at its sole cost and expense to provide an appropriate electrical subpanel for its specific emergency generator feeds.

During the Lease Term LESSEE shall have the option to share certain existing laboratory support systems (owned by LESSOR) including (i) compressed air/vacuum; (ii) RODI water system; and (iii) nitrogen generator) currently servicing, shared by and used by other the tenants) in the Building; in which case LESSEE shall be responsible to share in the costs and expenses of repairs, maintenance, servicing and operation thereof, pro rata with other actual users, and enter into LESSOR'S standard side agreement with respect thereto (attached hereto as Exhibit I). LESSOR does not provide any representations or warranties relative to any of the options selected by the LESSEE above, nor shall LESSOR be responsible, directly or indirectly, for any consequences arising from LESSEE'S election of any of said options or the suitability or performance of any of the equipment or systems related thereto, under any of the above scenarios; LESSEE to be solely, responsible therefor at its sole risk.

During the Lease Term LESSEE shall have the option to procure and install, at its sole cost and expenses in all instances, additional HVAC equipment, antennas, satellite dishes and related accessory equipment and connections on the roof of the Building, in locations that LESSOR deems acceptable in its sole discretion, and to tie-in said equipment to the New Leased Premises through areas of the Building that LESSOR deems acceptable in its sole discretion. LESSOR does not provide any representations or warranties relative to any of the options selected by the LESSEE above, nor shall LESSOR be responsible, directly or indirectly, for any consequences arising from LESSEE'S election of any of said options or the suitability or performance of any of such equipment or installations, under any of the above scenarios; LESSEE to be solely responsible therefor at its own risk.

During the Lease Term LESSEE shall have exclusive use of the existing acid neutralization system in the Leased Premises, with all costs and expenses of repairs, maintenance, servicing and operation to be borne solely by LESSEE. LESSOR does not provide any representations or warranties relative to this system, nor shall LESSOR be responsible, directly or indirectly, for any consequences arising from LESSEE'S repairs, maintenance, servicing or operation of said system; LESSEE to be solely responsible therefor at its sole risk.

During the Lease Term LESSEE shall be solely responsible to apply for and procure and maintain any and all permits and government authorizations for its installation, operation and use of any of the equipment and systems set forth above (e.g. MWRA permit for the acid neutralization system, etc.); and shall indemnify the LESSOR for any and all damages arising from its failure to do so.

12. Assignment and Subletting. LESSEE covenants and agrees that neither this Lease nor the Term and estate hereby granted, nor any interest therein will be assigned, mortgaged, pledged, encumbered or otherwise transferred, and that neither the Leased Premises, nor any part thereof, will be encumbered in any manner by reason or by act or omission of LESSEE, or used or occupied, or permitted to be used or occupied, by anyone other than LESSEE, its servants, agents, contractors and employees, or for any use or purpose other than as above stated, or be sublet, without in each case LESSOR'S prior written consent, which shall not be unreasonably withheld or delayed. Notwithstanding the foregoing, LESSOR'S prior written consent shall not be required for any assignment or sublet to an wholly or majority owned affiliate or subsidiary of the LESSOR, or any entity succeeding to LESSOR as a direct result of a merger or consolidation or asset or stock transfer or issuance of stock by LESSEE ("Permitted Transfer").

The grounds upon which LESSOR may reasonably withhold its consent are as follows:

- (i) The prospective assignee's or sub-lessee's intended use of the Premises is not identical to the permitted uses set forth in the Lease; or,
- (ii) The nature, character, class and standards of the prospective assignee's or sublessee's business will not be consistent with those of other lessees in the Building or will not conform to the mix of other lessees in the Building at that time; or,
- (iii) The financial strength and reliability of the prospective assignee or sublessee, excluding any additional personal or corporate guarantees, is not sufficient, in LESSOR'S reasonable business judgment, to meet all of LESSEE'S obligations to be performed as of and from the date of said assignment or sub-letting. The prospective assignee or sub-lessee must produce to LESSOR'S accountants a verified and current audited financial statement, (or if none has been prepared by said prospective assignee within the past three years, a CPA certified current financial statement), and such other documentation as is material in making such determination; which shall be kept confidential by them; or,
- (iv) The operations of the prospective assignee or sub-lessee will violate any exclusive or other rights given any other lessees in the Building.
- (v) The failure of LESSOR's mortgage lender(s) to consent (if and to the extent required in Landlord's mortgage loan documents).

Except in the case of a Permitted Transfer, LESSOR, in addition to Annual Base Rent and all Additional Rent hereunder, shall be entitled to fifty (50%) percent of the full amount of any and all sums assessed or collected by LESSEE, in whatever form, attributable to or arising from the permitted subletting or assignment, after deduction only for reasonable brokerage commissions and reasonable legal fees actually incurred, (herein, "Rent Mark-Up").

Notwithstanding LESSOR'S consent to the assignment or subletting, as contemplated above, LESSEE shall remain primarily liable to LESSOR for the payment of all Rent and for the full

performance of the covenants and conditions of this Lease; and LESSOR may collect all sums due as Rent directly from the assignee/subtenant.

Notwithstanding the foregoing, in the event that LESSEE desires to sublet the Leased Premises or any portion thereof, other than in connection with a Permitted Transfer, it shall in each instance notify the LESSOR in writing, stating the intended effective date of the proposed sublet (which shall not be less than 60 days from the date of said notice to LESSOR). Subject to the preceding sentence, if the proposed sublease itself (or cumulatively with other approved subleases) accounts for the sublease of greater than fifty (50%) percent of the area of the Leased Premises, or if there are more than two then existing subtenants, then LESSOR shall have a period of 60 days from the date it receives such notice to exercise an election to take back the Leased Premises, in LESSOR'S sole discretion and without any obligation to so elect, whatsoever, notwithstanding the circumstances, and without prejudice to or waiver of any of LESSOR's rights or LESSEE'S continuing obligations hereunder. LESSEE shall provide LESSOR with all reasonably material information relative to LESSOR making an informed decision concerning said sublet, immediately upon LESSOR's request. If LESSOR elects to take back the Premises, it shall send written notice thereof to LESSEE; and LESSEE shall be irrevocably bound to surrender and vacate the Premises as if the Term of the Lease had expired on the date set forth in the LESSEE'S initial notice to LESSOR; and provided LESSEE vacates and surrenders on said date, without being in default (of which LESSEE has been provided written notice) of any provision hereof as of said date, this Lease shall be null and void and without recourse to either party hereto (but for terms and conditions contemplated herein to survive termination of this Lease). LESSEE shall not be entitled to any payments, commissions, credits, offsets, or any kind or nature arising from said sublet, nor shall any individual or entity acting by, through, or under LESSEE be so entitled. Once an election is made by LESSOR, LESSEE shall be subject to the penalties for holding over set forth in this Lease, if it fails to vacate and surrender the Premises by the date stated in the notice, or if it fails to discharge (or cause its lenders or others with which LESSEE has dealt to discharge) any and all recorded liens or other encumbrances, notices, or restrictions on its leasehold or contractual interest in and to the Premises as of said date. Nothing in this paragraph shall require LESSOR to make an election to take back the Premises, and nothing in the aforesaid process shall relieve LESSEE of its liability under this Lease should LESSOR elect not to take back the Premises.

13. Subordination. This Lease shall be subject and subordinate to any and all mortgages and related documents placed on the Building, Leased Premises or the real property in existence as of the date hereof or coming into existence at any time hereafter. LESSEE shall upon execution of this Lease execute and deliver LESSOR'S lender's form of Subordination Nondisturbance and Attornment Agreement, substantially in the form attached hereto as Exhibit F ("Lender's SNDA Form"), and LESSOR shall use commercially reasonable efforts to procure execution thereof from its current lender and provide a fully executed original to LESSEE. LESSOR'S inability to provide the same despite its commercially reasonable efforts to do so shall not be deemed to be a default under this Lease. LESSOR shall be deemed to have used "commercially reasonable efforts" in the foregoing instance if it makes a prompt request in writing for execution of such Lender's SNDA Form upon the Lease Execution Date (with a copy to LESSEE); makes at least weekly phone inquiries to the lender or loan servicers as to the status of execution, by its counsel or in house leasing manager; and to the extent required by lender or loan servicer pays any required reasonable loan servicing fee. Further, at any other time during

the Term, LESSEE shall within fifteen (15) days after written request from LESSOR, execute and deliver the LESSEE'S Lender's SNDA Form to LESSOR who shall use commercially reasonable efforts to procure execution thereof from its then current lender(s) and provide a fully executed original to LESSEE, LESSOR'S inability to provide the same despite its commercially reasonable efforts to do so shall not be deemed to be a default under this Lease,

14. Lessor's Access to Leased Premises. LESSOR or agents of LESSOR may at reasonable times and upon reasonable notice (except in case of emergency) enter to view the Leased Premises and may remove any signs not approved and affixed as herein provided, and may make repairs and alterations as LESSOR is permitted to perform under this Lease and repairs which LESSEE is required but has failed to do (but only after notice and an opportunity to repair being provided to LESSEE), and may show the Leased Premises to prospective mortgagees and appraisers, and during the last twelve (12) months of the Term to brokers, and others and to prospective tenants. Additionally, to the extent necessary to service other portions of the Premises or the common areas or other tenant spaces in the building; LESSOR may add, relocate, or maintain a chase, pipes, conduits, or ducts, within the Premises provided the aforesaid do not materially interfere with LESSEE'S use of the Premises or its aesthetics. If any such addition or relocation reduces the space available for use by LESSEE, the amount of Annual Base Rent and LESSEE'S Allocable Percentage for Operating Expenses and Taxes shall be reduced accordingly. Any entry by LESSOR onto the Premises for this purpose shall be done in such manner as to minimally interfere with the business conducted thereon by LESSEE, and undertaken with reasonable steps to protect LESSEE'S property.

15. Snow Removal. LESSOR will be responsible for the removal or other treatment of snow and ice on walkways, sidewalks, entryways and parking areas.

16. Access and Parking. LESSEE shall be granted the right, at current rates (which may be increased from time to time to reflect market increases), to park up to sixteen (16) motor vehicles in the Building's on-site indoor parking lot or facility on an unassigned and unreserved basis, in single or tandem spaces or on a valet basis which LESSOR in its sole discretion shall designate from time to time. The initial parking rate therefor shall be \$ 210 per month, per car, which monthly rate may be changed by LESSOR in its discretion subject to and reflective of periodic market changes in accordance with this paragraph. All payments for these parking rights shall be considered to be Additional Rent under this Lease. The Building garage, plus any stairs, walkways or other means of ingress or egress controlled by the LESSOR shall not in any case be considered extensions of the Leased Premises. LESSEE will not obstruct in any manner any portion of the Building or the walkways or approaches to the Building, and will conform to all reasonable and non-discriminatory rules now or hereafter made by LESSOR for parking, and for the access and egress, security, care, use, or alteration of the Building, its facilities and approaches in connection with such parking, provided the same do not decrease LESSEE'S parking rights hereunder. LESSEE further warrants that LESSEE will not permit any employee or visitor to violate this or any other covenant or obligation to LESSEE. No vehicles shall be stored or left in any parking area for more than three nights without LESSOR'S written approval. Unregistered or disabled vehicles, or storage, trailers of any type, may not be parked overnight at any time. LESSEE agrees to assume all expense and risk for the towing of any misparked vehicle belonging to LESSEE or LESSEE'S agents, employees, business invitees, or callers, at any time. For the purpose of this section the term "space" shall mean general access for one

motor vehicle. All vehicles shall be parked and left on the premises at their owners' sole risk and LESSOR shall not be liable for any damages caused to said vehicles while they are parked or left on the premises.

17. Liability Insurance. Except to the extent caused by or arising as a result of the negligence or willful misconduct of Lessor or its agents, contractors or employees, LESSEE shall be solely responsible as between LESSOR and LESSEE for deaths or personal injuries to all persons whomsoever occurring in or on the Leased Premises from whatever cause arising, and damage to property to whomsoever belonging arising out of the use, control, condition or occupation of the Leased Premises by LESSEE; and LESSEE agrees to indemnify and save harmless LESSOR from any and all liability, reasonable expenses, damage, causes of action, suits, claims or judgments caused by or in any way growing out of any matters aforesaid. LESSOR shall be solely responsible as between LESSOR and LESSEE for deaths or personal injuries to all persons whomsoever occurring in or on the Leased Premises, Building, or the property on which the Building is located resulting or arising from any negligent act or omission by LESSOR, and damage to property to whomsoever belonging arising out of any negligent act or omission by LESSOR; and LESSOR agrees to indemnify and save harmless LESSEE from any and all liability, reasonable expenses, damage, causes of action, suits, claims or judgments caused by or in any way growing out of any matters aforesaid. LESSEE will secure and carry at its own expense a commercial general liability policy insuring LESSEE, LESSOR (and its lenders and any other entity reasonably requested in writing by LESSOR) against any claims based on bodily injury (including death) arising out of the condition of the Leased Premises or their use by LESSEE, such policy to insure LESSEE, LESSOR and said other entities against any claim up to Two Million (\$2,000,000.00) Dollars per occurrence for personal injury or damage to property. LESSOR and its lenders shall be included in such policy as additional insureds. LESSEE will promptly file with LESSOR certificates showing that such insurance is in force, and thereafter will file renewal certificates prior to the expiration of any such policies. All such insurance certificates shall provide that such policies shall not be canceled without at least thirty (30) days prior written notice, except in the event of cancellation for nonpayment of premium, whereby ten (10) days' prior notice will be provided to each insured named therein.

LESSOR shall maintain in full force from the date upon which LESSEE first enters the Premises for any reason, throughout the Term, a policy of insurance upon the Building insuring against all risks of physical loss or damage under an All Risk coverage endorsement in an amount at least equal to the full replacement value of the Building insured, with an Agreed Amount endorsement to satisfy co-insurance requirements, as well as insurance against breakdown of boilers and other machinery as customarily insured against. LESSOR shall supply to LESSEE from time to time upon request of LESSEE certificates of all such insurance issued by or on behalf of the insurers named therein by a duly authorized agent.

LESSOR and LESSEE waive all rights of recovery against the other and its respective officers, partners, members, managers, agents, representatives, and employees for loss or damage to its real and personal property kept in the Building which is required to be insured by such party hereunder. Each party shall notify the insurance carrier that the foregoing waiver is contained in this Lease and shall obtain an appropriate waiver of subrogation provision in the policies.

18. Fire, Casualty, Eminent Domain. Should a substantial portion of the Leased Premises, or of the property of which they are a part, be substantially damaged by fire or other casualty, or be taken by eminent domain (in either case such that restoration of the Premises within six (6) months after such event is not practicable), LESSOR or LESSEE may elect to terminate this Lease by written notice. When such fire, casualty, or taking renders the Leased Premises substantially unsuitable for their intended use and no termination has been elected, a just and proportionate abatement of rent shall be made, and LESSEE may elect to terminate this Lease if: (a) LESSOR fails to give written notice within ninety (90) days of intention to restore Leased Premises, or (b) LESSOR fails to restore the Leased Premises to a condition substantially suitable for their intended use within one hundred eighty (180) days of said fire, casualty or taking. LESSOR reserves all rights for all damages or injury to the Leased Premises for any taking by eminent domain; except for damage to LESSEE'S moveable fixtures, property or equipment, or moving expenses, which are specifically allocated to LESSEE by the taking authority or arbitrators.

19. Brokerage. LESSEE and LESSOR each warrants and represents to the other that they have dealt with no broker or third person with respect to this Lease or the Leased Premises or Building entitled to a commission as a result of this Lease, other than Cushman & Wakefield, whose fees shall be paid by LESSOR pursuant to separate written agreements; and LESSOR and LESSEE each agree to indemnify and hold harmless the other from any fees, expenses, or damages arising from breach of the above warranty.

20. Signage. LESSEE shall have the right to have its name included at LESSOR'S expense in any central directory maintained by LESSOR listing the Building's other tenants. LESSOR authorizes LESSEE, if desired, to display one sign on LESSEE'S office entrance door (at LESSEE'S expense) consistent with similar signs of other tenants.

21. Default. In the event that: (a) LESSEE shall default in the payment of the Security Deposit Amount or any installment of Annual Base Rent or any Additional Rent, and such default shall continue for five (5) days after written notice thereof; or (b) LESSEE shall default in the observance or performance of any other of LESSEE'S covenants, agreements, or obligations hereunder and such default shall not be corrected within thirty (30) days after written notice thereof; provided, however, that if such failure cannot reasonably be cured within such 30-day period, then LESSEE shall not be in default if, and so long as, LESSEE commences such cure within such 30-day period and thereafter diligently pursues such cure to completion (provided there is no material interference with the operations of the Building or any tenant therein during such protracted cure period); (c) LESSEE shall be declared bankrupt or insolvent according to law, or if any voluntary or involuntary petition for bankruptcy is filed against LESSEE and not discharged within sixty (60) days from filing; or if any assignment shall be made of LESSEE'S property for the benefit of creditors; then, while such default continues, and without demand or further notice, LESSOR shall have the right to re-enter and take complete possession of the Leased Premises, to declare the term of this Lease ended, and to remove LESSEE'S effects, without being guilty of any manner of trespass and without prejudice to any remedies which might be otherwise used for arrears of rent and other default of breach of covenant LESSEE shall indemnify LESSOR against all loss of Rent and other payments, which LESSOR may incur by reason of such termination during the remainder of the term, it being expressly understood that LESSOR shall use reasonable efforts to relet the Leased Premises and

20

collect all rents from such reletting. If LESSEE shall default, after reasonable notice thereof, in the observance or performance of any conditions or covenants on LESSEE'S part to be observed or performed under or by virtue of any one of the provisions in any section of this Lease, LESSOR, without being under any obligation to do so and without thereby waiving such default, may after the expiration of any applicable cure period, remedy same for the account and at the expense of LESSEE, (including but not limited to application of any or all of the Security Deposit held by LESSOR). If LESSOR pays or incurs any obligations for the payment of money in connection therewith, including but not limited to reasonable attorney's fees in instituting, prosecuting or defending any action or proceeding, such sums paid or obligations incurred, with interest at the rate of eight (8%) percent per annum and costs, shall be paid to LESSOR by LESSEE as additional rent. Upon default of this Lease by LESSEE, and because the payment of Rent in Monthly installments is for the sole convenience of LESSEE, the entire balance of Rent which would accrue hereunder shall, at the option of the LESSOR, become immediately due and payable; subject however to LESSOR'S obligation to use reasonable efforts to mitigate its damages occasioned by said default. LESSEE shall be responsible to pay reasonable attorneys fees incurred by LESSOR in any successful action by LESSOR for delinquent Rent or in the case of liquidated damages as aforesaid; and otherwise both LESSOR and LESSEE shall be entitled to such reasonable attorneys fees as a court of competent jurisdiction may award as part of its final judgment in the event of any dispute involving damages, injunctive relief or specific performance by either.

Notwithstanding any provision to the contrary contained herein, (i) in no event shall LESSEE be responsible for punitive or consequential damages incurred by LESSOR as a result of any act (or failure to act) by LESSEE, and (ii) in no event shall LESSOR be responsible for punitive or consequential damages incurred by LESSEE as a result of any act (or failure to act) by LESSOR.

22. Notices. Any notice from LESSOR to LESSEE relating to the Leased Premises or to the occupancy thereof shall be deemed duly served if sent to the Leased Premises by either certified mail, return receipt requested, postage prepaid, or by recognized overnight commercial delivery service (e.g. FedEx), addressed to LESSEE at the Leased Premises. Any notice from LESSEE to LESSOR relating to the Leased Premises or to the occupancy thereof shall be deemed duly served if delivered to LESSOR by certified mail, return receipt requested, postage prepaid, or by recognized overnight commercial delivery service (e.g. FedEx), addressed to: Rivertech Associates TL INC. (Attn: Dan Garvey, CFO) c/6 The Abbey Group 575 Boylston Street, Boston, Massachusetts 02116, with a copy to Christopher C. Tsouros, Esq., Posternak Blankstein & Lund LLP Prudential Tower 800 Boylston Street Boston, Mass. 02199. Notices shall be deemed given at the earlier of the date of actual delivery, or if by certified mail, three (3) business days after posting with the U.S. Postal Service. Time is of the essence in delivery of any notice, and the performance of any obligations relating thereto. Either party may designate a different address to which notice is to be sent by providing a notice of address change to the other in accordance with this Section 22. Prior to the Delivery Date, LESSEE'S notice address shall be LESSEE'S address set forth at the beginning of this Lease.

23. Lessee's Occupancy. In the event that LESSEE remains in any part of the Leased Premises after the agreed termination date of this Lease without the written permission of LESSOR, then all other terms of this Lease shall continue to apply, except that LESSEE shall be liable to LESSOR for any loss, damages or expenses incurred by LESSOR, and all Annual Base

21

Rent shall be due in monthly installments at a rate of two hundred (200%) percent of that which would otherwise be due under this Lease, it being understood between the parties that such extended occupancy as a tenant at sufferance.

24. Rules and Regulations. LESSEE and LESSEE'S servants, employees, agents, invitees and licensees shall observe faithfully and comply strictly with such reasonable and non-discriminatory rules and regulations governing the use of the Building and site and all common areas as LESSOR may from time to time, adopt, provided that a copy of such rules and regulations has been delivered to LESSEE.

25. Outside Area Limitations. No goods or things of any type or description shall be held or stored outside the Leased Premises at any time without the express written approval of LESSOR, except bicycles which shall be stored only in the bicycle rack to be provided by LESSOR

26. Environmental Compliance. LESSEE will so conduct and operate the Leased Premises as not to interfere in any way with the use and enjoyment of other portions of the same or neighboring buildings by others, by reason of offensive odors, smells, noise, accumulation of garbage or trash, vermin or other pests or otherwise and will, at its expense, employ a professional pest control service if necessary as a result of LESSEE'S operations. LESSEE agrees to maintain efficient and effective device for preventing damage to heating equipment from harmful solvents, degreasers, cutting oils, and the like, which may be used within the premises. Except in accordance with applicable laws and except as otherwise provided herein, no hazardous wastes, radioactive materials or chemical or harmful biological agents or materials of any sort shall be stored or allowed to remain within the Leased Premises at any time, without LESSOR'S prior notice and consent, which consent shall not be unreasonably withheld or delayed.

Prior to vacating the Leased Premises at the end of the Term (or any applicable extension), or sooner in the event of a default hereunder, LESSEE at its sole cost and expense shall provide LESSOR and Owner with environmental audit by qualified environmental engineering firm reasonably satisfactory to LESSOR (the "Exit Study"). Liability for any remedial actions required or recommended on the basis of the Exit Study to address materials introduced by LESSEE or parties claiming under LESSEE shall be borne by LESSEE; the parties acknowledging the foregoing liability shall accrue once LESSEE has received and reviewed an exit study (to be provided by LESSOR to LESSEE prior to and as condition of the Delivery Date) showing the then existing environmental condition of the Leased Premises to be free from any harmful hazardous materials or contaminants, and accepts the same in all respects. LESSOR shall indemnify, defend and hold LESSEE harmless from and against any and all claims, losses, damages, liabilities, costs, legal fees and expenses of any sort arising out of or relating to (i) the presence on the Premises, Building or the property on which the Building is located of any hazardous substances, hazardous wastes, pollutants, radiation or radioactive materials present at the Premises, Building or the property on which the Building is located as of the Delivery Date, and/or (ii) any release into the environment (including, but not limited to, the Building or the property on which the Building is located) of any hazardous substances, hazardous wastes, pollutants, radiation or radioactive materials to the extent such release results from the negligence of or willful misconduct or omission by LESSOR or its agents or employees.

27. Responsibility. Neither LESSOR nor LESSEE shall be held liable to anyone for loss or damage caused in any way by the use, leakage or escape of water or, except as otherwise provided herein, for cessation of any service rendered customarily to said Leased Premises or buildings or agreed to by the terms of this Lease, due to labor difficulties, weather conditions, or mechanical breakdowns, to trouble or scarcity in obtaining fuel, electricity, service or supplies from the sources from which they are usually obtained for said Building, or to any cause beyond such party's reasonable control.

28. Surrender. Subject to and without limiting Section 11 above, LESSEE shall at the expiration or other termination of this Lease remove all of LESSEE'S goods and effects from the Leased Premises. Subject to and without limiting Section 11 above, LESSEE shall deliver to LESSOR the Leased Premises and all keys, locks, thereto, and other fixtures and equipment connected therewith, and all alterations, additions and improvements made to or upon the Leased Premises, including but not limited to any offices, partitions, cold room, plumbing and plumbing fixtures, air conditioning equipment and ductwork of any type, exhaust fans or heaters, burglar alarms, telephone wiring, wooden or metal shelving which has been bolted, welded or otherwise attached to any concrete or steel member of the Building, compressors, air or gas distribution piping, cabinetry, overhead cranes, hoists, trolleys or conveyors, counters or signs attached to walls or floors, and all electrical work, including but not limited to lighting fixtures of any type, wiring, conduit, EMT, distribution panels, bus ducts, raceways, outlets and disconnects, and excluding the compressors, and any built-in component work stations that LESSEE may install during the term, but excluding any Alterations designated under Section 11 at the time of their approval to be removed by LESSEE and further excluding any hard-wired or hard-plumbed equipment purchased, paid for and installed by LESSEE, such as chemical fume hoods, as long as LESSEE restores the Leased Premises to the condition that it was in prior to the installation of such equipment LESSEE shall deliver the Leased Premises reasonable wear and tear and damage by fire or other casualty only excepted. In the event of LESSEE'S failure to remove any of LESSEE'S property from the premises, LESSOR is hereby authorized, without liability to LESSEE for loss or damage thereto and at the sole risk of LESSEE to remove and store any such property at LESSEE'S expense, or to retain same under LESSOR'S control or to sell at public or private sale, without notice, any or all of the property not so removed and to apply the net proceeds of such sale to the payment of any sum due hereunder, or to destroy such property which shall be conclusively deemed to have been abandoned.

29. Quiet Enjoyment. So long as this Lease is in full force and effect, LESSEE shall quietly enjoy the Leased Premises without hindrance or molestation by LESSOR or any party claiming by, through or under LESSOR or any party claiming a superior interest to the LESSOR.

30. Miscellaneous Provisions. The invalidity or unenforceability of any provision of this Lease shall not affect or render invalid or unenforceable any other provision hereof. The obligations of this Lease shall run with the land, and this Lease shall be binding upon and inure to the benefit of the parties hereto and their respective successors and assigns, except that LESSOR shall be liable only for obligations occurring while LESSOR is landlord hereunder. The obligations of LESSOR and LESSEE hereunder shall not be binding upon any director, officer, shareholder, partner, Trustee or beneficiary of such party. Notwithstanding the definition herein of "Commencement Date", "Termination Date", or "Term", or LESSOR'S obligations to

deliver the Premises, this Lease shall be binding and enforceable as against the parties hereto as of the date of its execution.

31. Waivers and Legal Limitations. No consent or waiver, express or implied, by LESSOR or LESSEE, to or of any other breach of the other party of any covenant, condition or duty of that party shall be construed as a consent or waiver to or of any other breach of the same or any other covenant, condition or duty. If LESSEE is several persons or a partnership, LESSEE'S obligations are joint or partnership and also several. Unless repugnant to the extent. "LESSOR" and "LESSEE" mean the person or persons, natural or corporate, named above as LESSOR and as LESSEE respectively, and their respective heirs, executors, administrators, successors and assigns. In any case where either party is required to do any act other than the payment of Rent, delays caused by or resulting from acts of god, war, civil commotion, acts of terrorism, fire, flood or other casualty, labor strikes or picketing, shortages of labor, materials or equipment, unusual or onerous government regulations, unusually severe weather or other causes beyond such party's reasonable control shall not be counted in determining the time during which such act shall be completed, whether such time be designated as a fixed date, a fixed time, or a "reasonable time" and such time shall be deemed to be extended by the period of such delay,

32. Lessor's Delivery of the Leased Premises; Early Access. LESSOR shall substantially complete the work set forth on Exhibit D (the "LESSOR'S Build-Out") at LESSOR'S sole cost and expense, prior to delivery of the Lease Premises to LESSEE on or before the Delivery Date as determined under Section 1 hereof The Delivery Date shall be established by delivery of a notice to LESSEE informing it that the LESSOR'S Build-Out is substantially complete pursuant to the foregoing, and by turning over the Leased Premises to the LESSEE (the 'Delivery Notice'), which Delivery Notice shall be delivered to LESSEE at least two (2) days prior to the Delivery Date; provided, however, that the LESSOR'S Build-Out shall not be deemed substantially complete and the Delivery Date shall not be deemed to occur unless and until all LESSOR'S Build-Out has been performed, other than any routine details of construction, the non-completion of which does not materially interfere with LESSEE'S use of the Premises (the "Punch List Items"). Following delivery of the Delivery Notice, LESSEE shall have the right to inspect the Leased Premises with LESSOR for purposes of agreeing upon the Punch List Items. With the exception of the Punch List Items and any latent defects, LESSEE shall be deemed to have accepted the condition of the Premises upon the delivery of LESSOR'S Delivery Notice as of the Delivery Date. LESSOR represents that it currently has a Certificate of Occupancy for the 3rd floor of the Building allowing use for general office, which includes laboratory use, and upon performance of LESSOR'S Build-Out and delivery of the Leased Premises on the Delivery Date, LESSEE may use the Premises for its Permitted Uses; subject however to requirements arising from alterations LESSEE may perform after the Delivery Date, and any other permits that are LESSEE'S responsibility hereunder to identify, procure and maintain.

LESSOR shall deliver the Leased Premises on the Delivery Date in its "AS/IS" condition (subject to the LESSOR'S Build Out requirements) in all respects and without representations or warranties of any kind or nature, except as otherwise set forth herein, and subject to the following requirements: (i) the Leased Premises conforms to LESSOR'S standard Building specifications and complies with applicable laws, codes and ordinances, including without limitation the Americans with Disabilities Act, (ii) all base building systems serving the Leased Premises, including without limitation electrical, plumbing and HVAC systems, are in good

operating condition and repair, and (iii) the laboratory-specific mechanical, electrical, HVAC and plumbing systems within or serving the Leased Premises are delivered in good operating condition and repair. Additionally, on the Delivery Date the Leased Premises shall be delivered with a separate acid neutralization system for LESSEE’S exclusive use as contemplated in Section 11 hereof, and expressly subject to LESSEE’S obligation to obtain its own MWRA permit therefor. LESSOR shall complete the Punch List Items after the Delivery Date, in a timely and complete fashion, in a manner that does not interfere with LESSEE’S use and occupancy of the Premises, and in any event within thirty (30) days of the Delivery Date (subject to availability of labor and materials, and any Force Majeure occurrences).

LESSEE shall have the right of early access to the intended laboratory portion of the Leased Premises (the “Early Access Lab Area”), to perform LESSEE’S work therein as set forth in Section 32, without obligation to pay any Rent, approximately twenty one (21) days prior to the actual Delivery Date, upon written notice from LESSOR. LESSOR shall use reasonably diligent efforts to complete its Landlord’s Work in said Early Access Lab Area to conform to this timeframe. Such early access to the Early Access Lab Area will be subject to the program set forth in Exhibit G hereto.

Additionally, provided that LESSEE does not interfere with any LESSEE Build-Out work being performed by LESSEE or its contractors, LESSEE shall have the right to limited access the Leased Premises prior to the Delivery Date (but at all times through and in coordination with the LESSOR) to make its initial improvements to the Premises, including but not limited to installing cabling and related equipment for voice, data and security systems and equipping the Premises for laboratory and research use, and upon LESSOR’S approval of LESSEE’S plans and specifications as contemplated above for any other work. LESSEE shall deliver copies of LESSEE’S plans and specifications for its cabling work for voice, data and security prior to the commencement of such work by LESSEE, subject to LESSOR’S approval which approval shall not be unreasonably withheld, conditioned or delayed, s LESSEE’S customized improvements to the Leased Premises, including without limitation all cabling and laboratory equipment shall be provided and installed at LESSEE’S sole cost and expense.

Notwithstanding any provision to the contrary contained in this Lease, LESSEE shall also be entitled to reasonable access to the Leased Premises from time to time, through and accompanied by the LESSOR, upon execution of this Lease for the purpose of planning its interior design and layout.

33. Option to Extend. LESSEE, provided there has been no default of LESSEE under this Lease beyond any applicable notice and cure periods more than twice during the original Lease Term, and provided there is then no default of LESSEE under this Lease beyond applicable notice and cure periods, shall have the option to extend the Term of this Lease as to the Leased Premises, on the terms and conditions herein, for one additional period of thirty six (36) months (herein, the “Extended Term”) at the then current “Market Rent” (including annual escalations thereon for each year of the extended term based on increases in the Consumer Price Index or fixed increases, as the case may be, as determined by then prevailing market forces), but in no event (including any appraisal or arbitration proceedings as set forth below) less than an amount equal to \$42.00 per rentable square foot of Leased Premises space (the “Extension Rent Floor”). Said Extended Term shall commence, subject to proper exercise of LESSEE’S option hereunder,

on the Termination Date of the original Term, and shall terminate on that date which is thirty six (36) consecutive months after the original Termination Date. LESSEE shall exercise its option by delivering to LESSOR its written notice not later than twelve (12) full months prior to the original Termination Date. Once delivered, written notice to extend is irrevocable.

“Market Rent” as used herein shall be that rent charged for comparable first class research laboratory and office space in the mid-Cambridge submarket as of the end of the original Term. If, after good faith attempts prior to the expiration of the original Term, the LESSOR and LESSEE cannot agree on a figure representing Market Rent, then either party, upon written notice to the other, may request appraisal and arbitration of the issue as provided in this section. Within fourteen (14) days of the request for arbitration, each party shall submit to the other the name of one unrelated individual or entity with proven expertise in the leasing of commercial real estate in greater Boston/Cambridge to serve as that party’s appraiser. Each appraiser shall be paid by the party selecting him or it. The two appraisers shall each submit their final reports to the parties within thirty (30) days of their selection making their determination as to Market Rent (subject however, to the Extension Rent Floor). The two appraisers shall meet within the next fourteen (14) days to reconcile their reports and collaboratively determine the Market Rent. They shall each make their determination in writing (subject however, to the Extension Rent Floor), including a statement if such is the case, that they are at an impasse. Such a statement of impasse shall be submitted to the parties along with the Market Rent figure which each appraiser has selected and his reasons and substantiation therefor. The appraisers, in case of an impasse, shall also agree on one unrelated individual or entity with expertise in commercial real estate in greater Boston, who shall evaluate the reports of the two original appraisers and within fourteen (14) days of submission of the issue to him, make his own determination as to a figure representing Market Rent (subject however, to the Extension Rent Floor). The determination of this individual or entity (i.e. arbitrator) absent, fraud, bias or undue prejudice shall be binding upon the parties.

Annual Base Rent and Additional Rent during any Extended Term shall be payable in advance, in equal monthly installments on the first day of each calendar month.

34. Extended Term Additional Rent. LESSEE in addition to the sums payable annually to LESSOR as Annual Base Rent, shall pay to LESSOR for each year of any Extended Term, as Additional Rent, LESSEE’S Allocable Percentage (as determined by the approximate total rentable space leased) for Operating Expenses, Real Estate Taxes and Utilities as contemplated in Sections 3,4 and 7 hereof.

35. Estoppel Certificates. Upon not less than fifteen days prior written request by either party, the other party shall execute, acknowledge and deliver to the requesting party a statement in writing certifying that this Lease is unmodified and in full force and effect and that LESSEE has at the time of such statement no defenses, offsets or counterclaims against its obligations to pay Annual Base Rent and Additional Rent and any other charges (in the case of any such certificate to be delivered by LESSEE) and to perform its other covenants under this Lease (or, if there have been any modifications that the same is in full force and effect as modified and stating the modifications and, if there are any defenses, offsets or counterclaims, setting them forth in reasonable detail), and the dates to which the Annual Base Rent and Additional Rent and other charges have been paid. Any such statement delivered pursuant to this Section may be relied

upon by any prospective purchase or mortgagee of the Premises, or any prospective assignee of any such mortgagee or, as applicable the LESSOR or LESSEE.

36. Governing Law. This Lease constitutes the full and complete agreement between the parties shall be construed under and according to the laws of the Commonwealth of Massachusetts. Any provision of this Lease which is deemed void or unenforceable shall not invalidate or render void or unenforceable the entire Lease.

[Execution Pages Follow]

IN WITNESS WHEREOF, LESSOR AND LESSEE have hereunto set their hands and seals and intend to be legally bound hereby as of the date first set forth above.

LESSOR

RIVERTECH ASSOCIATES II, LJ
By Rivertech Associates II, Inc.,
its duly authorized Manager

By: /s/ Robert Epstein
 Robert Epstein, President

LESSEE

ESSENTIENT INC.,

By: /s/ David A. Berry
 President

By: /s/ Harry Wilcox
 Treasurer

INDENTURE OF LEASE

by and between

RIVERTECH ASSOCIATES H, LLC

(“LESSOR”)

and

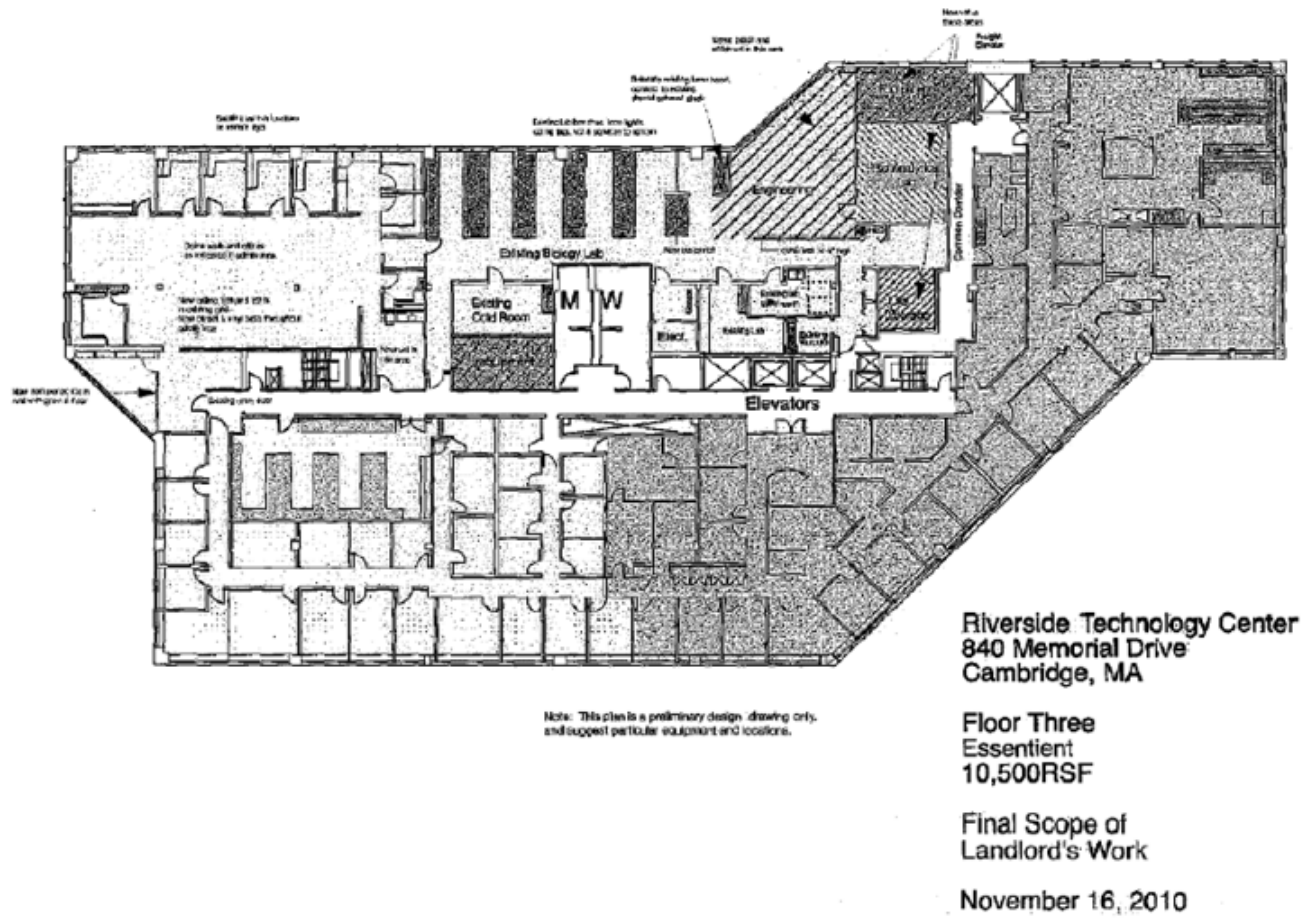
ESSENTTENT, INC.

(“LESSEE”)

RIVERSIDE TECHNOLOGY CENTER

**840 Memorial Drive
Cambridge, Massachusetts**

30



See Operating Expense Schedule attached hereto and incorporated herein

Operating Expenses 2009
840 Memorial Drive - Riverside Technology Center

DESCRIPTION	Total	PSF
HEAT	\$ 65,320	\$ 0.50
BUILDING ELECTRIC	\$ 234,906	\$ 1.81
WATER & SEWER	\$ 18,190	\$ 0.14
ELEVATOR MAINTENANCE	\$ 18,394	\$ 0.14
PARKING/CAFE EXPENSE	\$ 26,390	\$ 0.20
RUBBISH REMOVAL	\$ 22,259	\$ 0.17
INSURANCE	\$ 31,903	\$ 0.25
GROUNDS CARE		\$ 0.12
LEGAUACCTJADMIN		\$ 0.14
JANFTORIAL SERVICES	\$ 48,955	\$ 0.38
GENERAL MAINTENANCE	\$ 98,631	\$ 0.76
HVAC MAINTENANCE	\$ 80,346	\$ 0.62
LIFE SAFETY SYSTEMS	\$ 20,168	\$ 0.16
MANAGEMENT *	\$ 287,595	\$ 2.22
Total Operating Expenses	\$ 987,256	\$ 7.63
Real Estate Taxes (FY 2010)	\$ 767,145	\$ 5.93

* Based upon 5% of income; but not less than this amount.

See Letter of Credit Form attached hereto and incorporated herein

[Issuing Bank Letterhead]

STANDBY LETTER OF CREDIT NUMBER: **[Insert #1]**

Date: **[Insert Date]**

BENEFICIARY

APPLICANT

RIVERTECH ASSOCIATES II, LLC

C/o The Abbey Group
575 Boylston Street 8th Floor
Boston, Massachusetts 02116

[Insert Applicant's Name Address]

Gentlemen:

At die request and on the instructions of **[Insert Tenant Name]**, we hereby issue our Irrevocable Letter of Credit in your favor in an amount not to exceed in the aggregate USD **[Insert Amount]** available by your draft(s) drawn at sight on **[Insert Bank Name]** when accompanied by the following:

- (1) The original of this Letter of Credit and amendment(s) if any.
- (2) A statement, on the letterhead of and purportedly signed by an authorized officer of the Beneficiary, dated the same date as the draft, exactly in the format of the attached Exhibit A.

This Letter of Credit, including the attached EXHIBIT A (which form an integral part of the Credit), sets form in full rite terms of our undertaking and such undertaking shall not in any way be modified, amended or amplified by reference to any document, instrument or agreement referred to herein or in which this Letter of Credit is referred to or which this Letter of Credit relates, and any such reference shall not be deemed to incorporate herein by reference any document, instrument or agreement

It is a condition of this Letter of Credit that it shall be automatically extended, without amendment, for an additional period of one (1) year from the present or any farther expiration date, unless forty five (45) days prior to such date, we notify you in writing by overnight courier service that we elect not to renew this Letter of Credit for any such additional period. The FINAL EXPIRY DATE is **[Insert Final Expiration Date]**. Our notice of non-renewal will be sent to the Beneficiary, at the address given in this Letter of Credit, unless we are otherwise notified by the Beneficiary, in writing via registered mail, return receipt requested, of a charge of address.

Drafts drawn hereunder must be marked: "Drawn under **[Insert Issuing Bank Name]** Irrevocable Letter of Credit Number **[Insert Number]** dated **[Insert Date]**].

We engage with you that all drafts drawn under and in compliance with the terms of this Letter of Credit will be duly honored upon delivery of documents to us at **[Insert Presentation Location]** if presented on or before the close of business on **[Insert Initial Expiration Date]** any automatically extended date.

Except so far as otherwise expressly stated herein, this Letter of Credit is subject to the Uniform Customs and Practice for Documentary Credits (1983 Revision) International Chamber of Commerce, Publication No: 400.

Very truly yours,

Authorized Signature

Authorized Signature

IRREVOCABLE LETTER OF CREDIT

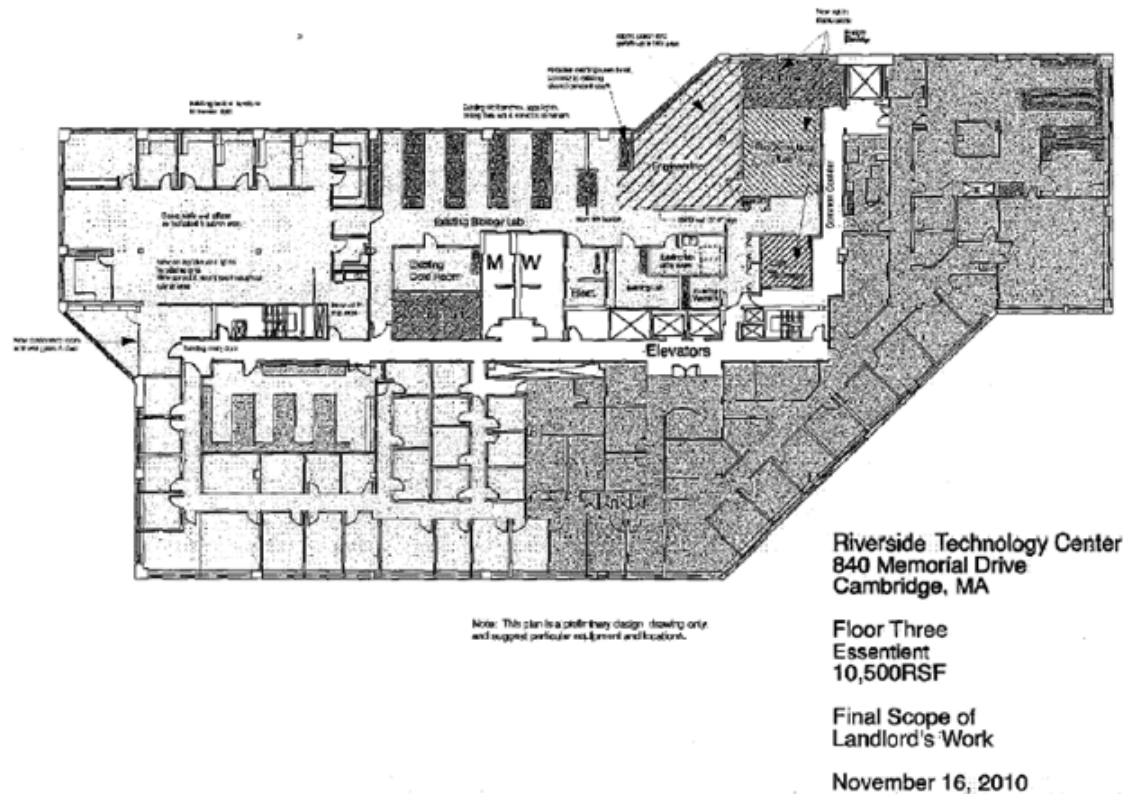
Exhibit A

The undersigned is a duly authorized agent of the Landlord, familiar with the Lease to _____, dated _____; hereby affirms that there has occurred an event of default under the Lease that has not been cured within any allowed notice, grace and cure periods (or alternatively, the Letter of Credit has not be timely renewed as required by the Lease); and that Landlord is entitled to liquidate rids Letter of Credit to satisfy said default (or renewal obligations) under the terms and conditions of the Lease, in the amount of \$ _____.

RIVERTECH ASSOCIATES II, LLC
(Landlord)

By: _____

See "Landlord's Work" specifications attached hereto and incorporated herein



THE ABBEY GROUP

ESSENTENT
Floor Three, 840 Memorial Drive
Scope of Work by Landlord

November 17, 2010

Office Area

- All walls to be repainted
- Existing ceiling mounted lights to be replaced with new T-8 fluorescent fixtures in existing grid.
- Existing carpet and base to be removed and replaced by building standard (Turn Key Collection, style # 50895 METRO by Shaw Industries) in color chosen by tenant.
- Existing vct in kitchen area to be removed and replaced with building standard
- Demo of walls and construction of new conference room wall as indicated on plans.
- Space to be cleaned and prepared for occupancy
- Existing benchtop in offices to remain.

Laboratory Area

Physical

- Demo and construction of new walls as indicated in plans.
- Repaint all walls
- Vinyl tile floor in labs to remain and added in all areas where seamless vinyl does not exist.
- New seamless vinyl floor in BL-2A Lab, BL-2B Lab & autoclave/glasswashing room.
- Relocate one fume hood from another location within the building to a location indicated in the plan.
- Clean all existing laboratory cabinets and bench tops.

Mechanical

- Assure proper operation of supplemental air conditioning supplying main Biology and Engineering Labs
- Assure proper operation of cold room.
- Assure proper operation of supplemental air conditioning in the internal equipment room.
- Provide adequate exhaust air for repeated fume hood and general lab exhaust.

Plumbing

- Provide separate water supply with approved backflow prevention devices and a hot water tank in or near the location indicated in the “Floor Plan Exhibit”.
 - Provide new limestone chips to the existing acid neutralization system
 - Assure connection of Tenant’s vacuum and air compressor to existing vacuum and air lines.
-

Electrical

- Provide separate electric service to the premises including submetering of all equipment.
- Provide backup generator panel from building or tenant specific backup generator. New connection to tenant's equipment to be responsibility of tenant.

NOTE: Maintenance of tenant specific backup generator will be tenant's sole responsibility.

Telecommunications

- All telecommunications/IT work to be done by tenant.

575 Boylston Street
Boston, Massachusetts 02116
617.266.8860
Fax 617.266.7424

See list of permitted materials etc. attached hereto and incorporated herein

Chris C. Tsouros

From: Labbe, Eric M [ELabbe@goodwinprocter.com]
Sent: Friday, December 17, 2010 10:07 AM
To: Chris C. Tsouros
Subject: Essentient Haz Mat

Here is the list.

Thanks

Eric M. Labbe
Goodwin Procter LLP
Exchange Place
53 State Street
Boston, MA 02109
T: 617-570-1688
F: 617-523-1231
elabbe@goodwinprocter.com
www.goodwinprocter.com

From: David Berry [mailto:dberry@FlagshlpVentures.com]
Sent: Wednesday, December 01,2010 6:32 PM
To: Labbe, Eric M
Cc: Mark Winters
Subject: RE: Essentient Revisions 11_30.DOC

These are at the genus/species level/strain level depending on the specific organism.

Escherichia Coli

Specifically including BL21, 3M109, DH5K and K12 strains

Saccharomyces cerevisiae

Specifically including S288C, YNN216, SKI, CEN.PK strains

Pichia Pastoris (various strains)

Aspergillus niger (various strains)

Chlorella vulgaris

Synechococcus

R2, PCC 6301, 7942, WH7803, WH&102, WH8103, MKBG15041c,
NKBG042902, NKBG15031C, PCC 7335, NKBG15031a, NKBG040606B, NKBG040607, S. elongatus Synechocystis
PCC 6714 and 6803; marine strain 7a

Chroococcidiopsis

Strains 029, 057, and 123

Plectonema

UTEX 596 and IAM-M101
Pseudanabaena
NKBG040605C
Anabaena
PCC 7120, PCC 73102, PCC 7118, PCC 7524, ATCC 29413 (PCC 7937), M131, 90,

L-31
Mostoc
PCC 6310, 7107, 7121, 73102 {ATCC 29133)

Fremyella/Calothrix PCC 7601
Fischerella muscicola UTEX 1829
Dunalliella (various strains)
Haematococcus (various strains)
Flavobacteriura (various strains)
Xanthophyllomyces dendrorhous
Chlaraydomonas reinhardtii

David Berry

Flagship Ventures | 1 Memorial Drive, 7th Floor, Cambridge, MA 02142 | Phone: 617-218-1653 | Fax: 617-868-1115

IRS CIRCULAR 230 DISCLOSURE: To ensure compliance with requirements imposed by the IRS, we inform you that any U.S. tax advice contained in this communication (including any attachments) is not intended or written to be used, and cannot be used, for the purpose of (i) avoiding penalties under the Internal Revenue Code or (if) promoting, marketing or recommending to another party any transaction or matter addressed herein.

This message is intended only for the designated recipient(s). It may contain confidential or proprietary information and may be subject to the attorney-client privilege or other confidentiality protections. If you are not a designated recipient, you may not review, copy or distribute this message. If you receive this in error, please notify the sender by reply e-mail and delete this message. Thank you.

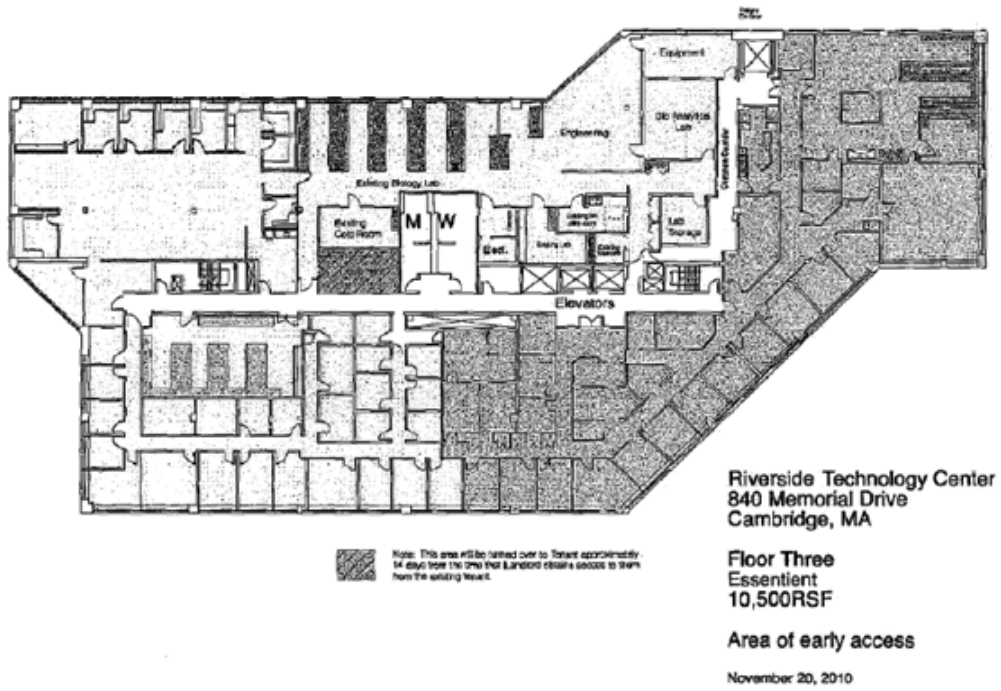
ESSENTEENT, INC.

LEASE EXHIBIT F

See LESSOR’S current lender’s SNDA Form attached hereto and incorporated herein (as a “form” under Lease Section 13)

Attach Early Access Lab Area Work Program Scope and Parameters

46



RIVERSIDE TECHNOLOGY CENTER

FIFTH LEASE EXTENSION AND MODIFICATION AGREEMENT

TO THE LEASE BETWEEN

**RIVERTECH ASSOCIATES II LLC AND AXCELLA HEALTH, INC.,
(f/k/a PRONUTRIA BIOSCIENCES, INC. and f/k/a ESSENTIENT, INC.)**

This Fifth Lease Extension and Modification Agreement (the "Fifth Lease Amendment") entered into this 28th day of April, 2017 by and between **Rivertech Associates II, LLC**, a Massachusetts limited liability company with a principal address c/o The Abbey Group 177 Huntington Ave. 24th Floor Boston, Massachusetts 02115 herein, (the "Lessor"), and **Axcella Health, Inc.** (as successor in interest to Pronutria Biosciences, Inc., itself the successor in interest to Essentient, Inc.), with a business address at 840 Memorial Drive Cambridge, Massachusetts (herein the "Lessee"), with respect to a certain Lease dated December 28, 2010 (the "Original Lease") for certain office and laboratory space in the building at 840 Memorial Drive Cambridge, Massachusetts (the "Building"); as amended by a Lease Extension and Modification Agreement December 9, 2013 ("First Lease Amendment"); by a Second Lease Extension and Modification Agreement July 31, 2014 ("Second Lease Amendment"); by a Third Lease Extension and Modification Agreement dated January 30, 2015 (the "Third Lease Amendment"); and by a Fourth Lease Extension and Modification Agreement dated December 30, 2015 (the "Fourth Lease Amendment"); all collectively referred to herein as of the date hereof as the "Existing Lease". The Existing Lease, as modified by this Fifth Lease Amendment, hereafter shall be referred to herein as the "Lease" (as the context so permits).

WHEREAS, the Lessee currently leases the following spaces in the Building as follows:

- A. Certain space on the third (3rd) floor of the Building (with a small portion in the garage portion of the Building), consisting of approximately 10,525 rentable square feet (defined herein as the "Third Floor Leased Premises" (previously defined as the Existing Leased Premises in the Fourth Lease Amendment), the term for which expires on August 31, 2017 (subject to two additional options to extend as set forth in Section 7 below); and,
- B. Certain space on the first (1st) floor of the Building, consisting of approximately 8,647 rentable square feet (i.e. the "First Floor Expansion Space" (as defined as such in the Fourth Lease Amendment), the term for which expires on April 30, 2021, subject to two additional options to extend as set forth in Section 7 below); and,

WHEREAS, the Lessee desires to extend the current stated Term of the Existing Lease as to the Third Floor Leased Premises, now set to expire on August 31, 2017, as a modification to the Existing Lease, and Lessor assents to such extension of the Term by the Lessee on this basis; and,

WHEREAS, given the extension of the Term of the Existing Lease as to the Third Floor Leased Premises beyond August 31, 2017 as provided herein, the parties also seek to clarify the Lessee's

further rights to further extend its lease and occupancy as to both the Third Floor Leased Premises, and the First Floor Expansion Space, with rights that may be exercised separately;

THEREFORE, in consideration of One (\$1.00) Dollar and the other good and valuable consideration recited herein, effective and irrevocable as of the date hereof, the Lessor and Lessee hereby agree as follows:

1. Additional Defined Terms

The following additional terms as used herein are defined as set forth below:

“Third Floor Leased Premises Termination Date” applies only to the Third Floor Leased Premises, and is August 31, 2017; and is subject to Lessee’s rights to further extend the term with respect to the Third Floor Leased Premises as set forth in Section 7 below.

“Third Floor Leased Premises Extension Termination Date” applies only to the Third Floor Leased Premises, and is April 30, 2021.

“First Floor Expansion Space Term” is the period already running as of the date of this Fifth Lease Amendment through April 30, 2021, and it is subject to Lessee’s rights to further extend the term with respect to the First Floor Expansion Space as set forth in Section 7 below.

“First Floor Expansion Space Termination Date” applies only to the First Floor Expansion Space, and is April 30, 2021, (subject however, to any extension elected by the Lessee as set forth in Section 7 hereof.

2. Third Floor Extended Term

Lessee hereby agrees to extend its tenancy of the Third Floor Leased Premises as of the end of the Third Floor Leased Premises Termination Date, for one (1) additional period of forty four (44) months, beginning on September 1, 2017 (the “Third Floor Extension Commencement Date”) and ending on April 30, 2021 (the “Third Floor Extension Termination Date”); which additional period shall be referred to as the “Third Floor Extended Term”.

By exercise of the aforesaid extension, the Lessee’s Reserved Option as set forth in the Third Amendment as further characterized as “Lessee’s Reserved Option” and as “Lessee’s Interim Option” in Section 2. A of the Fourth Amendment, are hereby extinguished in lieu of the foregoing.

3. Terms and Conditions

Lessee hereby agrees to lease the Third Floor Leased Premises on the same terms and conditions of the Existing Lease, as modified by this Fifth Lease Amendment, with exception only for those provisions as to which Lessor and Lessee have already performed their obligations as of the date hereof, (for example, Lessor has heretofore delivered the Existing Premises and Lessee has accepted the same). The Third Floor Leased Premises is leased in the same “AS/IS” condition as it is as of the execution of this Fifth Lease Amendment, and Lessee acknowledges Lessor is under no obligation to make any improvements or modifications thereto in any manner.

Lessor and Lessee each acknowledge that to the best of the respective knowledge of each, there are no material defaults by either party presently existing under the Existing Lease.

4. Annual Base Rent / Additional Rent / Security Deposit

A. Annual Base Rent

(a) Third Floor Leased Premises

Annual Base Rent for the Third Floor Leased Premises, for the balance of the current Term up to the Third Floor Leased Premises Termination Date, shall be that Annual Base Rent specified in the Existing Lease attributable to the Third Floor Leased Premises (i.e. the Existing Leased Premises as characterized in the Fourth Lease Amendment).

Annual Base Rent from the Third Floor Extension Commencement Date through the Third Floor Extension Termination Date shall be as follows:

(i) September 1, 2017 through August 31, 2018

\$ 657,812.50 per annum / \$ 54,817.71 per month

(ii) September 1, 2018 through August 31, 2019

\$ 678,862.50 per annum / \$ 56,571.88 per month

(iii) September 1, 2019 through August 31, 2020

\$699,912.50 per annum / \$ 58,326.04 per month

(iv) September 1, 2020 through April 30, 2021

\$ 480,641.68 for the eight month period / \$ 60,080.21 per month

Annual Base Rent above is intended to be “triple net” under the Lease, and it shall be payable in the corresponding monthly installments set forth above, due on the first of each month, in advance, and in all other respects shall be subject to the provisions relating to Annual Base Rent as set forth under the Existing Lease.

(b) First Floor Expansion Space

Annual Base Rent for the First Floor Expansion Space, for the balance of the current First Floor Expansion Space Term up to the First Floor Expansion Space Termination Date, shall be as set forth in the Fourth Amendment.

B. Additional Rent

(a) Third Floor Leased Premises

In addition to Annual Base Rent, Lessee shall continue to be responsible to pay all Additional Rent (Operating Expenses) under Section 3 of the Existing Lease and all Additional Rent (Taxes) under Section 4 thereof, as invoiced by Lessor, attributable to the Third Floor Leased Premises, up to the Third Floor Leased Premises Extension Termination Date.

(b) First Floor Expansion Space In addition to Annual Base Rent, Lessee shall continue to be responsible to pay all Additional Rent (Operating Expenses) under Section 3 of the Existing Lease and all Additional Rent (Taxes) under Section 4 thereof, as invoiced by Lessor, attributable to the First Floor Expansion Space, up to the First Floor Expansion Space Termination Date.

C. Rent Payment and other Costs and Expenses Determination and payment of all Annual Base Rent, Additional Rent and other sums due as Rent shall be payable and in all other respects shall be determined as contemplated under the Existing Lease for the full term up to April 30, 2021 (subject to any further extensions).

D. Security Deposit The Security Deposit currently held by the Lessor shall continue to be held by Lessor up to April 30, 2021 (subject to any further extensions).

5. Permitted Uses / Lessee's Rights of First Offer

The Permitted Uses in the Basic Data of the Original Lease, and all conditions attached thereto, are hereby restated and affirmed and shall govern the use and occupancy of the Third Floor Leased Premises and the First Floor Expansion Space through April 30, 2021 (and beyond if there be any further extension).

The parking rights and other ancillary rights as they are set forth in the Fourth Lease Amendment (other than extension rights and or term expiration, which are hereby be superseded by the provisions of this Fifth Lease Amendment), shall govern through April 30, 2021 (and beyond if there be any further extension).

Lessee shall retain the rights set forth in the Fourth Lease Amendment as to additional First Floor ROFO Space and Third Floor ROFO Space.

6. Brokers

The parties hereby agree that Newmark Grubb Knight Frank represents the Lessee in this transaction and shall be paid a commission by the Lessor, under the terms of a separate agreement; and represent that there are no brokerage or other third party fees or costs involved in this transaction and each agrees to indemnify, defend and hold harmless the other from and against any other claims for brokerage fees, commissions or other such payments arising from this transaction.

7. Lessee's Further Options to Extend

The Third Floor Leased Premises Extension Termination Date and the First Floor Expansion Space Termination Date are coterminous (i.e. each end on April 30, 2021).

Lessee, provided it is not then in material default after notice and expiration of any applicable grace or cure periods, and further provided there have not been any material defaults (beyond applicable notice, grace and cure periods) more than twice within any twelve (12) month period, shall have the option to further extend the Term of this Lease as to:

- (a) the Third Floor Leased Premises; and separately or conjunctively,
 - (b) the First Floor Expansion Space;
- (inclusive of any ROFO Space then being leased by Lessee).

on the terms and conditions set forth in Section 14 and 15 of the Fourth Lease Amendment, (including the determination of “Market Rent”), modified as follows:

- (i) the thirty-six (36) month extension period ending on the First Extension Termination Date, if exercised, will commence on May 1,2021; said exercise on notice by Lessee to occur no later than September 1,2020 (i.e. eight full months prior to such commencement), time being of the essence, and end on April 30, 2024 (the “First Revised Extension Period”); and,
- (ii) the thirty-six (36) month extension period ending on the Second Extension Termination Date, if exercised, will commence on May 1,2024; said exercise on notice by Lessee to occur no later than September 1,2023 (i.e. eight full months prior to such commencement), time being of the essence, and end on April 30,2027 (the “Second Revised Extension Period”).

The provisions as to the delivery and effect of each Option Exercise Notice as set forth in Section 14 remain and are to be applied to the aforesaid adjusted dates.

Additionally, the Extension Rent Floor for each extension period shall be adjusted accordingly such that it will be based on the end of each then expiring portion of the term (i.e. the Rent Floor for the First Revised Extension Period will be based on Annual Base Rent for the last month (annualized) of the Lease Year ending April 30,2021, and the Rent Floor for the Second Revised Extension Period will be based on Annual Base Rent for the last month (annualized) of the last year of the First Revised Extension Period).

Lessee shall be obligated to continue to pay all Additional Rent for the First Revised Extension Period and the Second Revised Extension Period, as applicable.

Annual Base Rent and Additional Rent for the First Revised Extension Period and the Second Revised Extension Period, as applicable, shall be payable in advance, in equal monthly installments on the first day of each calendar month.

8. Integration of Documents; Supremacy

This Fifth Lease Amendment, incorporating the terms and conditions of the Original Lease and all prior amendments through the Fourth Lease Amendment, contains the full understanding and agreement between the parties. The parties hereto intend that this Fifth Lease Amendment

operates to amend and modify the Existing Lease, and that those prior documents constituting the Existing Lease shall be interpreted conjunctively; with any express conflict between those prior documents and this Fifth Lease Amendment to be resolved in favor of the stated terms of this Fifth Lease Amendment. Except as modified hereby, all other terms and conditions of the Existing Lease shall remain unchanged and enforceable in a manner consistent with this Fifth Lease Amendment.

This Agreement shall be governed by the laws of the Commonwealth of Massachusetts. Any provisions deemed unenforceable shall be severable, and the remainder of this Fifth Lease Amendment and the Existing Lease shall be enforceable in accordance with their terms.

[Signature Pages Follow]

LESSOR

RIVERTech ASSOCIATES II, LLC

By: Rivertech Associates II, Inc.,
its Manager

By: /s/ Robert Epstein
Name: Robert Epstein
Title: President

LESSEE

AXCELLA HEALTH, INC,

By: /s/ Robert Connelly

Its duly authorized President/Vice President

By: /s/ Thomas Leggett

Its duly authorized Treasurer/Ass’t Treasurer

SOLAR CAPITAL

LOAN AND SECURITY AGREEMENT

THIS LOAN AND SECURITY AGREEMENT (as the same may be amended, restated, modified, or supplemented from time to time, this “**Agreement**”) dated as of January 9, 2018 (the “**Effective Date**”) among SOLAR CAPITAL LTD., a Maryland corporation, with an office located at 500 Park Avenue, 3rd Floor, New York, NY 10022 (“**SolarCap**”), as collateral agent (in such capacity, together with its successors and assigns in such capacity, “**Collateral Agent**”), and the Lenders listed on Schedule 1.1 hereof or otherwise a party hereto from time to time including SolarCap in its capacity as a Lender (each a “**Lender**” and collectively, the “**Lenders**”), and AXCELLA HEALTH INC., a Delaware corporation (“**Axcella**”), and ACORA NUTRITION LLC, a Delaware limited liability company (“**Acora**” and, individually and collectively, jointly and severally with Axcella, “**Borrower**”), with offices located at 840 Memorial Drive, 3rd Floor, Cambridge, MA 02139, provides the terms on which the Lenders shall lend to Borrower and Borrower shall repay the Lenders. The parties agree as follows:

1. DEFINITIONS AND OTHER TERMS

1.1 Terms. Capitalized terms used herein shall have the meanings set forth in Section 1.3 to the extent defined therein. All other capitalized terms used but not defined herein shall have the meaning given to such terms in the Code. Any accounting term used but not defined herein shall be construed in accordance with GAAP and all calculations shall be made in accordance with GAAP. The term “financial statements” shall include the accompanying notes and schedules.

1.2 Section References. Any section, subsection, schedule or exhibit references are to this Agreement unless otherwise specified.

1.3 Definitions. The following terms are defined in the Sections or subsections referenced opposite such terms:

“ Agreement ”	Preamble
“ Approved Lender ”	Section 12.1
“ Borrower ”	Preamble
“ Claims ”	Section 12.2
“ Collateral Agent ”	Preamble
“ Collateral Agent Report ”	Exhibit B, Section 5
“ Communication ”	Section 10
“ Default Rate ”	Section 2.3(b)
“ Effective Date ”	Preamble
“ Event of Default ”	Section 8
“ Indemnified Person ”	Section 12.2
“ Lender ” and “ Lenders ”	Preamble
“ Lender Transfer ”	Section 12.1
“ MSC Subsidiary ”	Section 7.8
“ New Subsidiary ”	Section 6.10
“ Non-Funding Lender ”	Exhibit B, Section 10(c)(ii)
“ Other Lender ”	Exhibit B, Section 10(c)(ii)
“ Perfection Certificate ” and “ Perfection Certificates ”	Section 5.1
“ Prior Loan Debt ”	Section 2.2(a)
“ SolarCap ”	Preamble
“ Termination Date ”	Exhibit B, Section 8
“ Term Loan ”	Section 2.2(a)(ii)
“ Transfer ”	Section 7.1

In addition to the terms defined elsewhere in this Agreement, the following terms have the following meanings:

“Account” is any “account” as defined in the Code with such additions to such term as may hereafter be made, and includes, without limitation, all accounts receivable and other sums owing to Borrower.

“Account Debtor” is any “account debtor” as defined in the Code with such additions to such term as may hereafter be made under the Code.

“Affiliate” of any Person is a Person that owns or controls directly or indirectly the Person, any Person that controls or is controlled by or is under common control with the Person, and each of that Person’s senior executive officers, directors, partners and, for any Person that is a limited liability company, that Person’s managers and members.

“Amortization Date” is February 1, 2019; *provided that*, if the Interest Only Extension Conditions are satisfied and Borrower so elects, then February 1, 2020.

“Anti-Terrorism Laws” are any laws relating to terrorism or money laundering, including without limitation Executive Order No. 13224 (effective September 24, 2001), the USA PATRIOT Act, the laws comprising or implementing the Bank Secrecy Act, and the laws administered by OFAC.

“Approved Fund” is any (i) investment company, fund, trust, securitization vehicle or conduit that is (or will be) engaged in making, purchasing, holding or otherwise investing in commercial loans and similar extensions of credit in the ordinary course of its business or (ii) any Person (other than a natural person) which temporarily warehouses loans for any Lender or any entity described in the preceding clause (i) and that, with respect to each of the preceding clauses (i) and (ii), is administered or managed by (a) a Lender, (b) an Affiliate of a Lender or (c) a Person (other than a natural person) or an Affiliate of a Person (other than a natural person) that administers or manages a Lender.

“Blocked Person” is any Person: (a) listed in the annex to, or is otherwise subject to the provisions of, Executive Order No. 13224, (b) a Person owned or controlled by, or acting for or on behalf of, any Person that is listed in the annex to, or is otherwise subject to the provisions of, Executive Order No. 13224, (c) a Person with which any Lender is prohibited from dealing or otherwise engaging in any transaction by any Anti-Terrorism Law, (d) a Person that commits, threatens or conspires to commit or supports “terrorism” as defined in Executive Order No. 13224, or (e) a Person that is named a “specially designated national” or “blocked person” on the most current list published by OFAC or other similar list.

“Borrower” is defined in the preamble hereof.

“Borrower’s Books” are Borrower’s or any of its Subsidiaries’ books and records including ledgers, federal, and state tax returns, records regarding Borrower’s or its Subsidiaries’ assets or liabilities, the Collateral, business operations or financial condition, and all computer programs or storage or any equipment containing such information.

“Business Day” is any day that is not a Saturday, Sunday or a day on which Collateral Agent is closed.

“Cash Equivalents” are (a) marketable direct obligations issued or unconditionally guaranteed by the United States or any agency or any State thereof having maturities of not more than one (1) year from the date of acquisition; (b) commercial paper maturing no more than one (1) year after its creation and having the highest rating from either Standard & Poor’s Ratings Group or Moody’s Investors Service, Inc., (c) certificates of deposit maturing no more than one (1) year after issue provided that the account in which any such certificate of deposit is maintained is subject to a Control Agreement in favor of Collateral Agent, and (d) money market mutual funds at least 90% of the investments of which consist of securities identified in clauses (a), (b) or (c).

“**Code**” is the Uniform Commercial Code, as the same may, from time to time, be enacted and in effect in the State of New York; provided, that, to the extent that the Code is used to define any term herein or in any Loan Document and such term is defined differently in different Articles or Divisions of the Code, the definition of such term contained in Article or Division 9 shall govern; provided further, that in the event that, by reason of mandatory provisions of law, any or all of the attachment, perfection, or priority of, or remedies with respect to, Collateral Agent’s Lien on any Collateral is governed by the Uniform Commercial Code in effect in a jurisdiction other than the State of New York, the term “Code” shall mean the Uniform Commercial Code as enacted and in effect in such other jurisdiction solely for purposes of the provisions thereof relating to such attachment, perfection, priority, or remedies and for purposes of definitions relating to such provisions.

“**Collateral**” is any and all properties, rights and assets of Borrower described on Exhibit A.

“**Collateral Account**” is any Deposit Account, Securities Account, or Commodity Account, or any other bank account maintained by Borrower or any Subsidiary at any time.

“**Collateral Agent**” is SolarCap, not in its individual capacity, but solely in its capacity as agent on behalf of and for the benefit of the Lenders.

“**Commitment Percentage**” is set forth in Schedule 1.1, as amended from time to time.

“**Commodity Account**” is any “commodity account” as defined in the Code with such additions to such term as may hereafter be made under the Code.

“**Compliance Certificate**” is that certain certificate in substantially the form attached hereto as Exhibit D.

“**Contingent Obligation**” is, for any Person, any direct or indirect liability, contingent or not, of that Person for (a) any indebtedness, lease, dividend, letter of credit or other obligation of another such as an obligation directly or indirectly guaranteed, endorsed, co-made, discounted or sold with recourse by that Person, or for which that Person is directly or indirectly liable; (b) any obligations for undrawn letters of credit for the account of that Person; and (c) all obligations from any interest rate, currency or commodity swap agreement, interest rate cap or collar agreement, or other agreement or arrangement designated to protect a Person against fluctuation in interest rates, currency exchange rates or commodity prices; but “Contingent Obligation” does not include endorsements in the ordinary course of business. The amount of a Contingent Obligation is the stated or determined amount of the primary obligation for which the Contingent Obligation is made or, if not determinable, the maximum reasonably anticipated liability for it determined by the Person in good faith; but the amount may not exceed the maximum of the obligations under any guarantee or other support arrangement.

“**Control Agreement**” is any control agreement entered into among the depository institution at which Borrower or any of its Subsidiaries maintains a Deposit Account or the securities intermediary or commodity intermediary at which Borrower or any of its Subsidiaries maintains a Securities Account or a Commodity Account, Borrower and such Subsidiary, and Collateral Agent pursuant to which Collateral Agent, for the benefit of the Lenders, obtains “control” (within the meaning of the Code) over such Deposit Account, Securities Account, or Commodity Account.

“**Copyrights**” are any and all copyright rights, copyright applications, copyright registrations and like protections in each work of authorship and derivative work thereof, whether published or unpublished and whether or not the same also constitutes a trade secret.

“**Deposit Account**” is any “deposit account” as defined in the Code with such additions to such term as may hereafter be made.

“**Designated Deposit Account**” is Borrower’s deposit account, account number XXXXXX3867, maintained at Silicon Valley Bank.

“**Dollars**,” “**dollars**” and “**\$**” each mean lawful money of the United States.

“Domestic Subsidiary” is a Subsidiary organized under the laws of the United States or any state or territory thereof or the District of Columbia.

“Eligible Assignee” is (i) a Lender, (ii) an Affiliate of a Lender, (iii) an Approved Fund and (iv) any commercial bank, savings and loan association or savings bank or any other entity which is an “accredited investor” (as defined in Regulation D under the Securities Act of 1933, as amended) and which extends credit or buys loans as one of its businesses, including insurance companies, mutual funds, lease financing companies and commercial finance companies, in each case, which either (A) has a rating of BBB or higher from Standard & Poor’s Rating Group and a rating of Baa2 or higher from Moody’s Investors Service, Inc. at the date that it becomes a Lender or (B) has total assets in excess of Five Billion Dollars (\$5,000,000,000.00), and in each case of clauses (i) through (iv), which, through its applicable lending office, is capable of lending to Borrower without the imposition of any withholding or similar taxes; provided that notwithstanding the foregoing, “Eligible Assignee” shall not include, unless an Event of Default has occurred and is continuing, (i) Borrower or any of Borrower’s Affiliates or Subsidiaries or (ii) a direct competitor of Borrower or a vulture hedge fund, each as determined by Collateral Agent. Notwithstanding the foregoing, (x) in connection with assignments by a Lender due to a forced divestiture at the request of any regulatory agency, the restrictions set forth herein shall not apply and Eligible Assignee shall mean any Person or party and (y) in connection with a Lender’s own financing or securitization transactions, the restrictions set forth herein shall not apply and Eligible Assignee shall mean any Person or party providing such financing or formed to undertake such securitization transaction and any transferee of such Person or party upon the occurrence of a default, event of default or similar occurrence with respect to such financing or securitization transaction; provided that no such sale, transfer, pledge or assignment under this clause (y) shall release such Lender from any of its obligations hereunder or substitute any such Person or party for such Lender as a party hereto until Collateral Agent shall have received and accepted an effective assignment agreement from such Person or party in form satisfactory to Collateral Agent executed, delivered and fully completed by the applicable parties thereto, and shall have received such other information regarding such Eligible Assignee as Collateral Agent reasonably shall require.

“Equipment” is all “equipment” as defined in the Code with such additions to such term as may hereafter be made, and includes without limitation all machinery, fixtures, goods, vehicles (including motor vehicles and trailers), and any interest in any of the foregoing.

“ERISA” is the Employee Retirement Income Security Act of 1974, as amended, and its regulations.

“Exigent Circumstance” means any event or circumstance that, in the reasonable judgment of Collateral Agent, imminently threatens the ability of Collateral Agent to realize upon all or any material portion of the Collateral, such as, without limitation, fraudulent removal, concealment, or abscondment thereof, destruction or material waste thereof, or failure of Borrower or any of its Subsidiaries after reasonable demand to maintain or reinstate adequate casualty insurance coverage, or which, in the judgment of Collateral Agent, could reasonably be expected to result in a material diminution in value of the Collateral.

“Exit Fee Agreement” is that certain Exit Fee Agreement, dated as of the date hereof, by and among Borrower, Collateral Agent and the Lenders.

“FDA” means the U.S. Food and Drug Administration or any successor thereto or any other comparable Governmental Authority.

“Final Fee” is a payment (in addition to and not a substitution for the regular monthly payments of principal plus accrued interest) due on the earliest to occur of (a) the Maturity Date, or (b) the acceleration of any Term Loan, or (c) the prepayment of a Term Loan by Borrower pursuant to Section 2.2(c) or (d), equal to 4.35% of the Term Loans funded under this Agreement.

“Foreign Currency” means lawful money of a country other than the United States.

“Foreign Subsidiary” is a Subsidiary that is not an entity organized under the laws of the United States or any state or territory thereof.

“Funding Date” is any date on which a Term Loan is made to or on account of Borrower which shall be a Business Day.

“GAAP” is generally accepted accounting principles set forth in the opinions and pronouncements of the Accounting Principles Board of the American Institute of Certified Public Accountants and statements and pronouncements of the Financial Accounting Standards Board or in such other statements by such other Person as may be approved by a significant segment of the accounting profession in the United States, which are applicable to the circumstances as of the date of determination.

“General Intangibles” are all “general intangibles” as defined in the Code in effect on the date hereof with such additions to such term as may hereafter be made, and includes without limitation, all copyright rights, copyright applications, copyright registrations and like protections in each work of authorship and derivative work, whether published or unpublished, any patents, trademarks, service marks and, to the extent permitted under applicable law, any applications therefor, whether registered or not, any trade secret rights, including any rights to unpatented inventions, payment intangibles, royalties, contract rights, goodwill, franchise agreements, purchase orders, customer lists, route lists, telephone numbers, domain names, claims, income and other tax refunds, security and other deposits, options to purchase or sell real or personal property, rights in all litigation presently or hereafter pending (whether in contract, tort or otherwise), insurance policies (including without limitation key man, property damage, and business interruption insurance), payments of insurance and rights to payment of any kind.

“Governmental Approval” is any consent, authorization, approval, order, license, franchise, permit, certificate, accreditation, registration, filing or notice, of, issued by, from or to, or other act by or in respect of, any Governmental Authority.

“Governmental Authority” is any nation or government, any state or other political subdivision thereof, any agency, authority, instrumentality, regulatory body (including, without limitation, the FDA), court, central bank or other entity exercising executive, legislative, judicial, taxing, regulatory or administrative functions of or pertaining to government, any securities exchange and any self-regulatory organization.

“Guarantor” is any Person providing a Guaranty in favor of Collateral Agent for the benefit of the Lenders.

“Guaranty” is any guarantee of all or any part of the Obligations, as the same may from time to time be amended, restated, modified or otherwise supplemented.

“Indebtedness” is (a) indebtedness for borrowed money or the deferred price of property or services, such as reimbursement and other obligations for surety bonds and letters of credit, (b) obligations evidenced by notes, bonds, debentures or similar instruments, (c) capital lease obligations, and (d) Contingent Obligations.

“Insolvency Proceeding” is any proceeding by or against any Person under the United States Bankruptcy Code, or any other bankruptcy or insolvency law, including assignments for the benefit of creditors, compositions or proceedings seeking reorganization, arrangement, or other relief.

“Insolvent” means not Solvent.

“Intellectual Property” means all of Borrower’s or any of its Subsidiaries’ right, title and interest in and to the following:

- (a) its Copyrights, Trademarks and Patents;
- (b) any and all trade secrets and trade secret rights, including, without limitation, any rights to unpatented inventions, know-how, operating manuals;
- (c) any and all source code;

(d) any and all design rights which may be available to Borrower;

(e) any and all claims for damages by way of past, present and future infringement of any of the foregoing, with the right, but not the obligation, to sue for and collect such damages for said use or infringement of the Intellectual Property rights identified above; and

(f) all amendments, renewals and extensions of any of the Copyrights, Trademarks or Patents.

“Interest Only Extension Conditions” shall mean satisfaction of each of the following: (a) no Default or Event of Default shall have occurred and be continuing; (b) after the Effective Date and on or before September 30, 2018, the Borrower shall have received an aggregate amount of at least Twenty-Five Million Dollars (\$25,000,000) in net cash proceeds (including not subject to any clawback, redemption, escrow or similar contractual restriction) from either (i) a bona fide equity financing from investors and on terms reasonably acceptable to Agent and the Lenders or (ii) strategic partnerships, corporate collaborations or licensing arrangements for a transaction on terms and with counterparties reasonably acceptable to Collateral Agent and the Lenders; and (c) on or before September 30, 2018, Collateral Agent and Lenders shall have received evidence reasonably satisfactory to Collateral Agent and Lenders (including supporting documentation reasonably requested by Collateral Agent and Lenders) that the Borrower has achieved therapeutically relevant success in human clinical studies, each testing subjects in separate disease indications, wherein the clinical programs are progressing to the next stage of clinical development, in at least two of the following areas: adult Nonalcoholic Fatty Liver, adult Nonalcoholic Steatohepatitis, muscle atrophy, intractable epilepsy or other disease indications mutually agreed by the Borrower, Collateral Agent and the Lenders.

“Inventory” is all “inventory” as defined in the Code in effect on the date hereof with such additions to such term as may hereafter be made under the Code, and includes without limitation all merchandise, raw materials, parts, supplies, packing and shipping materials, work in process and finished products, including without limitation such inventory as is temporarily out of any Person’s custody or possession or in transit and including any returned goods and any documents of title representing any of the above.

“Investment” is any beneficial ownership interest in any Person (including stock, partnership interest or other securities), and any loan, advance or capital contribution to any Person.

“IPO” means the initial public offering and sale of Borrower’s stock.

“Key Person” is (a) Borrower’s President and Chief Executive Officer, who is Robert Connelly as of the Effective Date, or (b) Chief Financial Officer, who is Thomas Leggett as of the Effective Date.

“Knowledge” means to the “best of” Borrower’s knowledge, or with a similar qualification, knowledge or awareness means the actual knowledge, after reasonable investigation, of the Responsible Officers.

“Lender” is any one of the Lenders.

“Lenders” are the Persons identified on Schedule 1.1 hereto and each assignee that becomes a party to this Agreement pursuant to Section 12.1.

“Lenders’ Expenses” are all out-of-pocket audit fees and expenses, costs, and expenses (including reasonable documented attorneys’ fees and expenses, as well as appraisal fees, fees incurred on account of lien searches, inspection fees, and filing fees) for preparing, amending, negotiating, administering, defending and enforcing the Loan Documents (including, without limitation, those incurred in connection with appeals or Insolvency Proceedings) or otherwise incurred by Collateral Agent and/or the Lenders in connection with the Loan Documents.

“LIBOR Rate” means the rate per annum rate published by the Intercontinental Exchange Benchmark Administration Ltd. (the **“Service”**) (or on any successor or substitute page of such Service, or any successor to or

substitute for such Service) for a term of one month, which determination by Collateral Agent shall be conclusive in the absence of manifest error.

“**Lien**” is a claim, mortgage, deed of trust, levy, charge, pledge, security interest, or other encumbrance of any kind, whether voluntarily incurred or arising by operation of law or otherwise against any property.

“**Loan Documents**” are, collectively, this Agreement, the Exit Fee Agreement, the Perfection Certificates, each Compliance Certificate, each Loan Payment Request Form, any subordination agreements, any note, or notes or guaranties executed by Borrower or any other Person, and any other present or future agreement entered into by Borrower, any Guarantor or any other Person for the benefit of the Lenders and Collateral Agent in connection with this Agreement; all as amended, restated, or otherwise modified from time to time.

“**Loan Payment Request Form**” is that certain form attached hereto as Exhibit C.

“**Material Adverse Change**” is (a) a material adverse change in the business, operations or condition (financial or otherwise) of Borrower or Borrower and its Subsidiaries, when taken as a whole; or (b) a material impairment of the prospect of repayment of any portion of the Obligations.

“**Material Agreement**” is any license, agreement or other contractual arrangement whereby Borrower or any of its Subsidiaries is reasonably likely to be required to transfer, either in-kind or in cash, in any year, assets or property valued (book or market) at more than \$350,000 in the aggregate.

“**MSC Account**” means any Collateral Account established and maintained by the MSC Subsidiary.

“**MSC Investment Conditions**” means that the Borrower has on deposit in a Collateral Account or Collateral Accounts subject to a Control Agreement in favor of the Collateral Agent an amount of at least One Hundred Twenty Five Percent (125%) of the total aggregate amount of outstanding Obligations.

“**Maturity Date**” is the date which is forty eight (48) months after the Effective Date.

“**Obligations**” are all of Borrower’s obligations to pay when due any debts, principal, interest, Lenders’ Expenses, the Prepayment Fee, the Final Fee and other amounts Borrower owes the Lenders now or later, in connection with, related to, following, or arising from, out of or under, this Agreement or, the other Loan Documents, or otherwise, and including interest accruing after Insolvency Proceedings begin (whether or not allowed) and debts, liabilities, or obligations of Borrower assigned to the Lenders and/or Collateral Agent, and the performance of Borrower’s duties under the Loan Documents.

“**OFAC**” is the U.S. Department of Treasury Office of Foreign Assets Control.

“**OFAC Lists**” are, collectively, the Specially Designated Nationals and Blocked Persons List maintained by OFAC pursuant to Executive Order No. 13224, 66 Fed. Reg. 49079 (Sept. 25, 2001) and/or any other list of terrorists or other restricted Persons maintained pursuant to any of the rules and regulations of OFAC or pursuant to any other applicable Executive Orders.

“**Operating Documents**” are, for any Person, such Person’s formation documents, as certified by the Secretary of State (or equivalent agency) of such Person’s jurisdiction of organization on a date that is no earlier than thirty (30) days prior to the Effective Date, and, (a) if such Person is a corporation, its bylaws in current form, (b) if such Person is a limited liability company, its limited liability company agreement (or similar agreement), and (c) if such Person is a partnership, its partnership agreement (or similar agreement), each of the foregoing with all current amendments or modifications thereto.

“**Patents**” means all patents, patent applications and like protections including without limitation improvements, divisions, continuations, renewals, reissues, extensions and continuations-in-part of the same.

“**Payment Date**” is the first (1st) calendar day of each calendar month, commencing on February 1, 2018.

“Permitted Indebtedness” is:

- (a) Borrower’s Indebtedness to the Lenders and Collateral Agent under this Agreement and the other Loan Documents;
- (b) Indebtedness existing on the Effective Date and disclosed on the Perfection Certificate(s);
- (c) Subordinated Debt;
- (d) unsecured Indebtedness to trade creditors and in connection with credit cards incurred in the ordinary course of business;

(e) Indebtedness consisting of capitalized lease obligations and purchase money Indebtedness, in each case incurred by Borrower or any of its Subsidiaries to finance the acquisition, repair, improvement or construction of fixed or capital assets of such person, provided that (i) the aggregate incurred principal amount of all such Indebtedness shall not exceed Five Hundred Thousand Dollars (\$500,000.00) per fiscal year of Borrower (and shall not, for the avoidance of doubt, exceed Two Million Dollars (\$2,000,000.00) in outstanding principal amount over the term of this Agreement), and (ii) the principal amount of such Indebtedness does not exceed the lower of the cost or fair market value of the property so acquired or built or of such repairs or improvements financed with such Indebtedness (each measured at the time of such acquisition, repair, improvement or construction is made);

(f) Indebtedness incurred as a result of endorsing negotiable instruments received in the ordinary course of Borrower’s business; and

(g) extensions, refinancings, modifications, amendments and restatements of any items of Permitted Indebtedness (a) through

(e) above, provided that the principal amount thereof is not increased or the terms thereof are not modified to impose materially more burdensome terms upon Borrower, or its Subsidiary, as the case may be.

“Permitted Investments” are:

(a) Investments disclosed on the Perfection Certificate(s) and existing on the Effective Date;

(b) (i) Investments consisting of cash and Cash Equivalents, and (ii) any Investments permitted by Borrower’s investment policy, as amended from time to time, provided that such investment policy (and any such amendment thereto) has been approved in writing by Collateral Agent;

(c) Investments consisting of the endorsement of negotiable instruments for deposit or collection or similar transactions in the ordinary course of Borrower;

(d) Investments consisting of Deposit Accounts in which Collateral Agent has a perfected security interest;

(e) Investments in connection with Transfers permitted by Section 7.1;

(f) Investments consisting of (i) travel advances and employee relocation loans and other employee loans and advances in the ordinary course of business, not to exceed One Hundred Thousand Dollars (\$100,000.00) in the aggregate in any fiscal year, and (ii) loans to employees, officers or directors relating to the purchase of equity securities of Borrower or its Subsidiaries pursuant to employee stock purchase plans;

(g) Investments (including debt obligations) received in connection with the bankruptcy or reorganization of customers or suppliers and in settlement of delinquent obligations of, and other disputes with, customers or suppliers arising in the ordinary course of business;

(h) Investments consisting of notes receivable of, or prepaid royalties and other credit extensions, to customers and suppliers who are not Affiliates, in the ordinary course of business; provided that this paragraph (h) shall not apply to Investments of Borrower in any Subsidiary;

(i) Investments in Subsidiaries that are co-borrowers under this Agreement or guarantors of the Obligations, in each case subject to terms and agreements in form and substance reasonably acceptable to Collateral Agent;

(j) Investments in Foreign Subsidiaries not to exceed Two Hundred Fifty Thousand Dollars (\$250,000) in the aggregate per fiscal year and

(k) non-cash Investments in joint ventures or strategic alliances in the ordinary course of Borrower's business consisting of the non-exclusive licensing of technology, the development of technology or the providing of technical support.

"Permitted Licenses" are (A) licenses of over-the-counter software that is commercially available to the public, and (B) licenses (which may be exclusive as to specified properties and/or fields of use for specified geographic territories and/or time periods) for the use of the Intellectual Property of Borrower or any of its Subsidiaries entered into in the ordinary course of business, provided, that, with respect to each such license described in clause (B), (i) the license constitutes an arms-length transaction, the terms of which, on their face, do not provide for a sale or assignment of any Intellectual Property and do not restrict the ability of Borrower or any of its Subsidiaries, as applicable, to pledge, grant a security interest in or lien on, or assign or otherwise Transfer any Intellectual Property, and (ii) the proceeds of such license are paid into an account that is at all times subject to a control agreement in favor of the Collateral Agent.

"Permitted Liens" are:

(a) Liens existing on the Effective Date and disclosed on the Perfection Certificates or arising under this Agreement and the other Loan Documents;

(b) Liens for taxes, fees, assessments or other government charges or levies, either (i) not due and payable or (ii) being contested in good faith and for which Borrower maintains adequate reserves on its Books, provided that no notice of any such Lien has been filed or recorded under the Internal Revenue Code of 1986, as amended, and the Treasury Regulations adopted thereunder;

(c) liens securing Indebtedness permitted under clause (e) of the definition of "Permitted Indebtedness," provided that (i) such liens exist prior to the acquisition of, or attach substantially simultaneous with, or within twenty (20) days after the, acquisition, lease, repair, improvement or construction of, such property financed or leased by such Indebtedness and (ii) such liens do not extend to any property of Borrower other than the property (and proceeds thereof) acquired, leased or built, or the improvements or repairs, financed by such Indebtedness;

(d) Liens of carriers, warehousemen, suppliers, or other Persons that are possessory in nature arising in the ordinary course of business so long as such Liens attach only to Inventory, securing liabilities in the aggregate amount not to exceed Two Hundred Fifty Thousand Dollars (\$250,000.00), and which are not delinquent or remain payable without penalty or which are being contested in good faith and by appropriate proceedings which proceedings have the effect of preventing the forfeiture or sale of the property subject thereto;

(e) Liens to secure payment of workers' compensation, employment insurance, old-age pensions, social security and other like obligations incurred in the ordinary course of business (other than Liens imposed by ERISA);

(f) Liens incurred in the extension, renewal or refinancing of the indebtedness secured by Liens described in (a) through (c), but any extension, renewal or replacement Lien must be limited to the property encumbered by the existing Lien and the principal amount of the indebtedness may not increase;

(g) leases or subleases of real property granted in the ordinary course of Borrower's business (or, if referring to another Person, in the ordinary course of such Person's business), and leases, subleases, licenses or sublicenses (which may be exclusive as to specified properties and/or uses for specified time periods) of personal property (other than Intellectual Property) granted in the ordinary course of Borrower's business (or, if referring to another Person, in the ordinary course of such Person's business), if the leases, subleases, licenses and sublicenses do not prohibit granting Collateral Agent or any Lender a security interest therein;

(h) banker's liens, rights of setoff and Liens in favor of financial institutions incurred in the ordinary course of business arising in connection with Borrower's deposit accounts or securities accounts held at such institutions solely to secure payment of fees and similar costs and expenses and provided such accounts are maintained in compliance with Section 6.6 hereof;

(i) Liens arising from judgments, decrees or attachments in circumstances not constituting an Event of Default under Section 8.4 or 8.7; and

(j) Permitted Licenses.

"Person" is any individual, sole proprietorship, partnership, limited liability company, joint venture, company, trust, unincorporated organization, association, corporation, institution, public benefit corporation, firm, joint stock company, estate, entity or government agency.

"Prepayment Fee" is, with respect to any Term Loan subject to voluntary prepayment by Borrower prior to the Maturity Date pursuant to the terms of Section 2.2(d) hereof, an additional fee payable to the Lenders in amount equal to:

(i) for a prepayment made on or after the Funding Date of such Term Loan through and including the first anniversary of the Funding Date of such Term Loan, two percent (2.00%) of the principal amount of such Term Loan prepaid;

(ii) for a prepayment made after the date which is the first anniversary of the Funding Date of such Term Loan through and including the second anniversary of the Funding Date of such Term Loan, one and one-half percent (1.50%) of the principal amount of the Term Loans prepaid; and

(iii) for a prepayment made after the date which is the second anniversary of the Funding Date of such Term Loan through and including the third anniversary of the Funding Date of such Term Loan, one-half percent (0.50%) of the principal amount of the Term Loans prepaid; and

(iv) for a prepayment made after the date which is the third anniversary of the Funding Date of such Term Loan and prior to the Maturity Date, zero percent (0.00%) of the principal amount of the Term Loans prepaid.

"Prior Loan Agreement" means that certain Amended and Restated Loan and Security Agreement dated as of August 31, 2015, among SolarCap, the lenders party thereto, and Borrower, as amended, restated, modified, or supplemented from time to time prior to the Effective Date.

"Property" means any interest in any kind of property or asset, whether real, personal or mixed, and whether tangible or intangible.

"Pro Rata Share" is, as of any date of determination, with respect to each Lender, a percentage (expressed as a decimal, rounded to the ninth decimal place) determined by dividing the outstanding principal amount of Term Loans held by such Lender by the aggregate outstanding principal amount of all Term Loans.

"Registered Organization" is any "registered organization" as defined in the Code with such additions to such term as may hereafter be made under the Code.

"Registration" means any registration, authorization, approval, license, permit, clearance, certificate, and exemption issued or allowed by the FDA (including, without limitation, new drug applications, abbreviated new drug applications, biologics license applications, investigational new drug applications, over-the-counter drug monograph, device pre-market approval applications, device pre-market notifications, investigational device exemptions, product recertifications, manufacturing approvals, registrations and authorizations, CE Marks, pricing and reimbursement approvals, labeling approvals or their foreign equivalent, controlled substance registrations, and wholesale distributor permits).

"Regulatory Action" means an administrative or regulatory enforcement action, proceeding, investigation or inspection, FDA Form 483 notice of inspectional observation, warning letter, untitled letter, other notice of violation letter, recall, seizure, Section 305 notice or other similar written communication, or consent decree, issued by the FDA.

"Related Persons" means, with respect to any Person, each Affiliate of such Person and each director, officer, employee, agent, trustee, representative, attorney, accountant and each insurance, environmental, legal, financial and other advisor and other consultants and agents of or to such Person or any of its Affiliates.

"Required Lenders" means (i) for so long as all of the Persons that are Lenders on the Effective Date (each an **"Original Lender"**) have not assigned or transferred any of their interests in their Term Loan, Lenders holding one hundred percent (100%) of the aggregate outstanding principal balance of the Term Loan, or (ii) at any time from and after any Original Lender has assigned or transferred any interest in its Term Loan, Lenders holding at least sixty six percent (66%) of the aggregate outstanding principal balance of the Term Loan and, in respect of this clause (ii), (A) each Original Lender that has not assigned or transferred any portion of its Term Loan, (B) each assignee or transferee of an Original Lender's interest in the Term Loan, but only to the extent that such assignee or transferee is an Affiliate or Approved Fund of such Original Lender, and (C) any Person providing financing to any Person described in clauses (A) and (B) above; provided, however, that this clause (C) shall only apply upon the occurrence of a default, event of default or similar occurrence with respect to such financing.

"Requirement of Law" is as to any Person, the organizational or governing documents of such Person, and any law (statutory or common), treaty, rule or regulation or determination of an arbitrator or a court or other Governmental Authority, in each case applicable to or binding upon such Person or any of its property or to which such Person or any of its property is subject.

“Responsible Officer” is any of the President, Chief Executive Officer, or Chief Financial Officer of Borrower acting alone.

“Securities Account” is any “securities account” as defined in the Code with such additions to such term as may hereafter be made under the Code.

“Solvent” is, with respect to any Person: the fair salable value of such Person’s consolidated assets (including goodwill minus disposition costs) exceeds the fair value of such Person’s liabilities; such Person is not left with unreasonably small capital after the transactions in this Agreement; and such Person is able to pay its debts (including trade debts) as they mature in the ordinary course (without taking into account any forbearance and extensions related thereto).

“Subordinated Debt” is indebtedness incurred by Borrower or any of its Subsidiaries subordinated to all Indebtedness (other than pursuant to the Exit Fee Agreement) of Borrower and/or its Subsidiaries to the Lenders (pursuant to a subordination, intercreditor, or other similar agreement in form and substance satisfactory to Collateral Agent and the Lenders entered into between Collateral Agent, Borrower, and/or any of its Subsidiaries, and the other creditor), on terms acceptable to Collateral Agent and the Lenders.

“Subsidiary” is, with respect to any Person, any Person of which more than fifty percent (50%) of the voting stock or other equity interests (in the case of Persons other than corporations) is owned or controlled, directly or indirectly, by such Person or through one or more intermediaries. Unless otherwise specified, references herein to a Subsidiary mean a Subsidiary of Borrower.

“**Term Loan Commitment**” is, for any Lender, the obligation of such Lender to make a Term Loan, up to the principal amount shown on Schedule 1.1. “**Term Loan Commitments**” means the aggregate amount of such commitments of all Lenders.

“**Trademarks**” means any trademark and servicemark rights, whether registered or not, applications to register and registrations of the same and like protections, and the entire goodwill of the business of Borrower connected with and symbolized by such trademarks.

2. LOANS AND TERMS OF PAYMENT

2.1 Promise to Pay. Borrower hereby unconditionally promises to pay each Lender, the outstanding principal amount of all Term Loans advanced to Borrower by such Lender and accrued and unpaid interest thereon and any other amounts due hereunder as and when due in accordance with this Agreement.

2.2 Term Loans.

(a) Availability. (i) Subject to the terms and conditions of this Agreement, the Lenders agree, severally and not jointly, to make term loans to Borrower on the Effective Date in an aggregate principal amount of Twenty-One Million Dollars (\$21,000,000.00) according to each Lender’s Term Loan Commitment as set forth on Schedule 1.1 hereto (such term loans are hereinafter referred to singly as a “**Term Loan**”, and collectively as the “**Term Loans**”), provided that a portion of the proceeds of the Term Loans shall be used to repay in full Borrower’s outstanding Indebtedness to SolarCap under the Prior Loan Agreement (the “**Prior Loan Debt**”). Borrower hereby authorizes Collateral Agent to apply the proceeds of the Term Loans to the Prior Loan Debt without actually depositing such funds in an account of Borrower (i.e., netting). After repayment, no Term Loan may be re-borrowed.

(b) Repayment. Borrower shall make monthly payments of interest only commencing on the first (1st) Payment Date following the Funding Date of each Term Loan, and continuing on the Payment Date of each successive month thereafter through and including the Payment Date immediately preceding the Amortization Date. Borrower agrees to pay, on the Funding Date of each Term Loan, any initial partial monthly interest payment otherwise due for the period between the Funding Date of such Term Loan and the first Payment Date after such Funding Date. Commencing on the Amortization Date, and continuing on the Payment Date of each month thereafter, Borrower shall make consecutive equal monthly payments of principal and interest, in arrears, to each Lender, as calculated by Collateral Agent (which calculations shall be deemed correct absent manifest error) based upon: (1) the amount of such Lender’s Term Loan, (2) the effective rate of interest, as determined in Section 2.3(a), and (3) the repayment schedule starting on the Amortization Date and ending on the Maturity Date. All unpaid principal and accrued and unpaid interest with respect to each Term Loan is due and payable in full on the Maturity Date. The Term Loans may only be prepaid in accordance with Sections 2.2(c) and 2.2(d).

(c) Mandatory Prepayments. If the Term Loans are accelerated following the occurrence of an Event of Default, Borrower shall immediately pay to Lenders, payable to each Lender in accordance with its respective Pro Rata Share, an amount equal to the sum of: (i) all outstanding principal of the Term Loans plus accrued and unpaid interest thereon through the prepayment date and (ii) the Final Fee plus (iii) all other outstanding Obligations that are due and payable hereunder, including, without limitation, Lenders’ Expenses and interest at the Default Rate with respect to any past due amounts. Notwithstanding (but without duplication with) the foregoing, on the Maturity Date, if the Final Fee had not previously been paid in full in connection with the prepayment of the Term Loans in full, Borrower shall pay to Collateral Agent for payment to each Lender in accordance with its respective Pro Rata Share the Final Fee in respect of the Term Loans.

(d) Permitted Prepayment of Term Loans. Borrower shall have the option to prepay all, but not less than all, of the Term Loans advanced by the Lenders under this Agreement, provided Borrower (i) provides written notice to Collateral Agent of its election to prepay the Term Loans at least five (5) Business Days prior to such prepayment, and (ii) pays to the Lenders on the date of such prepayment, payable to each Lender in accordance with its respective Pro Rata Share, an amount equal to the sum of (A) all outstanding principal of the Term Loans plus accrued and unpaid interest thereon through the prepayment date, (B) the Final Fee, (C) the Prepayment Fee,

plus (D) all other outstanding Obligations that are due and payable hereunder, including, without limitation, Lenders' Expenses and interest at the Default Rate with respect to any past due amounts.

2.3 Payment of Interest on the Term Loans.

(a) Interest Rate. Subject to Section 2.3(b), the principal amount outstanding under the Term Loans shall accrue interest at a floating per annum rate equal to the LIBOR Rate in effect from time to time plus 8.50%, which aggregate interest rate shall be determined by Collateral Agent in accordance with the definition of "LIBOR Rate" on the third Business Day prior to the Funding Date of the applicable Term Loan and on the date occurring on the third Business Day prior to each Payment Date occurring thereafter, which interest shall be payable monthly in arrears in accordance with Sections 2.2(b) and 2.3(e). Interest shall accrue on each Term Loan commencing on, and including, the Funding Date of such Term Loan, and shall accrue on the principal amount outstanding under such Term Loan through and including the day on which such Term Loan is paid in full.

(b) Default Rate. Immediately upon the occurrence and during the continuance of an Event of Default, Obligations shall accrue interest at a fixed per annum rate equal to the rate that is otherwise applicable thereto plus five percentage points (5.00%) (the "**Default Rate**"). Payment or acceptance of the increased interest rate provided in this Section 2.3(b) is not a permitted alternative to timely payment and shall not constitute a waiver of any Event of Default or otherwise prejudice or limit any rights or remedies of Collateral Agent.

(c) 360-Day Year. Interest shall be computed on the basis of a three hundred sixty (360) day year for the actual number of days elapsed.

(d) Debit of Accounts. Collateral Agent and each Lender may debit (or ACH) any deposit accounts, maintained by Borrower or any of its Subsidiaries, including the Designated Deposit Account, (but excluding any deposit accounts exclusively used for payroll, payroll taxes and other employee wage and benefit payments to or for the benefit of Borrower's employees, and in each case identified to Collateral Agent by Borrower as such) for principal and interest payments or any other amounts Borrower owes the Lenders under the Loan Documents when due. Any such debits (or ACH activity) shall not constitute a set-off.

(e) Payments. Except as otherwise expressly provided herein, all payments by Borrower under the Loan Documents shall be made to the respective Lender to which such payments are owed, at such Lender's office in immediately available funds on the date specified herein. Unless otherwise provided, interest is payable monthly on the Payment Date of each month. Payments of principal and/or interest received after 2:00 p.m. Eastern time are considered received at the opening of business on the next Business Day. When a payment is due on a day that is not a Business Day, the payment is due the next Business Day and additional fees or interest, as applicable, shall continue to accrue until paid. All payments to be made by Borrower hereunder or under any other Loan Document, including payments of principal and interest, and all fees, expenses, indemnities and reimbursements, shall be made without set-off, recoupment or counterclaim, in lawful money of the United States and in immediately available funds.

2.4 Fees. Borrower shall pay to Collateral Agent:

(a) Final Fee. The Final Fee, when due hereunder, to be shared between the Lenders in accordance with their respective Pro Rata Shares;

(b) Prepayment Fee. The Prepayment Fee, when due hereunder, to be shared between the Lenders in accordance with their respective Pro Rata Shares; and

(c) Fees of the Prior Loan Agreement. Notwithstanding the terms of the Prior Loan Agreement, the "Final Fee" as defined in the Prior Loan Agreement, which shall be reduced to \$900,000; no "Prepayment Fee" as defined in the Prior Loan Agreement shall be due and owed by Borrower in connection with this Agreement and the repayment in full of Indebtedness owed by Borrower under the Prior Loan Agreement); and

(d) Lenders' Expenses. All Lenders' Expenses (including reasonable documented attorneys' fees and expenses for documentation and negotiation of this Agreement) incurred through and after the Effective Date, when due.

2.5 Withholding. Payments received by the Collateral Agent or the Lenders from Borrower hereunder will be made free and clear of and without deduction for any and all present or future taxes, levies, imposts, duties, deductions, withholdings, assessments, fees or other charges imposed by any governmental authority (including any interest, additions to tax or penalties applicable thereto). Specifically, however, if at any time any Governmental Authority, applicable law, regulation or international agreement requires Borrower to make any withholding or deduction from any such payment or other sum payable hereunder to the Lenders, Borrower hereby covenants and agrees that the amount due from Borrower with respect to such payment or other sum payable hereunder will be increased to the extent necessary to ensure that, after the making of such required withholding or deduction, each Lender receives a net sum equal to the sum which it would have received had no withholding or deduction been required and Borrower shall pay the full amount withheld or deducted to the relevant Governmental Authority. Borrower will, upon request, furnish the Lenders with proof reasonably satisfactory to the Lenders indicating that Borrower has made such withholding payment; provided, however, that Borrower need not make any withholding payment if the amount or validity of such withholding payment is contested in good faith by appropriate and timely proceedings and as to which payment in full is bonded or reserved against by Borrower. The agreements and obligations of Borrower contained in this Section 2.5 shall survive the termination of this Agreement.

3. CONDITIONS OF LOANS

3.1 Conditions Precedent to Initial Term Loan. Each Lender's obligation to make a Term Loan is subject to the condition precedent that Collateral Agent and each Lender shall consent to or shall have received, in form and substance satisfactory to Collateral Agent and each Lender, such documents, and completion of such other matters, as Collateral Agent and each Lender may reasonably deem necessary or appropriate, including, without limitation:

- (a) original Loan Documents, each duly executed by Borrower and each Subsidiary party thereto, as applicable;
- (b) a completed Perfection Certificate for Borrower and each of its Subsidiaries;
- (c) the Operating Documents and good standing certificates of Borrower and its Subsidiaries certified by the Secretary of State (or equivalent agency) of Borrower's and such Subsidiaries' jurisdiction of organization or formation and each jurisdiction in which Borrower and each Subsidiary is qualified to conduct business, each as of a date no earlier than thirty (30) days prior to the Effective Date;
- (d) duly executed original officer's certificate for Borrower and each Subsidiary that is a party to the Loan Documents, in a form acceptable to Collateral Agent and the Lenders;
- (e) certified copies, dated as of date no earlier than thirty (30) days prior to the Effective Date, of financing statement searches, as Collateral Agent shall request, accompanied by written evidence (including any UCC termination statements) that the Liens indicated in any such financing statements either constitute Permitted Liens or have been or, in connection with the initial Term Loan, will be terminated or released;
- (f) a duly executed legal opinion of counsel to Borrower dated as of the Effective Date;
- (g) evidence satisfactory to Collateral Agent and the Lenders that the insurance policies required by Section 6.5 hereof are in full force and effect, together with ACORD insurance certificates showing loss payable and/or additional insured clauses or endorsements in favor of Collateral Agent, for the ratable benefit of the Lenders;
- (h) a copy of any applicable Investors Rights Agreement and any amendments thereto;

- (i) payment of the fees required under Section 2.4(d), and Lenders' Expenses then due, in each case as specified in Section 2.4 hereof.

3.2 Conditions Precedent to all Term Loans. The obligation of each Lender to extend each Term Loan, including the initial Term Loan, is subject to the following conditions precedent:

- (a) receipt by Collateral Agent of an executed Loan Payment Request Form in the form of Exhibit C attached hereto;
- (b) the representations and warranties in Section 5 hereof shall be true and accurate in all material respects on the Funding Date of each Term Loan; provided, however, that such materiality qualifier shall not be applicable to any representations and warranties that already are qualified or modified by materiality in the text thereof; and provided, further that those representations and warranties expressly referring to a specific date shall be true and accurate in all material respects as of such date, and no Event of Default shall have occurred and be continuing or result from the funding of such Term Loan;
- (c) in such Lender's reasonable discretion, there has not been any Material Adverse Change;
- (d) No Event of Default or an event that with the passage of time could result in an Event of Default, shall exist; and
- (e) payment of the fees and Lenders' Expenses then due as specified in Section 2.5 hereof.

3.3 Covenant to Deliver. Borrower agrees to deliver to Collateral Agent and the Lenders each item required to be delivered to Collateral Agent under this Agreement as a condition precedent to any Term Loan. Borrower expressly agrees that a Term Loan made prior to the receipt by Collateral Agent or any Lender of any such item shall not constitute a waiver by Collateral Agent or any Lender of Borrower's obligation to deliver such item, and any such Term Loan in the absence of a required item shall be made in each Lender's sole discretion.

3.4 Procedures for Borrowing. Subject to the prior satisfaction of all other applicable conditions to the making of a Term Loan set forth in this Agreement, to obtain a Term Loan (other than the Term Loan funded on the Effective Date), Borrower shall notify the Lenders (which notice shall be irrevocable) by electronic mail, facsimile, or telephone by 2:00 p.m. New York City time three (3) Business Days prior to the date the Term Loan is to be made. Together with any such electronic, facsimile or telephonic notification, Borrower shall deliver to Collateral Agent by electronic mail or facsimile a completed Loan Payment Request Form executed by a Responsible Officer or his or her designee. The Collateral Agent may rely on any telephone notice given by a person whom Collateral Agent reasonably believes is a Responsible Officer or designee. On the Funding Date, each Lender shall credit and/or transfer (as applicable) to the Designated Deposit Account, an amount equal to its Term Loan Commitment.

3.5 Post-Close Requirements. Borrower agrees that within 45 days of the Effective Date:

- (a) Borrower shall deliver to Collateral Agent a good standing certificate for Axcella, reflecting Axcella's current legal name, certified as of a recent date by the Secretary of the Commonwealth of Pennsylvania;
- (b) Borrower shall deliver to Collateral Agent certificates or other instruments representing or evidencing any Pledged Interests (as defined in that certain pledge agreement, dated as of the date hereof, by and among Axcella and Collateral Agent), accompanied by appropriate duly executed instruments of transfer or assignment (including, without limitation, stock powers) in blank, all in form and substance satisfactory to Collateral Agent; and
- (c) Borrower shall deliver to Collateral Agent evidence satisfactory to Collateral Agent and the Lenders that the insurance policies required by Section 6.5 hereof are in full force and effect, together with

appropriate evidence showing loss payable and/or additional insured clauses or endorsements in favor of Collateral Agent, for the ratable benefit of the Secured Parties.

4. CREATION OF SECURITY INTEREST

4.1 Grant of Security Interest. Borrower hereby grants, and reaffirms the grant under the Prior Loan Agreement, to Collateral Agent, for the ratable benefit of the Lenders, to secure the payment and performance in full of all of the Obligations (other than pursuant to the Exit Fee Agreement), a continuing first priority security interest (subject only to Permitted Liens) in, and pledges, and reaffirms any prior pledges, to Collateral Agent, for the ratable benefit of the Lenders, the Collateral, wherever located, whether now owned or hereafter acquired or arising, and all proceeds and products supporting obligations (as defined in the Code) in respect thereof. If Borrower shall acquire a commercial tort claim (as defined in the Code), Borrower shall grant to Collateral Agent, for the ratable benefit of the Lenders, a first priority security interest (subject only to Permitted Liens) therein and in the proceeds and products and supporting obligations (as defined in the Code) thereof, all upon the terms of this Agreement, with such writing to be in form and substance reasonably satisfactory to Collateral Agent.

If this Agreement is terminated, Collateral Agent's Lien in the Collateral shall continue until the Obligations (other than inchoate indemnity obligations) are repaid in full in cash. Upon payment in full in cash of the Obligations (other than inchoate indemnity obligations) and at such time as the Lenders' obligation to extend Term Loans has terminated, Collateral Agent shall, at the sole cost and expense of Borrower, terminate and release its Liens in the Collateral and all rights therein shall revert to Borrower.

4.2 Authorization to File Financing Statements. Borrower hereby authorizes Collateral Agent to file financing statements or take any other action required to perfect Collateral Agent's security interests in the Collateral, without notice to Borrower, with all appropriate jurisdictions to perfect or protect Collateral Agent's interest or rights under the Loan Documents.

5. REPRESENTATIONS AND WARRANTIES

Borrower represents and warrants to Collateral Agent and the Lenders as follows:

5.1 Due Organization, Authorization: Power and Authority. Borrower and each of its Subsidiaries is duly existing and in good standing as a Registered Organization in its jurisdictions of organization or formation and Borrower and each of its Subsidiaries is qualified and licensed to do business and is in good standing in any jurisdiction in which the conduct of its businesses or its ownership of property requires that it be qualified except where the failure to do so could not reasonably be expected to have a Material Adverse Change. In connection with this Agreement, Borrower and each of its Subsidiaries has delivered to Collateral Agent a completed perfection certificate and any updates or supplements thereto on or before the Effective Date (each a "**Perfection Certificate**" and collectively, the "**Perfection Certificates**"). Borrower represents and warrants that all the information set forth on the Perfection Certificates pertaining to Borrower and each of its Subsidiaries is accurate and complete (it being understood and agreed that Borrower and each of its Subsidiaries may from time to time update certain information in the Perfection Certificates).

The execution, delivery and performance by Borrower and each of its Subsidiaries of the Loan Documents to which it is a party have been duly authorized, and do not (i) conflict with any of Borrower's or such Subsidiaries' organizational documents, including its respective Operating Documents, (ii) contravene, conflict with, constitute a default under or violate any material Requirement of Law applicable thereto, (iii) contravene, conflict or violate any applicable order, writ, judgment, injunction, decree, determination or award of any Governmental Authority by which Borrower or such Subsidiary, or any of their property or assets may be bound or affected, (iv) require any action by, filing, registration, or qualification with, or Governmental Approval from, any Governmental Authority (except such Governmental Approvals which have already been obtained and are in full force and effect) or are being obtained pursuant to Section 6.1(b), or (v) constitute an event of default under any material agreement by which Borrower or any of such Subsidiaries, or their respective properties, is bound. Neither Borrower nor any of its Subsidiaries is in default under any agreement to which it is a party or by which it or any of its assets is bound in which such default could reasonably be expected to have a Material Adverse Change.

5.2 Collateral.

(a) Borrower and each its Subsidiaries have good title to, have rights in, and the power to transfer each item of the Collateral upon which it purports to grant a Lien under the Loan Documents, free and clear of any and all Liens except Permitted Liens, and neither Borrower nor any of its Subsidiaries have any Deposit Accounts, Securities Accounts, Commodity Accounts or other investment accounts other than the Collateral Accounts or the other investment accounts, if any, described in the Perfection Certificates delivered to Collateral Agent in connection herewith with respect of which Borrower or such Subsidiary has given Collateral Agent notice and taken such actions as are necessary to give Collateral Agent a perfected security interest therein to the extent required by Section 6.6(b). The Accounts are bona fide, existing obligations of the Account Debtors.

(b) The security interest granted herein is and shall at all times continue to be a first priority perfected security interest in the Collateral located in the United States, subject only to Permitted Liens that are permitted by the terms of this Agreement to have priority to Collateral Agent's Lien.

(c) On the Effective Date, and except as disclosed on the Perfection Certificate (i) the Collateral (other than mobile equipment in the possession of Borrower's employees in the ordinary course of business) is not in the possession of any third party bailee, and (ii) no such third party bailee possesses components of the Collateral in excess of Two Hundred Fifty Thousand Dollars (\$250,000.00).

(d) All Inventory and Equipment is in all material respects of good and marketable quality, free from material defects.

(e) Borrower and each of its Subsidiaries is the sole owner of the Intellectual Property each respectively purports to own, free and clear of all Liens other than Permitted Liens. Except as noted on the Perfection Certificates, neither Borrower nor any of its Subsidiaries is a party to, nor is bound by, any material license or other Material Agreement.

5.3 Litigation. Except as disclosed on the Perfection Certificate or with respect to which Borrower has provided notice as required hereunder, there are no actions, suits, investigations, or proceedings pending or, to the Knowledge of the Responsible Officers, threatened in writing by or against Borrower or any of its Subsidiaries involving more than Two Hundred and Fifty Thousand Dollars (\$250,000.00).

5.4 No Material Adverse Change; Financial Statements. All consolidated financial statements for Borrower and its Subsidiaries, delivered to Collateral Agent fairly present, in conformity with GAAP, in all material respects the consolidated financial condition of Borrower and its Subsidiaries, and the consolidated results of operations of Borrower and its Subsidiaries, as of the date thereof, except that unaudited financial statements may be subject to normal adjustments and need not contain adjustments for items such as stock compensation or depreciation, or footnotes. Since December 31, 2016, there has not been a Material Adverse Change.

5.5 Solvency. Borrower and its Subsidiaries, when taken as a whole, are Solvent.

5.6 Regulatory Compliance. Neither Borrower nor any of its Subsidiaries is an "investment company" or a company "controlled" by an "investment company" under the Investment Company Act of 1940, as amended. Neither Borrower nor any of its Subsidiaries is engaged as one of its important activities in extending credit for margin stock (under Regulations X, T and U of the Federal Reserve Board of Governors). Borrower and each of its Subsidiaries has complied in all material respects with the Federal Fair Labor Standards Act. Neither Borrower nor any of its Subsidiaries is a "holding company" or an "affiliate" of a "holding company" or a "subsidiary company" of a "holding company" as each term is defined and used in the Public Utility Holding Company Act of 2005. Neither Borrower nor any of its Subsidiaries has violated any laws, ordinances or rules, the violation of which could reasonably be expected to have a Material Adverse Change. Neither Borrower's nor any of its Subsidiaries' properties or assets has been used by Borrower or such Subsidiary or, to Borrower's Knowledge, by previous Persons, in disposing, producing, storing, treating, or transporting any hazardous substance other than in material compliance with applicable laws. Borrower and

each of its Subsidiaries has obtained all consents, approvals and authorizations of, made all declarations or filings with, and given all notices to, all Governmental Authorities that are necessary to continue their respective businesses as currently conducted.

None of Borrower, any of its Subsidiaries, or any of Borrower's or its Subsidiaries' Affiliates or any of their respective agents acting or benefiting in any capacity in connection with the transactions contemplated by this Agreement is (i) in violation of any Anti-Terrorism Law, (ii) engaging in or conspiring to engage in any transaction that evades or avoids, or has the purpose of evading or avoiding or attempts to violate, any of the prohibitions set forth in any Anti-Terrorism Law, or (iii) is a Blocked Person. None of Borrower, any of its Subsidiaries, or to the Knowledge of Borrower and any of their Affiliates or agents, acting or benefiting in any capacity in connection with the transactions contemplated by this Agreement, (x) conducts any business or engages in making or receiving any contribution of funds, goods or services to or for the benefit of any Blocked Person, or (y) deals in, or otherwise engages in any transaction relating to, any property or interest in property blocked pursuant to Executive Order No. 13224, any similar executive order or other Anti-Terrorism Law.

5.7 Investments. Neither Borrower nor any of its Subsidiaries owns any stock, shares, partnership interests or other equity securities except for Permitted Investments.

5.8 Tax Returns and Payments; Pension Contributions. Borrower and each of its Subsidiaries has timely filed all required tax returns and reports, and Borrower and each of its Subsidiaries, has timely paid all foreign, federal, state, and local taxes, assessments, deposits and contributions owed by Borrower and such Subsidiaries in an amount greater than Ten Thousand Dollars (\$10,000), in all jurisdictions in which Borrower or any such Subsidiary is subject to taxes, including the United States, unless such taxes are being contested in accordance with the next sentence. Borrower and each of its Subsidiaries, may defer payment of any contested taxes, provided that Borrower or such Subsidiary, in good faith contests its obligation to pay the taxes by appropriate proceedings promptly and diligently instituted and conducted. Neither Borrower nor any of its Subsidiaries is aware of any claims or adjustments proposed for any of Borrower's or such Subsidiaries', prior tax years which could result in additional taxes becoming due and payable by Borrower or its Subsidiaries. Borrower and each of its Subsidiaries have paid all amounts necessary to fund all present pension, profit sharing and deferred compensation plans in accordance with their terms, and neither Borrower nor any of its Subsidiaries have, withdrawn from participation in, and have not permitted partial or complete termination of, or permitted the occurrence of any other event with respect to, any such plan which could reasonably be expected to result in any liability of Borrower or its Subsidiaries, including any liability to the Pension Benefit Guaranty Corporation or its successors or any other Governmental Authority.

5.9 Use of Proceeds. Borrower shall use the proceeds of the Term Loans as working capital, to fund its general business requirements in accordance with the provisions of this Agreement, and to pay the fees and other amounts required hereunder on the Effective Date, and not for personal, family, household or agricultural purposes.

5.10 Full Disclosure. No written representation, warranty or other statement of Borrower or any of its Subsidiaries in any certificate or written statement given to Collateral Agent or any Lender in connection with the Loan Documents or the transactions contemplated thereby, as of the date such representation, warranty, or other statement was made, taken together with all such written certificates and written statements given to Collateral Agent or any Lender, contains any untrue statement of a material fact or omits to state a material fact necessary to make the statements contained in the certificates or statements not misleading in light of the circumstances under which they were made (it being recognized that projections and forecasts provided by Borrower in good faith and based upon reasonable assumptions are not viewed as facts and that actual results during the period or periods covered by such projections and forecasts may differ from the projected or forecasted results).

6. AFFIRMATIVE COVENANTS

Borrower shall, and shall cause each of its Subsidiaries to, do all of the following:

6.1 Government Compliance.

(a) Maintain its and (except as otherwise permitted by Section 7.3) all its Subsidiaries' legal existence and good standing in their respective jurisdictions of organization and maintain qualification in each jurisdiction in which the failure to so qualify could reasonably be expected to have a Material Adverse Change. Comply with all laws, ordinances and regulations to which Borrower or any of its Subsidiaries is subject, the noncompliance with which could reasonably be expected to have a Material Adverse Change.

(b) Obtain and keep in full force and effect, all of the material Governmental Approvals necessary for the performance by Borrower and its Subsidiaries of their respective businesses and obligations under the Loan Documents and the grant of a security interest to Collateral Agent for the ratable benefit of the Lenders, in all of the Collateral.

6.2 Financial Statements, Reports, Certificates; Notices.

(a) Deliver to Collateral Agent:

(i) as soon as available, but no later than thirty (30) days after the last day of each month, a company prepared consolidated and consolidating balance sheet, income statement and cash flow statement covering the consolidated operations of Borrower and its Subsidiaries for such month certified by a Responsible Officer and in a form reasonably acceptable to Collateral Agent;

(ii) as soon as available, but no later than one hundred eighty (180) days after the last day of Borrower's fiscal year or within five (5) days of filing with the Securities and Exchange Commission, audited consolidated financial statements prepared under GAAP, consistently applied, together with an unqualified opinion (other than with respect to going concern based solely on the amount of cash and cash equivalents held by Borrower) on the financial statements from Deloitte LLP or another independent certified public accounting firm acceptable to Collateral Agent in its reasonable discretion;

(iii) as soon as available after approval thereof by Borrower's board of directors, but no later than ten (10) days' after such approval, Borrower's annual financial projections for the entire current fiscal year as approved by Borrower's board of directors; provided that, any revisions to such projections approved by Borrower's board of directors shall be delivered to Collateral Agent and the Lenders no later than seven (7) days after such approval;

(iv) within five (5) days of delivery, copies of all non-ministerial statements, reports and notices made available to Borrower's security holders or holders of Subordinated Debt;

(v) in the event that Borrower becomes subject to the reporting requirements under the Securities Exchange Act of 1934, as amended, within five (5) days of filing, all reports on Form 10-K, 10-Q and 8-K filed with the Securities and Exchange Commission. Documents required to be delivered pursuant to the terms hereof (to the extent any such documents are included in materials otherwise filed with the Securities and Exchange Commission) may be delivered electronically and if so delivered, shall be deemed to have been delivered on the date on which Borrower posts such documents, or provides a link thereto, on Borrower's website on the Internet at Borrower's website address; provided, however, Borrower shall promptly notify Bank in writing (which may be by electronic mail) of the posting of any such documents;

(vi) prompt notice of any amendments of or other changes to the capitalization table of Borrower and to the Operating Documents of Borrower or any of its Subsidiaries, together with any copies reflecting such amendments or changes with respect thereto;

(vii) as soon as available, but no later than thirty (30) days after the last day of each month, copies of the month-end account statements for each Collateral Account maintained by Borrower or its Subsidiaries, which statements may be provided to Collateral Agent and each Lender by Borrower or directly from the applicable institution(s);

(viii) prompt delivery of (and in any event within five (5) days after the same are sent or received) copies of all material correspondence, reports, documents and other filings with any Governmental Authority that could reasonably be expected to have a material adverse effect on any of the Governmental Approvals material to Borrower's business or otherwise could reasonably be expected to have a Material Adverse Change;

(ix) prompt notice of any event that (A) could reasonably be expected to materially and adversely affect the value of the Intellectual Property and (B) could reasonably be expected to result in a Material Adverse Change;

(x) written notice at least (10) days' prior to Borrower's creation of a New Subsidiary in accordance with the terms of Section 6.10);

(xi) written notice at least ten (10) days' prior to Borrower's (A) adding any new offices or business locations, including warehouses (unless each such new office or business location contains less than One Hundred Twenty Five Thousand Dollars (\$125,000.00)) in assets or property of Borrower or any of its Subsidiaries), (B) changing its jurisdiction of organization, (C) changing its organizational structure or type, (D) changing its legal name, or (E) changing any organizational number (if any) assigned by its jurisdiction of organization;

(xii) upon Borrower becoming aware of the existence of any Event of Default or event which, with the giving of notice or passage of time, or both, would constitute an Event of Default, prompt (and in any event within three (3) Business Days) written notice of such occurrence, which such notice shall include a reasonably detailed description of such Event of Default or event which, with the giving of notice or passage of time, or both, would constitute an Event of Default;

(xiii) immediate notice if Borrower or such Subsidiary has Knowledge that Borrower, or any Subsidiary or Affiliate of Borrower, is listed on the OFAC Lists or (a) is convicted on, (b) pleads *nolo contendere* to, (c) is indicted on, or (d) is arraigned and held over on charges involving money laundering or predicate crimes to money laundering;

(xiv) notice of any commercial tort claim and of the general details thereof;

(xv) if Borrower or any of its Subsidiaries is not now a Registered Organization but later becomes one, written notice of such occurrence and information regarding such Person's organizational identification number within seven (7) Business Days of receiving such organizational identification number; and

(xvi) other information relating to Borrower or its Subsidiaries as reasonably requested by Collateral Agent.

(b) Concurrently with the delivery of the financial statements specified in Section 6.2(a)(i) above but no later than thirty (30) days after the last day of each month, deliver to Collateral Agent:

(i) a duly completed Compliance Certificate signed by a Responsible Officer;

(ii) [Reserved];

(iii) [Reserved];

(iv) written notice of the commencement of, and any material development in, the proceedings contemplated by Section 5.8 hereof;

(v) written notice of any litigation or governmental proceedings pending or threatened (in writing) against Borrower or any of its Subsidiaries, which could reasonably be expected to result in damages or costs to Borrower or any of its Subsidiaries of Two Hundred Fifty Thousand Dollars (\$250,000.00); and

(vi) written notice of all returns, recoveries, disputes and claims regarding Inventory that involve more than Two Hundred Fifty Thousand Dollars (\$250,000.00) individually or in the aggregate in any calendar year.

(c) Keep proper, complete and true books of record and account in accordance with GAAP in all material respects. Borrower shall, and shall cause each of its Subsidiaries to, allow, at the sole cost of Borrower, Collateral Agent or any Lender, during regular business hours upon reasonable prior notice (provided that no notice shall be required when an Event of Default has occurred and is continuing), to visit and inspect any of its properties, to examine and make abstracts or copies from any of its books and records, and to conduct a collateral audit and analysis of its operations and the Collateral. Such audits shall be conducted no more often than twice every year unless (and more frequently if) an Event of Default has occurred and is continuing.

6.3 Inventory; Returns. Keep all Inventory in good and marketable condition (ordinary wear and tear excepted), free from material defects. Returns and allowances between Borrower, or any of its Subsidiaries, and their respective Account Debtors shall follow Borrower's, or such Subsidiary's, customary practices as they exist at the Effective Date.

6.4 Taxes; Pensions. Timely file and require each of its Subsidiaries to timely file, all required tax returns and reports and timely pay, and require each of its Subsidiaries to timely file, all foreign, federal, state, and local taxes, assessments, deposits and contributions owed by Borrower or its Subsidiaries, except as otherwise permitted pursuant to the terms of Section 5.8 hereof, and shall deliver to Collateral Agent, on demand, appropriate certificates attesting to such payments, and pay all amounts necessary to fund all present pension, profit sharing and deferred compensation plans in accordance with the terms of such plans.

6.5 Insurance. Keep Borrower's and its Subsidiaries' business and the Collateral insured for risks and in amounts standard for companies in Borrower's and its Subsidiaries' industry and location and as Collateral Agent may reasonably request. Insurance policies shall be in a form, with companies, and in amounts that are reasonably satisfactory to Collateral Agent. All property policies shall have a lender's loss payable endorsement showing Collateral Agent as lender loss payee and waive subrogation against Collateral Agent, and all general liability policies shall show, or have endorsements showing, Collateral Agent, as additional insured. The Collateral Agent shall be named as lender loss payee and/or additional insured with respect to any such insurance providing coverage in respect of any Collateral, and each provider of any such insurance shall agree, by endorsement upon the policy or policies issued by it or by independent instruments furnished to the Collateral Agent, that it will give the Collateral Agent thirty (30) days prior written notice before any such policy or policies shall be canceled. At Collateral Agent's request, Borrower shall deliver certified copies of policies and evidence of all premium payments. Proceeds payable under any policy shall, at Collateral Agent's option, be payable to Collateral Agent, for the ratable benefit of the Lenders, on account of the Obligations. Notwithstanding the foregoing, (a) so long as no Event of Default has occurred and is continuing, Borrower shall have the option of applying the proceeds in an aggregate amount not exceeding Five Hundred Thousand (\$500,000) of any casualty policy within 120 days of receipt thereof toward the replacement or repair of destroyed or damaged property; provided that any such replaced or repaired property (i) shall be of equal or like value as the replaced or repaired Collateral and (ii) shall be deemed Collateral in which Collateral Agent has been granted a first priority security interest (subject to Permitted Liens that are permitted by the terms of this Agreement to have priority over Collateral Agent's Lien), and (b) after the occurrence and during the continuance of an Event of Default, all proceeds payable under such casualty policy shall, at the option of Collateral Agent, be payable to Collateral Agent, for the ratable benefit of the Lenders, on account of the Obligations. If Borrower or any of its Subsidiaries fails to obtain insurance as required under this Section 6.5 or to pay any amount or furnish any required proof of payment to third persons, Collateral Agent may make (but has no obligation to do so), at Borrower's expense, all or part of such payment or obtain such insurance policies required in this Section 6.5, and take any action under the policies Collateral Agent deems prudent.

6.6 Operating Accounts.

(a) Borrower shall provide Collateral Agent ten (10) days' prior written notice before Borrower or any of its Subsidiaries establishes any Collateral Account. In addition, for each domestic Collateral Account that Borrower or any of its Subsidiaries, at any time maintains, Borrower or such Subsidiary shall cause the applicable bank or financial institution at or with which such Collateral Account is maintained to execute and deliver a Control Agreement or other appropriate instrument with respect to such Collateral Account to perfect Collateral Agent's Lien in such Collateral Account in accordance with the terms hereunder prior to or contemporaneously with the establishment of such Collateral Account, which Control Agreement may not be terminated without prior written consent of Collateral Agent. The provisions of the previous sentence shall not apply to (a) deposit accounts exclusively used for payroll, payroll taxes and other employee wage and benefit payments to or for the benefit of Borrower's, or any of its Subsidiaries', employees and identified to Collateral Agent by Borrower as such in the Perfection Certificate, or (b) the MSC Account.

(b) Neither Borrower nor any of its Subsidiaries shall maintain any Collateral Accounts except Collateral Accounts maintained in accordance with Section 6.6.

6.7 Protection of Intellectual Property Rights. Borrower and each of its Subsidiaries shall: (a) use commercially reasonable efforts to protect, defend and maintain the validity and enforceability of its Intellectual Property that is material to its business; (b) promptly advise Collateral Agent in writing of material infringement by a third party of its Intellectual Property; and (c) not allow any Intellectual Property material to its business to be abandoned, forfeited or dedicated to the public without Collateral Agent's prior written consent.

6.8 Litigation Cooperation. Commencing on the Effective Date and continuing through the termination of this Agreement, make available to Collateral Agent, without expense to Collateral Agent or the Lenders, Borrower and each of Borrower's officers, employees and agents and Borrower's Books, to the extent that Collateral Agent may reasonably deem them necessary to prosecute or defend any third-party suit or proceeding instituted by or against Collateral Agent with respect to any Collateral or relating to Borrower.

6.9 Landlord Waivers; Bailee Waivers. In the event that Borrower or any of its Subsidiaries, after the Effective Date, intends to add any new offices or business locations, including warehouses, or otherwise store any portion of the Collateral with, or deliver any portion of the Collateral to, a bailee, in each case pursuant to Section 7.2, then Borrower or such Subsidiary will first deliver notice to Collateral Agent and, in the event that the Collateral at any new location is valued in excess of Two Hundred Fifty Thousand Dollars (\$250,000.00) in the aggregate, at Collateral Agent's election, such bailee or landlord, as applicable, must execute and deliver a bailee waiver or landlord waiver, as applicable, in form and substance reasonably

satisfactory to Collateral Agent prior to the addition of any new offices or business locations, or any such storage with or delivery to any such bailee, as the case may be.

6.10 Creation/Acquisition of Subsidiaries. In the event Borrower or any Subsidiary creates or acquires any Subsidiary after the Effective Date, Borrower or such Subsidiary shall promptly notify Collateral Agent of such creation or acquisition, and Borrower or such Subsidiary shall take all actions reasonably requested by Collateral Agent to achieve any of the following with respect to such “New Subsidiary” (defined as a Subsidiary formed after the date hereof during the term of this Agreement): (i) to cause such New Subsidiary (except for the MSC Subsidiary) to become either a co-Borrower hereunder, if such New Subsidiary is organized under the laws of the United States, or a secured guarantor with respect to the Obligations; and (ii) to grant and pledge to Collateral Agent a perfected security interest in 100% of the stock, units or other evidence of ownership held by Borrower or its Subsidiaries of any such New Subsidiary (including, for the avoidance of doubt, the MSC Subsidiary) which is organized under the laws of the United States, and 65% of the stock, units or other evidence of ownership held by Borrower or its Subsidiaries of any such New Subsidiary which is not organized under the laws of the United States.

6.11 Further Assurances. Execute any further instruments and take further action as Collateral Agent or any Lender reasonably requests to perfect or continue Collateral Agent’s Lien in the Collateral or to effect the purposes of this Agreement.

7. NEGATIVE COVENANTS

Borrower shall not, and shall not permit any of its Subsidiaries to, do any of the following without the prior written consent of Collateral Agent:

7.1 Dispositions. Convey, sell, lease, transfer, assign, dispose of (collectively, “**Transfer**”), or permit any of its Subsidiaries to Transfer, all or any part of its business or property, except for Transfers (a) of Inventory in the ordinary course of business; (b) of worn-out, obsolete or surplus Equipment; (c) in connection with Permitted Liens, Permitted Investments and Permitted Licenses; (d) consisting of the sale or issuance of any stock permitted under Section 7.2; and (e) consisting of the use or transfer of money or Cash Equivalents in the ordinary course of business for the payment of Borrower’s ordinary course business expenses.

7.2 Changes in Business, Management, Ownership, or Business Locations. (a) Engage in or permit any of its Subsidiaries to engage in any business other than the businesses engaged in by Borrower as of the Effective Date or reasonably related, incidental or ancillary thereto; (b) liquidate or dissolve; or (c) (i) any Key Person shall cease to be actively engaged in the management of Borrower unless written notice thereof is provided to Collateral Agent within ten (10) days of such, or (ii) enter into any transaction or series of related transactions in which (A) the stockholders of Borrower who were not stockholders immediately prior to the first such transaction own more than 40% of the voting stock of Borrower immediately after giving effect to such transaction or related series of such transactions (other than by the sale of Borrower’s equity securities in a public offering, a private placement of public equity or to venture capital or private equity investors so long as Borrower identifies to Collateral Agent the investors prior to the closing of the transaction) and (B) Borrower ceases to own (i) at least 100% of the ownership interests of a Foreign Subsidiary of Borrower or (ii) at least 80% of the ownership interests of a Domestic Subsidiary of Borrower. Borrower shall not, without at least thirty (30) days’ prior written notice to Collateral Agent: (A) add any new offices or business locations, including warehouses (unless each such new office or business location contains less than Two Hundred Fifty Thousand Dollars (\$250,000.00) in assets or property of Borrower or any of its Subsidiaries); (B) change its jurisdiction of organization, (C) change its organizational structure or type, (D) change its legal name, or (E) change any organizational number (if any) assigned by its jurisdiction of organization.

7.3 Mergers or Acquisitions. Merge or consolidate, or permit any of its Subsidiaries to merge or consolidate, with any other Person, or acquire, or permit any of its Subsidiaries to acquire, all or substantially all of the capital stock, shares or property of another Person. A Subsidiary may merge or consolidate into another Subsidiary (provided such surviving Subsidiary is a “co-Borrower” hereunder or has provided a secured Guaranty of Borrower’s Obligations hereunder) or with (or into) Borrower provided Borrower is the surviving legal entity, and as long as no Event of Default is occurring prior thereto or arises as a result therefrom.

7.4 Indebtedness. Create, incur, assume, or be liable for any Indebtedness, or permit any Subsidiary to do so, other than Permitted Indebtedness.

7.5 Encumbrance. Create, incur, allow, or suffer any Lien on any of its property, or assign or convey any right to receive income, including the sale of any Accounts, or permit any of its Subsidiaries to do so, except for Permitted Liens, or permit any Collateral not to be subject to the first priority security interest granted herein (except for Permitted Liens), or enter into any agreement, document, instrument or other arrangement (except with or in favor of Collateral Agent, for the ratable benefit of the Lenders) with any Person which directly or indirectly prohibits or has the effect of prohibiting Borrower, or any of its Subsidiaries, from assigning, mortgaging, pledging, granting a security interest in or upon, or encumbering any of Borrower’s or such Subsidiary’s Intellectual Property, except as is otherwise permitted in Section 7.1 hereof and the definition of “Permitted Liens”.

7.6 Maintenance of Collateral Accounts. Maintain any Collateral Account except pursuant to the terms of Section 6.6 hereof.

7.7 Restricted Payments. Pay any dividends (other than dividends payable solely in capital stock) or make any distribution or payment in respect of or redeem, retire or purchase any capital stock (other

than (i) repurchases pursuant to the terms of employee stock purchase plans, employee restricted stock agreements, stockholder rights plans, director or consultant stock option plans, or similar plans, provided such repurchases do not exceed Two Hundred Fifty Thousand Dollars (\$250,000.00) in the aggregate per fiscal year and (ii) non-cash conversions of any convertible securities into other securities pursuant to the terms of such convertible securities or otherwise in exchange thereof). Notwithstanding the foregoing, the MSC Subsidiary may pay dividends or make distributions to the Borrower.

7.8 Investments. Directly or indirectly make any Investment, or permit any of its Subsidiaries to do so other than (a) Permitted Investments, and (b) if the MSC Investment Conditions continue to be met and no Event of Default or an event that with the passage of time could result in an Event of Default, shall exist, Investments in a wholly-owned Subsidiary incorporated in Massachusetts for the purpose of holding Investments as a Massachusetts security corporation under 830 CMR 63.38B.1 of the Massachusetts tax code and applicable regulations (as the same may be amended, modified or replaced from time to time) (the “MSC Subsidiary”). If at any time after the incorporation of the MSC Subsidiary the MSC Investment Conditions are not met, then (i) the Borrower shall immediately cause the MSC Subsidiary to distribute to the Borrower all assets held by the MSC Subsidiary for deposit into a Collateral Account subject to a Control Agreement in favor of Collateral Agent, and (ii) the Borrower shall not permit the MSC Subsidiary to hold any assets. The Borrower shall not permit the MSC Subsidiary to make any Investments or hold any assets that would cause the MSC Subsidiary to fail to qualify as a Massachusetts security corporation under 830 CMR 63.38B.1 of the Massachusetts tax code and applicable regulations (as the same may be amended, modified or replaced from time to time).

7.9 Transactions with Affiliates. Directly or indirectly enter into or permit to exist any material transaction with any Affiliate of Borrower or any of its Subsidiaries, except for (a) transactions that are in the ordinary course of Borrower’s or such Subsidiary’s business, upon fair and reasonable terms that are no less favorable to Borrower or such Subsidiary than would be obtained in an arm’s length transaction with a non-affiliated Person, (b) Subordinated Debt or equity investments by Borrower’s investors in Borrower, or by Borrower in its Subsidiaries, and (c) transactions permitted pursuant to the terms of Section 7.2.

7.10 Subordinated Debt. (a) Make or permit any payment on any Subordinated Debt, except under the terms of the subordination, intercreditor, or other similar agreement to which such Subordinated Debt is subject, or (b) amend any provision in any document relating to the Subordinated Debt which would increase the amount thereof or adversely affect the subordination thereof to Obligations owed to the Lenders.

7.11 Compliance. Become an “investment company” or a company controlled by an “investment company”, under the Investment Company Act of 1940, as amended, or undertake as one of its important activities extending credit to purchase or carry margin stock (as defined in Regulation U of the Board of Governors of the Federal Reserve System), or use the proceeds of any Term Loan for that purpose; fail to meet the minimum funding requirements of ERISA, permit a Reportable Event or Prohibited Transaction, as defined in ERISA, to occur; fail to comply with the Federal Fair Labor Standards Act or violate any other law or regulation, if the violation could reasonably be expected to have a Material Adverse Change, or permit any of its Subsidiaries to do so; withdraw or permit any Subsidiary to withdraw from participation in, permit partial or complete termination of, or permit the occurrence of any other event with respect to, any present pension, profit sharing and deferred compensation plan which could reasonably be expected to result in any liability of Borrower or any of its Subsidiaries, including any liability to the Pension Benefit Guaranty Corporation or its successors or any other Governmental Authority.

7.12 Compliance with Anti-Terrorism Laws. Neither Borrower nor any of its Subsidiaries shall, nor shall Borrower or any of its Subsidiaries permit any Affiliate to, directly or indirectly, knowingly enter into any documents, instruments, agreements or contracts with any Person listed on the OFAC Lists. Neither Borrower nor any of its Subsidiaries shall, nor shall Borrower or any of its Subsidiaries, permit any Affiliate to, directly or indirectly, (i) conduct any business or engage in any transaction or dealing with any Blocked Person, including, without limitation, the making or receiving of any contribution of funds, goods or services to or for the benefit of any Blocked Person, (ii) deal in, or otherwise engage in any transaction relating to, any property or interests in property blocked pursuant to Executive Order No. 13224 or any similar executive order or other Anti-Terrorism Law, or (iii) engage in or conspire to engage in any transaction that

evades or avoids, or has the purpose of evading or avoiding, or attempts to violate, any of the prohibitions set forth in Executive Order No. 13224 or other Anti-Terrorism Law.

8. EVENTS OF DEFAULT

Any one of the following shall constitute an event of default (an “**Event of Default**”) under this Agreement:

8.1 Payment Default. Borrower fails to (a) make any payment of principal or interest on any Term Loan on its due date, or (b) pay any other Obligations within three (3) Business Days after such Obligations are due and payable (which three (3) Business Day grace period shall not apply to payments due on the Maturity Date or the date of acceleration pursuant to Section 9.1 (a) hereof);

8.2 Covenant Default.

(a) Borrower or any of its Subsidiaries fails or neglects to perform any obligation in Sections 6.2 (Financial Statements, Reports, Certificates), 6.4 (Taxes), 6.5 (Insurance), 6.6 (Operating Accounts), 6.7 (Protection of Intellectual Property Rights), 6.9 (Landlord Waivers; Bailee Waivers), 6.10 (Creation/Acquisition of Subsidiaries) or Borrower violates any provision in Section 7; or

(b) Borrower, or any of its Subsidiaries, fails or neglects to perform, keep, or observe any other term, provision, condition, covenant or agreement contained in this Agreement or any Loan Documents, and as to any default (other than those specified in this Section 8) under such other term, provision, condition, covenant or agreement that can be cured, has failed to cure the default within fifteen (15) days after the occurrence thereof; provided, however, that if the default cannot by its nature be cured within the fifteen (15) day period or cannot after diligent attempts by Borrower be cured within such ten (10) day period, and such default is likely to be cured within a reasonable time, then Borrower shall have an additional period (which shall not in any case exceed thirty (30) days) to attempt to cure such default, and within such reasonable time period the failure to cure the default shall not be deemed an Event of Default (but no Term Loans shall be made during such cure period).

8.3 Investor Abandonment. If (a) Collateral Agent determines in its good faith judgment that it is the clear intention of Borrower’s investors to not continue to fund Borrower in the amounts and timeframe to the extent necessary to enable Borrower to satisfy the Obligations as they become due and payable, and (b) prior to an IPO, Flagship Ventures or any of its affiliate funds ceases to hold over 30 percent of the voting stock in Borrower.

8.4 Attachment; Levy; Restraint on Business.

(a) (i) The service of process seeking to attach, by trustee or similar process, any funds of Borrower or any of its Subsidiaries or of any entity under control of Borrower or its Subsidiaries on deposit with any institution at which Borrower or any of its Subsidiaries maintains a Collateral Account, or (ii) a notice of lien, levy, or assessment is filed against Borrower or any of its Subsidiaries or their respective assets by any government agency, and the same under subclauses (i) and (ii) hereof are not, within ten (10) days after the occurrence thereof, discharged or stayed (whether through the posting of a bond or otherwise); and

(b) (i) any material portion of Borrower’s or any of its Subsidiaries’ assets is attached, seized, levied on, or comes into possession of a trustee or receiver; or (ii) any court order enjoins, restrains, or prevents Borrower or any of its Subsidiaries from conducting any part of its business;

8.5 Insolvency. (a) Borrower is or becomes insolvent and any Subsidiary, when taken as a whole with Borrower, is or becomes Insolvent; (b) Borrower or any of its Subsidiaries begins an Insolvency Proceeding; or (c) an Insolvency Proceeding is begun against Borrower or any of its Subsidiaries and not dismissed or stayed within forty-five (45) days (but no Term Loans shall be extended while Borrower or any Subsidiary is Insolvent and/or until any Insolvency Proceeding is dismissed);

8.6 Other Agreements. There is a default in (a) any agreement to which Borrower or any of its Subsidiaries is a party with a third party or parties resulting in a right by such third party or parties, whether or not exercised, to accelerate the maturity of any Indebtedness in an amount in excess of Two Hundred Fifty Thousand Dollars (\$250,000.00) or that could reasonably be expected to have a Material Adverse Change or (b) there is any default under a Material Agreement that permits the counterparty thereto to accelerate the payments owed thereunder;

8.7 Judgments. One or more judgments, orders, or decrees for the payment of money in an amount, individually or in the aggregate, of at least Two Hundred Fifty Thousand Dollars (\$250,000.00) (not covered by independent third-party insurance) shall be rendered against Borrower or any of its Subsidiaries and shall remain unsatisfied, unvacated, or unstayed for a period of ten (10) days after the entry thereof;

8.8 Misrepresentations. Borrower or any of its Subsidiaries or any Person acting for Borrower or any of its Subsidiaries makes any representation, warranty, or other statement now or later in this Agreement, any Loan Document or in any writing delivered to Collateral Agent and/or Lenders or to induce Collateral Agent and/or the Lenders to enter this Agreement or any Loan Document, and such representation, warranty, or other statement, when taken as a whole, is incorrect in any material respect when made;

8.9 Subordinated Debt. A default or breach occurs under any agreement between Borrower or any of its Subsidiaries and any creditor of Borrower or any of its Subsidiaries that signed a subordination, intercreditor, or other similar agreement with Collateral Agent or the Lenders, or any creditor that has signed such an agreement with Collateral Agent or the Lenders breaches any terms of such agreement;

8.10 Guaranty. (a) Any Guaranty terminates or ceases for any reason to be in full force and effect; (b) any Guarantor does not perform any obligation or covenant under any Guaranty; (c) any circumstance described in Section 8 occurs with respect to any Guarantor; or (d) a Material Adverse Change with respect to any Guarantor;

8.11 Governmental Approvals; FDA Action. (a) Any Governmental Approval shall have been revoked, rescinded, suspended, modified in an adverse manner, or not renewed in the ordinary course for a full term *and* such revocation, rescission, suspension, modification or non-renewal has resulted in or could reasonably be expected to result in a Material Adverse Change; or (b) (i) the FDA initiates a Regulatory Action or any other enforcement action against Borrower or any of its Subsidiaries or any supplier of Borrower or any of its Subsidiaries that causes Borrower or any of its Subsidiaries to recall, withdraw, remove or discontinue marketing any of its products; (ii) the FDA issues a warning letter to Borrower or any of its Subsidiaries with respect to any of its activities or products which could reasonably be expected to result in a Material Adverse Change; (iii) Borrower or any of its Subsidiaries conducts a mandatory or voluntary recall which could reasonably be expected to result in liability and expense to Borrower or any of its Subsidiaries of \$250,000 or more; (iv) Borrower or any of its Subsidiaries enters into a settlement agreement with the FDA that results in aggregate liability as to any single or related series of transactions, incidents or conditions, of \$250,000 or more, or that could reasonably be expected to result in a Material Adverse Change; or (v) the FDA revokes any authorization or permission granted under any Registration, or Borrower or any of its Subsidiaries withdraws any Registration, that could reasonably be expected to result in a Material Adverse Change.

8.12 Lien Priority. Any Lien created hereunder or by any other Loan Document shall at any time fail to constitute a valid and perfected Lien on any of the Collateral purported to be secured thereby, subject to no prior or equal Lien, other than Permitted Liens arising as a matter of applicable law.

9. RIGHTS AND REMEDIES

9.1 Rights and Remedies.

(a) Upon the occurrence and during the continuance of an Event of Default, Collateral Agent may, and at the written direction of Required Lenders shall, without notice or demand, do any or all of the following: (i) deliver notice of the Event of Default to Borrower, (ii) by notice to Borrower declare all Obligations

immediately due and payable (but if an Event of Default described in Section 8.5 occurs all Obligations shall be immediately due and payable without any action by Collateral Agent or the Lenders) or (iii) by notice to Borrower suspend or terminate the obligations, if any, of the Lenders to advance money or extend credit for Borrower's benefit under this Agreement or under any other agreement between Borrower and Collateral Agent and/or the Lenders (but if an Event of Default described in Section 8.5 occurs all obligations, if any, of the Lenders to advance money or extend credit for Borrower's benefit under this Agreement or under any other agreement between Borrower and Collateral Agent and/or the Lenders shall be immediately terminated without any action by Collateral Agent or the Lenders).

(b) Without limiting the rights of Collateral Agent and the Lenders set forth in Section 9.1(a) above, upon the occurrence and during the continuance of an Event of Default, Collateral Agent shall have the right, and at the written direction of the Required Lenders shall, without notice or demand, to do any or all of the following:

- (i) foreclose upon and/or sell or otherwise liquidate, the Collateral;
- (ii) apply to the Obligations any (a) balances and deposits of Borrower that Collateral Agent or any Lender holds or controls, or (b) any amount held or controlled by Collateral Agent or any Lender owing to or for the credit or the account of Borrower; and/or
- (iii) commence and prosecute an Insolvency Proceeding or consent to Borrower commencing any Insolvency Proceeding.

(c) Without limiting the rights of Collateral Agent and the Lenders set forth in Sections 9.1(a) and (b) above, upon the occurrence and during the continuance of an Event of Default, Collateral Agent shall have the right, and at the written direction of the Required Lenders shall, without notice or demand, to do any or all of the following to the extent not prohibited by applicable law:

(i) settle or adjust disputes and claims directly with Account Debtors for amounts on terms and in any order that Collateral Agent considers advisable, notify any Person owing Borrower money of Collateral Agent's security interest in such funds, and verify the amount of such account;

(ii) make any payments and do any acts it considers necessary or reasonable to protect the Collateral and/or its security interest in the Collateral. Borrower shall assemble the Collateral if Collateral Agent requests and make it available in a location as Collateral Agent reasonably designates. Collateral Agent may enter premises where the Collateral is located, take and maintain possession of any part of the Collateral, and pay, purchase, contest, or compromise any Lien which appears to be prior or superior to its security interest and pay all expenses incurred. Borrower grants Collateral Agent a license to enter and occupy any of its premises, without charge, to exercise any of Collateral Agent's rights or remedies;

(iii) ship, reclaim, recover, store, finish, maintain, repair, prepare for sale, and/or advertise for sale, the Collateral. Collateral Agent is hereby granted a non-exclusive, royalty-free license or other right to use, without charge, Borrower's and each of its Subsidiaries' labels, Patents, Copyrights, mask works, rights of use of any name, trade secrets, trade names, Trademarks, service marks, and advertising matter, or any similar property as it pertains to the Collateral, in completing production of, advertising for sale, and selling any Collateral and, in connection with Collateral Agent's exercise of its rights under this Section 9.1, Borrower's and each of its Subsidiaries' rights under all licenses and all franchise agreements inure to Collateral Agent, for the benefit of the Lenders;

(iv) place a "hold" on any account maintained with Collateral Agent or the Lenders and/or deliver a notice of exclusive control, any entitlement order, or other directions or instructions pursuant to any Control Agreement or similar agreements providing control of any Collateral;

(v) demand and receive possession of Borrower's Books;

(vi) appoint a receiver to seize, manage and realize any of the Collateral, and such receiver shall have any right and authority as any competent court will grant or authorize in accordance with any applicable law, including any power or authority to manage the business of Borrower or any of its Subsidiaries; and

(vii) subject to clauses 9.1(a) and (b), exercise all rights and remedies available to Collateral Agent and each Lender under the Loan Documents or at law or equity, including all remedies provided under the Code (including disposal of the Collateral pursuant to the terms thereof).

Notwithstanding any provision of this Section 9.1 to the contrary, upon the occurrence of any Event of Default, Collateral Agent shall have the right to exercise any and all remedies referenced in this Section 9.1 without the written consent of Required Lenders following the occurrence of an Exigent Circumstance.

9.2 Power of Attorney. Borrower hereby irrevocably appoints Collateral Agent as its lawful attorney-in-fact, exercisable upon the occurrence and during the continuance of an Event of Default, to: (a) endorse Borrower's or any of its Subsidiaries' name on any checks or other forms of payment or security; (b) sign Borrower's or any of its Subsidiaries' name on any invoice or bill of lading for any Account or drafts against Account Debtors; (c) settle and adjust disputes and claims about the Accounts directly with Account Debtors, for amounts and on terms Collateral Agent determines reasonable; (d) make, settle, and adjust all claims under Borrower's insurance policies; (e) pay, contest or settle any Lien, charge, encumbrance, security interest, and adverse claim in or to the Collateral, or any judgment based thereon, or otherwise take any action to terminate or discharge the same; and (f) transfer the Collateral into the name of Collateral Agent or a third party as the Code or any applicable law permits. Borrower hereby appoints Collateral Agent as its lawful attorney-in-fact to sign Borrower's or any of its Subsidiaries' name on any documents necessary to perfect or continue the perfection of Collateral Agent's security interest in the Collateral regardless of whether an Event of Default has occurred until all Obligations (other than inchoate indemnity obligations) have been satisfied in full and Collateral Agent and the Lenders are under no further obligation to make extend Term Loans hereunder. Collateral Agent's foregoing appointment as Borrower's or any of its Subsidiaries' attorney in fact, and all of Collateral Agent's rights and powers, coupled with an interest, are irrevocable until all Obligations (other than inchoate indemnity obligations) have been fully repaid and performed and Collateral Agent's and the Lenders' obligation to provide Term Loans terminates.

9.3 Protective Payments. If Borrower or any of its Subsidiaries fail to obtain the insurance called for by Section 6.5 or fails to pay any premium thereon or fails to pay any other amount which Borrower or any of its Subsidiaries is obligated to pay under this Agreement or any other Loan Document, Collateral Agent may obtain such insurance or make such payment, and all amounts so paid by Collateral Agent are Lenders' Expenses and immediately due and payable, bearing interest at the Default Rate, and secured by the Collateral. Collateral Agent will make reasonable efforts to provide Borrower with notice of Collateral Agent obtaining such insurance or making such payment at the time it is obtained or paid or within a reasonable time thereafter. No such payments by Collateral Agent are deemed an agreement to make similar payments in the future or Collateral Agent's waiver of any Event of Default.

9.4 Application of Payments and Proceeds. Notwithstanding anything to the contrary contained in this Agreement, upon the occurrence and during the continuance of an Event of Default, (a) Borrower irrevocably waives the right to direct the application of any and all payments at any time or times thereafter received by Collateral Agent from or on behalf of Borrower or any of its Subsidiaries of all or any part of the Obligations, and, as between Borrower on the one hand and Collateral Agent and Lenders on the other, Collateral Agent shall have the continuing and exclusive right to apply and to reapply any and all payments received against the Obligations in such manner as Collateral Agent may deem advisable notwithstanding any previous application by Collateral Agent, and (b) the proceeds of any sale of, or other realization upon all or any part of the Collateral shall be applied: first, to the Lenders' Expenses; second, to accrued and unpaid interest on the Obligations (including any interest which, but for the provisions of the United States Bankruptcy Code, would have accrued on such amounts); third, to the principal amount of the Obligations outstanding; and fourth, to any other indebtedness or obligations of Borrower owing to Collateral Agent or any Lender under the Loan Documents. Any balance remaining shall be delivered to Borrower or to whoever may be lawfully entitled to receive such balance or as a court of competent jurisdiction may direct. In

carrying out the foregoing, (x) amounts received shall be applied in the numerical order provided until exhausted prior to the application to the next succeeding category, and (y) each of the Persons entitled to receive a payment in any particular category shall receive an amount equal to its pro rata share of amounts available to be applied pursuant thereto for such category. Any reference in this Agreement to an allocation between or sharing by the Lenders of any right, interest or obligation “ratably,” “proportionally” or in similar terms shall refer to Pro Rata Share unless expressly provided otherwise. Collateral Agent, or if applicable, each Lender, shall promptly remit to the other Lenders such sums as may be necessary to ensure the ratable repayment of each Lender’s portion of any Term Loan and the ratable distribution of interest, fees and reimbursements paid or made by Borrower. Notwithstanding the foregoing, a Lender receiving a scheduled payment shall not be responsible for determining whether the other Lenders also received their scheduled payment on such date; provided, however, if it is later determined that a Lender received more than its ratable share of scheduled payments made on any date or dates, then such Lender shall remit to Collateral Agent or other Lenders such sums as may be necessary to ensure the ratable payment of such scheduled payments, as instructed by Collateral Agent. If any payment or distribution of any kind or character, whether in cash, properties or securities, shall be received by a Lender in excess of its ratable share, then the portion of such payment or distribution in excess of such Lender’s ratable share shall be received by such Lender in trust for and shall be promptly paid over to the other Lender for application to the payments of amounts due on the other Lenders’ claims. To the extent any payment for the account of Borrower is required to be returned as a voidable transfer or otherwise, the Lenders shall contribute to one another as is necessary to ensure that such return of payment is on a pro rata basis. If any Lender shall obtain possession of any Collateral, it shall hold such Collateral for itself and as agent and bailee for Collateral Agent and other Lenders for purposes of perfecting Collateral Agent’s security interest therein.

9.5 Liability for Collateral. So long as Collateral Agent and the Lenders comply with reasonable banking practices regarding the safekeeping of the Collateral in the possession or under the control of Collateral Agent and the Lenders, Collateral Agent and the Lenders shall not be liable or responsible for: (a) the safekeeping of the Collateral; (b) any loss or damage to the Collateral; (c) any diminution in the value of the Collateral; or (d) any act or default of any carrier, warehouseman, bailee, or other Person. Borrower bears all risk of loss, damage or destruction of the Collateral.

9.6 No Waiver; Remedies Cumulative. Failure by Collateral Agent or any Lender, at any time or times, to require strict performance by Borrower of any provision of this Agreement or any other Loan Document shall not waive, affect, or diminish any right of Collateral Agent or any Lender thereafter to demand strict performance and compliance herewith or therewith. No waiver hereunder shall be effective unless signed by Collateral Agent and the Required Lenders and then is only effective for the specific instance and purpose for which it is given. The rights and remedies of Collateral Agent and the Lenders under this Agreement and the other Loan Documents are cumulative. Collateral Agent and the Lenders have all rights and remedies provided under the Code, any applicable law, by law, or in equity. The exercise by Collateral Agent or any Lender of one right or remedy is not an election, and Collateral Agent’s or any Lender’s waiver of any Event of Default is not a continuing waiver. Collateral Agent’s or any Lender’s delay in exercising any remedy is not a waiver, election, or acquiescence.

9.7 Demand Waiver. Borrower waives, to the fullest extent permitted by law, demand, notice of default or dishonor, notice of payment and nonpayment, notice of any default, nonpayment at maturity, release, compromise, settlement, extension, or renewal of accounts, documents, instruments, chattel paper, and guarantees held by Collateral Agent or any Lender on which Borrower or any Subsidiary is liable.

10. NOTICES

All notices, consents, requests, approvals, demands, or other communication (collectively, “**Communication**”) by any party to this Agreement or any other Loan Document must be in writing and shall be deemed to have been validly served, given, or delivered: (a) upon the earlier of actual receipt and three (3) Business Days after deposit in the U.S. mail, first class, registered or certified mail return receipt requested, with proper postage prepaid; (b) upon transmission, when sent by facsimile transmission; (c) one (1) Business Day after deposit with a reputable overnight courier with all charges prepaid; or (d) when delivered, if hand-delivered by messenger, all of which shall be addressed to the party to be notified and sent to the address, facsimile number, or email address

indicated below. Any of Collateral Agent, Lender or Borrower may change its mailing address or facsimile number by giving the other party written notice thereof in accordance with the terms of this Section 10.

If to Borrower: AXCELLA HEALTH INC.
840 Memorial Drive, 3rd Floor
Cambridge, MA 02139
Attn: Robert Connelly, President and CEO;
Thomas Leggett, CFO
Email: rconnelly@axcellahealth.com
tleggett@axcellahealth.com

with a copy (which shall not constitute notice) to: GOODWIN PROCTER LLP
100 Northern Avenue
Boston, MA 02210
Attn: Mark D. Smith
Fax: (617) 801-8835
Email: marksmith@goodwinlaw.com

If to Collateral Agent and the Lender: SOLAR CAPITAL LTD.
500 Park Avenue, 3rd Floor
New York, NY 10022
Attention: Anthony Storino
Fax: (212) 993-1698
Email: storino@solarcapltd.com

with a copy (which shall not constitute notice) to: LATHAM & WATKINS LLP
505 Montgomery Street, Suite 2000
San Francisco, CA 94111
Attention: Haim Zaltzman
Facsimile: (415) 395-8095
Email: haim.zaltzman@lw.com

11. CHOICE OF LAW, VENUE AND JURY TRIAL WAIVER

11.1 Waiver of Jury Trial. EACH OF BORROWER, COLLATERAL AGENT AND LENDERS UNCONDITIONALLY WAIVES ANY AND ALL RIGHT TO A JURY TRIAL OF ANY CLAIM OR CAUSE OF ACTION BASED UPON OR ARISING OUT OF THIS AGREEMENT, ANY OF THE OTHER LOAN DOCUMENTS, ANY OF THE INDEBTEDNESS SECURED HEREBY, ANY DEALINGS AMONG BORROWER, COLLATERAL AGENT AND/OR LENDERS RELATING TO THE SUBJECT MATTER OF THIS TRANSACTION OR ANY RELATED TRANSACTIONS, AND/OR THE RELATIONSHIP THAT IS BEING ESTABLISHED AMONG BORROWER, COLLATERAL AGENT AND/OR LENDERS. THE SCOPE OF THIS WAIVER IS INTENDED TO BE ALL ENCOMPASSING OF ANY AND ALL DISPUTES THAT MAY BE FILED IN ANY COURT. THIS WAIVER IS IRREVOCABLE. THIS WAIVER MAY NOT BE MODIFIED EITHER ORALLY OR IN WRITING. THE WAIVER ALSO SHALL APPLY TO ANY SUBSEQUENT AMENDMENTS, RENEWALS, SUPPLEMENTS OR MODIFICATIONS TO THIS AGREEMENT, ANY OTHER LOAN DOCUMENTS, OR TO ANY OTHER DOCUMENTS OR AGREEMENTS RELATING TO THIS TRANSACTION OR ANY RELATED TRANSACTION. THIS AGREEMENT MAY BE FILED AS A WRITTEN CONSENT TO A TRIAL BY THE COURT.

11.2 Governing Law and Jurisdiction.

(a) **GOVERNING LAW.** THIS AGREEMENT, THE OTHER LOAN DOCUMENTS (EXCLUDING THOSE LOAN DOCUMENTS THAT BY THEIR OWN TERMS ARE EXPRESSLY GOVERNED BY THE LAWS OF ANOTHER JURISDICTION) AND THE RIGHTS AND OBLIGATIONS OF THE PARTIES HEREUNDER AND THEREUNDER SHALL IN ALL RESPECTS BE GOVERNED BY AND

CONSTRUED IN ACCORDANCE WITH, THE INTERNAL LAWS OF THE STATE OF NEW YORK (WITHOUT REGARD TO THE CONFLICT OF LAWS PRINCIPLES THAT WOULD RESULT IN THE APPLICATION OF ANY LAWS OTHER THAN THE LAWS OF SUCH STATE), INCLUDING ALL MATTERS OF CONSTRUCTION, VALIDITY AND PERFORMANCE, REGARDLESS OF THE LOCATION OF THE COLLATERAL, PROVIDED, HOWEVER, THAT IF THE LAWS OF ANY JURISDICTION OTHER THAN NEW YORK SHALL GOVERN IN REGARD TO THE VALIDITY, PERFECTION OR EFFECT OF PERFECTION OF ANY LIEN OR IN REGARD TO PROCEDURAL MATTERS AFFECTING ENFORCEMENT OF ANY LIENS IN COLLATERAL, SUCH LAWS OF SUCH OTHER JURISDICTIONS SHALL CONTINUE TO APPLY TO THAT EXTENT.

(b) Submission to Jurisdiction. Any legal action or proceeding with respect to the Loan Documents shall be brought exclusively in the courts of the State of New York located in the City of New York, Borough of Manhattan, or of the United States of America for the Southern District of New York and, by execution and delivery of this Agreement, Borrower hereby accepts for itself and in respect of its Property, generally and unconditionally, the jurisdiction of the aforesaid courts. Notwithstanding the foregoing, Collateral Agent and Lenders shall have the right to bring any action or proceeding against Borrower (or any property of Borrower) in the court of any other jurisdiction Collateral Agent or Lenders deem necessary or appropriate in order to realize on the Collateral or other security for the Obligations. The parties hereto hereby irrevocably waive any objection, including any objection to the laying of venue or based on the grounds of *forum non conveniens*, that any of them may now or hereafter have to the bringing of any such action or proceeding in such jurisdictions.

(c) Service of Process. Borrower irrevocably waives personal service of any and all legal process, summons, notices and other documents and other service of process of any kind and consents to such service in any suit, action or proceeding brought in the United States of America with respect to or otherwise arising out of or in connection with any Loan Document by any means permitted by applicable requirements of law, including by the mailing thereof (by registered or certified mail, postage prepaid) to the address of Borrower specified herein (and shall be effective when such mailing shall be effective, as provided therein). Borrower agrees that a final judgment in any such action or proceeding shall be conclusive and may be enforced in other jurisdictions by suit on the judgment or in any other manner provided by law.

(d) Non-exclusive Jurisdiction. Nothing contained in this Section 11.2 shall affect the right of Collateral Agent or Lenders to serve process in any other manner permitted by applicable requirements of law or commence legal proceedings or otherwise proceed against Borrower in any other jurisdiction.

12. GENERAL PROVISIONS

12.1 Successors and Assigns. This Agreement binds and is for the benefit of the successors and permitted assigns of each party. Borrower may not transfer, pledge or assign this Agreement or any rights or obligations under it without Collateral Agent's prior written consent (which may be granted or withheld in Collateral Agent's discretion, subject to Section 12.5). The Lenders have the right, without the consent of or notice to Borrower, to sell, transfer, assign, pledge, negotiate, or grant participation in (any such sale, transfer, assignment, negotiation, or grant of a participation, a **"Lender Transfer"**) all or any part of, or any interest in, the Lenders' obligations, rights, and benefits under this Agreement and the other Loan Documents; *provided, however*, that any such Lender Transfer (other than a transfer, pledge, sale or assignment to an Eligible Assignee) of its obligations, rights, and benefits under this Agreement and the other Loan Documents shall require the prior written consent of the Collateral Agent (such approved assignee, an **"Approved Lender"**). Borrower and Collateral Agent shall be entitled to continue to deal solely and directly with such Lender in connection with the interests so assigned until Collateral Agent shall have received and accepted an effective assignment agreement in form satisfactory to Collateral Agent executed, delivered and fully completed by the applicable parties thereto, and shall have received such other information regarding such Eligible Assignee or Approved Lender as Collateral Agent reasonably shall require. Notwithstanding anything to the contrary contained herein, so long as no Event of Default has occurred and is continuing, no Lender Transfer (other than a Lender Transfer in connection with (x) assignments by a Lender due to a forced divestiture at the request of any regulatory agency; or (y) upon the occurrence of a default, event of default or similar occurrence with respect to a Lender's own financing or securitization transactions) shall be permitted, without Borrower's consent, to any Person which is an Affiliate or Subsidiary of Borrower, a direct competitor of

Borrower or a vulture hedge fund, each as reasonably determined by Collateral Agent at the time of such assignment.

12.2 Indemnification. Borrower agrees to indemnify, defend and hold Collateral Agent and the Lenders and their respective directors, officers, employees, consultants, agents, attorneys, or any other Person affiliated with or representing Collateral Agent or the Lenders (each, an “**Indemnified Person**”) harmless against: (a) all obligations, demands, claims, and liabilities (collectively, “**Claims**”) asserted by any other party in connection with; related to; following; or arising from, out of or under, the transactions contemplated by the Loan Documents; and (b) all losses or Lenders’ Expenses incurred, or paid by an Indemnified Person in connection with; related to; following; or arising from, out of or under, the transactions contemplated by the Loan Documents between Collateral Agent, and/or the Lenders and Borrower (including reasonable attorneys’ fees and expenses), except for Claims and/or losses directly caused by such Indemnified Person’s gross negligence or willful misconduct. Borrower hereby further indemnifies, defends and holds each Indemnified Person harmless from and against any and all liabilities, obligations, losses, damages, penalties, actions, judgments, suits, claims, costs, expenses and disbursements of any kind or nature whatsoever (including the fees and disbursements of counsel for such Indemnified Person) in connection with any investigative, response, remedial, administrative or judicial matter or proceeding, whether or not such Indemnified Person shall be designated a party thereto and including any such proceeding initiated by or on behalf of Borrower, and the reasonable expenses of investigation by engineers, environmental consultants and similar technical personnel and any commission, fee or compensation claimed by any broker (other than any broker retained by Collateral Agent or Lenders) asserting any right to payment for the transactions contemplated hereby which may be imposed on, incurred by or asserted against such Indemnified Person as a result of or in connection with the transactions contemplated hereby and the use or intended use of the proceeds of the loan proceeds except for liabilities, obligations, losses, damages, penalties, actions, judgments, suits, claims, costs, expenses and disbursements directly caused by such Indemnified Person’s gross negligence or willful misconduct.

12.3 Severability of Provisions. Each provision of this Agreement is severable from every other provision in determining the enforceability of any provision.

12.4 Correction of Loan Documents. Collateral Agent may correct patent errors and fill in any blanks in this Agreement and the other Loan Documents consistent with the agreement of the parties.

12.5 Amendments in Writing; Integration. (a) No amendment, modification, termination or waiver of any provision of this Agreement or any other Loan Document, no approval or consent thereunder, or any consent to any departure by Borrower or any of its Subsidiaries therefrom, shall in any event be effective unless the same shall be in writing and signed by Borrower, Collateral Agent and the Required Lenders provided that:

(i) no such amendment, waiver or other modification that would have the effect of increasing or reducing a Lender’s Term Loan Commitment or Commitment Percentage shall be effective as to such Lender without such Lender’s written consent;

(ii) no such amendment, waiver or modification that would affect the rights and duties of Collateral Agent shall be effective without Collateral Agent’s written consent or signature; and

(iii) no such amendment, waiver or other modification shall, unless signed by all the Lenders directly affected thereby, (A) reduce the principal of, rate of interest on or any fees with respect to any Term Loan or forgive any principal, interest (other than default interest) or fees (other than late charges) with respect to any Term Loan (B) postpone the date fixed for, or waive, any payment of principal of any Term Loan or of interest on any Term Loan (other than default interest) or any fees provided for hereunder (other than late charges or for any termination of any commitment); (C) change the definition of the term “Required Lenders” or the percentage of Lenders which shall be required for the Lenders to take any action hereunder; (D) release all or substantially all of any material portion of the Collateral, authorize Borrower to sell or otherwise dispose of all or substantially all or any material portion of the Collateral or release any Guarantor of all or any portion of the Obligations or its guaranty obligations with respect thereto, except, in each case with respect to this clause (D), as otherwise may be expressly permitted under this Agreement or the other Loan Documents (including in connection with any disposition

permitted hereunder); (E) amend, waive or otherwise modify this Section 12.5 or the definitions of the terms used in this Section 12.5 insofar as the definitions affect the substance of this Section 12.5; (F) consent to the assignment, delegation or other transfer by Borrower of any of its rights and obligations under any Loan Document or release Borrower of its payment obligations under any Loan Document, except, in each case with respect to this clause (F), pursuant to a merger or consolidation permitted pursuant to this Agreement; (G) amend any of the provisions of Section 9.4 or amend any of the definitions of Pro Rata Share, Term Loan Commitment, Commitment Percentage or that provide for the Lenders to receive their Pro Rata Shares of any fees, payments, setoffs or proceeds of Collateral hereunder; (H) subordinate the Liens granted in favor of Collateral Agent securing the Obligations; or (I) amend any of the provisions of Section 12.5. It is hereby understood and agreed that all Lenders shall be deemed directly affected by an amendment, waiver or other modification of the type described in the preceding clauses (C), (D), (E), (F), (G) and (H) of the immediately preceding sentence.

(b) Other than as expressly provided for in Section 12.5(a)(i)-(iii), Collateral Agent may at its discretion, or if requested by Required Lenders, from time to time designate covenants in this Agreement less restrictive by notification to a representative of Borrower.

(c) This Agreement and the Loan Documents represent the entire agreement about this subject matter and supersede prior negotiations or agreements with respect to such subject matter. All prior agreements, understandings, representations, warranties, and negotiations between the parties about the subject matter of this Agreement and the Loan Documents merge into this Agreement and the Loan Documents.

12.6 Counterparts. This Agreement may be executed in any number of counterparts and by different parties on separate counterparts, each of which, when executed and delivered, is an original, and all taken together, constitute one Agreement. Delivery of an executed counterpart of a signature page of this Agreement by facsimile, portable document format (.pdf) or other electronic transmission will be as effective as delivery of a manually executed counterpart hereof.

12.7 Survival. All covenants, representations and warranties made in this Agreement continue in full force and effect until this Agreement has terminated pursuant to its terms and all Obligations (other than inchoate indemnity obligations and any other obligations which, by their terms, are to survive the termination of this Agreement) have been satisfied. The obligation of Borrower in Section 12.2 to indemnify each Lender and Collateral Agent, as well as the confidentiality provisions in Section 12.8 below, shall survive until the statute of limitations with respect to such claim or cause of action shall have run.

12.8 Confidentiality. In handling any confidential information of Borrower, the Lenders and Collateral Agent shall exercise the same degree of care that it exercises for their own proprietary information, but disclosure of information may be made: (a) subject to the terms and conditions of this Agreement, to the Lenders' and Collateral Agent's Subsidiaries or Affiliates, or in connection with a Lender's own financing or securitization transactions and upon the occurrence of a default, event of default or similar occurrence with respect to such financing or securitization transaction; (b) to prospective transferees (other than those identified in (a) above) or purchasers of any interest in the Term Loans (provided, however, the Lenders and Collateral Agent shall, except upon the occurrence and during the continuance of an Event of Default, obtain such prospective transferee's or purchaser's agreement to the terms of this provision or to similar confidentiality terms); (c) as required by law, regulation, subpoena, legal process or other order; (d) to Lenders' or Collateral Agent's regulators or as otherwise required in connection with an examination or audit; (e) as Collateral Agent reasonably considers appropriate in exercising remedies under the Loan Documents; and (f) to any Affiliate, officer, director, employee, agent or advisor of Collateral Agent or a Lender, including, without limitation, legal counsel, accountants, and other professional advisors of Collateral Agent or the Lenders, in each case on a need-to-know basis. Confidential information does not include information that either: (i) is in the public domain or in the Lenders' and/or Collateral Agent's possession when disclosed to the Lenders and/or Collateral Agent, or becomes part of the public domain after disclosure to the Lenders and/or Collateral Agent at no fault of the Lenders or the Collateral Agent; or (ii) is disclosed to the Lenders and/or Collateral Agent by a third party, if the Lenders and/or Collateral Agent does not know that the third party is prohibited from disclosing the information. Collateral Agent and the Lenders may use confidential information for any purpose, including, without limitation, for the development of client databases, reporting purposes, and market analysis. The provisions of the immediately preceding sentence shall survive the termination of this

Agreement. The agreements provided under this Section 12.8 supersede all prior agreements, understanding, representations, warranties, and negotiations between the parties about the subject matter of this Section 12.8.

12.9 Right of Set Off. Borrower hereby grants to Collateral Agent and to each Lender, a lien, security interest and right of set off as security for all Obligations to Collateral Agent and each Lender hereunder, whether now existing or hereafter arising upon and against all deposits, credits, collateral and property, now or hereafter in the possession, custody, safekeeping or control of Collateral Agent or the Lenders or any entity under the control of Collateral Agent or the Lenders (including a Collateral Agent affiliate) or in transit to any of them. At any time after the occurrence and during the continuance of an Event of Default, without demand or notice, Collateral Agent or the Lenders may set off the same or any part thereof and apply the same to any liability or Obligation of Borrower even though unmaturing and regardless of the adequacy of any other collateral securing the Obligations. ANY AND ALL RIGHTS TO REQUIRE COLLATERAL AGENT TO EXERCISE ITS RIGHTS OR REMEDIES WITH RESPECT TO ANY OTHER COLLATERAL WHICH SECURES THE OBLIGATIONS, PRIOR TO EXERCISING ITS RIGHT OF SETOFF WITH RESPECT TO SUCH DEPOSITS, CREDITS OR OTHER PROPERTY OF BORROWER ARE HEREBY KNOWINGLY, VOLUNTARILY AND IRREVOCABLY WAIVED BY BORROWER.

12.10 Cooperation of Borrower. If necessary, Borrower agrees to (i) execute any documents reasonably required to effectuate and acknowledge each assignment of a Term Loan Commitment or Term Loan to an assignee in accordance with Section 12.1, (ii) make Borrower's management available to meet with Collateral Agent and prospective participants and assignees of Term Loan Commitments (which meetings shall be conducted no more often than twice every twelve months unless an Event of Default has occurred and is continuing), and (iii) assist Collateral Agent or the Lenders in the preparation of information relating to the financial affairs of Borrower as any prospective participant or assignee of a Term Loan Commitment or Term Loan reasonably may request. Subject to the provisions of Section 12.8, Borrower authorizes each Lender to disclose to any prospective participant or assignee of a Term Loan Commitment, any and all information in such Lender's possession concerning Borrower and its financial affairs which has been delivered to such Lender by or on behalf of Borrower pursuant to this Agreement, or which has been delivered to such Lender by or on behalf of Borrower in connection with such Lender's credit evaluation of Borrower prior to entering into this Agreement.

12.11 Public Announcement. Borrower hereby agrees that Collateral Agent and each Lender, after consultation with Borrower, may make a public announcement of the transactions contemplated by this Agreement, and may publicize the same in marketing materials, newspapers and other publications, and otherwise, and in connection therewith may use Borrower's name, trade names and logos. Notwithstanding the foregoing, such consultation with Borrower shall not be required for any disclosures by Collateral Agent or the Lenders required by the Securities and Exchange Commission or other governmental agency and any other public disclosure with investors, other governmental agencies or other related persons.

12.12 Collateral Agent and Lender Agreement. Collateral Agent and the Lenders hereby agree to the terms and conditions set forth on Exhibit B attached hereto. Borrower acknowledges and agrees to the terms and conditions set forth on Exhibit B attached hereto.

12.13 Multiple Borrowers.

(a) Borrower's Agent. Each of the Borrowers hereby irrevocably appoints Axcella Health Inc. as its agent, attorney-in-fact and legal representative for all purposes, including requesting disbursement of the Term Loans and receiving account statements and other notices and communications to Borrowers (or any of them) from the Collateral Agent or the Lenders. The Collateral Agent or the Lenders may rely, and shall be fully protected in relying, on any request for the Term Loans, disbursement instruction, report, information or any other notice or communication made or given by Axcella Health Inc., whether in its own name or on behalf of one or more of the other Borrowers, and the Collateral Agent or the Lenders shall not have any obligation to make any inquiry or request any confirmation from or on behalf of any other Borrower as to the binding effect on it of any such request, instruction, report, information, other notice or communication, nor shall the joint and several character of the Borrowers' obligations hereunder be affected thereby.

(b) Waivers. Each Borrower hereby waives: (i) any right to require the Collateral Agent or the Lenders to institute suit against, or to exhaust its rights and remedies against, any other Borrower or any other person, or to proceed against any property of any kind which secures all or any part of the Obligations, or to exercise any right of offset or other right with respect to any reserves, credits or deposit accounts held by or maintained with any Lender or any Indebtedness of any Lender to any other Borrower, or to exercise any other right or power, or pursue any other remedy a Lender may have; (ii) any defense arising by reason of any disability or other defense of any other Borrower or any guarantor or any endorser, co-maker or other person, or by reason of the cessation from any cause whatsoever of any liability of any other Borrower or any guarantor or any endorser, co-maker or other person, with respect to all or any part of the Obligations, or by reason of any act or omission of Collateral Agent, any Lender or others which directly or indirectly results in the discharge or release of any other Borrower or any guarantor or any other person or any Obligations or any security therefor, whether by operation of law or otherwise; (iii) any defense arising by reason of any failure of Collateral Agent to obtain, perfect, maintain or keep in force any Lien on, any property of any Borrower or any other person; (iv) any defense based upon or arising out of any bankruptcy, insolvency, reorganization, arrangement, readjustment of debt, liquidation or dissolution proceeding commenced by or against any other Borrower or any guarantor or any endorser, co-maker or other person, including without limitation any discharge of, or bar against collecting, any of the Obligations (including without limitation any interest thereon), in or as a result of any such proceeding. Until all of the Obligations have been paid, performed, and discharged in full, nothing shall discharge or satisfy the liability of any Borrower hereunder except the full performance and payment of all of the Obligations. If any claim is ever made upon Collateral Agent or any Lender for repayment or recovery of any amount or amounts received by Collateral Agent or any Lender in payment of or on account of any of the Obligations, because of any claim that any such payment constituted a preferential transfer or fraudulent conveyance, or for any other reason whatsoever, and Collateral Agent or any Lender repays all or part of said amount by reason of any judgment, decree or order of any court or administrative body having jurisdiction over Collateral Agent or any Lender or any of its property, or by reason of any settlement or compromise of any such claim effected by Collateral Agent or any Lender with any such claimant (including without limitation the any other Borrower), then and in any such event, each Borrower agrees that any such judgment, decree, order, settlement and compromise shall be binding upon such Borrower, notwithstanding any revocation or release of this Agreement or the cancellation of any note or other instrument evidencing any of the Obligations, or any release of any of the Obligations, and each Borrower shall be and remain liable to Collateral Agent and the Lenders under this Agreement for the amount so repaid or recovered, to the same extent as if such amount had never originally been received by Collateral Agent or any Lender, and the provisions of this sentence shall survive, and continue in effect, notwithstanding any revocation or release of this Agreement. Each Borrower hereby expressly and unconditionally waives all rights of subrogation, reimbursement and indemnity of every kind against any other Borrower, and all rights of recourse to any assets or property of any other Borrower, and all rights to any collateral or security held for the payment and performance of any Obligations, including (but not limited to) any of the foregoing rights which Borrower may have under any present or future document or agreement with any other Borrower or other person, and including (but not limited to) any of the foregoing rights which any Borrower may have under any equitable doctrine of subrogation, implied contract, or unjust enrichment, or any other equitable or legal doctrine.

(c) Consents. Each Borrower hereby consents and agrees that, without notice to or by Borrower and without affecting or impairing in any way the obligations or liability of Borrower hereunder, Collateral Agent and the Lenders may, from time to time before or after revocation of this Agreement, do any one or more of the following in its sole and absolute discretion: (i) accept partial payments of, compromise or settle, renew, extend the time for the payment, discharge, or performance of, refuse to enforce, and release all or any parties to, any or all of the Obligations; (ii) grant any other indulgence to any Borrower or any other Person in respect of any or all of the Obligations or any other matter; (iii) accept, release, waive, surrender, enforce, exchange, modify, impair, or extend the time for the performance, discharge, or payment of, any and all property of any kind securing any or all of the Obligations or any guaranty of any or all of the Obligations, or on which Lender at any time may have a Lien, or refuse to enforce its rights or make any compromise or settlement or agreement therefor in respect of any or all of such property; (iv) substitute or add, or take any action or omit to take any action which results in the release of, any one or more other Borrowers or any endorsers or guarantors of all or any part of the Obligations, including, without limitation one or more parties to this Agreement, regardless of any destruction or impairment of any right of contribution or other right of Borrower; (v) apply any sums received from any other Borrower, any guarantor, endorser, or co-signer, or from the disposition of any Collateral or security, to any Indebtedness whatsoever owing from such person or secured by such Collateral or security, in such manner and

order as Lender determines in its sole discretion, and regardless of whether such Indebtedness is part of the Obligations, is secured, or is due and payable. Each Borrower consents and agrees that Collateral Agent shall be under no obligation to marshal any assets in favor of Borrower, or against or in payment of any or all of the Obligations. Each Borrower further consents and agrees that Collateral Agent shall have no duties or responsibilities whatsoever with respect to any property securing any or all of the Obligations. Without limiting the generality of the foregoing, Collateral Agent shall have no obligation to monitor, verify, audit, examine, or obtain or maintain any insurance with respect to, any property securing any or all of the Obligations.

(d) Independent Liability. Each Borrower hereby agrees that one or more successive or concurrent actions may be brought hereon against such Borrower, in the same action in which any other Borrower may be sued or in separate actions, as often as deemed advisable by Collateral Agent. Each Borrower is fully aware of the financial condition of each other Borrower and is executing and delivering this Agreement based solely upon its own independent investigation of all matters pertinent hereto, and such Borrower is not relying in any manner upon any representation or statement of Collateral Agent or any Lender with respect thereto. Each Borrower represents and warrants that it is in a position to obtain, and each Borrower hereby assumes full responsibility for obtaining, any additional information concerning any other Borrower's financial condition and any other matter pertinent hereto as such Borrower may desire, and such Borrower is not relying upon or expecting Collateral Agent or any Lender to furnish to it any information now or hereafter in Collateral Agent's or such Lender's possession concerning the same or any other matter.

(e) Subordination. All Indebtedness of a Borrower now or hereafter arising held by another Borrower is subordinated to the Obligations and the Borrower holding the Indebtedness shall take all actions reasonably requested by Collateral Agent to effect, to enforce and to give notice of such subordination.

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IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed as of the Effective Date.

BORROWER:

AXCELLA HEALTH INC.

By /s/ Thomas Leggett
Name: Thomas Leggett
Title: CFO & Secretary

ACORA NUTRITION LLC

By /s/ Thomas Leggett
Name: Thomas Leggett
Title: Secretary

COLLATERAL AGENT AND LENDER:

SOLAR CAPITAL LTD.

By /s/ Anthony J. Storino
Name: Anthony J. Storino
Title: Authorized Signatory

[Signature Page to Loan and Security Agreement (Solar/Axcella)]

SCHEDULE 1.1

Lenders and Commitments

Term Loans

Lender	Term Loan Commitment	Commitment Percentage
Solar Capital Ltd.	\$ 21,000,000	100.00%
TOTAL	\$ 21,000,000	100.00%

EXHIBIT A

Description of Collateral

The Collateral consists of all of Borrower's right, title and interest in and to the following personal property:

All goods, Accounts (including health-care receivables), Equipment, Inventory, contract rights or rights to payment of money, leases, license agreements, franchise agreements, General Intangibles (except as noted below), commercial tort claims, documents, instruments (including any promissory notes), chattel paper (whether tangible or electronic), cash, deposit accounts and other Collateral Accounts, all certificates of deposit, fixtures, letters of credit rights (whether or not the letter of credit is evidenced by a writing), securities, and all other investment property, supporting obligations, and financial assets, whether now owned or hereafter acquired, wherever located; and

All Borrower's Books relating to the foregoing, and any and all claims, rights and interests in any of the above and all substitutions for, additions, attachments, accessories, accessions and improvements to and replacements, products, proceeds and insurance proceeds of any or all of the foregoing.

Notwithstanding the foregoing, the Collateral does not include (i) any Intellectual Property; provided, however, the Collateral shall include all Accounts and all proceeds of Intellectual Property. If a judicial authority (including a U.S. Bankruptcy Court) would hold that a security interest in the underlying Intellectual Property is necessary to have a security interest in such Accounts and such property that are proceeds of Intellectual Property, then the Collateral shall automatically, and effective as of the Effective Date, include the Intellectual Property to the extent necessary to permit perfection of Collateral Agent's security interest in such Accounts and such other property of Borrower that are proceeds of the Intellectual Property; (ii) unless no adverse tax consequence would occur under the Internal Revenue Code of the United States of America for a pledge of 100% of the outstanding shares of capital stock of any Foreign Subsidiary, more than 65% of the total combined voting power of all classes of stock entitled to vote the shares of capital stock of any Foreign Subsidiary; and (iii) any permit, license or contract, in each case if the granting of a Lien in such permit, license or contract is prohibited by or would constitute a default under the agreement governing such license or contract (but (A) only to the extent such prohibition is enforceable under applicable law and (B) other than to the extent that any such term would be rendered ineffective pursuant to Sections 9-406, 9-408 or 9-409 (or any other Section) of Article 9 of the Code); provided that upon the termination, lapsing or expiration of any such prohibition, such license or contract, as applicable, shall automatically be subject to the security interest granted in favor of Collateral Agent hereunder and become part of the "Collateral."

EXHIBIT B

Collateral Agent and Lender Terms

1. Appointment of Collateral Agent.

(a) Each Lender hereby appoints SolarCap (together with any successor Collateral Agent pursuant to Section 7 of this Exhibit B as Collateral Agent under the Loan Documents and authorizes Collateral Agent to (i) execute and deliver the Loan Documents and accept delivery thereof on its behalf from Borrower, (ii) take such action on its behalf and to exercise all rights, powers and remedies and perform the duties as are expressly delegated to Collateral Agent under such Loan Documents and (iii) exercise such powers as are reasonably incidental thereto.

(b) Without limiting the generality of clause (a) above, Collateral Agent shall have the sole and exclusive right and authority (to the exclusion of the Lenders), and is hereby authorized, to (i) act as the disbursing and collecting agent for the Lenders with respect to all payments and collections arising in connection with the Loan Documents (including in any other bankruptcy, insolvency or similar proceeding), and each Person making any payment in connection with any Loan Document to any Lender is hereby authorized to make such payment to Collateral Agent, (ii) file and prove claims and file other documents necessary or desirable to allow the claims of Collateral Agent and Lenders with respect to any Obligation in any bankruptcy, insolvency or similar proceeding (but not to vote, consent or otherwise act on behalf of such Lender), (iii) act as collateral agent for Collateral Agent and each Lender for purposes of the perfection of all Liens created by the Loan Documents and all other purposes stated therein, (iv) manage, supervise and otherwise deal with the Collateral, (v) take such other action as is necessary or desirable to maintain the perfection and priority of the Liens created or purported to be created by the Loan Documents, (vi) except as may be otherwise specified in any Loan Document, exercise all remedies given to Collateral Agent and the other Lenders with respect to the Borrower and/or the Collateral, whether under the Loan Documents, applicable Requirements of Law or otherwise and (vii) execute any amendment, consent or waiver under the Loan Documents on behalf of any Lender that has consented in writing to such amendment, consent or waiver; provided, however, that Collateral Agent hereby appoints, authorizes and directs each Lender to act as collateral sub-agent for Collateral Agent and the Lenders for purposes of the perfection of all Liens with respect to the Collateral, including any Deposit Account maintained by Borrower with, and cash and Cash Equivalents held by, such Lender, and may further authorize and direct the Lenders to take further actions as collateral sub-agents for purposes of enforcing such Liens or otherwise to transfer the Collateral subject thereto to Collateral Agent, and each Lender hereby agrees to take such further actions to the extent, and only to the extent, so authorized and directed. Collateral Agent may, upon any term or condition it specifies, delegate or exercise any of its rights, powers and remedies under, and delegate or perform any of its duties or any other action with respect to, any Loan Document by or through any trustee, co-agent, employee, attorney-in-fact and any other Person (including any Lender). Any such Person shall benefit from this Exhibit B to the extent provided by Collateral Agent.

(c) Under the Loan Documents, Collateral Agent (i) is acting solely on behalf of the Lenders, with duties that are entirely administrative in nature, notwithstanding the use of the defined term "Collateral Agent", the terms "agent", "Collateral Agent" and "collateral agent" and similar terms in any Loan Document to refer to Collateral Agent, which terms are used for title purposes only, (ii) is not assuming any obligation under any Loan Document other than as expressly set forth therein or any role as agent, fiduciary or trustee of or for any Lender or any other Person and (iii) shall have no implied functions, responsibilities, duties, obligations or other liabilities under any Loan Document, and each Lender, by accepting the benefits of the Loan Documents, hereby waives and agrees not to assert any claim against Collateral Agent based on the roles, duties and legal relationships expressly disclaimed in clauses (i) through (iii) above. Except as expressly set forth in the Loan Documents, Collateral Agent shall not have any duty to disclose, and shall not be liable for failure to disclose, any information relating to Borrower or any of its Subsidiaries that is communicated to or obtained by SolarCap or any of its Affiliates in any capacity.

2. Binding Effect; Use of Discretion; E-Systems.

(a) Each Lender, by accepting the benefits of the Loan Documents, agrees that (i) any action taken by Collateral Agent or Required Lenders (or, if expressly required in any Loan Document, a greater proportion

of the Lenders) in accordance with the provisions of the Loan Documents, (ii) any action taken by Collateral Agent in reliance upon the instructions of Required Lenders (or, where so required, such greater proportion) and (iii) the exercise by Collateral Agent or Required Lenders (or, where so required, such greater proportion) of the powers set forth herein or therein, together with such other powers as are reasonably incidental thereto, shall be authorized and binding upon all of Lenders.

(b) If Collateral Agent shall request instructions from Required Lenders or all affected Lenders with respect to any act or action (including failure to act) in connection with any Loan Document, then Collateral Agent shall be entitled to refrain from such act or taking such action unless and until Collateral Agent shall have received instructions from Required Lenders or all affected Lenders, as the case may be, and Collateral Agent shall not incur liability to any Person by reason of so refraining. Collateral Agent shall be fully justified in failing or refusing to take any action under any Loan Document (i) if such action would, in the opinion of Collateral Agent, be contrary to any Requirement of Law or any Loan Document, (ii) if such action would, in the opinion of Collateral Agent, expose Collateral Agent to any potential liability under any Requirement of Law or (iii) if Collateral Agent shall not first be indemnified to its satisfaction against any and all liability and expense which may be incurred by it by reason of taking or continuing to take any such action. Without limiting the foregoing, no Lender shall have any right of action whatsoever against Collateral Agent as a result of Collateral Agent acting or refraining from acting under any Loan Document in accordance with the instructions of Required Lenders or all affected Lenders, as applicable.

(c) Collateral Agent is hereby authorized by Borrower and each Lender to establish procedures (and to amend such procedures from time to time) to facilitate administration and servicing of the Term Loans and other matters incidental thereto. Without limiting the generality of the foregoing, Collateral Agent is hereby authorized to establish procedures to make available or deliver, or to accept, notices, documents (including, without limitation, borrowing base certificates) and similar items on, by posting to or submitting and/or completion, on E-Systems. Borrower and each Lender acknowledges and agrees that the use of transmissions via an E-System or electronic mail is not necessarily secure and that there are risks associated with such use, including risks of interception, disclosure and abuse, and Borrower and each Lender assumes and accepts such risks by hereby authorizing the transmission via E-Systems or electronic mail. Each “e-signature” on any such posting shall be deemed sufficient to satisfy any requirement for a “signature”, and each such posting shall be deemed sufficient to satisfy any requirement for a “writing”, in each case including pursuant to any Loan Document, any applicable provision of any Code, the federal Uniform Electronic Transactions Act, the Electronic Signatures in Global and National Commerce Act and any substantive or procedural Requirement of Law governing such subject matter. All uses of an E-System shall be governed by and subject to, in addition to this Section, the separate terms, conditions and privacy policy posted or referenced in such E-System (or such terms, conditions and privacy policy as may be updated from time to time, including on such E-System) and related contractual obligations executed by Collateral Agent, Borrower and/or Lenders in connection with the use of such E-System. ALL E-SYSTEMS AND ELECTRONIC TRANSMISSIONS SHALL BE PROVIDED “AS IS” AND “AS AVAILABLE”. NO REPRESENTATION OR WARRANTY OF ANY KIND IS MADE BY AGENT, ANY LENDER OR ANY OF THEIR RELATED PERSONS IN CONNECTION WITH ANY E-SYSTEMS.

3. Collateral Agent’s Reliance, Etc. Collateral Agent may, without incurring any liability hereunder, (a) consult with any of its Related Persons and, whether or not selected by it, any other advisors, accountants and other experts (including advisors to, and accountants and experts engaged by, Borrower) and (b) rely and act upon any document and information (including those transmitted by electronic transmission) and any telephone message or conversation, in each case believed by it to be genuine and transmitted, signed or otherwise authenticated by the appropriate parties. None of Collateral Agent and its Related Persons shall be liable for any action taken or omitted to be taken by any of them under or in connection with any Loan Document, and each Lender and Borrower hereby waives and shall not assert (and Borrower shall cause its Subsidiaries to waive and agree not to assert) any right, claim or cause of action based thereon, except to the extent of liabilities resulting from the gross negligence or willful misconduct of Collateral Agent or, as the case may be, such Related Person (each as determined in a final, non-appealable judgment of a court of competent jurisdiction) in connection with the duties of Collateral Agent expressly set forth herein. Without limiting the foregoing, Collateral Agent: (i) shall not be responsible or otherwise incur liability for any action or omission taken in reliance upon the instructions of the Required Lenders or for the actions or omissions of any of its Related Persons, except to the extent that a court of competent jurisdiction determines in a final non-appealable judgment that Collateral Agent acted with gross

negligence or willful misconduct in the selection of such Related Person; (ii) shall not be responsible to any Lender or other Person for the due execution, legality, validity, enforceability, effectiveness, genuineness, sufficiency or value of, or the attachment, perfection or priority of any Lien created or purported to be created under or in connection with, any Loan Document; (iii) makes no warranty or representation, and shall not be responsible, to any Lender or other Person for any statement, document, information, representation or warranty made or furnished by or on behalf of Borrower or any Related Person of Borrower in connection with any Loan Document or any transaction contemplated therein or any other document or information with respect to Borrower, whether or not transmitted or (except for documents expressly required under any Loan Document to be transmitted to the Lenders) omitted to be transmitted by Collateral Agent, including as to completeness, accuracy, scope or adequacy thereof, or for the scope, nature or results of any due diligence performed by Collateral Agent in connection with the Loan Documents; and (iv) shall not have any duty to ascertain or to inquire as to the performance or observance of any provision of any Loan Document, whether any condition set forth in any Loan Document is satisfied or waived, as to the financial condition of Borrower or as to the existence or continuation or possible occurrence or continuation of any Event of Default, and shall not be deemed to have notice or Knowledge of such occurrence or continuation unless it has received a notice from Borrower or any Lender describing such Event of Default that is clearly labeled “notice of default” (in which case Collateral Agent shall promptly give notice of such receipt to all Lenders, provided that Collateral Agent shall not be liable to any Lender for any failure to do so, except to the extent that such failure is attributable to Collateral Agent’s gross negligence or willful misconduct as determined by a final non-appealable judgment of a court of competent jurisdiction); and, for each of the items set forth in clauses (i) through (iv) above, each Lender and Borrower hereby waives and agrees not to assert (and Borrower shall cause its Subsidiaries to waive and agree not to assert) any right, claim or cause of action it might have against Collateral Agent based thereon.

4. Collateral Agent Individually. Collateral Agent and its Affiliates may make loans and other extensions of credit to, acquire stock and stock equivalents of, engage in any kind of business with, Borrower or any Affiliate of Borrower as though it were not acting as Collateral Agent and may receive separate fees and other payments therefor. To the extent Collateral Agent or any of its Affiliates makes any Term Loans or otherwise becomes a Lender hereunder, it shall have and may exercise the same rights and powers hereunder and shall be subject to the same obligations and liabilities as any other Lender and the terms “Lender”, “Required Lender” and any similar terms shall, except where otherwise expressly provided in any Loan Document, include, without limitation, Collateral Agent or such Affiliate, as the case may be, in its individual capacity as Lender, or as one of the Required Lenders.

5. Lender Credit Decision; Collateral Agent Report. Each Lender acknowledges that it shall, independently and without reliance upon Collateral Agent, any Lender or any of their Related Persons or upon any document solely or in part because such document was transmitted by Collateral Agent or any of its Related Persons, conduct its own independent investigation of the financial condition and affairs of Borrower and make and continue to make its own credit decisions in connection with entering into, and taking or not taking any action under, any Loan Document or with respect to any transaction contemplated in any Loan Document, in each case based on such documents and information as it shall deem appropriate. Except for documents expressly required by any Loan Document to be transmitted by Collateral Agent to the Lenders, Collateral Agent shall not have any duty or responsibility to provide any Lender with any credit or other information concerning the business, prospects, operations, Property, financial and other condition or creditworthiness of Borrower or any Affiliate of Borrower that may come in to the possession of Collateral Agent or any of its Related Persons. Each Lender agrees that it shall not rely on any field examination, audit or other report provided by Collateral Agent or its Related Persons (a “**Collateral Agent Report**”). Each Lender further acknowledges that any Collateral Agent Report (a) is provided to the Lenders solely as a courtesy, without consideration, and based upon the understanding that such Lender will not rely on such Collateral Agent Report, (b) was prepared by Collateral Agent or its Related Persons based upon information provided by Borrower solely for Collateral Agent’s own internal use, and (c) may not be complete and may not reflect all information and findings obtained by Collateral Agent or its Related Persons regarding the operations and condition of Borrower. Neither Collateral Agent nor any of its Related Persons makes any representations or warranties of any kind with respect to (i) any existing or proposed financing, (ii) the accuracy or completeness of the information contained in any Collateral Agent Report or in any related documentation, (iii) the scope or adequacy of Collateral Agent’s and its Related Persons’ due diligence, or the presence or absence of any errors or omissions contained in any Collateral Agent Report or in any related documentation, and (iv) any work performed by Collateral Agent or Collateral Agent’s Related Persons in connection with or using any Collateral

Agent Report or any related documentation. Neither Collateral Agent nor any of its Related Persons shall have any duties or obligations in connection with or as a result of any Lender receiving a copy of any Collateral Agent Report. Without limiting the generality of the foregoing, neither Collateral Agent nor any of its Related Persons shall have any responsibility for the accuracy or completeness of any Collateral Agent Report, or the appropriateness of any Collateral Agent Report for any Lender's purposes, and shall have no duty or responsibility to correct or update any Collateral Agent Report or disclose to any Lender any other information not embodied in any Collateral Agent Report, including any supplemental information obtained after the date of any Collateral Agent Report. Each Lender releases, and agrees that it will not assert, any claim against Collateral Agent or its Related Persons that in any way relates to any Collateral Agent Report or arises out of any Lender having access to any Collateral Agent Report or any discussion of its contents, and agrees to indemnify and hold harmless Collateral Agent and its Related Persons from all claims, liabilities and expenses relating to a breach by any Lender arising out of such Lender's access to any Collateral Agent Report or any discussion of its contents.

6. Indemnification. Each Lender agrees to reimburse Collateral Agent and each of its Related Persons (to the extent not reimbursed by Borrower as required under the Loan Documents) promptly upon demand for its Pro Rata Share of any out-of-pocket costs and expenses (including, without limitation, fees, charges and disbursements of financial, legal and other advisors and any taxes or insurance paid in the name of, or on behalf of, Borrower) incurred by Collateral Agent or any of its Related Persons in connection with the preparation, syndication, execution, delivery, administration, modification, amendment, consent, waiver or enforcement of, or the taking of any other action (whether through negotiations, through any work-out, bankruptcy, restructuring or other legal or other proceeding (including, without limitation, preparation for and/or response to any subpoena or request for document production relating thereto) or otherwise) in respect of, or legal advice with respect to, its rights or responsibilities under, any Loan Document. Each Lender further agrees to indemnify Collateral Agent and each of its Related Persons (to the extent not reimbursed by Borrower as required under the Loan Documents), ratably according to its Pro Rata Share, from and against any and all liabilities, obligations, losses, damages, penalties, actions, judgments, suits, costs, expenses or disbursements of any kind or nature whatsoever (including, to the extent not indemnified by the applicable Lender, taxes, interests and penalties imposed for not properly withholding or backup withholding on payments made to or for the account of any Lender) that may be imposed on, incurred by, or asserted against Collateral Agent or any of its Related Persons in any matter relating to or arising out of, in connection with or as a result of any Loan Document or any other act, event or transaction related, contemplated in or attendant to any such document, or, in each case, any action taken or omitted to be taken by Collateral Agent or any of its Related Persons under or with respect to the foregoing; provided that no Lender shall be liable to Collateral Agent or any of its Related Persons under this Section 6 of this Exhibit B to the extent such liability has resulted from the gross negligence or willful misconduct of Collateral Agent or, as the case may be, such Related Person, as determined by a final non-appealable judgment of a court of competent jurisdiction. To the extent required by any applicable Requirement of Law, Collateral Agent may withhold from any payment to any Lender under a Loan Document an amount equal to any applicable withholding tax. If the Internal Revenue Service or any other Governmental Authority asserts a claim that Collateral Agent did not properly withhold tax from amounts paid to or for the account of any Lender for any reason, or if Collateral Agent reasonably determines that it was required to withhold taxes from a prior payment to or for the account of any Lender but failed to do so, such Lender shall promptly indemnify Collateral Agent fully for all amounts paid, directly or indirectly, by Collateral Agent as tax or otherwise, including penalties and interest, and together with all expenses incurred by Collateral Agent. Collateral Agent may offset against any payment to any Lender under a Loan Document, any applicable withholding tax that was required to be withheld from any prior payment to such Lender but which was not so withheld, as well as any other amounts for which Collateral Agent is entitled to indemnification from such Lender under the immediately preceding sentence of this Section 6 of this Exhibit B.

7. Successor Collateral Agent. Collateral Agent may resign at any time by delivering notice of such resignation to the Lenders and Borrower, effective on the date set forth in such notice or, if no such date is set forth therein, upon the date such notice shall be effective, in accordance with the terms of this Section 7 of this Exhibit B. If Collateral Agent delivers any such notice, the Required Lenders shall have the right to appoint a successor Collateral Agent. If, after 30 days after the date of the retiring Collateral Agent's notice of resignation, no successor Collateral Agent has been appointed by the Required Lenders that has accepted such appointment, then the retiring Collateral Agent may, on behalf of the Lenders, appoint a successor Collateral Agent from among the Lenders. Effective immediately upon its resignation, (a) the retiring Collateral Agent shall be discharged from its duties and obligations under the Loan Documents, (b) the Lenders shall assume and perform all of the duties of

Collateral Agent until a successor Collateral Agent shall have accepted a valid appointment hereunder, (c) the retiring Collateral Agent and its Related Persons shall no longer have the benefit of any provision of any Loan Document other than with respect to any actions taken or omitted to be taken while such retiring Collateral Agent was, or because such Collateral Agent had been, validly acting as Collateral Agent under the Loan Documents, and (iv) subject to its rights under Section 2(b) of this Exhibit B, the retiring Collateral Agent shall take such action as may be reasonably necessary to assign to the successor Collateral Agent its rights as Collateral Agent under the Loan Documents. Effective immediately upon its acceptance of a valid appointment as Collateral Agent, a successor Collateral Agent shall succeed to, and become vested with, all the rights, powers, privileges and duties of the retiring Collateral Agent under the Loan Documents.

8. Release of Collateral. Each Lender hereby consents to the release and hereby directs Collateral Agent to release (or in the case of clause (b)(ii) below, release or subordinate) the following:

(a) any Guarantor or Subsidiary “co-Borrower” if all of the stock of such Subsidiary owned by Borrower is sold or transferred in a transaction permitted under the Loan Documents (including pursuant to a valid waiver or consent), to the extent that, after giving effect to such transaction, such Subsidiary would not be required to guaranty any Obligations pursuant to any Loan Document; and

(b) any Lien held by Collateral Agent for the benefit of itself and the Lenders against (i) any Collateral that is sold or otherwise disposed of by Borrower in a transaction permitted by the Loan Documents (including pursuant to a valid waiver or consent), (ii) any Collateral subject to a Lien that is expressly permitted under clause (c) of the definition of the term “Permitted Lien” and (iii) all of the Collateral and Borrower, upon (A) termination of all of the Commitments, (B) payment in full in cash of all of the Obligations that Collateral Agent has theretofore been notified in writing by the holder of such Obligation are then due and payable, and (C) to the extent requested by Collateral Agent, receipt by Collateral Agent and Lenders of liability releases from Borrower in form and substance acceptable to Collateral Agent (the satisfaction of the conditions in this clause (iii), the “**Termination Date**”).

9. Setoff and Sharing of Payments. In addition to any rights now or hereafter granted under any applicable requirement of law and not by way of limitation of any such rights, upon the occurrence and during the continuance of any Event of Default and subject to Section 10(d) of this Exhibit B, each Lender is hereby authorized at any time or from time to time upon the direction of Collateral Agent, without notice to Borrower or any other Person, any such notice being hereby expressly waived, to setoff and to appropriate and to apply any and all balances held by it at any of its offices for the account of Borrower (regardless of whether such balances are then due to Borrower) and any other properties or assets at any time held or owing by that Lender or that holder to or for the credit or for the account of Borrower against and on account of any of the Obligations that are not paid when due. Any Lender exercising a right of setoff or otherwise receiving any payment on account of the Obligations in excess of its Pro Rata Share thereof shall purchase for cash (and the other Lenders or holders shall sell) such participations in each such other Lender’s or holder’s Pro Rata Share of the Obligations as would be necessary to cause such Lender to share the amount so offset or otherwise received with each other Lender or holder in accordance with their respective Pro Rata Shares of the Obligations. Borrower agrees, to the fullest extent permitted by law, that (a) any Lender may exercise its right to offset with respect to amounts in excess of its Pro Rata Share of the Obligations and may purchase participations in accordance with the preceding sentence and (b) any Lender so purchasing a participation in the Term Loans made or other Obligations held by other Lenders or holders may exercise all rights of offset, bankers’ lien, counterclaim or similar rights with respect to such participation as fully as if such Lender or holder were a direct holder of the Term Loans and the other Obligations in the amount of such participation. Notwithstanding the foregoing, if all or any portion of the offset amount or payment otherwise received is thereafter recovered from the Lender that has exercised the right of offset, the purchase of participations by that Lender shall be rescinded and the purchase price restored without interest.

10. Advances; Payments; Non-Funding Lenders; Actions in Concert.

(a) Advances; Payments. If Collateral Agent receives any payment with respect to a Term Loan for the account of Lenders on or prior to 2:00 p.m. (New York time) on any Business Day, Collateral Agent shall pay to each applicable Lender such Lender’s Pro Rata Share of such payment on such Business Day. If Collateral Agent receives any payment with respect to a Term Loan for the account of Lenders after 2:00 p.m. (New

York time) on any Business Day, Collateral Agent shall pay to each applicable Lender such Lender's Pro Rata Share of such payment on the next Business Day.

(b) Return of Payments.

(i) If Collateral Agent pays an amount to a Lender under this Agreement in the belief or expectation that a related payment has been or will be received by Collateral Agent from Borrower and such related payment is not received by Collateral Agent, then Collateral Agent will be entitled to recover such amount (including interest accruing on such amount at the rate otherwise applicable to such Obligation) from such Lender on demand without setoff, counterclaim or deduction of any kind.

(ii) If Collateral Agent determines at any time that any amount received by Collateral Agent under any Loan Document must be returned to Borrower or paid to any other Person pursuant to any insolvency law or otherwise, then, notwithstanding any other term or condition of any Loan Document, Collateral Agent will not be required to distribute any portion thereof to any Lender. In addition, each Lender will repay to Collateral Agent on demand any portion of such amount that Collateral Agent has distributed to such Lender, together with interest at such rate, if any, as Collateral Agent is required to pay to Borrower or such other Person, without setoff, counterclaim or deduction of any kind and Collateral Agent will be entitled to set off against future distributions to such Lender any such amounts (with interest) that are not repaid on demand.

(c) Non-Funding Lenders.

(i) Unless Collateral Agent shall have received notice from a Lender prior to the date of any Term Loan that such Lender will not make available to Collateral Agent such Lender's Pro Rata Share of such Term Loan, Collateral Agent may assume that such Lender will make such amount available to it on the date of such Term Loan in accordance with Section 2(b) of this Exhibit B, and Collateral Agent may (but shall not be obligated to), in reliance upon such assumption, make available a corresponding amount for the account of Borrower on such date. If and to the extent that such Lender shall not have made such amount available to Collateral Agent, such Lender and Borrower severally agree to repay to Collateral Agent forthwith on demand such corresponding amount together with interest thereon, for each day from the day such amount is made available to Borrower until the day such amount is repaid to Collateral Agent, at a rate per annum equal to the interest rate applicable to the Obligation that would have been created when Collateral Agent made available such amount to Borrower had such Lender made a corresponding payment available. If such Lender shall repay such corresponding amount to Collateral Agent, the amount so repaid shall constitute such Lender's portion of such Term Loan for purposes of this Agreement.

(ii) To the extent that any Lender has failed to fund any Term Loan or any other payments required to be made by it under the Loan Documents after any such Term Loan is required to be made or such payment is due (a "**Non-Funding Lender**"), Collateral Agent shall be entitled to set off the funding short-fall against that Non-Funding Lender's Pro Rata Share of all payments received from Borrower. The failure of any Non-Funding Lender to make any Term Loan or any payment required by it hereunder shall not relieve any other Lender (each such other Lender, an "**Other Lender**") of its obligations to make such Term Loan, but neither any Other Lender nor Collateral Agent shall be responsible for the failure of any Non-Funding Lender to make such Term Loan or make any other payment required hereunder. Notwithstanding anything set forth herein to the contrary, a Non-Funding Lender shall not have any voting or consent rights under or with respect to any Loan Document or constitute a "Lender" (or be included in the calculation of "Required Lender" hereunder) for any voting or consent rights under or with respect to any Loan Document. At Borrower's request, Collateral Agent or a Person reasonably acceptable to Collateral Agent shall have the right with Collateral Agent's consent and in Collateral Agent's sole discretion (but Collateral Agent or any such Person shall have no obligation) to purchase from any Non-Funding Lender, and each Lender agrees that if it becomes a Non-Funding Lender it shall, at Collateral Agent's request, sell and assign to Collateral Agent or such Person, all of the Term Loan Commitment (if any), and all of the outstanding Term Loan of that Non-Funding Lender for an amount equal to the aggregate outstanding principal balance of the Term Loan held by such Non-Funding Lender and all accrued interest with respect thereto through the date of sale, such purchase and sale to be consummated pursuant to an executed assignment agreement in form and substance reasonably satisfactory to, and acknowledged by, Collateral Agent.

(d) Actions in Concert. Anything in this Agreement to the contrary notwithstanding, each Lender hereby agrees with each other Lender that no Lender shall take any action to protect or enforce its rights arising out of any Loan Document (including exercising any rights of setoff) without first obtaining the prior written consent of Collateral Agent or Required Lenders, it being the intent of Lenders that any such action to protect or enforce rights under any Loan Document shall be taken in concert and at the direction or with the consent of Collateral Agent or Required Lenders.

EXHIBIT C

Loan Payment Request Form

Fax To: _____

Date: _____

LOAN PAYMENT:	
AXCELLA HEALTH INC.	
From Account # _____ (Deposit Account #)	To Account # _____ (Loan Account #)
Principal \$ _____	and/or Interest \$ _____
Authorized Signature: _____	Phone Number: _____
Print Name/Title: _____	

LOAN ADVANCE:	
Complete <i>Outgoing Wire Request</i> section below if all or a portion of the funds from this loan advance are for an outgoing wire.	
From Account # _____ (Loan Account #)	To Account # _____ (Deposit Account #)
Amount of Advance \$ _____	
All Borrower's representations and warranties in the Loan and Security Agreement are true, correct and complete in all material respects on the date of the request for an advance; provided, however, that such materiality qualifier shall not be applicable to any representations and warranties that already are qualified or modified by materiality in the text thereof; and provided, further that those representations and warranties expressly referring to a specific date shall be true, accurate and complete in all material respects as of such date:	
Authorized Signature: _____	Phone Number: _____
Print Name/Title: _____	

OUTGOING WIRE REQUEST:	
Complete only if all or a portion of funds from the loan advance above is to be wired.	
Beneficiary Name: _____	Amount of Wire: \$ _____
Beneficiary Bank: _____	Account Number: _____
City and State: _____	
Beneficiary Bank Transit (ABA) #: _____	Beneficiary Bank Code (Swift, Sort, Chip, etc.): _____
(For International Wire Only)	
Intermediary Bank: _____	Transit (ABA) #: _____
For Further Credit to: _____	
Special Instruction: _____	
By signing below, I (we) acknowledge and agree that my (our) funds transfer request shall be processed in accordance with and subject to the terms and conditions set forth in the agreements(s) covering funds transfer service(s), which agreements(s) were previously received and executed by me (us).	
Authorized Signature: _____	2 nd Signature (if required): _____
Print Name/Title: _____	Print Name/Title: _____
Telephone #: _____	Telephone #: _____

EXHIBIT D

Compliance Certificate

TO: SOLAR CAPITAL LTD., as Collateral Agent and Lender

FROM: AXCELLA HEALTH INC., as Borrower

The undersigned authorized officer ("**Officer**") of Axcella Health Inc. ("**Borrower**"), hereby certifies that in accordance with the terms and conditions of the Loan and Security Agreement dated as of January 9, 2018, by and among Borrower, Collateral Agent, and the Lenders from time to time party thereto (the "**Loan Agreement**," capitalized terms used but not otherwise defined herein shall have the meanings given them in the Loan Agreement),

(a) Borrower is in complete compliance for the period ending _____ with all required covenants except as noted below;

(b) There are no Events of Default, except as noted below;

(c) Except as noted below, all representations and warranties of Borrower stated in the Loan Documents are true and correct in all material respects on this date and for the period described in (a), above; provided, however, that such materiality qualifier shall not be applicable to any representations and warranties that already are qualified or modified by materiality in the text thereof; and provided, further that those representations and warranties expressly referring to a specific date shall be true, accurate and complete in all material respects as of such date.

(d) Borrower, and each of Borrower's Subsidiaries, has timely filed all required tax returns and reports, Borrower, and each of Borrower's Subsidiaries, has timely paid all foreign, federal, state, and local taxes, assessments, deposits and contributions owed by Borrower, or Subsidiary, except as otherwise permitted pursuant to the terms of Section 5.8 of the Loan Agreement;

(e) No Liens have been levied or claims made against Borrower or any of its Subsidiaries relating to unpaid employee payroll or benefits of which Borrower has not previously provided written notification to Collateral Agent and the Lenders.

Attached are the required documents, if any, supporting our certification(s). The Officer, on behalf of Borrower, further certifies that the attached financial statements are prepared in accordance with Generally Accepted Accounting Principles (GAAP) and are consistently applied from one period to the next except as explained in an accompanying letter or footnotes and except, in the case of unaudited financial statements, for the absence of footnotes and subject to year-end audit adjustments as to the interim financial statements.

Please indicate compliance status since the last Compliance Certificate by circling Yes, No, or N/A under "Complies" column.

	Reporting Covenant	Requirement	Actual	Complies		
1)	Financial statements	Monthly within 30 days	Yes	No	N/A	
2)	Annual (CPA Audited) statements	Within 180 days after FYE	Yes	No	N/A	
3)	Annual Financial Projections/Budget (prepared on a monthly basis)	Annually (within 10 days of approval), and when revised	Yes	No	N/A	
4)	A/R & A/P agings	If applicable	Yes	No	N/A	

5)	8-K, 10-K and 10-Q Filings	If applicable, within 5 days of filing	Yes	No	N/A
6)	Compliance Certificate	Monthly within 30 days	Yes	No	N/A
7)	[Reserved]		Yes	No	N/A
8)	Total amount of Borrower's cash and cash equivalents at the last day of the measurement period	\$ _____	Yes	No	N/A
9)	Total amount of Borrower's Subsidiaries' cash and cash equivalents at the last day of the measurement period	\$ _____	Yes	No	N/A

Deposit and Securities Accounts

(Please list all accounts; attach separate sheet if additional space needed)

	Institution Name	Account Number	New Account?		Account Control Agreement in place?	
1)			Yes	No	Yes	No
2)			Yes	No	Yes	No
3)			Yes	No	Yes	No
4)			Yes	No	Yes	No

Other Matters

1)	Have there been any changes in Key Persons since the last Compliance Certificate?	Yes	No
2)	Have there been any transfers/sales/disposals/retirement of Collateral or IP prohibited by the Loan Agreement?	Yes	No
3)	Have there been any new or pending claims or causes of action against Borrower that involve more than Five Hundred Thousand Dollars (\$500,000.00)?	Yes	No
4)	Have there been any amendments of or other changes to the capitalization table of Borrower and to the Operating Documents of Borrower or any of its Subsidiaries? If yes, provide copies of any such amendments or changes with this Compliance Certificate.	Yes	No
5)	[Reserved]	Yes	No
6)	Has Borrower provided the Collateral Agent with all notices required to be delivered under Sections 6.2(a) and 6.2(b) of the Loan Agreement?	Yes	No

Exceptions

Please explain any exceptions with respect to the certification above: (If no exceptions exist, state "No exceptions."
Attach separate sheet if additional space needed.)

AXCELLA HEALTH INC.

By: _____

Name: _____

Title: _____

Date: _____

COLLATERAL AGENT USE ONLY

Received by: _____ Date: _____

Verified by: _____ Date: _____

Compliance Status: Yes No

FIRST AMENDMENT TO LOAN AND SECURITY AGREEMENT

THIS **FIRST AMENDMENT TO LOAN AND SECURITY AGREEMENT** (this “**Amendment**”), dated as of October 5, 2018 (the “**Amendment Effective Date**”), is made among Axcella Health Inc., a Delaware corporation (the “**Axcella**”), and Acora Nutrition LLC, a Delaware limited liability company (“**Acora**” and, individually and collectively, jointly and severally with Axcella, the “**Borrower**”), Solar Capital Ltd., a Maryland corporation (“**Solar**”), in its capacity as collateral agent (in such capacity, together with its successors and assigns in such capacity, “**Collateral Agent**”) and the Lenders listed on Schedule 1.1 of the Loan and Security Agreement (as defined below) or otherwise a party hereto from time to time including Solar in its capacity as a Lender (each a “**Lender**” and collectively, the “**Lenders**”).

The Borrower, the Lenders and Collateral Agent are parties to a Loan and Security Agreement dated as of January 9, 2018 (as amended, restated or modified from time to time, the “**Loan and Security Agreement**”). The Borrower has requested that the Lenders agree to certain amendments to the Loan and Security Agreement. The Lenders have agreed to such request, subject to the terms and conditions hereof.

Accordingly, the parties hereto agree as follows:

SECTION 1. Definitions; Interpretation.

(a) **Terms Defined in Loan and Security Agreement.** All capitalized terms used in this Amendment (including in the recitals hereof) and not otherwise defined herein shall have the meanings assigned to them in the Loan and Security Agreement.

(b) **Interpretation.** The rules of interpretation set forth in Section 1.1 of the Loan and Security Agreement shall be applicable to this Amendment and are incorporated herein by this reference.

SECTION 2. Amendments to the Loan and Security Agreement.

(a) The Loan and Security Agreement shall be amended as follows effective as of the Amendment Effective Date:

(i) **Lenders and Commitments.** Schedule 1.1 of the Loan and Security Agreement is each hereby amended and restated and replaced in their entirety with Annex A hereto.

(ii) **New Definitions.** The following definitions are added to Section 1.3 in their proper alphabetical order:

“**Equity Event 1**” is the receipt by Borrower, after the Effective Date and on or before November 30, 2018, of an aggregate amount of at least Twenty-Five Million Dollars (\$25,000,000) in net cash proceeds (including not subject to any clawback, redemption, escrow or similar contractual restriction) from either (i) a bona fide equity financing on terms reasonably acceptable to Agent and the Lenders or (ii) strategic partnerships, corporate

collaborations or licensing arrangements for a transaction on terms reasonably acceptable to Collateral Agent and the Lenders.

“Equity Event 2” is (a) the receipt by Borrower, after the Effective Date and on or before November 30, 2018, of an aggregate amount of at least Sixty Million Dollars (\$60,000,000) (inclusive net cash proceeds received from Equity Event 1) in net cash proceeds (including not subject to any clawback, redemption, escrow or similar contractual restriction) from either (i) a bona fide equity financing on terms reasonably acceptable to Agent and the Lenders or (ii) strategic partnerships, corporate collaborations or licensing arrangements for a transaction on terms reasonably acceptable to Collateral Agent and the Lenders and (b) achievement of a “post-money” valuation for the Borrower of at least Three Hundred Sixty Million Dollars (\$360,000,000) determined in Collateral Agent’s reasonable discretion based on the price per share times the fully diluted number of Borrower’s shares outstanding immediately after the consummation of the transaction or the last date of the series of related transactions, if applicable, under clause (a) of this definition.

“Equity Event 3” is (a) the receipt by Borrower, after the Effective Date and on or before June 30, 2019, of an aggregate amount of at least Seventy-Five Million Dollars (\$75,000,000) (inclusive net cash proceeds received from Equity Event 1 and Equity Event 2) in net cash proceeds (including not subject to any clawback, redemption, escrow or similar contractual restriction) from either (i) a bona fide equity financing on terms reasonably acceptable to Agent and the Lenders or (ii) strategic partnerships, corporate collaborations or licensing arrangements for a transaction on terms reasonably acceptable to Collateral Agent and the Lenders and (b) achievement of a valuation for the Borrower of at least Three Hundred Seventy-Five Million Dollars (\$375,000,000) determined in Collateral Agent’s reasonable discretion based on either (i) prior to Borrower’s initial public offering, price per share times the fully diluted number of Borrower’s shares outstanding immediately after the consummation of the transaction or the last date of the series of related transactions, if applicable, under clause (a) of this definition, or (ii) following Borrower’s initial public offering, Borrower’s public trading price per share times the fully diluted shares outstanding (i.e. “market capitalization”) immediately after the consummation of the transaction or the last date of the series of related transactions, if applicable, under clause (a) of this definition.

“Equity Event 4” is (a) the receipt by Borrower, after the Effective Date and on or before June 30, 2019, of an aggregate amount of at least One Hundred Thirty-Five Million Dollars (\$135,000,000) (inclusive net cash proceeds received from Equity Event 1, Equity Event 2 and Equity Event 3) in net cash proceeds (including not subject to any clawback, redemption, escrow or similar contractual restriction) from either (i) a bona fide equity financing on terms reasonably acceptable to Agent and the Lenders or (ii)

strategic partnerships, corporate collaborations or licensing arrangements for a transaction on terms reasonably acceptable to Collateral Agent and the Lenders and (b) achievement of a valuation for the Borrower of at least Four Hundred Thirty-Five Million Dollars (\$435,000,000) determined in Collateral Agent's reasonable discretion based on either (i) prior to Borrower's initial public offering, price per share times the fully diluted number of Borrower's shares outstanding immediately after the consummation of the transaction or the last date of the series of related transactions, if applicable, under clause (a) of this definition, or (ii) following Borrower's initial public offering, Borrower's public trading price per share times the fully diluted shares outstanding (i.e. "market capitalization") immediately after the consummation of the transaction or the last date of the series of related transactions, if applicable, under clause (a) of this definition.

"First Interest Only Extension Conditions" shall mean satisfaction of each of the following: (a) no Default or Event of Default shall have occurred and be continuing and (b) after the Effective Date and on or before November 30, 2018, the Borrower shall have achieved Equity Event 1.

"Second Draw Period" is the period commencing on the date on which Borrower achieves the Second Equity Event and ending on the earlier of December 31, 2018 and the occurrence of an Event of Default.

"Second Interest Only Extension Conditions" shall mean satisfaction of each of the following: (a) no Default or Event of Default shall have occurred and be continuing; (b) after the Effective Date and on or before November 30, 2018, the Borrower shall have achieved Equity Event 2 and (c) achievement of the First Interest Only Extension Conditions.

"Third Draw Period" is the period commencing on the date on which Borrower achieves the Equity Event 3 and ending on the earlier of (i) thirty (30) days following achievement of Equity Event 3 and (ii) June 30, 2019.

"Third Interest Only Extension Conditions" shall mean satisfaction of each of the following: (a) no Default or Event of Default shall have occurred and be continuing; (b) after the Effective Date and on or before June 30, 2019, the Borrower shall have achieved Equity Event 4 and (c) achievement of the First Interest Only Extension Conditions and Second Interest Only Conditions.

(iii) Amended Definition. The definition of "Final Fee" is hereby amended by replacing "4.35%" with "5.35%" therein.

(iv) Amended and Restated Definition. The following definitions are hereby amended and restated as follows:

“Amortization Date” is February 1, 2019; *provided that*, (i) if the First Interest Only Extension Conditions are satisfied and Borrower so elects, then February 1, 2020; (ii) if the Second Interest Only Extension Conditions are satisfied and Borrower so elects, then August 1, 2020; and (iii) if the Third Interest Only Extension Conditions are satisfied and Borrower so elects, then February 1, 2021.

“Maturity Date” is January 1, 2022; *provided that*, (i) if the Second Interest Only Extension Conditions are satisfied and Borrower so elects, then July 1, 2022; and (iii) if the Third Interest Only Extension Conditions are satisfied and Borrower so elects, then January 1, 2023.

(v) **Deleted Definition.** The definition of “Interest Only Extension Conditions” is hereby deleted.

(vi) Section 2.2(a). Section 2.2(a) is hereby amended and restated as follows:

(a) **“Availability.** Subject to the terms and conditions of this Agreement, the Lenders agree, severally and not jointly, to make term loans to Borrower as follows:

(i) on the Effective Date in an aggregate principal amount of Twenty-One Million Dollars (\$21,000,000.00) according to each Lender’s Term A Loan Commitment as set forth on Schedule 1.1 hereto (such term loans are hereinafter referred to singly as a **“Term A Loan”**, and collectively as the **“Term A Loans”**), provided that a portion of the proceeds of the Term A Loans shall be used to repay in full Borrower’s outstanding Indebtedness to SolarCap under the Prior Loan Agreement (the **“Prior Loan Debt”**). Borrower hereby authorizes Collateral Agent to apply the proceeds of the Term A Loans to the Prior Loan Debt without actually depositing such funds in an account of Borrower (i.e., netting).

(ii) during the Second Draw Period in an aggregate principal amount of up to Five Million Dollars (\$5,000,000.00) according to each Lender’s Term B Loan Commitment as set forth on Schedule 1.1 hereto (such term loans are hereinafter referred to singly as a **“Term B Loan”**, and collectively as the **“Term B Loans”**),

(iii) during the Third Draw Period in an aggregate principal amount of up to Four Million Dollars (\$4,000,000.00) according to each Lender’s Term C Loan Commitment as set forth on Schedule 1.1 hereto (such term loans are hereinafter referred to singly as a **“Term C Loan”**, and collectively as the **“Term C Loans”**); each Term A Loan, Term B Loan or Term C Loan is hereinafter referred to singly as a **“Term Loan”** and the Term A Loans, the Term B Loans and the Term C Loans are hereinafter referred to collectively as the **“Term Loans”**);

After repayment, no Term Loan may be re-borrowed.”

(b) **References Within Loan and Security Agreement.** Each reference in the Loan and Security Agreement to “this Agreement” and the words “hereof,” “herein,” “hereunder,” or words of like import, shall mean and be a reference to the Loan and Security Agreement as amended by this Amendment.

SECTION 3. SECTION 3 Conditions of Effectiveness. The effectiveness of Section 2 of this Amendment shall be subject to the satisfaction of each of the following conditions precedent:

(a) **Fees and Expenses.** The Borrower shall have paid (i) an amendment fee of Forty-Five Thousand Dollars (\$45,000), which shall be deemed fully earned and non-refundable upon payment, (ii) all invoiced costs and expenses then due in accordance with Section 5(e), and (iii) all other fees, costs and expenses, if any, due and payable as of the Amendment Effective Date under the Loan and Security Agreement.

(b) **This Amendment.** Collateral Agent shall have received this Amendment, executed by the Borrower.

(c) **Officer’s Certificate.** Collateral Agent shall have received a certificate of an officer of the Borrower with respect to incumbency and resolutions authorizing the execution and delivery of this Agreement, in form acceptable to Collateral Agent and the Lenders.

(d) **Representations and Warranties; No Default.** On the Amendment Effective Date, after giving effect to the amendment of the Loan and Security Agreement contemplated hereby:

(i) The representations and warranties contained in Section 4 shall be true and correct on and as of the Amendment Effective Date as though made on and as of such date; and (ii) There exist no Events of Default or events that with the passage of time would result in an Event of Default.

SECTION 4. Representations and Warranties. To induce the Lenders to enter into this Amendment, the Borrower hereby confirms, as of the date hereof, (a) that the representations and warranties made by it in Section 5 of the Loan and Security Agreement and in the other Loan Documents are true and correct in all material respects; provided, however, that such materiality qualifier shall not be applicable to any representations and warranties that already are qualified or modified by materiality in the text thereof; (b) that there has not been and there does not exist a Material Adverse Change; and (c) that the information included in the Perfection Certificate delivered to Collateral Agent on the Effective Date is true and correct in all material respects as of the Amendment Effective Date, subject to changes reflected in Borrower’s monthly Compliance Certificates. For the purposes of this Section 4, (i) each reference in Section 5 of the Loan and Security Agreement to “this Agreement,” and the words “hereof,” “herein,” “hereunder,” or words of like import in such Section, shall mean and be a reference to the Loan and Security Agreement as amended by this Amendment, and (ii) any representations and warranties which relate solely to an earlier date shall not be deemed confirmed and restated as of the date hereof (provided that such representations and warranties shall be true, correct and complete in all material respects as of such earlier date).

SECTION 5. Miscellaneous.

(a) **Loan Documents Otherwise Not Affected; Reaffirmation.** Except as expressly amended pursuant hereto or referenced herein, the Loan and Security Agreement and the other Loan Documents shall remain unchanged and in full force and effect and are hereby ratified and confirmed in all respects. The Lenders' and Collateral Agent's execution and delivery of, or acceptance of, this Amendment shall not be deemed to create a course of dealing or otherwise create any express or implied duty by any of them to provide any other or further amendments, consents or waivers in the future. The Borrower hereby reaffirms the grant of security under Section 4.1 of the Loan and Security Agreement and hereby reaffirms that such grant of security in the Collateral secures all Obligations under the Loan and Security Agreement, including without limitation any Term Loans funded on or after the Amendment Effective Date, as of the date hereof.

(b) **Conditions.** For purposes of determining compliance with the conditions specified in Section 3, each Lender that has signed this Amendment shall be deemed to have consented to, approved or accepted or to be satisfied with, each document or other matter required thereunder to be consented to or approved by or acceptable or satisfactory to a Lender unless Collateral Agent shall have received notice from such Lender prior to the Amendment Effective Date specifying its objection thereto.

(c) **Release.** In consideration of the agreements of Collateral Agent and each Lender contained herein and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Borrower, on behalf of itself and its successors, assigns, and other legal representatives, hereby fully, absolutely, unconditionally and irrevocably releases, remises and forever discharges Collateral Agent and each Lender, and its successors and assigns, and its present and former shareholders, affiliates, subsidiaries, divisions, predecessors, directors, officers, attorneys, employees, agents and other representatives (Agent, Lenders and all such other persons being hereinafter referred to collectively as the "**Releasees**" and individually as a "**Releasee**"), of and from all demands, actions, causes of action, suits, covenants, contracts, controversies, agreements, promises, sums of money, accounts, bills, reckonings, damages and any and all other claims, counterclaims, defenses, rights of set-off, demands and liabilities whatsoever of every name and nature, known or unknown, suspected or unsuspected, both at law and in equity, which Borrower, or any of its successors, assigns, or other legal representatives may now or hereafter own, hold, have or claim to have against the Releasees or any of them for, upon, or by reason of any circumstance, action, cause or thing whatsoever which arises at any time on or prior to the day and date of this Amendment, including, without limitation, for or on account of, or in relation to, or in any way in connection with the Loan Agreement, or any of the other Loan Documents or transactions thereunder or related thereto. Borrower understands, acknowledges and agrees that the release set forth above may be pleaded as a full and complete defense and may be used as a basis for an injunction against any action, suit or other proceeding which may be instituted, prosecuted or attempted in breach of the provisions of such release. Borrower agrees that no fact, event, circumstance, evidence or transaction which could now be asserted or which may hereafter be discovered shall affect in any manner the final, absolute and unconditional nature of the release set forth above.

(d) **No Reliance.** The Borrower hereby acknowledges and confirms to Collateral Agent and the Lenders that the Borrower is executing this Amendment on the basis of its own investigation and for its own reasons without reliance upon any agreement, representation, understanding or communication by or on behalf of any other Person.

(e) **Costs and Expenses.** The Borrower agrees to pay to Collateral Agent within thirty (30) days of its receipt of an invoice (or on the Amendment Effective Date to the extent invoiced on or prior to the Amendment Effective Date), the out-of-pocket costs and expenses of Collateral Agent and the Lenders party hereto, and the reasonable documented fees and disbursements of counsel to Collateral Agent and the Lenders party hereto (including allocated costs of internal counsel), in connection with the negotiation, preparation, execution and delivery of this Amendment and any other documents to be delivered in connection herewith on the Amendment Effective Date or after such date.

(f) **Binding Effect.** This Amendment binds and is for the benefit of the successors and permitted assigns of each party.

(g) **Governing Law.** THIS AMENDMENT AND THE RIGHTS AND OBLIGATIONS OF THE PARTIES HEREUNDER SHALL IN ALL RESPECTS BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH, THE INTERNAL LAWS OF THE STATE OF NEW YORK (WITHOUT REGARD TO THE CONFLICT OF LAWS PRINCIPLES THAT WOULD RESULT IN THE APPLICATION OF ANY LAWS OTHER THAN THE LAWS OF THE STATE OF NEW YORK), INCLUDING ALL MATTERS OF CONSTRUCTION, VALIDITY AND PERFORMANCE, REGARDLESS OF THE LOCATION OF THE COLLATERAL.

(h) **Complete Agreement; Amendments.** This Amendment and the Loan Documents represent the entire agreement about this subject matter and supersede prior negotiations or agreements with respect to such subject matter. All prior agreements, understandings, representations, warranties, and negotiations between the parties about the subject matter of this Amendment and the Loan Documents merge into this Amendment and the Loan Documents.

(i) **Severability of Provisions.** Each provision of this Amendment is severable from every other provision in determining the enforceability of any provision.

(j) **Counterparts.** This Amendment may be executed in any number of counterparts and by different parties on separate counterparts, each of which, when executed and delivered, is an original, and all taken together, constitute one Amendment. Delivery of an executed counterpart of a signature page of this Amendment by facsimile, portable document format (.pdf) or other electronic transmission will be as effective as delivery of a manually executed counterpart hereof.

(k) **Loan Documents.** This Amendment and the documents related thereto shall constitute Loan Documents.

[Balance of Page Intentionally Left Blank; Signature Pages Follow]

IN WITNESS WHEREOF, the parties hereto have duly executed this Amendment, as of the date first above written.

BORROWER:

AXCELLA HEALTH INC.,
as Borrower

By: /s/ Thomas Leggett
Title: CFO

ACORA NUTRITION LLC,
as Borrower

By: /s/ Thomas Leggett
Title: CFO

COLLATERAL AGENT AND LENDER:

SOLAR CAPITAL LTD.,
as Collateral Agent and a Lender

By: /s/ Anthony J. Storino
Name: Anthony J. Storino
Title: Authorized Signatory

ANNEX A

SCHEDULE 1.1

Lenders and Commitments

Term A Loans

Lender	Term Loan Commitment	Commitment Percentage
Solar Capital Ltd.	\$ 21,000,000	100.00%
TOTAL	\$ 21,000,000	100.00%

Term B Loans

Lender	Term Loan Commitment	Commitment Percentage
Solar Capital Ltd.	\$ 5,000,000	100.00%
TOTAL	\$ 5,000,000	100.00%

Term C Loans

Lender	Term Loan Commitment	Commitment Percentage
Solar Capital Ltd.	\$ 4,000,000	100.00%
TOTAL	\$ 4,000,000	100.00%

Aggregate (all Term Loans)

Lender	Term Loan Commitment	Commitment Percentage
Solar Capital Ltd.	\$ 30,000,000	100.00%
TOTAL	\$ 30,000,000	100.00%

SECOND AMENDMENT TO LOAN AND SECURITY AGREEMENT

THIS SECOND AMENDMENT TO LOAN AND SECURITY AGREEMENT (this “**Amendment**”), dated as of November 30, 2018 (the “**Amendment Effective Date**”), is made among Axcella Health Inc., a Delaware corporation (the “**Axcella**”), and Acora Nutrition LLC, a Delaware limited liability company (“**Acora**” and, individually and collectively, jointly and severally with Axcella, the “**Borrower**”), Solar Capital Ltd., a Maryland corporation (“**Solar**”), in its capacity as collateral agent (in such capacity, together with its successors and assigns in such capacity, “**Collateral Agent**”) and the Lenders listed on Schedule 1.1 of the Loan and Security Agreement (as defined below) or otherwise a party hereto from time to time including Solar in its capacity as a Lender (each a “**Lender**” and collectively, the “**Lenders**”).

The Borrower, the Lenders and Collateral Agent are parties to a Loan and Security Agreement dated as of January 9, 2018 (as amended by that certain First Amendment to Loan and Security Agreement, dated as of October 5, 2018, as further amended, restated or modified from time to time, the “**Loan and Security Agreement**”). The Borrower has requested that the Lenders agree to certain amendments to the Loan and Security Agreement. The Lenders have agreed to such request, subject to the terms and conditions hereof.

Accordingly, the parties hereto agree as follows:

SECTION 1. Definitions; Interpretation.

(a) **Terms Defined in Loan and Security Agreement.** All capitalized terms used in this Amendment (including in the recitals hereof) and not otherwise defined herein shall have the meanings assigned to them in the Loan and Security Agreement.

(b) **Interpretation.** The rules of interpretation set forth in Section 1.1 of the Loan and Security Agreement shall be applicable to this Amendment and are incorporated herein by this reference.

SECTION 2. Amendments to the Loan and Security Agreement.

(a) The Loan and Security Agreement shall be amended as follows effective as of the Amendment Effective Date:

(i) **Amended Definition.** The following definitions are hereby amended as follows:

The definition of “Equity Event 1” is hereby amended by replacing “November 30, 2018” with “December 14, 2018” therein.

The definition of “Equity Event 2” is hereby amended by (1) replacing “November 30, 2018” with “December 14, 2018” therein and (2) replacing “Sixty Million Dollars (\$60,000,000)” with “Fifty Eight Million Five Hundred Thousand Dollars (\$58,500,000)” therein.

The definition of “First Interest Only Extension Conditions” is hereby amended by replacing “November 30, 2018” with “December 14, 2018” therein.

The definition of “Second Draw Period” is hereby amended by replacing “Second Equity Event” with “Equity Event 2” therein.

The definition of “Second Interest Only Extension Conditions” is hereby amended by replacing “November 30, 2018” with “December 14, 2018” therein.

(b) **References Within Loan and Security Agreement.** Each reference in the Loan and Security Agreement to “this Agreement” and the words “hereof,” “herein,” “hereunder,” or words of like import, shall mean and be a reference to the Loan and Security Agreement as amended by this Amendment.

SECTION 3. Conditions of Effectiveness. The effectiveness of Section 2 of this Amendment shall be subject to the satisfaction of each of the following conditions precedent:

(a) **Fees and Expenses.** The Borrower shall have paid (i) all invoiced costs and expenses then due in accordance with Section 5(e), and (ii) all other fees, costs and expenses, if any, due and payable as of the Amendment Effective Date under the Loan and Security Agreement.

(b) **This Amendment.** Collateral Agent shall have received this Amendment, executed by the Borrower.

(c) **Representations and Warranties; No Default.** On the Amendment Effective Date, after giving effect to the amendment of the Loan and Security Agreement contemplated hereby:

(i) The representations and warranties contained in Section 4 shall be true and correct on and as of the Amendment Effective Date as though made on and as of such date; and

(ii) There exist no Events of Default or events that with the passage of time would result in an Event of Default.

SECTION 4. Representations and Warranties. To induce the Lenders to enter into this Amendment, the Borrower hereby confirms, as of the date hereof, (a) that the representations and warranties made by it in Section 5 of the Loan and Security Agreement and in the other Loan Documents are true and correct in all material respects; provided, however, that such materiality qualifier shall not be applicable to any representations and warranties that already are qualified or modified by materiality in the text thereof; (b) that there has not been and there does not exist a Material Adverse Change; and (c) that the information included in the Perfection Certificate delivered to Collateral Agent on the Effective Date is true and correct in all material respects as of the Amendment Effective Date, subject to changes reflected in Borrower's monthly Compliance Certificates. For the purposes of this Section 4, (i) each reference in Section 5 of the Loan and Security Agreement to "this Agreement," and the words "hereof," "herein," "hereunder," or words of like import in such Section, shall mean and be a reference to the Loan and Security Agreement as amended by this Amendment, and (ii) any representations and warranties which relate solely to an earlier date shall not be deemed confirmed and restated as of the date hereof (provided that such representations and warranties shall be true, correct and complete in all material respects as of such earlier date).

SECTION 5. Miscellaneous.

(a) **Loan Documents Otherwise Not Affected; Reaffirmation.** Except as expressly amended pursuant hereto or referenced herein, the Loan and Security Agreement and the other Loan Documents shall remain unchanged and in full force and effect and are hereby ratified and confirmed in all respects. The Lenders' and Collateral Agent's execution and delivery of, or acceptance of, this Amendment shall not be deemed to create a course of dealing or otherwise create any express or implied duty by any of them to provide any other or further amendments, consents or waivers in the future. The Borrower hereby reaffirms the grant of security under Section 4.1 of the Loan and Security Agreement and hereby reaffirms that such grant of security in the Collateral secures all Obligations under the Loan and Security Agreement, including without limitation any Term Loans funded on or after the Amendment Effective Date, as of the date hereof.

(b) **Conditions.** For purposes of determining compliance with the conditions specified in Section 3, each Lender that has signed this Amendment shall be deemed to have consented to, approved or accepted or to be satisfied with, each document or other matter required thereunder to be consented to or approved by or acceptable or satisfactory to a Lender unless Collateral Agent shall have received notice from such Lender prior to the Amendment Effective Date specifying its objection thereto.

(c) **Release.** In consideration of the agreements of Collateral Agent and each Lender contained herein and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Borrower, on behalf of itself and its successors, assigns, and other legal representatives, hereby fully, absolutely, unconditionally and irrevocably releases, remises and forever discharges Collateral Agent and each Lender, and its

successors and assigns, and its present and former shareholders, affiliates, subsidiaries, divisions, predecessors, directors, officers, attorneys, employees, agents and other representatives (Agent, Lenders and all such other persons being hereinafter referred to collectively as the “**Releasees**” and individually as a “**Releasee**”), of and from all demands, actions, causes of action, suits, covenants, contracts, controversies, agreements, promises, sums of money, accounts, bills, reckonings, damages and any and all other claims, counterclaims, defenses, rights of set-off, demands and liabilities whatsoever of every name and nature, known or unknown, suspected or unsuspected, both at law and in equity, which Borrower, or any of its successors, assigns, or other legal representatives may now or hereafter own, hold, have or claim to have against the Releasees or any of them for, upon, or by reason of any circumstance, action, cause or thing whatsoever which arises at any time on or prior to the day and date of this Amendment, including, without limitation, for or on account of, or in relation to, or in any way in connection with the Loan Agreement, or any of the other Loan Documents or transactions thereunder or related thereto. Borrower understands, acknowledges and agrees that the release set forth above may be pleaded as a full and complete defense and may be used as a basis for an injunction against any action, suit or other proceeding which may be instituted, prosecuted or attempted in breach of the provisions of such release. Borrower agrees that no fact, event, circumstance, evidence or transaction which could now be asserted or which may hereafter be discovered shall affect in any manner the final, absolute and unconditional nature of the release set forth above.

(d) **No Reliance.** The Borrower hereby acknowledges and confirms to Collateral Agent and the Lenders that the Borrower is executing this Amendment on the basis of its own investigation and for its own reasons without reliance upon any agreement, representation, understanding or communication by or on behalf of any other Person.

(e) **Costs and Expenses.** The Borrower agrees to pay to Collateral Agent within thirty (30) days of its receipt of an invoice (or on the Amendment Effective Date to the extent invoiced on or prior to the Amendment Effective Date), the out-of-pocket costs and expenses of Collateral Agent and the Lenders party hereto, and the reasonable documented fees and disbursements of counsel to Collateral Agent and the Lenders party hereto (including allocated costs of internal counsel), in connection with the negotiation, preparation, execution and delivery of this Amendment and any other documents to be delivered in connection herewith on the Amendment Effective Date or after such date.

(f) **Binding Effect.** This Amendment binds and is for the benefit of the successors and permitted assigns of each party.

(g) **Governing Law.** **THIS AMENDMENT AND THE RIGHTS AND OBLIGATIONS OF THE PARTIES HEREUNDER SHALL IN ALL RESPECTS BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH, THE INTERNAL LAWS OF THE STATE OF NEW YORK (WITHOUT REGARD TO THE CONFLICT OF LAWS PRINCIPLES THAT WOULD RESULT IN THE APPLICATION OF ANY LAWS OTHER THAN THE LAWS OF THE STATE OF NEW YORK), INCLUDING ALL MATTERS OF CONSTRUCTION, VALIDITY AND PERFORMANCE, REGARDLESS OF THE LOCATION OF THE COLLATERAL.**

(h) **Complete Agreement; Amendments.** This Amendment and the Loan Documents represent the entire agreement about this subject matter and supersede prior negotiations or agreements with respect to such subject matter. All prior agreements, understandings, representations, warranties, and negotiations between the parties about the subject matter of this Amendment and the Loan Documents merge into this Amendment and the Loan Documents.

(i) **Severability of Provisions.** Each provision of this Amendment is severable from every other provision in determining the enforceability of any provision.

(j) **Counterparts.** This Amendment may be executed in any number of counterparts and by different parties on separate counterparts, each of which, when executed and delivered, is an original, and all taken together, constitute one Amendment. Delivery of an executed counterpart of a signature page of this Amendment by facsimile, portable document format (.pdf) or other electronic transmission will be as effective as delivery of a manually executed counterpart hereof.

(k) **Loan Documents.** This Amendment and the documents related thereto shall constitute Loan Documents.

IN WITNESS WHEREOF, the parties hereto have duly executed this Amendment, as of the date first above written.

BORROWER:

AXCELLA HEALTH INC.,
as Borrower

By: /s/ William R. Hinshaw, Jr.
Title: President and CEO

ACORA NUTRITION LLC,
as Borrower

By: /s/ William R. Hinshaw, Jr.
Title: President

COLLATERAL AGENT AND LENDER:

SOLAR CAPITAL LTD.,
as Collateral Agent and a Lender

By: /s/ Anthony J Storino
Name: Anthony J. Storino
Title: Authorized Signatory

May 7, 2018

Robert Connelly

Re: Separation Agreement

Dear Bob:

The purpose of this letter agreement (the "Agreement") is to confirm the terms regarding your separation of employment from Axcella Health, Inc. (the "Company"). As more fully set forth below, the Company desires to provide you with severance pay and benefits in exchange for certain agreements by you. This Agreement shall become effective on the eighth (8th) day following your acceptance of it (the "Effective Date"), as provided below.

1. Transition Period; Separation from Employment.

(a) You and the Company agree that, subject to the terms of this section, you shall remain employed with the Company from May 7, 2018 until May 31, 2018 (the "Transition Period"). During the Transition Period, the Company may in its sole discretion: (1) remove any duties assigned to you; (2) assign you to other duties; (3) require you to remain away from the Company's place of business; or (4) waive the remaining portion of the Transition Period and consider your separation to be effective immediately or as of a specified date prior to the end of the Transition Period. During the Transition Period you shall continue to be paid your current salary and otherwise remain subject to the Company's plans and policies. The Company reserves the right to immediately terminate the Transition Period and end your employment without any further liability or obligation, other than legally required payments and reimbursements, upon: (a) you acting in an unethical, unprofessional or illegal manner, (b) you exhibiting moral turpitude, or (c) your negligence or which causes harm of any type to the Company or any other person or entity. Your separation from employment shall be effective on the conclusion of the Transition Period or an earlier date as permitted above (as applicable, your "Separation Date"). You hereby resign from the Board (and any committees thereof) as of the Separation Date, and as of such date, to relinquish any and all positions that you have held with the Company. From and after the Separation Date, you shall have no authority to act on behalf of the Company and shall not represent yourself as an employee, agent, officer, or Board member of the Company.

(b) On the Separation Date, the Company shall pay or provide to you the following: (i) your base salary through the Separation Date; (ii) any accrued but unused vacation pay (20 days); (iii) any properly incurred but unpaid documented business expenses; and (iv) any other amounts or benefits which you are entitled to receive under any plan, program, policy or contract of the Company.

(c) Following the Separation Date, your coverage under the Company's Directors and Officers Liability Insurance Policy shall continue pursuant to such Policy's terms and conditions.

2. Severance Benefit. In exchange for the mutual covenants set forth in this Agreement, including but not limited to your covenants set forth in Sections 4 and 5 hereof, the Company agrees to provide you with the following (together, the "Severance Benefit"):

(a) Provided that you use best efforts to cooperate reasonably with the Company in the

transition of matters related to your employment as set forth in Section 4 below, the Company shall pay to you nine (9) months of severance pay ("Severance Pay") based on your base salary as of the Separation Date. The Severance Pay shall be paid in equal installments effective for the period from the date immediately following the Separation Date to and including the date that is nine (9) months from the Separation Date ("Severance Pay Period"), in accordance with the Company's usual payroll schedule and subject to applicable deductions and withholdings, provided that the Company shall not be obligated to include you on the payroll before this Agreement becomes effective. If the Company does not make one or more payments of severance pay on a regular payroll date because this Agreement has yet to become effective, the Company shall make all such delayed payments by the first regular payroll date when it is practicable to do so after the Effective Date.

(b) If you elect COBRA continuation coverage, the Company shall pay the monthly premium for the same level of group health and medical coverage as in effect for you on the Separation Date until the earliest of the following: (i) the end of the Severance Pay Period; (ii) your eligibility for group medical care coverage through other employment; or (iii) the end of your eligibility under COBRA for continuation coverage for health and medical care. You agree to notify the Company promptly if you become eligible for group medical care coverage through another employer. You also agree to respond promptly and fully to any reasonable requests for information by the Company concerning your eligibility for such coverage. You may continue coverage after the end of the Severance Pay Period at your own expense for the remainder of the COBRA continuation period, subject to continued eligibility. Notwithstanding the foregoing, if the Company determines at any time that its payments pursuant to this paragraph may be taxable income to you, it may convert such payments to payroll payments directly to you on the Company's regular payroll dates, which shall be subject to tax-related deductions and withholdings.

(c) To the extent applicable, the terms and conditions of the Company's 2010 Stock Option and Grant Plan (the "Equity Plan") and any agreements executed by you pursuant thereto (the "Equity Agreements") are expressly incorporated by reference herein and shall survive the signing of this Agreement. You and the Company agree that as of the Separation Date, any "Service Relationship", as that term may be used or referenced in your Equity Agreements, shall be deemed to be terminated. You and the Company agree that (i) you own 1,154,655 shares of restricted stock, (ii) in accordance with the terms of the Promissory Note dated September 5, 2013 from you to the Company ("Note"), the outstanding principal of the Note as of the Separation Date is \$529,986.64, and the outstanding interest accrued on such principal as of the Separation Date is \$38,171.97, for a current outstanding balance as of the Separation Date of \$568,158.61, (iii) in accordance with the Repurchase Agreement attached as **Exhibit 1** hereto, the Company is hereby exercising its repurchase right with respect to the 168,594 shares, at cost which is \$3.37 per share, resulting in an aggregate repurchase price of \$568,161.78 (the "Aggregate Repurchase Price") and this Agreement shall serve as written notice of the Company's exercise of such repurchase right, and (iv) in accordance with the terms of the Note, and the Repurchase Agreement, the Aggregate Repurchase Price will be applied against the current outstanding balance under the Note as of the Separation Date, resulting in a net payment to you of \$3.17 and the Note will be cancelled and deemed repaid in full. You agree that in accordance with the Incentive Stock Option Agreement between you and the Company, dated June 13, 2017 ("ISO Agreement"), as of the Separation Date you are vested in an option to purchase 28,248 shares of common stock of the Company, at the option exercise price of \$3.54 per share. Your option to purchase 69,288 unvested shares pursuant to the ISO Agreement shall be forfeited and void effective on the Separation Date. In addition, in accordance with the Non-Qualified Stock Option Agreement between you and the Company, dated June 13, 2017 ("NQ Agreement"), as of the Separation Date you are vested in an option to purchase 22,898 shares of common stock of the Company, at the option exercise price of \$3.54 per share. Your option to purchase 84,150 unvested shares pursuant to the NQ Agreement shall be forfeited and void effective

on the Separation Date. You and the Company also agree that the date by which you may exercise the vested options to purchase shares pursuant to the ISO Agreement and the NQ Agreement as provided above, shall be extended until the earlier of (i) the date that is six (6) months following the closing of an initial public offering of the Company's stock ("IPO"), or (ii) December 31, 2019, and that the Equity Agreements are hereby amended to reflect and align with the terms set forth in this sentence.

(d) The Company agrees to transfer ownership to you of the Company iPhone you presently use, provided that you transfer your cell phone number to a personal service plan by the Separation Date, when your Company service plan will terminate.

(e) The Company shall make deductions, withholdings and tax reports with respect to payments and benefits under this Agreement that it reasonably determines to be required. Payments under this Agreement shall be in amounts net of any such deductions or withholdings. Nothing in this Agreement shall be construed to require the Company to make any payments to compensate you for any adverse tax effect associated with any payments or benefits or for any deduction or withholding from any payment or benefit.

You acknowledge and agree that the Severance Benefit is not intended to and shall not constitute a severance plan, and shall confer no benefit on anyone other than the parties hereto. You further acknowledge that except for the specific financial consideration set forth herein, you are not entitled to any other compensation from the Company including, without limitation, wages, bonuses, vacation pay, holiday pay or any other form of compensation or benefit.

3. Unemployment Benefits. The Company agrees that it shall not contest any claim for unemployment benefits by you with the Massachusetts Division of Unemployment Assistance. The Company, of course, shall not be required to falsify any information.

4. Cooperation. At any time after your employment, you shall cooperate fully with the Company in connection with any matter or event relating to your employment or events that occurred during your employment, including, without limitation, in the defense or prosecution of any claims or actions now in existence or which may be brought or threatened in the future against or on behalf of the Company and its affiliates, and its officers and employees. Your cooperation in connection with such matters or events includes, but is not limited to: (a) cooperating with the Company in connection with the transition of matters related to your employment (including, but not limited to, assisting with the transition of matters in which you have been involved and transferring your work knowledge to other the Company employees); (b) being available upon reasonable notice to meet with the Company regarding matters in which you have been involved, including any contract matters or audits; (c) preparing for, attending and participating in any legal proceeding (including depositions, consultation, discovery or trial); (d) providing affidavits; (e) assisting with any audits, inspections, proceedings or other inquiries; and/or (f) acting as a witness in connection with any litigation or other legal proceeding affecting the Company. You further agree that should you be contacted (directly or indirectly) by any person or entity (for example, by any party representing an individual or entity) adverse to the Company, you shall promptly notify Stacie Rader. You shall be reimbursed for any reasonable costs and expenses approved in advance by the Company and incurred in connection with providing such cooperation under this section. In addition, until September 30, 2018, you agree to make yourself available to the Company to consult with respect to any matter for which you were responsible during your employment. You and the Company shall work together reasonably in scheduling any services required pursuant to this Section, and the Company shall not require you to provide any such consulting services at times that would unreasonably interfere with your prescheduled personal activities or with your search for employment or with any subsequent employment.

5. Additional Covenants. You expressly acknowledge and agree to the following:

(a) You shall abide by your Employee Non-Competition, Non-Solicitation, Confidentiality and Assignment Agreement dated May 24, 2013, which is expressly incorporated by reference herein, and shall survive the signing of this Agreement and remain in full force and effect. In addition to all covenants contained therein, you expressly represent that for a period of eighteen (18) months following the Separation Date, you will not directly or indirectly engage, participate or invest in any business activity for any person or entity that develops, manufactures or markets any products, or performs any services, that are otherwise competitive with or similar to the products or services of the Company, including but not limited to, the business of developing amino acids or proteins. You have returned to the Company, and have not retained, any Company property, files or documents (and any copies thereof, in any form or media), including any cell phone, computer, keys and/or key cards. You shall abide by all common law and statutory obligations relating to the protection and non-disclosure of the Company's trade secrets and confidential and proprietary information.

(b) All information relating to the negotiation of this Agreement, including the terms provided for in this Agreement, shall be held confidential by you and shall not be publicized or disclosed to: (i) any person, other than an immediate family member, legal counsel or financial advisor, provided that any such individual to whom disclosure is made agrees to be bound by these confidentiality obligations; (ii) any business entity, or (iii) any government agency, except as mandated or permitted by state or federal law.

(c) Nothing contained in this Agreement limits your ability to file a charge or complaint with any federal, state or local governmental agency or commission (a "Government Agency"). In addition, nothing contained in this Agreement limits your ability to communicate with any Government Agency or otherwise participate in any investigation or proceeding that may be conducted by any Government Agency, including your ability to provide documents or other information, without notice to the Company, nor does anything contained in this Agreement apply to truthful testimony in litigation. If you file any charge or complaint with any Government Agency and if the Government Agency pursues any claim on your behalf, or if any other third party pursues any claim on your behalf, you waive any right to monetary or other individualized relief (either individually or as part of any collective or class action). In addition, for the avoidance of doubt, pursuant to the federal Defend Trade Secrets Act of 2016, you shall not be held criminally or civilly liable under any federal or state trade secret law or under this Agreement or your Employee Non-Competition, Non-Solicitation, Confidentiality and Assignment Agreement for the disclosure of a trade secret that (a) is made (i) in confidence to a federal, state, or local government official, either directly or indirectly, or to an attorney; and (ii) solely for the purpose of reporting or investigating a suspected violation of law; or (b) is made in a complaint or other document filed in a lawsuit or other proceeding, if such filing is made under seal.

(d) You shall not make any statements that are disparaging about the Company or its officers, directors and managers, in any medium, form or platform, including statements that disparage any product, service, finances, financial condition, capability or any other aspect of the Company, and you shall not engage in conduct which is intended to harm the reputation of the Company or its officers, directors and managers. The Company agrees to instruct its executive team and its Board not to make any statement about you during their employment or relationship with the Company, that is disparaging or intended to harm your reputation.

(e) A breach of any of Section 5 of this Agreement shall constitute a material breach of this Agreement and, in addition to any other legal or equitable remedy available to the Company, shall entitle

the Company to recover any Severance Benefit paid to you hereunder.

6. Your Release of Claims.

(a) You agree and acknowledge that by signing this Agreement, and for other good and valuable consideration provided for in this Agreement, you are waiving and releasing your right to assert any form of legal claim against the Company⁽¹⁾ whatsoever for any alleged action, inaction or circumstance existing or arising from the beginning of time through the Separation Date. Your waiver and release herein is intended to bar any form of legal claim, charge, complaint or any other form of action (jointly “Claims”) against the Company seeking any form of relief including, without limitation, equitable relief (whether declaratory, injunctive or otherwise), the recovery of any damages or any other form of monetary recovery whatsoever (including, without limitation, back pay, front pay, compensatory damages, emotional distress damages, punitive damages, attorney’s fees and any other costs) for any alleged action, inaction or circumstance existing or arising through the Separation Date. Without limiting the foregoing, you specifically waive and release the Company from any waivable claim arising from or related to your employment relationship with the Company up through the Separation Date including, without limitation: (i) claims under any Massachusetts or any other state or federal statute, regulation or executive order (as amended) relating to employment, fair employment practices, termination, discrimination, wages, hours, leaves of absence, and any other terms and conditions of employment, including the Age Discrimination in Employment Act, the Older Workers Benefit Protection Act, the Civil Rights Acts of 1866 and 1871, Title VII of the Civil Rights Act of 1964, the Civil Rights Act of 1991, the Equal Pay Act, the Americans With Disabilities Act, the Genetic Information Nondiscrimination Act, the Uniformed Services Employment and Reemployment Rights Act of 1994, the Lily Ledbetter Fair Pay Act, the National Labor Relations Act, the Family and Medical Leave Act, the Employee Retirement Income Security Act of 1974, COBRA, the Worker Adjustment and Retraining Notification Act, the Massachusetts Fair Employment Practices Statute, the Massachusetts Equal Rights Act, the Massachusetts Civil Rights Act, the Massachusetts Privacy Statute, the Massachusetts Sexual Harassment Statute, the Massachusetts Wage Act, the Massachusetts Minimum Fair Wages Act, the Massachusetts Equal Pay Act, and any similar Massachusetts or other state or federal statute; *please note that this section specifically includes a waiver and release of claims regarding payments covered by the Massachusetts Wage Act or the Massachusetts Minimum Fair Wages Act, including hourly wages, salary, overtime, minimum wages, commissions, vacation pay, holiday pay, sick leave pay, dismissal pay, bonus pay or severance pay*; (ii) claims under any Massachusetts or any other state or federal common law theory, including, without limitation, wrongful discharge, breach of express or implied contract, promissory estoppel, unjust enrichment, breach of a covenant of good faith and fair dealing, retaliation, violation of public policy, defamation, interference with contractual relations, intentional or negligent infliction of emotional distress, invasion of privacy, misrepresentation, deceit, fraud or negligence or any claim to attorneys’ fees under any applicable statute or common law theory of recovery; and (iii) any other claim arising under any Massachusetts or other state or federal law.

(b) Notwithstanding the foregoing, this Section 6 does not: (i) release the Company from any obligation expressly set forth in this Agreement; (ii) waive or release any legal claims which you may not waive or release by law, including without limitation obligations under workers compensation laws; (iii) release the Company from any obligations it has, or rights you may have, for indemnification or

(1) For the purposes of this section, the parties agree that the term “The Company” shall include Axcella Health, Inc., Flagship Ventures, and its and their divisions, affiliates, parents and subsidiaries, and its and their respective officers, directors, shareholders, owners, employees, attorneys, agents and assigns.

defense (x) in accordance with applicable laws or the corporate governance documents of the Company or its affiliates in accordance with their terms as in effect from time to time, or (y) pursuant to any applicable directors and officers insurance policy with respect to any liability incurred as an officer or director of the Company or its affiliates in accordance with the terms; or (iv) prohibit you from challenging the validity of this release under federal law, from filing a charge or complaint of employment related discrimination with the Equal Employment Opportunity Commission (“EEOC”) or similar state agency, or from participating in any investigation or proceeding conducted by the EEOC or similar state agency. Your waiver and release, however, are intended to be a complete bar to any recovery or personal benefit by or to you with respect to any claim (except those which cannot be released under law), including those raised through a charge with the EEOC. Accordingly, nothing in this Section 6 shall be deemed to limit the Company’s right to seek immediate dismissal of such charge or complaint on the basis that your signing of this Agreement constitutes a full release of any individual rights under the federal discrimination laws, or to seek restitution to the extent permitted by law of the economic benefits provided to you under this Agreement in the event you successfully challenge the validity of this release and prevail in any claim under the federal discrimination laws.

(c) You acknowledge and agree that, but for providing this waiver and release, you would not be receiving the Severance Benefit provided to you under this Agreement.

7. ADEA/OWBPA Review and Revocation Period. You and the Company acknowledge that you are over the age of 40 and that you, therefore, have specific rights under the Age Discrimination in Employment Act (“ADEA”) and the Older Workers Benefit Protection Act (the “OWBPA”), which prohibit discrimination on the basis of age. It is the Company’s desire and intent to make certain that you fully understand the provisions and effects of this Agreement, which includes a release of claims under the ADEA and OWBPA. To that end, you have been encouraged and given the opportunity to consult with legal counsel for the purpose of reviewing the terms of this Agreement. Consistent with the provisions of the ADEA and OWBPA, the Company also is providing you with twenty one (21) days in which to consider and accept the terms of this Agreement by signing below and returning it to Joan Zahka, Human Resources, 840 Memorial Drive, 3rd Floor, Cambridge, MA 02139. You may rescind your assent to this Agreement if, within seven (7) days after you sign this Agreement, you deliver by hand or send by mail (certified, return receipt and postmarked within such 7 day period) a notice of rescission to Joan Zahka at the above-referenced address.

8. Taxes and Withholdings; Rule 409A.

(a) The Severance Benefit provided under this Agreement shall be reduced by all applicable federal, state, local and other deductions, taxes, and withholdings.

(b) This Agreement shall be interpreted and administered in a manner so that any amount or benefit payable hereunder shall be paid or provided in a manner that is either exempt from or compliant with the requirements Section 409A of the Code and applicable Internal Revenue Service guidance and Treasury Regulations issued thereunder (and any applicable transition relief under Section 409A of the Code). Nevertheless, the tax treatment of the benefits provided under the Agreement is not warranted or guaranteed. Neither the Company nor its directors, officers, employees or advisers shall be held liable for any taxes, interest, penalties or other monetary amounts owed by you as a result of the application of Section 409A of the Code.

(c) Notwithstanding anything in this Agreement to the contrary, to the extent that any amount or benefit that would constitute non-exempt “deferred compensation” for purposes of Section 409A of the Code would otherwise be payable or distributable hereunder, or a different form of payment

would be effected, by reason of a Change in Control or your Disability or termination of employment, such amount or benefit shall not be payable or distributable to you, and/or such different form of payment shall not be effected, by reason of such circumstance unless (i) the circumstances giving rise to such Change in Control, Disability or termination of employment, as the case may be, meet any description or definition of “change in control event,” “disability” or “separation from service,” as the case may be, in Section 409A of the Code and applicable regulations (without giving effect to any elective provisions that may be available under such definition), or (ii) the payment or distribution of such amount or benefit would be exempt from the application of Section 409A of the Code by reason of the short-term deferral exemption or otherwise. This provision does not prohibit the vesting of any amount upon a Change in Control, Disability or termination of employment, however defined. If this provision prevents the payment or distribution of any amount or benefit, such payment or distribution shall be made on the date, if any, on which an event occurs that constitutes a Section 409A-compliant “change in control event,” “disability” or “separation from service,” as the case may be, or such later date as may be required by subsection (d) below. If this provision prevents the application of a different form of payment of any amount or benefit, such payment shall be made in the same form as would have applied absent such designated event or circumstance.

(d) Notwithstanding anything in this Agreement to the contrary, if any amount or benefit that would constitute non-exempt “deferred compensation” for purposes of Section 409A of the Code would otherwise be payable or distributable under this Agreement by reason of your separation from service during a period in which you are a Specified Employee (as defined below), then, subject to any permissible acceleration of payment by the Company under Treas. Reg. Section 1.409A-3(j)(4)(ii) (domestic relations order), (j)(4)(iii) (conflicts of interest), or (j)(4)(vi) (payment of employment taxes): (i) the amount of such non-exempt deferred compensation that would otherwise be payable during the six-month period immediately following your separation from service shall be accumulated through and paid or provided on the first day of the seventh month following your separation from service (or, if you die during such period, within 30 days after your death) (in either case, the “Required Delay Period”); and (ii) the normal payment or distribution schedule for any remaining payments or distributions shall resume at the end of the Required Delay Period. For purposes of this Agreement, the term “Specified Employee” has the meaning given such term in Code Section 409A and the final regulations thereunder; provided, however, that the Company’s Specified Employees and its application of the six-month delay rule of Code Section 409A(a)(2)(B)(i) shall be determined in accordance with rules adopted by the Board or a committee thereof, which shall be applied consistently with respect to all nonqualified deferred compensation arrangements of the Company, including this Agreement.

9. General.

(a) **Integration.** You acknowledge and agree that this Agreement and any agreements explicitly incorporated by reference herein (e.g., the Equity Agreements and the Employee Non-Competition, Non-Solicitation, Confidentiality and Assignment Agreement) contain the entire agreement between you and the Company, and that this Agreement supersedes any and all prior or contemporaneous oral and/or written agreements between you and the Company.

(b) **Modification; Waiver; Severability.** No variations or modifications hereof shall be deemed valid unless reduced to writing and signed by the parties hereto. The failure of the Company to seek enforcement of any provision of this Agreement in any instance or for any period of time shall not be construed as a waiver of such provision or the Company’s right to seek enforcement of such provision in the future. The provisions of this Agreement are severable, and if for any reason any part hereof shall be found to be unenforceable, the remaining provisions shall be enforced in full.

(c) Choice of Law; Venue and Jurisdiction; Jury Waiver. This Agreement shall be deemed to have been made in the Massachusetts, shall take effect as an instrument under seal within Massachusetts, and shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts, without giving effect to conflict of law principles. You agree that any action, demand, claim or counterclaim relating to the terms and provisions of this Agreement, or to its formation or breach, shall be commenced in Massachusetts in a court of competent jurisdiction, and you further acknowledge that venue for such actions shall lie exclusively in Massachusetts and that material witnesses and documents would be located in Massachusetts. Both parties hereby waive and renounce in advance any right to a trial by jury in connection with such legal action.

(d) Knowing and Voluntary Execution. By executing this Agreement, you are acknowledging that you have been afforded sufficient time to understand the terms and effects of this Agreement, that your agreements and obligations hereunder are made voluntarily, knowingly and without duress, and that neither the Company nor its agents or representatives have made any representations inconsistent with the provisions of this Agreement.

[Signature Page Follows]

This Agreement may be signed on one or more copies, each of which when signed shall be deemed to be an original, and all of which together shall constitute one and the same Agreement. If the foregoing correctly sets forth our understanding, please sign, date and return the enclosed copy of this Agreement to the Company within twenty-one (21) days.

Axcella Health, Inc.

By: /s/ Thomas Leggett

Dated: 5/30/18

Confirmed and Agreed:

/s/ Robert T. Connelly
Robert T. Connelly

Dated: 5/29/18

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the use in this Amendment No. 1 to Registration Statement No. 333-230822 on Form S-1 of our report dated March 15, 2019 (April 29, 2019 as to the effects of the reverse stock split described in Note 13) relating to the consolidated financial statements of Axcella Health Inc. appearing in the Prospectus, which is part of this Registration Statement, and to the reference to us under the heading "Experts" in such Prospectus.

/s/ DELOITTE & TOUCHE LLP

Boston, Massachusetts
April 29, 2019

QuickLinks

[Exhibit 23.1](#)

[CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM](#)