

**UNITED STATES
SECURITIES AND EXCHANGE COMMISSION**

Washington, D.C. 20549

FORM 10-K

- (Mark One)
- ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2019
- OR
- TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934 FOR THE
TRANSITION PERIOD FROM

TO
Commission File Number 001-37566

SYNOLOGIC, INC.

(Exact name of Registrant as specified in its Charter)

Delaware
(State or other jurisdiction of
incorporation or organization)
301 Binney St., Suite 402
Cambridge, MA
(Address of principal executive offices)

26-1824804
(I.R.S. Employer
Identification No.)

02142
(Zip Code)

(617) 401-9975

(Registrant's telephone number, including area code)

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol	Name of exchange on which registered
Common Stock, par value \$0.001 per share	SYBX	The Nasdaq Capital Market

Securities registered pursuant to Section 12(g) of The Act:
None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. YES NO

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act. YES NO

Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. YES NO

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). YES NO

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, 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	<input type="checkbox"/>	Accelerated filer	<input checked="" type="checkbox"/>
Non-accelerated filer	<input type="checkbox"/>	Small reporting company	<input checked="" type="checkbox"/>
Emerging growth company	<input checked="" type="checkbox"/>		

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 pursuant to Section 13(a) of the Exchange Act.

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). YES NO

The aggregate market value of common stock held by non-affiliates of the registrant as of June 30, 2019, the last business day of the registrant's most recently completed second quarter, was \$161.9 million, computed based on the closing price of \$9.10 per share on June 30, 2019.

As of March 5, 2020 there were 32,250,814 shares of the registrant's common stock, par value \$0.001 per share, outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

The following documents (or parts thereof) are incorporated by reference into the following parts of this Form 10-K: Certain information required in Part III of this Annual Report on Form 10-K is incorporated from the registrant's definitive proxy statement for the 2020 annual meeting of stockholders to be filed pursuant to Regulation 14A with the Securities and Exchange Commission within 120 days of the registrant's fiscal year ended December 31, 2019.

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FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K contains forward-looking statements that involve risks and uncertainties. We make such forward-looking statements pursuant to the safe harbor provisions of the Private Securities Litigation Reform Act of 1995 and other federal securities laws. All statements other than statements of historical facts contained herein are forward-looking statements. In some cases, you can identify forward-looking statements by terminology such as “may,” “will,” “should,” “expects,” “intends,” “plans,” “anticipates,” “believes,” “estimates,” “predicts,” “potential,” “continue” or the negative of these terms or other comparable terminology. These forward-looking statements include, but are not limited to, statements about:

- the success of our research and development efforts;
- the initiation, progress, timing, costs and results of clinical trials for our product candidates;
- the time and costs involved in obtaining regulatory approvals for our product candidates;
- the success of our collaborations with third parties;
- the progress, timing and costs involved in developing manufacturing processes and in manufacturing products, as well as agreements with third-party manufacturers;
- the rate of progress and cost of our commercialization activities;
- the expenses we incur in marketing and selling our product candidates;
- the revenue generated by sales of our product candidates;
- the emergence of competing or complementary technological developments;
- the terms and timing of any additional collaborative, licensing or other arrangements that we may establish;
- the acquisition of businesses, products and technologies;
- our need to implement additional infrastructure and internal systems;
- our need to add personnel and financial and management information systems to support our product development and potential future commercialization efforts, and to enable us to operate as a public company; and
- other risks and uncertainties, including those listed under Part I, Item 1A. “Risk Factors”.

Any forward-looking statements in this Annual Report on Form 10-K reflect our current views with respect to future events or to our future financial performance and involve known and unknown risks, uncertainties and other factors that may cause our actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by these forward-looking statements. Factors that may cause actual results to differ materially from current expectations include, among other things, those listed under Part I, Item 1A. “Risk Factors” and elsewhere in this Annual Report on Form 10-K. Given these uncertainties, you should not place undue reliance on these forward-looking statements. Except as required by law, we assume no obligation to update or revise these forward-looking statements for any reason, even if new information becomes available in the future.

This Annual Report on Form 10-K also contains estimates, projections and other information concerning our industry, our business, and the markets for certain diseases, including data regarding the incidence and prevalence of certain medical conditions. Information that is based on estimates, forecasts, projections, market research or similar methodologies is inherently subject to uncertainties and actual events or circumstances may differ materially from events and circumstances reflected in this information. Unless otherwise expressly stated, we obtained this industry, business, market and other data from reports, research surveys, studies and similar data prepared by market research firms and other third parties, industry, medical and general publications, government data and similar sources.

Item 1. Business.

Overview

We are a clinical-stage biopharmaceutical company focused on advancing our proprietary drug discovery and development platform to create Synthetic Biotic™ medicines. Our Synthetic Biotic medicines apply the principles and tools of synthetic biology to engineer beneficial therapeutic characteristics into microbes, transforming them into efficient and targeted biologic engines. We believe that many patients with serious diseases are underserved today based on the limitations of conventional therapeutic approaches, such as small or large molecules. Synthetic Biotic medicines have the potential to address unmet medical need by performing therapeutic mechanisms not achievable by other drug modalities. Synthetic Biotic medicines are designed to be programmed to metabolize, or consume, a toxic substance, compensate for damaged metabolic pathways in patients, or produce one or more therapeutic factors. Our platform has generated a portfolio of Synthetic Biotic medicines designed to impact both genetic and acquired metabolic diseases, as well as oncology and inflammatory disorders. In a clinical trial with our lead program SYN1618, we have demonstrated consumption of a phenylalanine (Phe), an amino acid that accumulates in a rare metabolic disorder known as phenylketonuria (PKU), and are expanding our pipeline based on learnings from this program.

We believe we have the core competencies in synthetic biology and manufacturing, as well as translational medicine, regulatory experience and clinical development to successfully discover and develop our Synthetic Biotic medicines. In June 2019, we announced an expanded collaboration with Ginkgo Bioworks (Ginkgo) to complement our in-house expertise in strain design and development. Ginkgo uses software and automation to program and optimize microbial strains at a large scale. Ginkgo's technology provides us with a synthetic biology-based cell programming platform for testing thousands of microbial strains to accelerate progression of early preclinical leads to drug candidates optimized for clinical development.

While we believe that our Synthetic Biotic platform has potential to address a broad range of diseases, our initial internal pipeline focus is on rare metabolic diseases. We will consider leveraging partnerships to advance programs for other diseases including oncology and inflammatory disorders. Our most advanced programs target rare metabolic diseases that could potentially be treated by oral delivery of Synthetic Biotic medicines. These includes conditions caused by a genetic mutation characterized by a dysfunctional metabolic pathway including PKU and maple syrup urine disease (MSUD), as well as acquired metabolic diseases caused by organ dysfunction, such as enteric hyperoxaluria. When delivered orally, Synthetic Biotic medicines are designed to function in the gut to consume a disease-causing toxic metabolite with the intended consequence of reducing its systemic levels. We believe that success in our metabolic disease programs will enable us to demonstrate the potential of our Synthetic Biotic medicines while bringing meaningful change to the lives of patients suffering from these debilitating conditions.

Our most advanced product candidate for the treatment of metabolic dysfunction is SYN1618, an oral therapy intended for the treatment of PKU, a rare metabolic disease in which Phe accumulates in the body as a result of genetic defects. Elevated levels of Phe are toxic to the brain and can lead to neurological dysfunction. SYN1618 is designed to function in the gut of patients to reduce excess Phe, with the goal of lowering levels in the blood and other tissues. SYN1618 has received both Fast Track designation and orphan drug designation for PKU from the FDA. We initiated a Phase 1/2a clinical trial of an early liquid formulation of SYN1618 in April 2018 and announced top-line data from healthy volunteers evaluated in this study in September 2018. In July 2019, we announced data that demonstrated that SYN1618 was safe and well-tolerated and achieved proof-of-mechanism of strain activity in both healthy volunteers and patients with PKU. We have also evaluated a new lyophilized formulation of SYN1618 in a bridging study in healthy volunteers. The study of this more patient- and commercialization-appropriate presentation of SYN1618 demonstrated improved tolerability over the early liquid formulation. We expect to initiate a Phase 2 clinical trial of the lyophilized formulation in patients with PKU in the first half of 2020 to evaluate its potential for blood Phe-lowering and to validate our pharmacodynamic and pre-clinical modeling.

The strain design and engineering, translational research, clinical and regulatory planning and scalable manufacturing of our PKU program has informed development of future clinical candidates. We are also developing pre-clinical product candidates to address other metabolic conditions including enteric hyperoxaluria and maple syrup urine disease (MSUD). Enteric hyperoxaluria is a form of secondary hyperoxaluria caused by increased absorption of oxalate as a result of certain intestinal diseases, including Crohn's disease and short bowel syndrome or as a result of surgical procedures such as bariatric weight-loss surgery. The disorder can lead to a range of conditions of increasing severity from urinary tract infections to recurrent kidney stones and renal failure. MSUD is an inherited, rare metabolic disease characterized by a deficiency of enzymes required to break down certain amino acids. The most common and severe form of the disease is the classic type, which becomes apparent soon after birth and, if left untreated, can lead to seizures, coma, and death. Variant forms of the disorder become apparent later in infancy or childhood and are typically milder, but also lead to delayed development and other health problems if not treated.

In August 2019, we announced that we were discontinuing the development of SYN1020, an early stage clinical product candidate for the treatment of hyperammonemia. The decision to discontinue the program was based on top-line data from an interim analysis of a randomized, double-blind, placebo-controlled Phase 1b/2a study of the Synthetic Biotic medicine in 23 patients with cirrhosis and elevated blood ammonia. While SYN1020 was well tolerated in Phase 1b/2a study, the study showed it did not lower blood ammonia in patients with cirrhosis.

We have also developed a portfolio of Synthetic Biotic medicines to treat certain cancers which are designed to modify the tumor microenvironment, activate the immune system and result in tumor reduction. We envision that multiple engineered functions could be combined in one Synthetic Biotic medicine. These Synthetic Biotic medicines could also be used in combination with other cancer therapies such as check-point inhibitors. Our first Synthetic Biotic clinical immuno-oncology (IO) candidate is SYN1891, an intratumorally administered Synthetic Biotic medicine engineered to act as a dual innate and adaptive immune activator. SYN1891 has been designed to activate the immune response in tumors via the *E.coli* Nissle chassis and production of cyclic di-AMP, an activator of the Stimulator of Interferon Genes, also referred to as the STING pathway. In January 2020, we announced that we had treated the first subject in a Phase 1 clinical trial of SYN1891 in patients with advanced solid tumors and lymphoma. The clinical trial is designed to identify a maximum tolerated dose (MTD) of SYN1891 delivered as a monotherapy and we expect to have data from this arm of the study in 2020. Once an MTD is identified, we will evaluate treatment of patients with a combination of SYN1891 and the checkpoint inhibitor atezolizumab (Tecentriq®), provided through a supply agreement with Roche.

We are also leveraging our proprietary technology platform to develop Synthetic Biotic medicines to treat a broader range of human diseases. To achieve this goal, we collaborate with key disease experts who have developed robust models of relevant diseases and to inform our translational medicine strategy. These collaborators bring complementary expertise in preclinical development, clinical development and commercialization. Inflammatory bowel disease (IBD) is an attractive target for our technology as Synthetic Biotic medicines can be designed to locally deliver combinations of complementary therapeutics to potentially address the unmet medical need for maintenance of disease remissions. We have a collaboration with AbbVie S.à.r.l. (AbbVie) to develop Synthetic Biotic medicines for the treatment of types of IBD, including Crohn’s disease and ulcerative colitis. We may enter into additional strategic partnerships in the future to maximize the value of our programs and our Synthetic Biotic platform.

We are supported by our Board of Directors and our scientific advisory board, each of which offer complementary experience in drug discovery and development, as well as expertise in building public companies, management, and business development. Our founding science came from the laboratories of Professors James Collins and Timothy Lu from the Massachusetts Institute of Technology (MIT), who remain highly engaged in guiding development and application of our platform.

Our pipeline of our programs is shown below.



As we advance our lead programs, we continue to learn and improve our Synthetic Biotic platform, which will inform all future portfolio programs. Consequently, we believe we have a robust engine for building a sustainable pipeline of novel, Synthetic Biotic medicines across a range of diseases. Through the strength of our internal team and network of partners, we believe we can deliver on the promise of Synthetic Biotic medicines to improve the lives of patients with significant unmet medical needs.

Our Strategy

Our mission is to address patients' dynamic therapeutic needs by developing Synthetic Biotic medicines that sense and respond to disease. In this way, we discover and develop Synthetic Biotic medicines that are designed to transform the lives of patients for whom conventional treatment approaches are either not available or have limited efficacy and safety. To achieve our goal, we are pursuing the following key strategies:

Advance an internal portfolio of Synthetic Biotic medicines that consume toxic metabolites in order to treat rare metabolic diseases that can be accessed from the gut

Advance Clinical Development of SYN1618 for PKU. In September 2019, we presented data from a Phase 1/2a clinical trial that demonstrated that an early liquid formulation of SYN1618 was safe in healthy volunteers and patients with PKU and achieved proof-of-mechanism demonstrating that SYN1618 is consuming Phe in the GI tract. In the second half of 2019, we initiated a bridging study in healthy volunteers to evaluate a new solid lyophilized formulation which provides a more commercially appropriate presentation of SYN1618. The bridging study demonstrated improved tolerability of the lyophilized SYN1618 over the early liquid formulation and enabled us to determine an MTD to take forward to test in patients. In the first half of 2020, we expect to initiate a Phase 2 clinical trial of the solid formulation in patients with PKU to evaluate its potential for blood Phe-lowering and to validate our pharmacodynamic and pre-clinical modeling.

Advance additional early stage metabolic programs in our preclinical pipeline. We plan to continue to leverage our expertise from our lead program in PKU to accelerate development of Synthetic Biotic programs for the potential treatment of GI disorders and other rare metabolic diseases with high unmet needs, including enteric hyperoxaluria and MSUD. We are advancing these programs through pre-clinical studies with the goal of moving into IND-enabling studies as appropriate.

Expand the breadth of our platform with partnerships and programs for partnership

Advance Clinical Development of our First IO program, SYN1891. We initiated a Phase 1 clinical trial of our first IO program, SYN1891, in patients with advanced solid tumors and lymphoma and in January 2020 announced that we had treated the first subject. The first arm of the study is designed to evaluate SYN1891 as a monotherapy and to establish an MTD which will inform dosing in the second arm in which SYN1891 will be evaluated in combination with atezolizumab. We expect to have data from the monotherapy arm of the study in 2020.

Maximize the Value of the Synthetic Biotic Platform by Leveraging Strategic Collaborations. Our current partnership with AbbVie is focused on the discovery and development of Synthetic Biotic medicines for the treatment of IBD, and in March 2019 we received a milestone payment for this program. We expect to continue to explore strategic partnerships that would leverage the complementary capabilities of our partners to develop Synthetic Biotic medicines and maximize the value of our Synthetic Biotic platform.

Expand our Synthetic Biotic platform capabilities including expertise in synthetic biology, microbial and disease biology, process development and manufacturing, clinical and regulatory development

Support Clinical Pipeline Progress with Expanded Manufacturing and Formulation Capability. We have established internal manufacturing capabilities to produce both liquid and solid formulations of clinical trial material for mid-stage studies of our rare metabolic disease and IO programs, through entry into an agreement to lease good manufacturing practice (GMP) clean-room space in Waltham, Massachusetts. The clean-room facility provides an affordable and flexible option that maximizes control over our processes and timelines enabling us to move efficiently through clinical development to bring our Synthetic Biotic medicines to patients. We continue to evaluate additional formulation and presentation options for later stage clinical studies and eventual commercialization of our Synthetic Biotic medicines.

Enhance our Synthetic Biotic Platform Capabilities to Expand our Pipeline of Synthetic Biotic Medicines. As a leader in the development of engineered non-pathogenic bacteria for therapeutic use, we intend to advance the field of Synthetic Biotic medicines by continuing to innovate and broaden the potential of our platform to deliver clinically meaningful benefits for patients. We intend to build on our expertise in design, optimization and manufacturing to further develop the Synthetic Biotic platform as a reproducible and scalable engine for generating a pipeline of innovative product candidates that address a broad range of diseases. We established a technology collaboration with Ginkgo Bioworks, a privately held high-throughput synthetic biology company, to enable the rapid optimization of Synthetic Biotic candidates. We will collaborate with other groups as appropriate to further develop our platform capabilities.

Protect and Leverage Our Intellectual Property Portfolio and Patents. We believe that we have a broad intellectual property portfolio that includes patents and patent applications relevant to the engineering, development, manufacturing and formulation of human therapeutic products based on synthetic biology and the metabolic engineering of non-pathogenic bacteria. We intend to continue to protect and leverage our intellectual property assets by maintenance and expansion of our worldwide portfolio of intellectual property, including the pursuit of composition of matter and other intellectual property focused on our Synthetic Biotic programs and our technology platform.

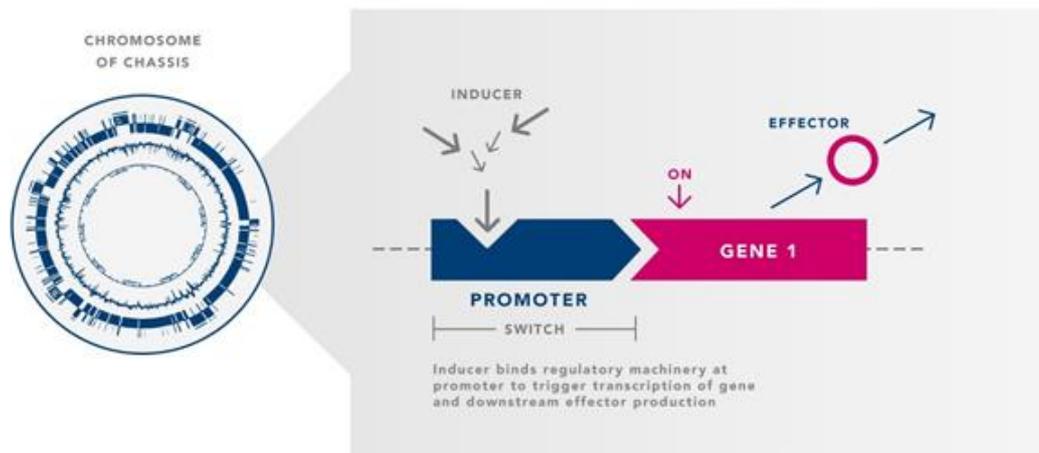
Our Focus: Synthetic Biotic Medicines

Our novel, proprietary Synthetic Biotic discovery and development platform combines synthetic biology and metabolic engineering to re-design the genetic circuitry of beneficial non-pathogenic microbes. Synthetic Biotic medicines are designed to perform metabolic transformations to compensate for missing or defective pathways in a patient or to produce therapeutically beneficial molecules. Synthetic Biotic medicines have unique advantages as potential therapeutics. Engineered microbes can be programmed to carry out functions that cannot be performed by conventional drug treatments, such as small molecules or antibodies. In contrast to conventional therapeutics that largely engage a single target and address one molecular dysfunction, Synthetic Biotic medicines can be designed to dynamically sense diseased environments and respond with a programmed and combinatorial effect compensating for the dysfunction of entire processes or pathways missing in disease. Moreover, a Synthetic Biotic medicine can also function catalytically, since a single living cell can carry out multiple cycles of the intended therapeutic activity during its time in the patient.

Leveraging Synthetic Biology and Metabolic Engineering of Non-Pathogenic Bacteria to Produce Synthetic Biotic Medicines

Non-Pathogenic Bacteria. Bacteria have been isolated from the human microbiota and widely used as supplements (probiotics) that are believed to provide health benefits. Bacteria have evolved over millions of years to adapt, survive, and actively metabolize to consume or produce metabolites in the human body. They are also amenable to genetic manipulation. To confer a therapeutic effect, we use basic biological properties of bacteria and tools of synthetic biology to develop Synthetic Biotic medicines from non-pathogenic microbes, focusing initially on a single strain of bacteria *E. coli* Nissle.

Using Synthetic Biology to Generate Synthetic Biotic Medicines. Our scientists genetically engineer this non-pathogenic bacterium with “wiring” or biological circuits to direct cellular biological processes in a manner analogous to designing electrical circuits. The critical parts of an engineered Synthetic Biotic medicine include (1) the “chassis,” or non-pathogenic bacterium, (2) the effector module, which is a gene or pathway encoding the core biological activity that provides the therapeutic function, and (3) tunable switches to precisely determine the circumstances under which the effector module will be active, as well as the potency, performance and output of the effectors themselves. We aim to precisely and appropriately control the amount, location and activity of our Synthetic Biotic medicines to address specific diseases.



(1) *The Chassis*: Our Synthetic Biotic platform starts with a well-characterized bacteria used as probiotic to serve as the chassis upon which we build our living medicines. Our initial programs use *E. coli* Nissle, which is one of many non-pathogenic strains isolated from the human microbiota. *E. coli* Nissle is non-colonizing in the GI and has been used as a probiotic bacterial supplement for many years to promote gut health. Clinical studies have demonstrated that *E. coli* Nissle is rapidly cleared from most individuals with no significant safety issues (Clin. Transl. Sci. (2017) 00, 1–8). We also observed similar rates of clearance from subjects in our recent Phase 1 clinical trial of SYN1020 in healthy volunteers (Sci. Transl. Med. 2019: Vol. 11, Issue 475, eaau7975). We believe *E. coli* Nissle’s widespread use as a probiotic is evidence of its utility as a safe background chassis to apply synthetic biology to confer a therapeutic benefit. There are a number of additional features of *E. coli* Nissle organism that makes it an attractive chassis for our platform:

- *E. coli* Nissle’s genetic and metabolic machinery are well understood and provide a robust cellular context into which genetic information can be introduced with high efficiency and little or no damage to the fitness of the bacterium.
- The advanced nature of the synthetic biology toolkit available for *E. coli* Nissle enables rapid iterative design, assembly, and testing of prototype product candidates and remains unique among other bacterial and cellular engineering approaches.
- *E. coli* is relatively easy to manufacture at large scale compared to other bacteria.
- As a Gram-negative bacterium, with a protective outer wall, *E. coli* Nissle survives well in the human GI tract.

(2) *Building the Effector Module or Circuit*: Synthetic Biotic medicines have the advantage that they can be designed with multiple pathway components. We have developed proprietary integration systems to direct stable insertion of multiple genetic circuits and pathways into optimal chromosomal locations, or “landing pads,” of *E. coli* Nissle. This enables efficient and stable expression of multiple genes encoding enzymes and other proteins. These activities may be further improved for therapeutic effect when combined or when under the control of tunable switches that determine when the mechanisms should be activated. Our Synthetic Biotic platform allows us to engineer two types of mechanistic activities into our Synthetic Biotic medicines: 1) we can engineer living medicines capable of metabolic transformations that can substitute or compensate for missing or defective pathways in a patient, and 2) we can engineer living medicines to produce therapeutically beneficial molecules. We have leveraged proprietary tools, know-how and intellectual property to build multiple Synthetic Biotic lead strains that produce therapeutically relevant effects in pre-clinical experiments. Progression of these strains as product candidates in diseases with high unmet need is based on prioritizing those with feasible drug development paths in terms of availability of informative animal models and existence of biomarkers to guide efficient clinical development.

(3) *Tunable Switches*: We also design and engineer proprietary switches to mediate the activity of the new pathways we introduce into our Synthetic Biotic medicines, with the goal of controlling the engineered circuit or its therapeutic output. To optimize the fitness of a Synthetic Biotic strain, it is critical that the effector is activated only at the appropriate time and place. The switches are based on engineering DNA elements called “inducible promoters” that are designed to sense and respond to disease states, specific environmental signals, or exogenously added inducing molecules. Our goal is to design and develop Synthetic Biotic medicines programmed with switches to produce therapeutic effects at precisely the right time and location such as the anaerobic environment of the gut, or in the context of local inflammation or other pathogenic factors.

Advantages of Our Synthetic Biotic Drug Development Platform and Synthetic Biotic Living Medicines

We believe our platform has the potential to provide safe and effective therapies for patients given several attributes of our Synthetic Biotic approach:

Synthetic Biotic Medicines Have Potential to Address Unmet Need with Mechanisms Not Possible with Other Modalities

- *Consuming Toxins*: Unlike other therapeutic approaches, Synthetic Biotic medicines can be programmed with a unique mechanistic activity. In our initial internal metabolic programs we are engineering Synthetic Biotic medicines with entire pathways designed to degrade or “consume” toxic metabolites. We believe using a consumption pathway is advantageous compared to gene, RNA or enzyme replacement therapies that are limited to targeting a single gene or protein defect and may require several unique drug products to address genetically heterogeneous patient populations. By compensating with an entire pathway delivered in probiotic bacteria Synthetic Biotic medicines may provide a safe, therapeutic solution to broader disease populations as a single engineered therapeutic. Our SYN1618 program was designed to consume Phe and was shown to be active in PKU patients. The experience and lessons learned from this program are being applied to our additional preclinical programs.
- *Production of Therapeutic Molecules*: Synthetic Biotic medicines can also be programmed to produce beneficial molecules. SYN1891, our first oncology candidate is engineered to produce a beneficial molecule that has the potential to shift the tumor microenvironment of the immune system towards anti-tumor activity.
- *Combinations of Mechanisms*: Currently many complex diseases such as inflammatory and autoimmune indications and cancer require that patients are treated systemically with a combination of therapeutic agents such as cytokines, antibody and protein therapies, often resulting in poor tolerability, multiple adverse events and increased cost of therapy. Our approach is to leverage the adaptability of *E. coli* Nissle to enable the combination of multiple activities into one therapy, which therefore could have greater efficacy while avoiding the toxic negative impact of multiple systemic therapies. We believe that the potential to program the control of expression of one or more proteins represents a unique approach to targeted therapy. One example of a combination of effectors is SYN1618, which has been engineered to express two enzymes, phenylalanine ammonia lyase (PAL) and L-amino acid deaminase (LAAD) for the consumption of Phe. We have also developed approaches to enhance the secretion of protein effectors to the extracellular environment. In oncology, our programs are being designed to produce effectors to promote immune system activity against a tumor. These activities may further be combined with mechanisms that target tumor metabolism. By incorporating multiple actions, Synthetic Biotic medicines have the potential to address multifactorial disease biology while reducing development costs associated with combining systemic therapies.

Synthetic Biotic Medicines Have Potential to Tune Efficacy in the Context of Disease

A key feature of our Synthetic Biotic platform is the ability to regulate the timing and amount of therapeutic effector produced via a suite of switches that can be controlled by different stimuli such as oxygen concentration, inflammatory compounds or small molecules. Thus, Synthetic Biotic therapies may be designed such that they can sense and respond to disease symptoms; they can be activated to produce the desired effect in a particular disease environment, such as sites of inflammation. For example, in the case of inflammatory conditions, Synthetic Biotic medicines may be programmed to detect inflammation and respond with the production and secretion of one or more anti-inflammatory molecules. This tuning has the potential to increase the therapeutic window by increasing the margin between the level of medicine needed for efficacy relative to the risk of systemic toxic side effects. Our vision is for Synthetic Biotic medicines to be able to sense and respond to the disease context to provide the right therapy at the right time and site.

Synthetic Biotic Medicines Provide Local Therapeutic Delivery to Reduce Safety Risk

We believe that when delivered locally, Synthetic Biotic medicines have the potential to avoid the risks of dose-limiting side effects often associated with systemic therapies, especially when combinations of systemic therapies are required. Our Synthetic Biotic programs for metabolic diseases are designed to be dosed orally, and act locally while transiting through the gut and, as a consequence, decrease toxic metabolite levels in the blood, thereby providing a systemic therapeutic benefit to the patient. This approach is well suited to regulate the amount of a metabolic byproduct in a patient’s body, particularly when there is unconstrained metabolite flux between the systemic circulation and the gut. Given the potential for chronic oral dosing, Synthetic Biotic medicines may have benefits in terms of dose prediction and reversibility of activity.

Synthetic Biotic Medicines are Rationally Designed to Achieve Predictable Drug-like Properties

We have demonstrated the ability to move a program from concept to clinical development in as little as three years for our lead programs. Features of our Synthetic Biotic platform enable a highly efficient drug discovery and development process and have the potential to advance product candidates more rapidly and efficiently than is typically possible with other novel or emerging modalities. These include:

- **Single Strain as Safe Chassis.** There are several benefits of employing a single, safe and well-characterized probiotic bacterium such as *E. coli* Nissle as the background chassis. First, because our lead programs are based on *E. coli* Nissle, experience can be leveraged broadly across the portfolio, further optimizing the efficiency and reproducibility of discovery, development and manufacturing efforts. Next, the non-colonizing nature of *E. coli* Nissle can be combined with engineering approaches to optimize safety in terms of impact on the patient and the environment. *E. coli* Nissle can be engineered to require a specific exogenous nutrient supplement for growth, which limits the ability to replicate in the human body and environment. By controlling replication, we can control the number of cells being administered to a patient, which limits patient-to-patient variability. Also, dependence on an essential nutritional supplement not available in the environment reduces biocontainment risk. Moreover, the risk of a Synthetic Biotic medicine to the environment is further limited given that it is disadvantaged in terms of fitness due to its modifications.
- **Predictive Pharmacology and Biomarkers.** Synthetic Biotic programs are designed to achieve a target activity, and the platform supports an iterative design-build-test cycle to improve performance for achieving this target. For example, Synthetic Biotic programs can be optimized by including multiple copies or regulated control of certain genes, by adding transporters for particular substrates or by optimizing enzymes for basic bacterial metabolism. These tools enable rational and iterative engineering cycles in the discovery phase.

Biomarkers as indicators of mechanistic and clinical activity may also be engineered into Synthetic Biotic medicines from the beginning to drive optimization and decision-making. By assessing the activities of our Synthetic Biotic programs in *in vitro* and *in vivo* preclinical models, we can model activity in humans. As we progress through clinical studies, we expect our predictive pharmacology models will be further refined to inform dosing and development decisions for our additional programs.

- **Stability and Manufacturing.** Our lead Synthetic Biotic programs have advanced the platform by defining manufacturing processes that can be used for the entire portfolio. Our use of synthetic biology switches permits the precise control of engineered metabolic pathway activation. We use switches to suppress effector activity during manufacturing, enabling development of reproducible processes for generation of biomass and robust, cost-efficient scale up of product candidates.

Manufacturing efforts have demonstrated reproducibility, yield and stability during small, medium and Phase 1 clinical-scale campaigns where we have developed and executed processes to manufacture 3,000 to 5,000 doses of active drug. In December 2018, we entered into an agreement to lease GMP clean-room space from the Azzur Group, LLC. The agreement has expanded our manufacturing capabilities to enable in-house manufacturing of liquid and solid formulations for mid-stage clinical trials of our orally administered and intratumorally administered Synthetic Biotic medicines.

Our Product Pipeline

Approach to Selection of Therapeutic Area

We believe that our Synthetic Biotic platform has potential to address both metabolic and immune-mediated diseases and we are evaluating these medicines at different sites of action via different routes of administration, either orally or via injection. Our decision to focus initially on metabolic disease is based on the potential of the Synthetic Biotic platform to uniquely address conditions in which there is: (1) unmet medical need with (2) well understood biology that is (3) based on an imbalance of a metabolite that can be consumed by our strains and (4) where that metabolite is available within or originates from the gut lumen. Additional considerations include the availability of animal models, relevant biomarkers and feasible clinical development paths. Our initial clinical and pre-clinical programs have been focused on certain rare inherited or acquired metabolic diseases that share these characteristics. When delivered orally, our Synthetic Biotic medicines are designed to act from the gut to compensate for the dysfunctional metabolic pathway with the intended consequence of reducing systemic levels of the toxic metabolites. We believe that clinical success in these programs will enable us to demonstrate the potential of our oral Synthetic Biotic medicines to address metabolic dysfunction, while bringing meaningful change to lives of patients suffering from these debilitating conditions. Our lead therapeutic program for metabolic disease is SYN1618 being developed for the treatment of PKU. Our early-stage metabolic pipeline includes preclinical-stage product candidates for rare metabolic and GI tract diseases, including MSUD and enteric hyperoxaluria.

We are leveraging our proprietary technology platform to develop Synthetic Biotic medicines to treat additional diseases, including metabolic diseases, inflammation and cancer. We have a clinical stage program in oncology that capitalizes on the natural immunostimulatory characteristic of our bacterial chassis, and we have used a rational approach to engineer the bacterium to produce specific effectors to stimulate the innate and adaptive arms of the immune system. We have generated other strains that have been engineered to produce effectors designed to alter the tumor microenvironment potentially enabling us to select combinations of relevant mechanisms and treatments to address specific tumor types.

Our Initial Programs: Overview of Metabolic Diseases

There are a number of metabolic diseases characterized by a dysfunctional metabolic pathway that causes a toxic accumulation of a metabolite which results in deleterious health consequences. In a subset of these diseases, the toxic metabolite originates in the gut or is available in the gut. Our Synthetic Biotic medicines can be engineered to consume such metabolites with the intended consequence of reducing systemic levels for therapeutic benefit. Although in some cases diet modification can be beneficial, high unmet medical need remains as there are few current therapeutic treatments for these diseases.

Rare Metabolic Diseases

Patients with rare metabolic diseases lack certain enzymes that are responsible for metabolizing commonly occurring byproducts of digestion. The absence of these enzymes is caused by either a genetic mutation characterized by a dysfunctional metabolic pathway including PKU and MSUD or organ dysfunction, such as enteric hyperoxaluria. In patients with such diseases, byproducts can accumulate to toxic levels in the gut and systemically throughout the body to cause serious health consequences, including irreversible neurological dysfunction.

While there are hundreds of conditions that fall into this class, individual disorders are considered orphan diseases, with each disease affecting fewer than 200,000 patients in the United States and fewer than five per 10,000 people in the European Union. This includes amino acid metabolism disorders such as PKU and MSUD.

SYNB1618 for PKU

PKU is an inherited metabolic disease caused by a genetic defect in the gene phenylalanine hydroxylase (PAH) leading to Phe accumulation in the blood and brain, where it is neurotoxic and can lead to neurological deficits and even death. Current disease management of PKU involves dietary protein restriction with the consumption of phenylalanine-free protein supplements. There are currently two approved medications for treatment of PKU:

- Kuvan® (sapropterin dihydrochloride), an oral medication that is indicated for a subgroup of patients who have some residual PAH activity and does not eliminate the need for ongoing dietary management.
- Palynziq™ (pegvaliase-pqpz), an injectable, pegylated, bacterial enzyme (phenylalanine ammonia-lyase or PAL) that metabolizes Phe and that is indicated for treatment of adult patients.

Despite recommendations supporting life-long control of Phe levels, compliance is challenging due to the highly restrictive nature of the diet, putting patients at risk for cognitive and psychiatric disease and supporting the need for novel treatment approaches.

Our Synthetic Biotic platform is well-suited to complement the missing enzyme function in PKU patients by providing alternative metabolic pathways to consume Phe. SYNB1618 is designed to remove excess Phe from the blood by transforming it into non-toxic metabolites. The FDA granted SYNB1618 orphan drug designation for PKU in October 2017 and Fast Track designation in April 2018.

Overview of PKU

Phe is an essential amino acid that enters the body primarily through dietary protein and can be toxic if not sufficiently broken down and eliminated. The metabolism of Phe by the liver is dependent on adequate function of the liver enzyme PAH and the cofactor tetrahydrobiopterin (BH4) necessary for its activity. When the PAH gene is mutated and/or the production of BH4 is blocked, Phe cannot be sufficiently broken down and accumulates to toxic levels (i.e., hyperphenylalaninemia), which can cause irreversible brain damage. PKU is an inherited metabolic disease that presents as a severe form of hyperphenylalaninemia.

The disease course of PKU typically involves worsening neurological function that begins in infancy or early childhood. The clinical manifestations vary depending on severity of the enzyme mutation, the time of diagnosis and treatment initiation, and compliance. Symptoms may be extensive, such as severe cognitive impairment, or they may reflect more moderate neurocognitive or physical issues, such as below average intelligence, behavioral or mood disorders, memory loss, difficulty concentrating, decreased motor function, eczema, body odor, and tremors or seizures. A woman with PKU who becomes pregnant could develop maternal PKU if her diet is not strictly controlled, and there is a risk that the baby will be born with one or more birth defects such as cognitive impairment, microcephaly or congenital heart disease.

Based on the success of newborn screening efforts that began in developed countries in the 1960s, it is believed that nearly all PKU patients under the age of 40 have been diagnosed at birth. The National PKU Alliance estimates that in the United States there are currently 16,500 people living with PKU and it is estimated that there are 50,000 patients worldwide.

Currently, management of PKU requires a heavily modified diet that restricts protein intake, combined with essential amino acid and vitamin supplementation. Special medical foods, including phenylalanine-free protein formula, provide patients with dietary protein and fulfill other nutrient needs. However, it is challenging for most PKU patients to adhere to the restricted diet to the level that provides the necessary control of Phe levels even with the efforts of supportive family and social networks. Patients often have trouble adhering to the diet, with particular challenges arising during times of increasing independence during adolescence. Furthermore, access to low protein foods can be challenging, as they are costlier and less nutritious than their higher protein, non-modified counterparts.

Kuvan® (sapropterin dihydrochloride) was the first drug approved for the treatment of PKU in 2007. It is indicated for the reduction of blood phenylalanine in patients with hyperphenylalaninemia with residual PAH activity as it is a synthetic form of the BH4 cofactor. Oral administration of Kuvan, along with protein restriction, has lowered phenylalanine levels in patients who have residual PAH activity and/or mild forms of the disease, which accounts for approximately 20-50% of the PKU population. However, Kuvan does not eliminate the need for ongoing dietary management in all patients. Large neutral amino acids have also demonstrated activity in blocking absorption of excess phenylalanine by the intestines and brain but are currently only administered in adolescents and adults.

Palynziq™ (pegvaliase-pqpz), a pegylated form of recombinant phenylalanine ammonia lyase (PAL), an enzyme that metabolizes phenylalanine but does not require cofactor activity, was approved by the FDA in 2018. While daily Palynziq injections have been proven to lower phenylalanine levels, many patients experience injection site reactions and/or develop antibodies to the product. A Black Box warning of a risk of anaphylaxis is included on the Palynziq label and Palynziq is currently only indicated for adult patients. Other therapeutics in early development include various gene therapy approaches, modified cell therapies and a modified orally delivered enzyme replacement therapy.

Despite recent improvements in PKU therapy, patients continue to suffer from poor outcomes. Even patients who are diagnosed and treated early have increased risk of neurocognitive abnormalities and psychiatric complications and are burdened by the life-long struggle to comply with strict dietary modifications. Available drug therapies demonstrate limited effectiveness, are accompanied by immunologic and other toxicities, and may still require patients to maintain a heavily restricted diet. We believe a truly transformative therapy would be orally dosed and provide sustained, safe concentrations of phenylalanine while enabling a normal or only moderately restricted diet. We believe that a Synthetic Biotic medicine could be an effective oral therapeutic that acts from the gut to consume excess Phe with the consequent effect of reducing levels in the blood without the need for severe Phe restriction or risk of systemic toxicities.

SYNB1618 Design

SYNB1618 is a strain of *E. coli* Nissle that we have engineered to express synthetic pathways for transporting and metabolizing Phe in patients with PKU following oral administration. SYNB1618 was designed to compensate for the missing enzyme function in patients with PKU with complementary pathways to reduce phenylalanine levels in the gut and, as a consequence, in the systemic circulation.

In designing SYNB1618, we integrated genes, including a form of the PAL enzyme that converts Phe to the non-toxic byproduct *trans* cinnamic acid (TCA), which is then converted in the liver to hippuric acid (HA) and excreted in the urine. TCA and HA function as useful biomarkers of SYNB1618 activity *in vivo*. SYNB1618 has also been engineered to express a second Phe-consuming pathway, L-amino acid deaminase (LAAD) that results in the production of another non-toxic product, phenylpyruvate (PP). A detailed description of the engineering of SYNB1618 and data from preclinical studies in an animal model of disease and healthy non-human primates was published in September 2018 (Nat. Biotechnol. 36, 857–864 (2018)).

SYNB1618 Nonclinical Program

Preclinical Efficacy Studies

In vivo studies in a mouse model of PKU (*enu2*^{-/-}) demonstrated that urinary HA concentrations increased in a dose-dependent fashion in SYNB1618-treated mice compared to mice treated with an unengineered *E. coli* Nissle control that did not have the phenylalanine degradation pathway. We also observed that subcutaneous injection of mice on a Phe-restricted diet with phenylalanine resulted in a rapid increase in blood phenylalanine concentrations. The increase associated with this phenylalanine challenge was significantly blunted upon oral administration of SYNB1618 compared to administration of the non-engineered control strain. Similar data were generated with SYNB1618 in healthy non-human primates. With increasing oral doses of SYNB1618, we observed increasing levels of plasma TCA and urinary HA demonstrating that SYNB1618 is functional in the primate gut. Taken together, these data demonstrate that SYNB1618 has activity in the GI tract and can decrease blood Phe levels by degradation of recirculating phenylalanine, as well as dietary Phe. A detailed description of the engineering of SYNB1618 and data from preclinical studies in an animal model of disease and healthy non-human primates was published in September 2018 (Nat. Biotechnol. 36, 857–864 (2018)).

SYNB1618 Clinical Development Plan

In April 2018, we initiated a Phase 1/2a, randomized, double-blinded, placebo-controlled study to evaluate the safety, tolerability, and gastrointestinal clearance of an early liquid formulation of SYNB1618. We treated healthy adult volunteers with single- or multiple-ascending doses of SYNB1618 and, having identified an MTD, a small cohort of PKU patients were treated with SYNB1618 as a single dose and as multiple doses.

Primary endpoints of the study were safety, tolerability and identification of a suitable dose to evaluate in patients with PKU. In addition, exploratory endpoints were designed to evaluate the pharmacodynamic effects of SYNB1618, including production of previously identified biomarkers related to SYNB1618 activity, TCA in plasma and HA in urine, and to provide mechanistic and clinical insights in both healthy volunteers and patients with PKU.

Fifty-six healthy volunteers were dosed orally with either SYNB1618 or placebo (ratio three to one), including 24 in six cohorts in the SAD portion of the study and 32 subjects in three cohorts of the MAD portion of the trial. In September 2017, we announced top-line data demonstrating that in healthy volunteers SYNB1618 was safe and well tolerated at doses up to 2×10^{11} CFU three times a day for seven days. Higher doses were associated with mild to moderate gastrointestinal symptoms, mainly nausea and vomiting. The data also demonstrated proof-of-mechanism for SYNB1618.

During the treatment part of the study, subjects were housed in a clinical unit and provided a defined diet. The activity of SYNB1618 was evaluated in fasted subjects in both the SAD and MAD cohorts after administration of a standardized breakfast drink containing a defined amount of protein. At one dose level in the SAD portion of the study, solid food containing an equivalent amount of protein was substituted for the liquid meal. In addition, a labeled Phe tracer (D5-Phe) was orally administered. Blood and urine were collected over a subsequent six-hour period and several metabolites were measured including Phe and SYNB1618-specific biomarkers of Phe metabolism, TCA in blood and HA in urine. This was conducted in the SAD cohorts on the day of dosing and in the MAD cohorts on Day -1 (baseline) and Day 7 (the last day of dosing).

A statistically significant dose-dependent increase in both plasma TCA and urinary HA was observed in SYNB1618-treated subjects but not in those treated with placebo. Production of metabolites from Phe administered as a free amino acid was similar to Phe administered as whole protein. In addition, production of metabolites was similar whether the protein was administered as a liquid or as a solid meal. In healthy volunteers, who all have normal Phe metabolism, there was no impact on blood Phe levels. All healthy volunteers enrolled in the study cleared SYNB1618 from their GI tracts within the expected timeframe.

In July 2019, we announced positive top-line clinical data from the patient cohorts of the Phase 1/2a study of the liquid formulation in which 14 subjects were treated with either SYNB1618 or placebo (3:1) with four treated with a single dose (7×10^{10}) and 10 with multiple doses. The primary objectives were to evaluate safety and tolerability of the early liquid formulation in patients. Exploratory outcomes were related to the assessment of the pharmacodynamic effects of SYNB1618, including measurement of previously identified biomarkers, TCA and HA, related to SYNB1618's engineered ability to consume Phe. A statistically significant increase in these biomarkers of SYNB1618 activity was observed in SYNB1618-treated subjects but not in those treated with placebo.

Based on the data from the Phase 1/2a study, which demonstrated that SYNB1618 was able to consume equivalent amounts of Phe in the GI-tract in both PKU patients and healthy volunteers, we studied a solid formulation of SYNB1618 in a bridging study in healthy volunteers. This study was designed to evaluate safety and tolerability and Phe-consuming activity, as determined by TCA and HA production, compared to the early liquid formulation. In December 2019, we announced that the solid formulation of SYNB1618 was better tolerated than the liquid and identified a maximum tolerated dose of 2×10^{12} live cells (5.3×10^{11} colony forming units, or CFUs). The study further demonstrated that a dose ramp improved SYNB1618 tolerability and that pH buffering was required for maximum Phe-consuming activity of the strain.

SYNB1618 Upcoming Clinical Milestones

In the first half of 2020, we expect to initiate a Phase 2 clinical trial of the solid formulation of SYNB1618 in patients with PKU to evaluate its potential for Phe-lowering and to confirm pharmacodynamic and pre-clinical modeling.

Synthetic Biotic Program for MSUD

MSUD is a rare metabolic disease that was first described in the 1950s as an inherited progressive neurological degenerative disorder. Patients with this disease have mutations in one of the protein subunits of the mitochondrial multi-enzyme complex called branched-chain alpha-ketoacid dehydrogenase. These mutations cause the patients to accumulate high levels of the branched chain amino acids (BCAA) leucine, isoleucine and valine that are neurotoxic and can lead to severe neurological pathologies characterized by brain edema, seizure, spasticity and respiratory irregularities that may result in death. The MSUD name derives from the strong maple syrup odor in the urine of these patients. It is difficult to estimate the prevalence of this rare indication given that there have been few longitudinal studies. However, based on estimates of the live birth rate of MSUD of 1:185,000 and applying assumptions to account for mortality and survival rates, it is estimated that there may be approximately 1,500 MSUD patients in the United States, or over 3,000 patients worldwide.

Currently available treatments for MSUD are inadequate for the long-term management of the disorder and have severe limitations. A low protein/BCAA-restricted diet with micronutrient and vitamin supplementation as necessary is the widely accepted long-term disease management strategy. However, BCAA-intake restrictions can be problematic since these amino acids are also essential nutrients that can only be acquired through diet and are necessary for critical metabolic activities such as protein synthesis. Even with proper monitoring and patient compliance, branched chain amino acid dietary restrictions result in a high incidence of mental retardation and mortality. MSUD can be cured by liver transplantation; however, limited availability of donor organs, costs, and the need to rely on life-long immunosuppressant therapy are limiting. Therefore, there is significant unmet need for an effective, reliable, and/or long-term treatment involving the catabolism of branched chain amino acids.

We have engineered Synthetic Biotic medicines to modulate the expression of BCAA transporters and BCAA-degrading enzymes. Results *in vitro* demonstrate the efficient degradation of BCAAs into branched-chain alcohols that can then be further metabolized and eliminated from the body. In preliminary studies in a mouse model of MSUD, the oral delivery of the Synthetic Biotic strain suppressed the increase in blood BCAA levels induced by a high-protein diet. This strain also blunted the elevation of blood leucine in non-human primates orally administered a high protein load. Based on the *in vivo* therapeutic effects observed, we intend to select a Synthetic Biotic lead candidate and advance it into IND-enabling studies as a potential therapy for MSUD patients.

Synthetic Biotic Medicines for Other Metabolic Disorders with High Unmet Need

The strain design and engineering, translational research, clinical and regulatory planning and scalable manufacturing of our PKU program has informed development of future clinical candidates. As we have proof of clinical activity of our PKU strain, additional programs with similar mechanisms can be developed leveraging our learnings to date. Additional programs have been selected based on our expertise discovering and developing Synthetic Biotic medicines that consume a toxic metabolite known to be associated with the relevant clinical endpoint and to be accessible in the GI tract.

Synthetic Biotic Program for Enteric Hyperoxaluria

Humans lack the capacity to digest oxalate, a compound commonly found in plants, and primarily depend on excretion via the urine to eliminate it from the body. Hyperoxaluria occurs when there are significantly elevated oxalate levels in the urine due to either overproduction of oxalate by the liver from a genetic defect, called primary hyperoxaluria, or from over-absorption of oxalate from the diet, called secondary hyperoxaluria. Secondary hyperoxaluria can be further characterized as enteric, resulting from certain intestinal diseases, including Crohn's disease and short bowel syndrome, and surgical procedures such as bariatric weight-loss surgery. The disorder can lead to a range of conditions of increasing severity from recurrent kidney stones and urinary tract infections to chronic kidney disease and, potentially, the need for a kidney transplant. There are an estimated 250,000 patients with enteric hyperoxaluria in the United States, and more than 80,000 patients who experience recurrent kidney stones due to hyperoxaluria.

There is no approved pharmacologic therapy for the reduction of urinary oxalate excretion in patients with hyperoxaluria, either primary or secondary. Existing treatment options for enteric hyperoxaluria generally are non-specific and include high fluid intake to increase urine output to more than two to three liters per day, a diet low in salt and oxalate, oral citrate and/or calcium and/or magnesium supplementation. Despite these strategies, many patients continue to experience hyperoxaluria with recurrent kidney stones and continued risk for long-term kidney damage.

We have engineered Synthetic Biotic medicines that are designed to degrade oxalate in the gut to prevent its absorption by the body. We have demonstrated efficient oxalate degradation *in vitro* and in preliminary studies in mice the oral delivery of a prototype Synthetic Biotic strain led to a reduction of oxalate in the urine of treated animals. Based on the *in vivo* therapeutic effects observed, we intend to optimize and select a Synthetic Biotic lead candidate and advance it into IND-enabling studies as a potential therapy for patients with enteric hyperoxaluria.

Our Synthetic Biotic Medicines for Immuno-Oncology (IO)

We believe boosting the body's immune response against tumor cells is one of the most promising advances in the treatment of cancer. The so-called "hot tumors," those with robust immune cell infiltration, specifically by T cells, have responded well to immunotherapies such as PD-1 and CTLA-4 checkpoint inhibitors. Checkpoint inhibitors work by blocking pathways that inhibit T cells thus enabling them to recognize and destroy the tumor. Checkpoint inhibitors have significantly extended the lives of patients with several cancer types and, in some cases, have resulted in complete clinical responses. However, a large proportion of tumors are "cold" (i.e., they lack T cells), and respond poorly to current immunotherapy.

Our goal is to leverage our Synthetic Biotic platform to design living medicines that can engage multiple immunomodulatory pathways to enhance tumor inflammation and promote robust T cell responses enabling broad tumor response and remission. We believe that such medicines have the potential to expand the patient population that could benefit from immunotherapy. Our initial approach is designed to deliver robust therapeutic combinations directly to the tumors, without significant systemic exposure. Synthetic Biotic medicines are also being developed to be administered by an intra-tumor injection or, in the case of GI cancers, by oral administration and can be engineered to perform three types of functions: metabolic consumption of an immune-suppressive metabolite, production of an immuno-activating metabolite, secretion or bacterial surface display of proteins (cytokines, chemokines, receptor ligands and single chain antibody domains, known as scFv).

We believe our Synthetic Biotic platform can be deployed in a rational, mechanistic way, and can deliver multiple validated mechanisms to elicit specific immune responses in the tumor microenvironment. Lack of effective presentation of tumor-specific antigens to T cells is recognized as a significant limitation to the initiation of immune responses in tumors. Our lead clinical program in immuno-oncology (SYNB1891) is an approach to activate the immune system and enhance T cell priming, capitalizing on the innate stimulatory effect of the *E.coli* Nissle chassis and supplementing this with the directed delivery of an additional immune-stimulatory factor. SYNB1891 is an engineered *E.coli* Nissle strain designed to produce, but not secrete, a STING agonist. The STING pathway plays a critical role in the control of tumor growth by initiating an antitumor immune response and driving tumor regression. SYNB1891 can be delivered directly into the tumor, where it is engulfed by antigen presenting cells (APCs), enabling its localized site of action in the tumor microenvironment. The approach of using intratumoral injection elicits STING activation in the tumor, but not systemically, potentially decreasing the risk of adverse events that may arise from the production of systemic interferon. Moreover, as the STING agonist it produces is not secreted but is released directly into the APCs, immune cells such as T cells that might be negatively impacted by exposure are spared.

SYNB1891 being evaluated in a Phase 1 open-label, multicenter, dose escalation trial in patients with refractory solid tumors and lymphoma. The study's primary objectives are to evaluate safety and tolerability of escalating doses of intratumorally administered SYNB1891 as a monotherapy. Once a maximum tolerated dose is established, patients will receive escalating dose levels of SYNB1891 in combination with the PD-L1-blocking checkpoint inhibitor, atezolizumab, (Tecentriq®) to establish a recommended Phase 2 dose for the combination regimen. We expect to have data from the monotherapy arm of the study in 2020.

Our Synthetic Biotic Medicines for Inflammatory Bowel Disease (IBD)

Among immune conditions, IBD is particularly attractive for our Synthetic Biotic platform, as it allows us to leverage knowledge and expertise gleaned from our oral metabolic programs to develop living medicines that can act locally at the site of disease in the gut. Because our approach is based on local delivery to the site of inflammation and not on systemic administration, we anticipate that our Synthetic Biotic medicines may offer an attractive safety profile in this setting. In 2015, we entered into a multi-year global collaboration with AbbVie focused on the discovery and development of Synthetic Biotic medicines for the treatment of IBD. In June 2017 and September 2018, we announced the achievement of the first and second milestones, respectively in this collaboration.

IBD is a group of diseases characterized by significant local inflammation in the GI tract typically driven by T cells, activated macrophages and compromised function of the epithelial barrier. IBD pathogenesis is linked to both genetic and environmental factors and may be caused by altered interactions between gut microbes and the intestinal immune system. Current approaches to treat IBD are focused on therapeutics that modulate the immune system and suppress inflammation. These therapies include steroids, such as prednisone, and tumor necrosis factor inhibitors, such as Humira® (adalimumab). However, these approaches are associated with

systemic immunosuppression, which includes greater susceptibility to infectious diseases and cancer. According to the CDC, in 2015 an estimated 3.0 million adults in the United States are reported as being diagnosed with IBD.

Compromised gut barrier function also plays a central role in autoimmune diseases pathogenesis. A single layer of epithelial cells separates the luminal contents of the gut from the host circulatory system and the immune cells in the body. Disrupting the epithelial layer can lead to pathological exposure of foreign antigens from the lumen resulting in increased susceptibility to autoimmune disorders. The interplay between the gut microbiota and the host is thought to play a key role in the maintenance of the epithelial barrier as well as homeostatic immunity. Thus, enhancing barrier function and reducing inflammation in the gastrointestinal tract are potential therapeutic mechanisms for the treatment or prevention of autoimmune disorders. Our Synthetic Biotic platform allows for the effective programming of *E. coli* Nissle to execute these functions, including the metabolic production of factors such as short chain fatty acids to enhance barrier function, and secreting proteins, such as immunomodulatory cytokines.

Collaboration Agreements

To accelerate the development and commercialization of Synthetic Biotic medicines to patients, we have formed, and intend to seek other opportunities to form, strategic alliances with collaborators that can expand our pipeline of therapeutic development and product candidates. We also work, and intend to seek additional opportunities to work, with multiple academic, research and translational medicine organizations and entities to deepen our understanding and development of living medicines with the potential to treat disease and disorders.

Ginkgo Bioworks

In June 2019 we entered into an agreement with Ginkgo Bioworks (“Ginkgo”). The agreement provided an \$80.0 million equity investment at a premium in Synlogic by Ginkgo and entry into a long-term strategic platform collaboration to expand and accelerate the development of Synlogic’s pipeline of Synthetic Biotic medicines. We are using Ginkgo’s cell programming platform to build and test thousands of microbial strains to accelerate progression of early preclinical leads to drug candidates optimized for further clinical development.

As part of the agreement, Ginkgo purchased 6,340,771 shares of our common stock and accompanying Pre-Funded warrants (the “Pre-Funded Warrants”) to purchase up to 2,548,117 shares of our common stock, at a combined price of \$9.00 per share and Pre-Funded Warrant. Gross proceeds were approximately \$80 million. Under the agreement, we made a prepayment to Ginkgo of \$30.0 million for its foundry services that are being provided to us over an initial term of five years which can be extended. Upon the expiration of such initial term and, if applicable, such additional period, any portion of our prepayment that has not been used to purchase services from Ginkgo will be retained by Ginkgo. We have exclusive rights to any Synthetic Biotic medicines that we develop as part of the collaboration and to intellectual property covering such products.

AbbVie

In July 2015, we entered into a license agreement with our subsidiary Synlogic IBDCo, Inc. (IBDCo) and an Agreement and Plan of Merger with AbbVie (together, the AbbVie Agreements) to collaborate on the discovery and development of Synthetic Biotic medicines for the treatment of IBD. The AbbVie Agreements provide AbbVie with an exclusive option to acquire IBDCo, which would then have an exclusive worldwide license to develop and commercialize up to three specified Synthetic Biotic medicines for the treatment of IBD.

Under the terms of the collaboration with AbbVie, we have the responsibility to discover, characterize and optimize one lead Synthetic Biotic product candidate to the point of an IND-enabling package, together with two backup product candidates, through a research and development program covering a limited number of effectors that modulate the IBD pathophysiology. The multi-year collaboration combines AbbVie’s expertise in inflammatory diseases with our expertise in synthetic biology and metabolic engineering. AbbVie agreed to pay IBDCo an upfront payment of \$2.0 million, received in December 2015, and up to \$16.5 million upon the achievement of certain research milestones.

In May 2017, IBDCo achieved the first of these research milestones under the AbbVie Agreements for which it received \$2.0 million. On September 27, 2018, AbbVie and the Company signed an amendment (the Second Amendment) to the AbbVie Agreements. The Second Amendment clarified the requirements necessary to complete the second phase which resulted in additional time and effort in the second phase of the research plan. Additionally, the Second Amendment split the next milestone payment under the AbbVie Agreements into two payments: a milestone payment of \$2.0 million earned by the Company upon execution of the Second Amendment and the remaining milestone payment of \$2.5 million, due upon the successful achievement of specified research

and pre-clinical events and the advancement to the third phase of the research plan. The Company achieved the remaining milestone of \$2.5 million under the Second Amendment on February 28, 2019, and advanced to the third phase of the research plan.

On December 18, 2018, AbbVie and the Company signed an amendment (the Third Amendment) to the AbbVie Agreements. The Third Amendment provides that in the event AbbVie determines that it is necessary to enter into license agreements with certain third parties in a particular country or other jurisdiction which, but for such license, would be infringed by the manufacture, use or sale of any product governed by the AbbVie Agreements, AbbVie would be entitled to deduct certain expenses related to such license agreements from particular payments made to the Company.

If AbbVie accepts our IND-enabling package covering the lead Synthetic Biotic product candidate, AbbVie may exercise its exclusive option to acquire IBDCo, which would house the lead and two backup product candidates. If this option is exercised, AbbVie would pay us an option exercise fee upon the closing of the IBDCo merger and we would be eligible to receive future development, regulatory and commercial milestone payments, and low single digit royalties on sales of the Synthetic Biotic medicines. In addition, AbbVie would then assume full control of all further clinical development and commercial activity, including responsibility for all expenses and decisions.

Potential Future Collaborations

We believe strategic partnerships can be important drivers for accelerating our goal of developing Synthetic Biotic medicines, and we will continue to seek strategic alliances with collaborators who can help fund, develop and commercialize our novel therapeutic development and product candidates, particularly in large metabolic indications and immuno-oncology. As the potential application of our Synthetic Biotics platform is extremely broad, we also plan to continue to identify academic, research and translational medicine organizations and entities that can contribute expertise and resources to our programs, to allow us to more rapidly expand our impact to broader patient populations.

Intellectual Property and Technology Licenses

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 licensed from our collaborators or other third parties. Our policy is to seek to protect our proprietary position by, among other methods, filing patent applications in the United States and in certain jurisdictions outside of the United States related to our proprietary technology, inventions, improvements, and product candidates that are important to the development and implementation of our business. We also rely on trade secrets and know-how relating to our proprietary technology and product candidates, continuing innovation, and in-licensing opportunities to develop, strengthen, and maintain our proprietary position in the field of synthetic biology. We additionally rely on data exclusivity, market exclusivity, and patent term extensions when available, and 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 we are well positioned in terms of intellectual property because we:

- have built and expanded, and intend to continue expansion in, a broad worldwide portfolio of intellectual property, including patents and patent applications, in areas relevant to the development, manufacturing and formulation of human therapeutic products using live biotherapeutics based on synthetic biology;
- intend to take additional steps, where appropriate, to further protect our intellectual property rights, including, for example, through the use of copyright and trademark protection, as well as regulatory protection available via orphan drug designations, data exclusivity, market exclusivity and patent term extensions.

We believe our intellectual property portfolio provides broad coverage of our Synthetic Biotic platform and applicable disease-related technologies, which are directed to diseases and conditions associated with hyperphenylalanemia, other rare metabolic diseases and metabolic disorders, autoimmune and other inflammatory disorders and oncology. As of March 5, 2020, we had 130 Synlogic-owned patents and patent applications in U.S. and foreign jurisdictions, of which 8 have been issued or allowed.

Synlogic Intellectual Property

Disease-related applications

The disease-related applications in our intellectual property portfolio relate to certain pathological conditions including, but not limited to hyperammonemia, hyperphenylalaninemia, certain inherited metabolic diseases and conditions, metabolic disorders, diseases and conditions associated with an inflammatory state, diseases associated with gut inflammation, compromised gut mucosal barrier (leaky gut), and various autoimmune disorders as well as use in immuno-oncology and provide coverage for engineered bacteria having genetic circuitry designed to specifically address those conditions and the associated disease states. The intellectual property portfolio provides coverage for compositions directed to engineered bacterial strains, methods of making the bacterial strains and methods for treating diseases. Currently, intellectual property relating to this technology includes pending applications in U.S. and foreign jurisdictions, as well as several issued U.S. patents directed to composition of matter and pharmaceutical composition claims covering our clinical candidates. The patent term for our current IP has expiration dates ranging from December 2035 to January 2038, depending on the indication and excluding any patent term adjustments or extensions.

Platform Technology Applications

In addition to the disease-related technology, our intellectual property portfolio also includes applications directed to platform technologies developed internally by us. Exemplary platform technologies include bacterial chassis-related and genetic circuitry-related technological developments, including, for example, improvements in inducible gene regulation, control of bacterial cell growth, including auto-regulation thereof, and systems for importing metabolites, as well as production of therapeutic effectors. These platform technologies, and our intellectual property coverage thereof, are broadly applicable to our therapeutic Synthetic Biotic medicines.

General Considerations

Individual patents extend for varying periods of time, depending 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 are effective for 20 years from the earliest effective non-provisional filing date. In addition, in certain instances, a patent term can be extended to account for delays in prosecution at the U.S. Patent and Trademark Office (USPTO) and/or to recapture a portion of the term effectively lost as a result of the FDA regulatory review period. For regulatory delays, the restoration period cannot be longer than five years and the total patent term, including the restoration period, must not exceed 14 years following FDA approval. The duration of patents outside of the United States varies in accordance with provisions of applicable local law, but typically is also 20 years from the earliest effective non-provisional filing date. However, 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 the validity and enforceability of the patent.

The patent positions of companies like us are generally uncertain and involve complex legal and factual questions. No consistent policy regarding the scope of claims allowable in patents in the field of synthetic biology has emerged in the United States. The patent situation outside of the United States is even more uncertain. With respect to both licensed and company-owned intellectual property, 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 the future will be commercially useful in protecting our products and the methods used to manufacture those products. For additional risks, please see the section entitled “Risk Factors—Risks Related to Intellectual Property”.

Trademarks

Our registered trademark portfolio currently contains 16 registered trademarks, and 5 pending applications

Other

Generally, we seek to protect our technology and product candidates, in part, by entering into confidentiality agreements with those who have access to our confidential information, including employees, contractors, consultants, collaborators, and advisors. In some circumstances, we may rely on trade secrets to protect our technology. We seek to preserve the integrity and confidentiality of our proprietary technology, trade secrets 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. To the extent that company employees, contractors, consultants, collaborators, and advisors use intellectual property owned by others in their work for us, 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 products, please see the section entitled “Risk Factors—Risks Related to Intellectual Property”.

Regulatory Matters

Government Regulation and Product Approval

Government authorities in the United States, at the federal, state and local level, and other countries extensively regulate, among other things, the research, development, testing, manufacture, quality control, approval, labeling, packaging, storage, record keeping, promotion, advertising, distribution, marketing and export and import of products such as those we are developing. A new drug must be approved by the FDA through the NDA process and a new biologic must be approved by the FDA through the Biologics License Application (BLA), process before such products may be legally marketed in the United States.

U.S. Drug Development Process

In the United States, the FDA regulates drugs under the Federal Food, Drug, and Cosmetic Act (FDCA) and in the case of biologics, also under the Public Health Service Act (PHSA) and implementing regulations. Our product candidates will be regulated by the FDA as biologics. The process of obtaining regulatory approvals and the subsequent compliance with applicable federal, state, local, and foreign statutes and regulations require the expenditure of substantial time and financial resources. Failure to comply with the applicable U.S. requirements at any time during the product development process, approval process or after approval, may subject an applicant to administrative or judicial sanctions. These sanctions could include the FDA’s refusal to approve pending applications, withdrawal of an approval, license revocation, a clinical hold, warning letters, product recalls, product seizures, total or partial suspension of production or distribution, injunctions, fines, refusals of government contracts, restitution, disgorgement, or civil or criminal penalties. Any agency or judicial enforcement action could have a material adverse effect on us. The process required by the FDA before a biologic may be marketed in the United States generally involves the following:

- completion of required preclinical laboratory tests, animal studies and formulation studies performed in accordance with GLP and other applicable regulations;
- submission to the FDA of an investigational new drug application (IND) which must become effective before shipment of investigational product for human clinical trials may begin;
- approval by an independent institutional review board, or IRB, or ethics committee at each clinical trial site before each clinical trial may be initiated;
- performance of adequate and well-controlled human clinical trials performed in accordance with applicable IND regulations, GCP, and other clinical-trial related regulations to evaluate the safety and efficacy of the investigational product for each proposed indication;
- development and approval of a companion diagnostic device, if the FDA or the sponsor believes that its use is essential for the safe and effective use of a corresponding product;
- submission to the FDA of a BLA for marketing approval, including payment of application user fees;
- satisfactory completion of an FDA inspection of the manufacturing facility or facilities at which the biologic is produced to assess compliance with GMP to assure that the facilities, methods and controls are adequate to preserve the product’s identity, strength, quality and purity;
- potential FDA audit of the clinical trial sites to assure compliance with GCP and the integrity of the clinical data submitted in support of the BLA; and
- FDA review and approval of the BLA, including satisfactory completion of an FDA advisory committee review of the product candidate, where appropriate or if applicable, prior to any commercial marketing or sale of the product in the United States.

Once a pharmaceutical candidate is identified for development, it enters the preclinical testing stage. Preclinical tests include laboratory evaluations of product chemistry and formulation, animal toxicity and pharmacology studies to assess the potential for adverse events and in some cases to establish a rationale for therapeutic use. The conduct of preclinical studies is subject to federal regulations and requirements, including GLP regulations for safety/toxicology studies.

An IND sponsor must submit the results of the preclinical tests, together with manufacturing information and analytical data, to the FDA as part of the IND. In June 2016, the FDA issued an updated guidance for the industry entitled “Early Clinical Trials with

Live Biotherapeutic Products: Chemistry, Manufacturing and Control Information,” which included recommendations from the FDA regarding the chemistry, manufacturing and control information that should be included in an IND for early clinical trials with live biotherapeutic products. This Guidance reflects the FDA’s thinking on a topic at the time that it was issued and although it is not binding on the FDA or a sponsor, it provided us with additional information about what should be included in our IND. The sponsor will also include in the IND a protocol detailing, among other things, the objectives of the clinical trial, the parameters to be used in monitoring safety, and the effectiveness criteria to be evaluated, if a first phase study lends itself to an efficacy evaluation. Some long-term preclinical testing, such as animal tests of reproductive adverse events and carcinogenicity, may continue after an IND for an investigational drug candidate is submitted to the FDA and human clinical trials have been initiated. The IND automatically becomes effective 30 days after receipt by the FDA, unless the FDA, within the 30-day time period, places the clinical trial on a clinical hold. In such a case, the IND sponsor and the FDA must resolve any outstanding concerns before the clinical trial can begin. Clinical holds also may be imposed by the FDA at any time before or during clinical trials due to safety concerns about ongoing or proposed clinical trials or non-compliance with specific FDA requirements, and the trials may not begin or continue until the FDA notifies the sponsor that the hold has been lifted.

All clinical trials must be conducted under the supervision of one or more qualified investigators, and in accordance with GCP requirements. They must be conducted under protocols detailing the objectives of the trial, dosing procedures, subject selection and exclusion criteria and the safety and effectiveness criteria to be evaluated. Each protocol must be submitted to the FDA as part of the IND, and timely safety reports must be submitted to the FDA and the investigators for serious and unexpected adverse events. An institutional review board (IRB) at each institution participating in the clinical trial must review and approve each protocol before a clinical trial commences at that institution and must also approve the information regarding the trial and the consent form that must be provided to each trial subject or his or her legal representative, monitor the study until completed and otherwise comply with IRB rules and regulations. Study subjects must sign the IRB-approved informed consent form participating in a clinical trial.

In addition, an IRB representing each institution that is participating in the clinical trial must review and approve the plan for any clinical trial before it commences at that institution, and the IRB must conduct a continuing review and reapprove the trial at least annually. The IRB must review and approve, among other things, the trial protocol and informed consent information to be provided to clinical trial subjects. An IRB must operate in compliance with FDA regulations.

Human clinical trials are typically conducted in three sequential phases that may overlap or be combined:

- Phase 1: The product candidate is initially introduced into healthy human subjects and tested for safety, dosage tolerance, absorption, metabolism, distribution and excretion. In the case of some products for severe or life-threatening diseases, such as cancer, especially when the product may be too inherently toxic to ethically administer to healthy volunteers, the initial human testing is usually conducted in patients.
- Phase 2: This phase involves clinical trials in a limited patient population to identify possible adverse effects and safety risks, to preliminarily evaluate the efficacy of the product for specific targeted diseases and to determine dosage tolerance and optimal dosage.
- Phase 3: Larger clinical trials are undertaken to further evaluate dosage, clinical efficacy and safety in an expanded patient population, often at geographically dispersed clinical study sites. These clinical trials are intended to establish the overall risk: benefit ratio of the product candidate and provide, if appropriate, an adequate basis for product labeling. These trials may include comparisons with placebo and/or other comparator treatments. The duration of treatment is often extended to mimic the actual use of a product during marketing.

Post-approval trials, sometimes referred to as Phase 4, 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. In certain instances, the FDA may mandate the performance of Phase 4 clinical trials as a condition of approval of a BLA.

The FDA or the sponsor may suspend or terminate a clinical trial at any time on various grounds, including a finding that the research subjects or patients are being exposed to an unacceptable health risk. Similarly, an IRB can suspend or terminate approval of a clinical trial at its institution if the clinical trial is not being conducted in accordance with the clinical protocol, GMP or IRB requirements or if the drug has been associated with unexpected serious harm to patients. Additionally, some clinical trials are overseen by an independent group of qualified experts organized by the sponsor, known as a data safety monitoring board or committee. Depending on its charter, this group may determine whether a trial may move forward at designated check points based on access to certain data from the trial. Phase 1, Phase 2, and Phase 3 testing may not be completed successfully within any specified period, if at all.

During the development of a new biologic, sponsors have the opportunity to meet with the FDA at certain points. These points may be prior to submission of an IND, at the end of Phase 2, and before a BLA is submitted. Meetings at other times may be

requested. These meetings can provide an opportunity for the sponsor to share information about the data gathered to date, for the FDA to provide advice, and for the sponsor and the FDA to reach agreement on the next phase of development. Sponsors typically use the end of Phase 2 meeting to discuss their Phase 2 clinical results with the FDA and to present their plans for the pivotal Phase 3 clinical trial that they believe will support approval of the new biologic. If this type of discussion occurs, a sponsor may be able to request a Special Protocol Assessment (SPA), the purpose of which is to reach agreement with the FDA on the design of the Phase 3 clinical trial protocol design and analysis that will form the primary basis of an efficacy claim.

Concurrent with clinical trials, companies usually complete the additional animal studies that may be required for approval and must also develop additional information about the chemistry and physical characteristics of the biologic and finalize a process for manufacturing the product in commercial quantities in accordance with GMP requirements. The manufacturing process must be capable of consistently producing acceptable quality batches of the product candidate and, among other things the manufacturer must develop methods for testing the identity, strength, quality and purity of the final 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.

While the IND is active and before approval, progress reports must be submitted at least annually to the FDA, and written IND safety reports must be submitted to the FDA and investigators for serious and unexpected suspected adverse reactions, findings from other studies suggesting a significant risk to humans exposed to the same or similar drugs, findings from animal or in vitro testing suggesting a significant risk to humans, and any clinically important increased incidence of a serious suspected adverse reaction compared to that listed in the protocol or investigator brochure. The annual report is customarily submitted in the form of a Drug Safety Update Report (DSUR) which is accepted as being equivalent to an IND Annual Report and also meets requirements of the EU (European Union) and ICH (International Conference on Harmonization).

There are also requirements governing the reporting of ongoing clinical trials and completed trial results to public registries. Sponsors of most clinical trials of FDA-regulated products are required to register and disclose specified clinical trial information, which is publicly available at www.clinicaltrials.gov. Information related to the product, patient population, phase of investigation, trial sites and investigators and other aspects of the clinical trial is then made public as part of the registration. Sponsors are also obligated to submit the results of their clinical trials after completion, within a specified time frame. Disclosure of the results of these trials can be delayed until the new product or new indication being studied has been approved. However, there are evolving rules and increasing requirements for publication of all trial related information, and data and other information from trials involving drugs that never garner approval will require disclosure. Failure to post results of clinical trials in a timely fashion is subject to daily fines and other potential penalties.

U.S. Review and Approval Processes

Assuming successful completion of the required clinical testing, the results of the nonclinical studies and clinical trials, along with detailed information relating to the product's chemistry, manufacturing, and controls, stability, quality control and product release procedures, proposed labeling, and other relevant information are submitted to the FDA as part of a BLA, requesting approval to market the product for one or more indications. The submission of a BLA is subject to the payment of a significant user fee (for example, for FY2020 this application fee exceeds \$2.9 million); although a waiver of such fee may be obtained under certain limited circumstances, including where the biologic has been designated as an orphan drug. The sponsor of an approved BLA is also subject to an annual program fee, currently more than \$300,000 per program. These fees are typically increased annually, but exemptions and waivers may be available under certain circumstances (such as a waiver for the first human drug application submitted by a qualifying small business and exemptions for orphan products).

Under the goals and policies agreed to by the FDA under the Prescription Drug User Fee Act, or PDUFA, for original BLAs, the FDA has ten months from the filing date in which to complete its initial review of a standard application and respond to the applicant, and six months from the filing date for an application with priority review. The FDA does not always meet its PDUFA goal dates, and the review process is often significantly extended by FDA requests for additional information or clarification and a sponsor's process to respond to such inquiries. This FDA review typically takes twelve months from the date the BLA is submitted to the FDA (for a standard review) and eight months from the date the BLA is submitted (for a "priority review") because the FDA has approximately two months, or 60 days, after BLA submission to make a "filing" decision.

The FDA reviews all BLAs submitted to ensure that they are sufficiently complete for substantive review before it accepts them for filing. The FDA may request additional information rather than accept a BLA for filing. In this event, the BLA must be resubmitted with the additional information. The resubmitted application also is 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 review process may be extended by the FDA for three additional months to consider new information or in the case of a clarification provided by the applicant to address an outstanding deficiency identified by the FDA following the original submission.

Before approving a BLA, the FDA will typically conduct a pre-approval inspection of the manufacturing facilities for the new product to determine whether the manufacturing processes and facilities comply with cGMPs. The FDA will not approve the product unless it determines that the manufacturing processes and facilities are in compliance with cGMP requirements and adequate to assure consistent production of the product within required specifications. The FDA also may inspect the sponsor and one or more clinical trial sites to assure compliance with GCP requirements and the integrity of the clinical data submitted to the FDA.

The FDA may refer any BLA including applications for novel biologic candidates which present difficult questions of safety or efficacy, to an advisory committee for review, evaluation and recommendation as to whether the application should be approved and under what conditions. The FDA is not bound by the recommendation of an advisory committee, but it considers such recommendations when making final decisions on approval. The approval process is lengthy and often difficult, and the FDA may refuse to approve a BLA if the applicable regulatory criteria are not satisfied or may require additional clinical or other data and information. Even if such data and information are submitted, the FDA may ultimately decide that the BLA does not satisfy the criteria for approval. Data obtained from clinical trials are not always conclusive and the FDA may interpret data differently than we interpret the same data. . After the FDA evaluates a BLA, it will issue an approval letter or a Complete Response Letter (CRL). An approval letter authorizes commercial marketing of the drug with prescribing information for specific indications. A CRL indicates that the review cycle of the application is complete and the application will not be approved in its present form. A CRL usually describes the specific deficiencies in the BLA identified by the FDA and may require additional clinical data, such as an additional pivotal Phase 3 trial or other significant and time-consuming requirements related to clinical trials, nonclinical studies or manufacturing. If a CRL is issued, the sponsor must resubmit the BLA, addressing all of the deficiencies identified in the letter, or withdraw the application. Even if such data and information are submitted, the FDA may decide that the BLA does not satisfy the criteria for approval. The FDA reviews a BLA to determine, among other things, whether the product is safe, pure and potent and the facility in which it is manufactured, processed, packed or held meets standards designed to assure the product's continued safety, purity and potency.

BLAs receive either standard or priority review. A drug representing a significant improvement in treatment, prevention or diagnosis of disease may receive priority review. Priority review for an original BLA should occur within six months from the date that the BLA is filed. In addition, products studied for their safety and effectiveness in treating serious or life threatening illnesses and that provide meaningful therapeutic benefit over existing treatments may receive accelerated approval and may be conditionally approved on the basis of adequate and well controlled clinical trials establishing that the drug product has an effect on a surrogate endpoint that is reasonably likely to predict clinical benefit or on the basis of an effect on a clinical endpoint other than survival or irreversible morbidity. As a condition of approval, the FDA may require that a sponsor of a drug receiving accelerated approval perform adequate and well controlled Phase 4 clinical trials. Priority review and accelerated approval do not change the standards for approval, but may expedite the approval process.

If a product receives regulatory approval, the approval is limited to the conditions of use (e.g., patient population, indication) described in the BLA, which could restrict the commercial value of the product. Further, depending on the specific risk(s) to be addressed, the FDA may require that contraindications, warnings or precautions be included in the product labeling, require a sponsor to conduct Phase 4 testing which involves clinical trials designed to further assess a drug's safety and effectiveness after BLA approval and may require testing and surveillance programs to monitor the safety of approved products which have been commercialized. The FDA may also place other conditions on approval including the requirement for a Risk Evaluation and Mitigation Strategy (REMS), to assure the safe use of the drug. If the FDA concludes a REMS is needed, the sponsor of the BLA must submit a proposed REMS. The FDA will not approve the BLA without an approved REMS, if required. A REMS could include medication guides, physician communication plans or elements to assure safe use, such as restricted distribution methods, patient registries and other risk minimization tools. Any of these limitations on approval or marketing could restrict the commercial promotion, distribution, prescription or dispensing of products. Marketing approval may be withdrawn for non-compliance with regulatory requirements or if problems occur following initial marketing.

The Pediatric Research Equity Act (PREA), requires a sponsor to conduct pediatric clinical trials for most newly approved drugs and biologics, for a new active ingredient, new indication, new dosage form, new dosing regimen or new route of administration. Under PREA, original BLAs and supplements thereto, must contain a pediatric assessment unless the sponsor has received a deferral or waiver. The required assessment must evaluate the safety and effectiveness of the product for the claimed indications in all relevant pediatric subpopulations and support dosing and administration for each pediatric subpopulation for which the product is safe and effective. The sponsor or the FDA may request a deferral of pediatric clinical trials for some or all of the pediatric subpopulations. A deferral may be granted for several reasons, including a finding that the drug or biologic is ready for approval for use in adults before pediatric clinical trials are complete or that additional safety or effectiveness data needs to be collected before the pediatric clinical trials begin. Orphan indications are exempt from PREA. The FDA must send a non-compliance letter to any sponsor that fails to submit the required assessment, keep a deferral current or fails to submit a request for approval of a pediatric formulation.

Patent Term Restoration and Marketing Exclusivity

Depending upon the timing, duration and specifics of FDA approval of our drugs, some of our U.S. patents may be eligible for limited patent term extension under the Drug Price Competition and Patent Term Restoration Act of 1984 (referred to as the Hatch Waxman Amendments). The Hatch Waxman Amendments permit a patent restoration term of up to five years as compensation for patent term lost during product development and the FDA regulatory review process. However, patent term restoration cannot extend the remaining term of a patent beyond a total of 14 years from the product's approval date. The patent term restoration period is generally one half the time between the effective date of an IND, and the submission date of a BLA, plus the time between the submission date of a BLA and the approval of that application. Only one patent applicable to an approved drug is eligible for the extension, and the extension must be applied for, prior to expiration of the patent. The USPTO, in consultation with the FDA, reviews and approves the application for any patent term extension or restoration. In the future, we intend to apply for restorations of patent term for some of its currently-owned or licensed patents to add patent life beyond their current expiration date, depending on the expected length of clinical trials and other factors involved in the filing of the relevant BLA.

Pediatric exclusivity is a type of non-patent marketing exclusivity available in the United States, and, if granted, it provides for the attachment of an additional six months of marketing protection to the term of any existing regulatory exclusivity or listed patents. This six-month exclusivity may be granted if an NDA sponsor submits clinical pediatric data that fairly respond to a written request from the FDA for such data. The data do not need to show the product to be effective in the pediatric population studied; rather, if the clinical trial is deemed to fairly respond to the FDA's request, the additional protection is granted. If reports of requested pediatric studies are submitted to and accepted by the FDA within the statutory time limits, whatever statutory or regulatory periods of exclusivity or patent protection cover the product are extended by six months. This is not a patent term extension, but it effectively extends the regulatory period during which the FDA cannot approve another application for the same biologic. The issuance of a written request does not require the sponsor to undertake the described clinical trials. To date, we have not received or requested any FDA written requests.

Biologics Price Competition and Innovation Act of 2009

The Patient Protection and Affordable Care Act, as amended by the Health Care and Education Affordability Reconciliation Act of 2010 (collectively, ACA), which included the BPCIA, amended the PHSA to create an abbreviated approval pathway for biological products that are biosimilar to or interchangeable with an FDA-licensed reference biological product. A federal district court ruling in Texas struck down the Affordable Care Act in its entirety based on constitutionality last year, and in December 2019 the Fifth Circuit Court of Appeals upheld lower court's finding that the individual mandate I the law is unconstitutional. However, the Fifth Circuit also reversed and remanded the case to the district court to determine if other reforms enacted as part of the Affordable Care Act but not specifically related to the individual mandate or health insurance, including the BPCIA, could be severed from the rest of the Affordable Care Act so as not to be declared invalid. It is unclear how this decision, subsequent appeals including potentially to the U.S. Supreme Court, and other efforts to repeal and replace the Affordable Care Act will affect the implementation of that law and our business. To date, the FDA has approved a number of biosimilars, and numerous biosimilars have been approved in Europe. The FDA has also issued several guidance documents outlining its approach to reviewing and approving biosimilars and interchangeable biosimilars. A biosimilar product is defined as one that is highly similar to a reference product notwithstanding minor differences in clinically-inactive components and for which there are no clinically meaningful differences between the biological product and the reference product in terms of the safety, purity and potency of the product. An interchangeable product is a biosimilar product that can be expected to produce the same clinical results as the reference product in any given patient and, for products administered multiple times to an individual, that the product and the reference product may be alternated or switched after one has been previously administered without increasing safety risks or risks of diminished efficacy relative to exclusive use of the reference biological product without such alternation or switch. Upon licensure by the FDA, an interchangeable biosimilar may be substituted for the reference product without the intervention of the health care provider who prescribed the reference product.

The biosimilar applicant must demonstrate that the product is biosimilar based on data from (1) analytical studies showing that the biosimilar product is highly similar to the reference product; (2) animal studies (including toxicity); and (3) one or more clinical trials to demonstrate safety, purity and potency in one or more appropriate conditions of use for which the reference product is approved. In addition, the applicant must show that the biosimilar and reference products have the same mechanism of action for the conditions of use on the label, route of administration, dosage and strength, and the production facility must meet standards designed to assure product safety, purity and potency.

A reference biological product is granted 12 years of data exclusivity from the time of first licensure of the product, and the first approved interchangeable biologic product will be granted an exclusivity period of up to one year after it is first commercially marketed. If pediatric studies are performed and accepted by the FDA as responsive to a Written Request, the 12-year exclusivity period will be extended for an additional six months. In addition, the FDA will not accept an application for a biosimilar or interchangeable product based on the reference biological product until four years after the date of first licensure of the reference product. "First licensure" typically means the initial date the particular product at issue was licensed in the United States. Date of first

licensure does not include the date of licensure of (and a new period of exclusivity is not available for) a supplement for the reference product for a subsequent application filed by the same sponsor or manufacturer of the reference product (or licensor, predecessor in interest or other related entity) for a change (not including a modification to the structure of the biological product) that results in a new indication, route of administration, dosing schedule, dosage form, delivery system, delivery device or strength or for a modification to the structure of the biological product that does not result in a change in safety, purity or potency. Therefore, one must determine whether a new product includes a modification to the structure of a previously licensed product that results in a change in safety, purity or potency to assess whether the licensure of the new product is a first licensure that triggers its own period of exclusivity. Whether a subsequent application, if approved, warrants exclusivity as the “first licensure” of a biological product is determined on a case-by-case basis with data submitted by the sponsor.

The BPCIA is complex and only beginning to be interpreted and implemented by the FDA. In addition, recent government proposals have sought to reduce the 12-year reference product exclusivity period. Other aspects of the BPCIA, some of which may impact the BPCIA exclusivity provisions, have also been the subject of recent litigation. As a result, the ultimate impact, implementation and meaning of the BPCIA is subject to significant uncertainty.

Orphan Drug Designation

Under the Orphan Drug Act, the FDA may grant orphan drug designation to a drug intended to treat a rare disease or condition, which is generally defined as a disease or condition that affects fewer than 200,000 individuals in the United States, or more than 200,000 individuals in the United States and for which there is no reasonable expectation that the cost of developing and making available in the United States a drug for this type of disease or condition will be recovered from sales in the United States for that drug. Orphan drug designation must be requested before submitting a BLA. After the FDA grants orphan drug designation, the identity of the therapeutic agent and its potential orphan use will be disclosed publicly by the FDA; the posting will also indicate whether a drug is no longer designated as an orphan drug. More than one product candidate may receive an orphan drug designation for the same indication. Orphan drug designation does not convey any advantage in or shorten the duration of the regulatory review and approval process.

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 seven years of orphan product exclusivity, except in very limited circumstances. The FDA will not recognize orphan drug exclusive approval if a sponsor fails to demonstrate upon approval that the drug is clinically superior to a previously approved drug, regardless of whether or not the approved drug was designated an orphan drug or had orphan drug exclusivity. Thus orphan drug exclusivity could also block the approval of one of our products for seven years if a competitor obtains approval of the same drug, as defined by the FDA, and we are not able to show the clinical superiority of our drug or if our product candidate is determined to be contained within the competitor’s product for the same indication or disease.

In October 2017, the FDA granted SYN1618 orphan drug designation for the treatment of PKU.

Fast Track, Breakthrough Therapy and Priority Review Designations

The FDA is authorized to designate certain products for expedited development or review if they are intended to address an unmet medical need in the treatment of a serious or life-threatening disease or condition. These programs include fast track designation, breakthrough therapy designation and priority review designation.

To be eligible for a fast track designation, the FDA must determine, based on the request of a sponsor, that a product is intended to treat a serious or life-threatening disease or condition and demonstrates the potential to address an unmet medical need by providing a therapy where none exists or a therapy that may be potentially superior to existing therapy based on efficacy or safety factors. Fast track designation provides opportunities for more frequent interactions with the FDA review team to expedite development and review of the product. The FDA may also review sections of the NDA or BLA for a fast track product on a rolling basis before the complete application is submitted, if the sponsor and the FDA agree on a schedule for the submission of the application sections, and the sponsor pays any required user fees upon submission of the first section of the NDA or BLA. In addition, fast track designation may be withdrawn by the sponsor or rescinded by the FDA if the designation is no longer supported by data emerging in the clinical trial process.

In addition, with the enactment of FDASIA in 2012, Congress created a new regulatory program for product candidates designated by FDA as “breakthrough therapies” upon a request made by the IND sponsors. A breakthrough therapy is defined as a drug or biologic that is intended, alone or in combination with one or more other drugs or biologics, to treat a serious or life-threatening disease or condition, and preliminary clinical evidence indicates that the drug or biologic may demonstrate substantial improvement over existing therapies on one or more clinically significant endpoints, such as substantial treatment effects observed early in clinical development. Drugs or biologics designated as breakthrough therapies are also eligible for accelerated approval of their respective marketing applications. The FDA must take certain actions with respect to breakthrough therapies, such as holding

timely meetings with and providing advice to the product sponsor, intended to expedite the development and review of an application for approval of a breakthrough therapy.

Finally, the FDA may designate a product for priority review if it is a drug or biologic that treats a serious condition and, if approved, would provide a significant improvement in safety or effectiveness. The FDA determines at the time that the marketing application is submitted, on a case-by-case basis, whether the proposed drug represents a significant improvement in treatment, prevention or diagnosis of disease when compared with other available therapies. Significant improvement may be illustrated by evidence of increased effectiveness in the treatment of a condition, elimination or substantial reduction of a treatment-limiting drug reaction, documented enhancement of patient compliance that may lead to improvement in serious outcomes, or evidence of safety and effectiveness in a new subpopulation. A priority review designation is intended to direct overall attention and resources to the evaluation of such applications, and to shorten the FDA's goal for taking action on a marketing application from ten months to six months for an original BLA or for an NDA for a new molecular entity from the date of filing.

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 decide that the time period for FDA review or approval will not be shortened. Furthermore, fast track designation, breakthrough therapy designation and priority review do not change the standards for approval and may not ultimately expedite the development or approval process.

In April 2018, the FDA granted Fast-Track designation for the use of SYN1618 for the treatment of PKU.

Accelerated Approval Pathway

In addition, products studied for their safety and effectiveness in treating serious or life-threatening illnesses and that provide meaningful therapeutic benefit over existing treatments may receive accelerated approval from the FDA and may be approved on the basis of adequate and well-controlled clinical trials establishing that the drug product has an effect on a surrogate endpoint that is reasonably likely to predict clinical benefit. The FDA may also grant accelerated approval for such a drug or biologic when the product has an effect on an intermediate clinical endpoint that can be measured earlier than an effect on irreversible morbidity or mortality, or IMM, and that is reasonably likely to predict an effect on IMM or other clinical benefit, taking into account the severity, rarity, or prevalence of the condition and the availability or lack of alternative treatments. As a condition of approval, the FDA may require that a sponsor of a drug receiving accelerated approval perform post-marketing clinical trials to verify and describe the predicted effect on IMM or other clinical endpoint, and the product may be subject to expedited withdrawal procedures. Drugs and biologics granted accelerated approval must meet the same statutory standards for safety and effectiveness as those granted traditional approval.

For the purposes of accelerated approval, a surrogate endpoint is a marker, such as a laboratory measurement, radiographic image, physical sign, or other measure that is thought to predict clinical benefit, but is not itself a measure of clinical benefit. Surrogate endpoints can often be measured more easily or more rapidly than clinical endpoints. An intermediate clinical endpoint is a measurement of a therapeutic effect that is considered reasonably likely to predict the clinical benefit of a drug, such as an effect on IMM. The FDA has limited experience with accelerated approvals based on intermediate clinical endpoints, but has indicated that such endpoints generally may support accelerated approval when the therapeutic effect measured by the endpoint is not itself a clinical benefit and basis for traditional approval, if there is a basis for concluding that the therapeutic effect is reasonably likely to predict the ultimate long-term clinical benefit of a drug.

The accelerated approval pathway is most often used in settings in which the course of a disease is long and an extended period of time is required to measure the intended clinical benefit of a drug, even if the effect on the surrogate or intermediate clinical endpoint occurs rapidly. For example, accelerated approval has been used extensively in the development and approval of drugs for treatment of a variety of cancers in which the goal of therapy is generally to improve survival or decrease morbidity and the duration of the typical disease course requires lengthy and sometimes large clinical trials to demonstrate a clinical or survival benefit.

The accelerated approval pathway is usually contingent on a sponsor's agreement to conduct, in a diligent manner, additional post-approval confirmatory studies to verify and describe the drug's clinical benefit. As a result, a product candidate approved on this basis is subject to rigorous post-marketing compliance requirements, including the completion of Phase 4 or post-approval clinical trials to confirm the effect on the clinical endpoint. Failure to conduct required post-approval studies, or to confirm the predicted clinical benefit of the product during post-marketing studies, would allow the FDA to withdraw approval of the drug. All promotional materials for product candidates being considered and approved under the accelerated approval program are subject to prior review by the FDA.

Post-Approval Requirements

Following approval of a new product, the manufacturer and the approved product are subject to pervasive and continuing regulation by the FDA, including, among other things, monitoring and recordkeeping activities, reporting of adverse experiences with the product, product sampling and distribution restrictions, complying with promotion and advertising requirements, which include restrictions on promoting biologics for unapproved uses or patient populations (i.e., “off-label use”) and limitations on industry-sponsored scientific and educational activities. Although physicians may prescribe legally available products for off-label uses, manufacturers may not market or promote such uses. The FDA and other agencies actively enforce the laws and regulations prohibiting the promotion of off-label uses, and a company that is found to have improperly promoted off-label uses may be subject to significant liability. If there are any modifications to the product, including changes in indications, labeling or manufacturing processes or facilities, the applicant may be required to submit and obtain FDA approval of a new BLA or a BLA supplement, which may require the applicant to develop additional data or conduct additional pre-clinical studies and clinical trials. The FDA may also place other conditions on approvals including the requirement for a REMS to assure the safe use of the product. A REMS could include medication guides, physician communication plans or elements to assure safe use, such as restricted distribution methods, patient registries and other risk minimization tools. Any of these limitations on approval or marketing could restrict the commercial promotion, distribution, prescription or dispensing of products. Product approvals may be withdrawn for non-compliance with regulatory standards or if problems occur following initial marketing.

FDA regulations require that products be manufactured in specific approved facilities and in accordance with cGMPs. The cGMP regulations include requirements relating to organization of personnel, buildings and facilities, equipment, control of components and finished product containers and closures, production and process controls, packaging and labeling controls, holding and distribution, laboratory controls, records and reports and returned or salvaged products. The manufacturing facilities for our product candidates must meet cGMP requirements and satisfy the FDA or comparable foreign regulatory authorities before any product is approved and our commercial products can be manufactured. We rely, and expect to continue to rely, on third parties for the production of clinical and commercial quantities of our products in accordance with cGMP regulations. These manufacturers must comply with cGMP regulations that require, among other things, quality control and quality assurance, the maintenance of records and documentation and the obligation to investigate and correct any deviations from cGMP. Manufacturers and other entities involved in the manufacture and distribution of approved drugs or biologics 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 cGMP and other laws. Accordingly, manufacturers must continue to expend time, money and effort in the area of production and quality control to maintain cGMP compliance. Future inspections by the FDA and other regulatory agencies may identify compliance issues at the facilities of our CMOs that may disrupt production or distribution or require substantial resources to correct. In addition, the discovery of conditions that violate these rules, including failure to conform to cGMPs, could result in enforcement actions, and the discovery of problems with a product after approval may result in restrictions on a product, manufacturer or holder of an approved BLA, including voluntary recall and regulatory sanctions as described below.

Once an approval is granted, the FDA may withdraw the approval if compliance with regulatory standards is not maintained or if problems occur or are discovered after the product reaches the market. Later discovery of previously unknown problems with a product may result in mandatory revisions to the approved labeling to add new safety information; imposition of post-market or clinical trials to assess new safety risks; or imposition of distribution or other restrictions under a REMS program. 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;
- fines, warning letters or other enforcement-related letters or clinical holds on post-approval clinical trials;
- refusal of the FDA to approve pending NDAs/BLAs or supplements to approved NDAs/BLAs, or suspension or revocation of product approvals;
- product seizure or detention, or refusal to permit the import or export of products;
- injunctions or the imposition of civil or criminal penalties; and
- consent decrees, corporate integrity agreements, debarment, or exclusion from federal health care programs; or mandated modification of promotional materials and labeling and the issuance of corrective information.

In addition, the distribution of prescription pharmaceutical products is subject to the Prescription Drug Marketing Act, or PDMA, which regulates the distribution of drugs and drug samples at the federal level, and sets minimum standards for the registration and regulation of drug distributors by the states. Both the PDMA and state laws limit the distribution of prescription pharmaceutical product samples and impose requirements to ensure accountability in distribution. Most recently, the Drug Supply Chain Security Act, or DSCSA, was enacted with the aim of building an electronic system to identify and trace certain prescription

drugs distributed in the United States, including most biological products. The DSCSA mandates phased-in and resource-intensive obligations for pharmaceutical manufacturers, wholesale distributors, and dispensers over a 10-year period that is expected to culminate in November 2023.

From time to time, new legislation is drafted, introduced and passed in Congress that could significantly change the statutory provisions governing the approval, manufacturing and marketing of products regulated by the FDA. It is impossible to predict whether further legislative changes will be enacted, or FDA regulations, guidance or interpretations will be changed or what the impact of such changes, if any, may be.

Foreign Regulation

In addition to regulations in the United States, we will be subject to a variety of foreign regulations governing the performance of clinical trials outside the U.S. and commercial sales and distribution of our products outside of the United States. Whether or not we obtain FDA approval for a product candidate, we must obtain approval by the comparable regulatory authorities of foreign countries or economic areas, such as the European Union, before we may commence clinical trials or market products in those countries or areas. It is not yet clear how the United Kingdom's withdrawal from the European Union, now taking place on January 31, 2020, will affect the approval of medicinal products in the UK. The approval process and requirements governing the conduct of clinical trials, product licensing, pricing and reimbursement vary greatly between countries and jurisdictions and can involve additional testing and additional administrative review periods. The time required to obtain approval in other countries and jurisdictions might differ from and be longer than that required to obtain FDA approval. Regulatory approval in one country or jurisdiction does not ensure regulatory approval in another, but a failure or delay in obtaining regulatory approval in one country or jurisdiction may negatively impact the regulatory process in others.

European Union drug development, review and approval

In the European Union, our product candidates also may be subject to extensive regulatory requirements. As in the United States, medicinal products can be marketed only if a marketing authorization from the competent regulatory agencies has been obtained. Similar to the United States, the various phases of pre-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 IMPD (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. All suspected unexpected serious adverse reactions to the investigated drug that occur during the clinical trial have to be reported to the competent national authority and the Ethics Committee of the Member State where they occurred.

In April 2014, the new Clinical Trials Regulation, (EU) No 536/2014 (Clinical Trials Regulation) was adopted and it is anticipated to come into application in late 2020 or early 2021. 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 deadlines 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.

To obtain a marketing authorization of a drug in the European Union, we may submit marketing authorization applications, or MAA, either under the so-called centralized or national authorization procedures.

Centralized procedure

The centralized procedure provides for the grant of a single marketing authorization following a favorable opinion by the European Medicines Agency, or EMA, that is valid in all EU member states, as well as Iceland, Liechtenstein and Norway. The centralized procedure is compulsory for medicines produced by specified biotechnological processes, products designated as orphan medicinal products, advanced-therapy medicines (such as gene-therapy, somatic cell-therapy or tissue-engineered medicines) and products with a new active substance indicated for the treatment of specified diseases, such as HIV/AIDS, cancer, diabetes, neurodegenerative disorders or autoimmune diseases and other immune dysfunctions and viral diseases. The centralized procedure is optional for products that represent a significant therapeutic, scientific or technical innovation, or whose authorization would be in the interest of public health. 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 Committee for Medicinal Products for Human Use, or 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 of 150 days, excluding stop-clocks.

National authorization procedures

There are also two other possible routes to authorize medicinal products in several EU countries, which are available for investigational medicinal 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, further marketing authorizations can be sought from other EU countries in a procedure whereby the countries concerned agree to recognize the validity of the original, national marketing authorization.

Under the above described procedures, before granting the marketing authorization, the EMA or the competent authorities of the Member States of the EEA make an assessment of the risk-benefit balance of the product on the basis of scientific criteria concerning its quality, safety and efficacy.

Conditional approval

In specific circumstances, E.U. legislation (Article 14(7) Regulation (EC) No 726/2004 and Regulation (EC) No 507/2006 on Conditional Marketing Authorizations for Medicinal Products for Human Use) enables applicants to obtain a conditional marketing authorization prior to obtaining the comprehensive clinical data required for an application for a full marketing authorization. Such conditional approvals may be granted for product candidates (including medicines designated as orphan medicinal products) if (1) the risk-benefit balance of the product candidate is positive, (2) it is likely that the applicant will be in a position to provide the required comprehensive clinical trial data, (3) the product fulfills unmet medical needs and (4) the benefit to public health of the immediate availability on the market of the medicinal product concerned outweighs the risk inherent in the fact that additional data are still required. A conditional marketing authorization may contain specific obligations to be fulfilled by the marketing authorization holder, including obligations with respect to the completion of ongoing or new studies, and with respect to the collection of pharmacovigilance data. Conditional marketing authorizations are valid for one year, and may be renewed annually, if the risk-benefit balance remains positive, and after an assessment of the need for additional or modified conditions or specific obligations. The timelines for the centralized procedure described above also apply with respect to the review by the CHMP of applications for a conditional marketing authorization.

Pediatric studies

Prior to obtaining a marketing authorization in the European Union, applicants have to demonstrate compliance with all measures included in an EMA-approved Pediatric Investigation Plan, or PIP, covering all subsets of the pediatric population, unless the EMA has granted a product-specific waiver, a class waiver, or a deferral for one or more of the measures included in the PIP. The respective requirements for all marketing authorization procedures are set forth in Regulation (EC) No 1901/2006, which is referred to as the Pediatric Regulation. This requirement also applies when a company wants to add a new indication, pharmaceutical form or route of administration for a medicine that is already authorized. The Pediatric Committee of the EMA, or PDCO, may grant deferrals

for some medicines, allowing a company to delay development of the medicine in children until there is enough information to demonstrate its effectiveness and safety in adults. The PDCO may also grant waivers when development of a medicine in children is not needed or is not appropriate, such as for diseases that only affect the elderly population.

Before a marketing authorization application can be filed, or an existing marketing authorization can be amended, the EMA determines that companies actually comply with the agreed studies and measures listed in each relevant PIP.

European Union regulatory exclusivity

In the European Union, new products 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 pre-clinical and clinical trial data contained in the dossier of the reference product when applying for a generic or biosimilar marketing authorization in the European Union during a period of eight years from the date on which the reference product was first authorized in the European Union. 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.

European Union orphan designation and exclusivity

The criteria for designating an orphan medicinal product in the European Union, are similar in principle to those in the United States. Under Article 3 of Regulation (EC) 141/2000, 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 European Union when the application is made, or (b) the product, without the benefits derived from orphan status, would not generate sufficient return in the European Union to justify investment; and (3) there exists no satisfactory method of diagnosis, prevention or treatment of such condition authorized for marketing in the European Union, or if such a method exists, the product will be of significant benefit to those affected by the condition, as defined in Regulation (EC) 847/2000. 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. The application for orphan designation must be submitted before the application for marketing authorization. The applicant will receive a fee reduction for the marketing authorization application if the orphan designation has been granted, but not if the designation is still pending at the time the marketing authorization is submitted. Orphan designation does not convey any advantage in, or shorten the duration of, the regulatory review and approval process.

The ten-year market exclusivity in the European Union 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:

- the second applicant can establish that its product, although similar, is safer, more effective or otherwise clinically superior;
- the applicant consents to a second orphan medicinal product application; or
- the applicant cannot supply enough orphan medicinal product.

PRIME designation

The EMA grants access to the Priority Medicines, or PRIME, program to investigational medicines for which it determines there to be preliminary data available showing the potential to address an unmet medical need and bring a major therapeutic advantage to patients. As part of the program, EMA provides early and enhanced dialogue and support to optimize the development of eligible medicines and speed up their evaluation, aiming to bring promising treatments to patients sooner.

Periods of authorization and renewals

A marketing authorization is valid for five years in principle and the marketing authorization may be renewed after five years on the basis of a re-evaluation of the risk-benefit balance by the EMA or by the competent authority of the authorizing member state. To this end, the marketing authorization holder must provide the EMA or the competent authority with a consolidated version of the file in respect of quality, safety and efficacy, including all variations introduced since the marketing authorization was granted, at least six months before the marketing authorization ceases to be valid. Once renewed, the marketing authorization is valid for an unlimited

period, unless the European Commission or the competent authority decides, on justified grounds relating to pharmacovigilance, to proceed with one additional five-year renewal. Any authorization which is not followed by the actual placing of the drug on the E.U. market (in case of centralized procedure) or on the market of the authorizing member state within three years after authorization ceases to be valid (the so-called sunset clause).

Rest of the world regulation

For other countries outside of the European Union and the United States, such as countries in Eastern Europe, Latin America or Asia, the requirements governing the conduct of clinical trials, product licensing, pricing and reimbursement vary from jurisdiction to jurisdiction. Additionally, the clinical trials must be conducted in accordance with cGCP requirements and the applicable regulatory requirements and the ethical principles that have their origin in the Declaration of Helsinki.

If we fail to comply with applicable foreign regulatory requirements, we may be subject to, among other things, fines, suspension or withdrawal of regulatory approvals, product recalls, seizure of products, operating restrictions and criminal prosecution.

Coverage, Pricing and Reimbursement

Sales of pharmaceutical products depend in significant part on the availability of third-party coverage and reimbursement. Third-party payors include government healthcare programs such as Medicare, managed care providers, private health insurers and other organizations. We anticipate third-party payors will provide reimbursement for our products. However, these third-party payors are increasingly challenging the price and examining the cost effectiveness of medical products and services. In addition, significant uncertainty exists as to the reimbursement status of newly-approved healthcare products. The process for determining whether a payor will provide coverage for a product may be separate from the process for setting the price or reimbursement rate that the payor will pay for the product once coverage is approved. Third-party payors may limit coverage to specific products on an approved list, or formulary, which might not include all of the approved products for a particular indication. We may need to conduct expensive pharmacoeconomic studies in order to demonstrate the medical necessity and cost effectiveness of our products. Moreover, a payor's decision to provide coverage for a drug product does not imply that an adequate reimbursement rate will be approved. Third-party reimbursement may not be sufficient to maintain price levels high enough to realize an appropriate return on investment in product development. Our product candidates may not be considered cost effective. It is time consuming and expensive for us to seek reimbursement from third-party payors. Reimbursement may not be available or sufficient to allow us to sell our products on a competitive and profitable basis.

Medicare is a federal healthcare program administered by the federal government that covers individuals age 65 and over as well as individuals with certain disabilities. Drugs may be covered under one or more sections of Medicare depending on the nature of the drug and the conditions associated with and site of administration. For example, under Part D, Medicare beneficiaries may enroll in prescription drug plans offered by private entities which provide coverage for outpatient prescription drugs. Part D plans include both stand-alone prescription drug benefit plans and prescription drug coverage as a supplement to Medicare Advantage plans. Unlike Medicare Parts A and B, Part D coverage is not standardized. Part D prescription drug plan sponsors are not required to pay for all covered Part D drugs, and each drug plan can develop its own drug formulary that identifies which drugs it will cover and at what tier or level.

Medicare Part B covers most injectable drugs given in an in-patient setting and some drugs administered by a licensed medical provider in hospital outpatient departments and doctors' offices. Medicare Part B is administered by Medicare Administrative Contractors, which generally have the responsibility of making coverage decisions. Subject to certain payment adjustments and limits, Medicare generally pays for a Part B-covered drug based on a percentage of manufacturer-reported average sales price, which is regularly updated. We believe that our product candidates that are intended to be administered intratumorally will be subject to the Medicare Part B rules.

We expect that there will continue to be a number of federal and state proposals to implement governmental pricing controls and limit the growth of healthcare costs, including the cost of prescription drugs. For example, the ACA enacted in March 2010, was expected to have a significant impact on the health care industry. The ACA has been under scrutiny by the U.S. Congress almost since its passage, and certain sections of the ACA have not been fully implemented or effectively repealed. As a result, its longevity continues to be uncertain. In addition, ongoing initiatives in the U.S. have increased and will continue to increase pressure on drug pricing. The announcement or adoption of any such initiative could have an adverse effect on potential revenues from any product candidate that we may successfully develop.

In addition, in some foreign countries, the proposed pricing for a drug must be approved before it may be lawfully marketed. The requirements governing drug pricing vary widely from country to country. Moreover, a payor's decision to provide coverage for a drug product does not imply that an adequate reimbursement rate will be approved. Third-party reimbursement may not be sufficient to maintain price levels high enough to realize an appropriate return on investment in product development. 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. 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 our profitability placing the medicinal product on the market. Other member states allow companies to fix their own prices for drug products but monitor and control prescription volumes and issue guidance to physicians to limit prescriptions. 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 and other countries do not follow price structures of the United States and generally prices tend to be significantly lower.

The downward pressure on health care costs in general, particularly prescription drugs, has become intense. As a result, increasingly high barriers are being erected to the entry of new products. In addition, there can be considerable pressure by governments and other stakeholders on prices and reimbursement levels, including as part of cost containment measures. Political, economic and regulatory developments may further complicate pricing negotiations, and pricing negotiations may continue after reimbursement has been obtained. Reference pricing used by various EU member states and parallel distribution (arbitrage between low-priced and high-priced member states) can further reduce prices. Any country that has price controls or reimbursement limitations for drug products may not allow favorable reimbursement and pricing arrangements.

Other US Health Care Laws and Regulations

If our product candidates are approved in the United States, we will have to comply with various U.S. federal and state laws, rules and regulations pertaining to health care fraud and abuse, including anti-kickback laws and physician self-referral laws, rules and regulations. Violations of the fraud and abuse laws are punishable by criminal and civil sanctions, including, in some instances, exclusion from participation in federal and state health care programs, including Medicare and Medicaid. These laws include:

- the federal anti-kickback statute prohibits, among other things, persons from knowingly and willfully soliciting, offering, receiving or paying remuneration, directly or indirectly, in cash or in kind, to induce or reward either the referral of an individual for, or the purchase, order or recommendation of, any good or service, for which payment may be made, in whole or in part, under a federal health care program such as Medicare and Medicaid;
- the federal False Claims Act imposes civil penalties, and provides for civil whistleblower or qui tam actions, against individuals or entities for knowingly presenting, or causing to be presented, to the federal government, claims for payment that are false or fraudulent or making a false statement to avoid, decrease or conceal an obligation to pay money to the federal government;
- the federal Health Insurance Portability and Accountability Act of 1996, or HIPAA, imposes criminal and civil liability for executing a scheme to defraud any health care benefit program or making false statements relating to health care matters;
- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act, or HITECH Act, and its implementing regulations, also imposes obligations, including mandatory contractual terms, with respect to safeguarding the privacy, security and transmission of individually identifiable health information;
- the federal transparency requirements under the Physician Payments Sunshine Act require manufacturers of FDA-approved drugs, devices, biologics and medical supplies covered by Medicare or Medicaid to report, on an annual basis, to the Department of Health and Human Services information related to payments and other transfers of value to physicians, teaching hospitals, and certain advanced non-physician health care practitioners and physician ownership and investment interests; and
- analogous state and foreign laws and regulations, such as state anti-kickback and false claims laws, may apply to sales or marketing arrangements and claims involving health care items or services reimbursed by nongovernmental third-party payors, including private insurers.

Some state laws require pharmaceutical companies to comply with the pharmaceutical industry's voluntary compliance guidelines, or the relevant compliance guidance promulgated by the federal government, in addition to requiring drug manufacturers to report information related to payments to physicians and other health care providers or marketing expenditures to the extent that those laws impose requirements that are more stringent than the Physician Payments Sunshine Act. State and foreign laws also govern the privacy and security of health information in some circumstances, many of which differ from each other in significant ways and often are not preempted by HIPAA, thus complicating compliance efforts.

Health Care Reform in the US and Potential Changes to Health Care Laws

The FDA's and other regulatory authorities' policies may change and additional government regulations may be enacted that could prevent, limit or delay regulatory approval of our product candidates. For example, in December 2016, the 21st Century Cures

Act, or Cures Act, was signed into law. The Cures Act, among other things, is intended to modernize the regulation of drugs and devices and to spur innovation, but its ultimate implementation is uncertain. In addition, in August 2017, the FDA Reauthorization Act was signed into law, which reauthorized the FDA's user fee programs and included additional drug and device provisions that build on the Cures Act. 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 otherwise may have obtained and we may not achieve or sustain profitability, which would adversely affect our business, prospects, financial condition and results of operations.

As previously mentioned, primary trend in the US health care industry and elsewhere is cost containment. Government authorities and other third-party payors have attempted to control costs by limiting coverage and the amount of reimbursement for particular medical products and services, implementing reductions in Medicare and other health care funding and applying new payment methodologies. For example, in March 2010, the Affordable Care Act was enacted, which, among other things, increased the minimum Medicaid rebates owed by most manufacturers under the Medicaid Drug Rebate Program; introduced 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; extended the Medicaid Drug Rebate Program to utilization of prescriptions of individuals enrolled in Medicaid managed care plans; imposed mandatory discounts for certain Medicare Part D beneficiaries as a condition for manufacturers' outpatient drugs coverage under Medicare Part D; and established a Center for Medicare Innovation at the US Centers for Medicare and Medicaid Services, or CMS, to test innovative payment and service delivery models to lower Medicare and Medicaid spending.

Since its enactment, there have been judicial and Congressional challenges to certain aspects of the Affordable Care Act, and we expect there will be additional challenges and amendments to the Affordable Care Act in the future. The current Presidential administration and members of the US Congress have indicated that they may continue to seek to modify, repeal or otherwise invalidate all, or certain provisions of, the Affordable Care Act. For example, the Tax Cuts and Jobs Act was enacted in 2017, which, among other things, removed penalties for not complying with the individual mandate to carry health insurance. As noted above, a 2018 federal district court ruling struck down the Affordable Care Act in its entirety although the Fifth Circuit Court of Appeals recently limited it to the individual mandate and remanded the case to the district court to determine if other reforms not specifically related to the individual mandate or health insurance could be severed from the rest of the Affordable Care Act. It is unclear how this decision, subsequent appeals including potentially to the U.S. Supreme Court, and other efforts to repeal and replace the Affordable Care Act will affect the implementation of that law and our business.

In addition, other legislative changes have been proposed and adopted in the United States since the Affordable Care Act that affect health care expenditures. There has been heightened governmental scrutiny in recent years over the manner in which manufacturers set prices for their marketed products, which has resulted in several 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 pharmaceutical and biologic products. Notably, on December 20, 2019, President Trump signed the Further Consolidated Appropriations Act for 2020 into law (P.L. 116-94) that includes a piece of bipartisan legislation called the Creating and Restoring Equal Access to Equivalent Samples Act of 2019 or the "CREATES Act." The CREATES Act aims to address the concern articulated by both the FDA and others in the industry that some brand manufacturers have improperly restricted the distribution of their products, including by invoking the existence of a REMS for certain products, to deny generic and biosimilar product developers access to samples of brand products. Because generic and biosimilar product developers need samples to conduct certain comparative testing required by the FDA, some have attributed the inability to timely obtain samples as a cause of delay in the entry of generic and biosimilar products. To remedy this concern, the CREATES Act establishes a private cause of action that permits a generic or biosimilar product developer to sue the brand manufacturer to compel it to furnish the necessary samples on "commercially reasonable, market-based terms." Whether and how generic and biosimilar product developments will use this new pathway, as well as the likely outcome of any legal challenges to provisions of the CREATES Act, remain highly uncertain and its potential effects on our future commercial products are unknown.

We 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. We expect that additional state and federal health care reform measures will be adopted in the future, any of which could limit the amounts that federal and state governments will pay for health care products and services.

Other Regulatory Matters

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. These operations may involve the use of hazardous and flammable materials, including chemicals and biological materials. Our operations may also produce hazardous

waste products. We contract with third parties for the disposal of these materials and wastes. Our products are defined as Genetically Modified Organisms (GMO) or Genetically Modified Micro-organisms (GMM) and, dependent on their classification and containment, may be subject to regulation.

The United States does not have any federal legislation that is specific to genetically modified organisms. GMOs are regulated pursuant to health, safety, and environmental legislation governing conventional products. The U.S. approach to regulating GMOs is premised on the assumption that regulation should focus on the nature of the products, rather than the process in which they were produced.

The clinical development and marketing of GMM within the European Union, and elsewhere, falls under different regulations and practices in each country, which may involve approval by environmental or other regulatory bodies, as well as health authorities, and may establish the requirement for a risk assessment for the testing or authorization of the product.

Manufacturing

We have made and continue to make significant investments in our manufacturing organization, including process development and cGMP production infrastructure to establish manufacturing processes designed to support production of clinical trial material. The manufacturing processes are designed to enable us to reproducibly manufacture high quality living medicines at clinical scale and, later, at commercial scale to enable approval of our product candidates. We have built a fully integrated development and manufacturing organization with an internal process development group, quality group and manufacturing capabilities with the lease of cGMP cleanroom space in Waltham, Massachusetts. This facility enables us to produce clinical trial material for early to mid-stage studies of our rare metabolic disease and IO programs. We continue to build the organization to support scale-up and development towards commercialization. We currently expect to continue to work with contract manufacturing organizations (CMOs) for production of late-stage clinical trial material.

Clinical trial material for our Phase 1 studies of SYN1020 for hyperammonemia and SYN1618 for PKU were manufactured by a CMO. These first clinical trials used a liquid formulation as the drug presentation. Since then we have made additional investment in our formulation development that now enables production of both liquid and solid dose formulations for our clinical programs. The solid oral formulation capability allows us to produce a more user-friendly presentation for later stage clinical development and future commercial use. We are continuing to invest and investigate the utility of additional presentations for solid formulations of our Synthetic Biotic medicines including capsules.

To enable the production of high levels of cells, or biomass, we can engineer our Synthetic Biotic medicines with switches. These switches are comprised of transcription factor and promoter pairs that allow for controlled expression of the therapeutic effectors produced by our Synthetic Biotic medicines. To ensure the metabolic capacity of the cells is allotted to the production of a high level of biomass during manufacturing, the effector circuits in the Synthetic Biotic programs are not expressed during this growth phase. At the end of the manufacturing process, the circuits are then induced, or activated. This two-step approach was designed to enable a high level of biomass production as well as to deliver the required activity necessary at the time of administration. We continue to devote resources to process development and the generation of improved products.

As we progress in clinical development, we will need to increase our scale and eventually to commercial-scale manufacturing. We are in the process of assessing CMOs who meet our criteria to supply our late-stage clinical development and commercial supply. We will compare the merits of working with one or more CMOs who meet our criteria with the possibility of building GMP manufacturing capacity and capabilities internally.

Competition

The biotechnology industry is extremely competitive in the race to develop new products. While we believe we have significant competitive advantages with our industry-leading expertise in synthetic biology and metabolic engineering of non-pathogenic bacteria, our clinical development expertise, and strong intellectual property position, we currently face and will continue to face competition for our development programs from companies that use synthetic biology or cell therapy development platforms and from companies focused on more conventional therapeutic modalities such as small molecules and antibodies. The competition is likely to come from multiple sources, including larger pharmaceutical companies, biotechnology companies and academia. Many of these competitors may have access to greater capital and resources than us. These competitors also compete with us in recruiting and retaining qualified scientific and management personnel, in establishing clinical trial sites and patient registration for clinical trials, and in accessing technologies to enable our programs. For any products that we may ultimately commercialize, not only will we compete with any existing therapies and those therapies currently in development, but we will also have to compete with new therapies that may become available in the future.

Competitors to our efforts to provide living medicines to patients with a wide range of indications include other synthetic biology companies developing other synthetic biology methods, cellular and microbiome-based companies, DNA and RNA-based companies, as well as companies developing small molecules or other biologics. In the case of indications that we are targeting with our own Synthetic Biotic medicines, competitors include, but are not limited to:

- *PKU*
 - BioMarin, Inc. has two approved products and a development stage product;
 - Censa Pharmaceuticals, Inc., Nestle Health Sciences S.A. (Codexis, Inc.), and Homology Medicines, Inc. have products in clinical trials;
 - Moderna, Inc., Agios Pharmaceuticals, Inc., Generation Bio Co., American Gene Technologies International Inc., Sangamo Therapeutics, Inc., Sanofi, S.A., TruCode Gene Repair, Inc., SOM Biotech SL and others are developing product candidates

- *HOX*
 - Allena Pharmaceuticals, Inc. has a recombinant enzyme in clinical trials;
 - Novome Biotechnologies, Inc., Oxidien Pharmaceuticals, LLC and others are developing product candidates

- *MSUD*
 - Acer Therapeutics has a clinical stage program

- *IO*
 - The field of immuno-oncology is highly competitive with many companies developing and commercializing a wide range of types of pharmaceutical products and combinations. Companies with STING agonists in clinical development include Aduro BioTech, Inc., Merck & Co. Inc., Spring Bank Pharmaceuticals, Inc., GlaxoSmithKline plc., and Bristol Myers Squibb Company. Examples of companies developing other modalities include companies such as Roche (Genentech) and Pfizer Inc. / Merck KGaA that develop and market antibodies called checkpoint inhibitors and Bristol-Myers Squibb Company and Gilead Sciences, Inc, that market autologous cell-based therapies called CAR-T. Other companies are developing and or marketing oncolytic viruses, cancer vaccines, cytotoxic agents, and other approaches to treat cancer.

Our Team: Executives, Founders and Scientific Advisors

Our team of executives has proven track records of successfully translating scientific visions into successful commercial therapeutic products, solving complex issues in developing novel therapeutics and progressing new and novel products through regulatory approval. Our scientific founders, Timothy Lu, M.D., Ph.D., and James Collins, Ph.D., are experts in the emerging field of synthetic biology. In addition to our management team and founders, we have established advisory relationships with researchers and clinicians dedicated to the development of Synthetic Biotic therapeutic products for patients with significant unmet medical needs and whose expertise spans synthetic biology, metabolic engineering, metabolism, immuno-modulation and immuno-oncology arenas. Our scientific advisors include Dr. Lu and Dr. Collins; Paul Miller, Ph.D., Christopher Voigt, Ph.D., Cammie Lesser, M.D., Ph.D. and Kristala Prather, Ph.D., experts in synthetic biology and bacterial metabolism. We expect to expand our advisory boards as we grow. All of our founders and advisors are equity holders in us and receive compensation as scientific advisors. Although they are regularly available for scientific consultation, our arrangements with these individuals do not entitle us to any of their existing or future intellectual property derived from their independent research or research with other third parties.

Employees

As of March 5, 2020, we had 76 full-time employees. Of our full-time employees, 60 were primarily engaged in research and development activities. None of our employees are subject to a collective bargaining agreement. We believe that we have good relations with our employees.

Corporate Information and History

We were originally incorporated in the State of Delaware in December 2007 under the name “Mirna Therapeutics, Inc.” We carry on our business directly and through our subsidiaries.

Our subsidiary, Synlogic Operating Company, Inc. was incorporated in Delaware as TMC Therapeutics, Inc. on March 14, 2014. On July 15, 2014, TMC Therapeutics, Inc. changed its name to Synlogic, Inc. (Private Synlogic when referred to prior to the Merger (as defined below)). On July 2, 2015, the common and preferred shareholders of Private Synlogic executed the Synlogic, LLC Contribution Agreement, pursuant to which such common and preferred shareholders contributed such shareholders’ equity interests in Private Synlogic in exchange for common and preferred units in a newly formed parent company named Synlogic, LLC (the 2015 Reorganization). In addition, IBDCo was formed as a subsidiary of Synlogic, LLC, as part of the 2015 Reorganization, and we entered into a license, option and merger agreement with AbbVie for the development of treatments for IBD. In May 2017, we completed a series of transactions pursuant to which Synlogic, LLC merged with and into Private Synlogic with Private Synlogic continuing as the surviving corporation.

On August 28, 2017, Synlogic, Inc., formerly known as Mirna Therapeutics, Inc. (NASDAQ: MIRN) (Mirna), completed its business combination with Synlogic, Inc. in accordance with the terms of the Agreement and Plan of Merger and Reorganization, dated as of May 15, 2017, by and among Mirna, Meerkat Merger Sub, Inc. (Merger Sub), and Private Synlogic (the Merger Agreement), pursuant to which Merger Sub merged with and into Private Synlogic, with Private Synlogic surviving as a wholly owned subsidiary of Mirna (the Merger). On August 25, 2017, in connection with, and prior to the completion of the Merger, Mirna effected a reverse stock split of its common stock (the Reverse Stock Split), and on August 28, 2017, immediately after completion of the Merger, Mirna changed its name to “Synlogic, Inc.” (NASDAQ: SYBX).

Under the terms of the Merger Agreement, Mirna issued shares of its common stock to Private Synlogic’s stockholders, using an exchange ratio, after taking into account the Reverse Stock Split, for each share of Private Synlogic common stock and preferred stock outstanding immediately prior to the Merger (Exchange Ratio). In addition, Mirna assumed all of the stock options outstanding under the Synlogic 2017 Stock Incentive Plan (2017 Plan), with such stock options henceforth representing the right to purchase a number of shares of Mirna’s common stock equal to the Exchange Ratio multiplied by the number of shares of Private Synlogic common stock previously represented by such options. Mirna also assumed the 2017 Plan.

Our Internet address is www.synlogictx.com. Our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K, and all amendments to those reports, are available to you free of charge through our website as soon as reasonably practicable after such materials have been electronically filed with, or furnished to, the Securities and Exchange Commission (SEC).

Item 1A. Risk Factors.

Investing in our common stock involves a high degree of risk. Our business, prospects, financial condition or operating results could be materially adversely affected by the risks identified below, as well as other risks not currently known to us or that we currently consider immaterial. Furthermore, these factors represent risks and uncertainties that could cause actual results to differ materially from those implied by forward-looking statements. Accordingly, in evaluating our business, we encourage you to consider the following discussion of risk factors, in its entirety, in addition to other information contained in this Annual Report on Form 10- and our other public filings with the SEC. The following risk factors may be amended, supplemented or superseded from time to time by other reports we file with the SEC in the future.

In the following discussion of risk factors, References to “we”, “us”, “our” and similar terms refer to the combined business of Synlogic, Inc. after the Merger on August 28, 2017.

Risks Related to Our Financial Condition, Capital Requirements and Operating Results

We are a clinical-stage biopharmaceutical company with a history of losses, and we expect to continue to incur losses for the foreseeable future, and we may never achieve or maintain profitability.

We are a clinical-stage biopharmaceutical company focused on the development of Synthetic Biotic medicines and we have incurred significant operating losses since our inception. Our net loss was approximately \$51.4 million and \$48.4 million for the fiscal years ended December 31, 2019 and 2018, respectively. As of December 31, 2019, we had an accumulated deficit of approximately \$171.1 million. To date, we have not generated any product revenue. Substantially all of our losses have resulted from expenses incurred in connection with our research and development programs and from general and administrative costs associated with our operations. We have no products on the market and expect that it will be many years, if ever, before we have a product candidate ready for commercialization.

We have not generated, and do not expect to generate, any product revenue for the foreseeable future, and we expect to continue to incur significant operating losses for the foreseeable future due to the cost of research and development, preclinical studies and clinical trials, the regulatory review process for product candidates, and the development of manufacturing and marketing capabilities for any product candidates approved for commercial sale. The amount of our potential future losses is uncertain. To achieve profitability, we must successfully develop product candidates, obtain regulatory approvals to market and commercialize product candidates, manufacture any approved product candidates on commercially reasonable terms, establish a sales and marketing organization or suitable third-party alternatives for any approved product candidates and raise sufficient funds to finance our business activities. We may never succeed in these activities and, even if we do, may never generate revenues that are significant or large enough to achieve profitability. Even 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 our value and could impair our ability to raise capital, maintain our research and development efforts, expand our business or continue our operations. A decline in our value could also cause our stockholders to lose all or part of their investment.

We will require substantial additional funding, which may not be available on acceptable terms, or at all.

We have used substantial funds to discover and develop our programs and proprietary drug development platform and will require substantial additional funds to conduct further research and development, including preclinical studies and clinical trials of our product candidates, seek regulatory approvals for our product candidates and manufacture and market any products that are approved for commercial sale. Our future capital requirements and the period for which we expect our existing resources to support our operations may vary significantly from what we expect. Our monthly spending levels vary based on new and ongoing research and development and corporate activities. Because we cannot be certain of the length of time or activities associated with successful development and commercialization of our product candidates, we are unable to estimate the actual funds we will require to develop and commercialize them.

We do not expect to realize any appreciable revenue from product sales or royalties in the foreseeable future, if at all. Our revenue sources will remain very limited unless and until our product candidates complete clinical development and are approved for commercialization and successfully marketed. To date, we have primarily financed our operations through sales of our securities, our third-party collaborations and the Merger. We intend to seek additional funding in the future through collaborations, equity or debt financings, credit or loan facilities or a combination of one or more of these financing sources. Our ability to raise additional funds will depend on financial, economic and other factors, many of which are beyond our control. Additional funds may not be available to us on acceptable terms or at all. If we raise additional funds by issuing equity or convertible debt securities, our stockholders will suffer dilution and the terms of any financing may adversely affect the rights of our stockholders. In addition, as a condition to providing additional funds to us, future investors may demand, and may be granted, rights superior to those of existing stockholders. Debt financing, if available, may involve restrictive covenants limiting our flexibility in conducting future business activities, and, in the event of insolvency, debt holders would be repaid before holders of equity securities received any distribution of corporate assets.

If we are unable to obtain funding on a timely basis or on acceptable terms, or at all, we may have to delay, limit or terminate our research and development programs and preclinical studies or clinical trials, if any, limit strategic opportunities or undergo reductions in our workforce or other corporate restructuring activities. We also could be required to seek funds through arrangements with collaborators or others that may require us to relinquish rights to some of our product candidates or technologies that we would otherwise pursue on our own.

Our quarterly and annual operating results may fluctuate in the future. As a result, we may fail to meet the expectations of research analysts or investors, which could cause our stock price to decline.

Our financial condition and operating results may fluctuate from quarter to quarter and year to year in the future due to a variety of factors, many of which are beyond our control. Factors relating to our business that may contribute to these fluctuations include the following factors, as well as factors described elsewhere in this Annual Report on Form 10-K and others:

- our ability to achieve or maintain profitability;
- our ability to develop and maintain Synthetic Biotic technologies;
- our ability to manage our growth;
- the outcomes of research programs, clinical trials, or other product development and approval processes;
- our ability to accurately report our financial results in a timely manner;
- our dependence on, and the need to attract and retain, key management and other personnel;
- our ability to obtain, protect and enforce our intellectual property rights;
- our ability to prevent the theft or misappropriation of our intellectual property, know-how or technologies;
- potential advantages that our competitors and potential competitors may have in securing funding or developing competing technologies or products; and
- our ability to obtain additional capital that may be necessary to expand our business.

Due to the various factors mentioned above, and others, the results of any prior quarterly or annual periods should not be relied upon as indications of our future operating performance.

Our stock price is volatile and our stockholders may not be able to resell shares of our common stock at or above the price they paid.

The trading price of our common stock is highly volatile and could be subject to wide fluctuations in response to various factors, some of which are beyond our control, such as reports by industry analysts, investor perceptions or negative announcements by other companies involving similar technologies or diseases. These factors also include those discussed in this “Risk Factors” section of this Annual Report on Form 10-K and others such as:

- announcements relating to collaborations that we may enter into with respect to the development or commercialization of our product candidates;
- announcements relating to the receipt, modification or termination of government contracts or grants;
- termination or delay of a development program;
- product liability claims related to our clinical trials or product candidates;
- prevailing economic conditions;
- additions or departures of key personnel;
- business disruptions caused by earthquakes or other natural disasters;
- disputes concerning our intellectual property or other proprietary rights;
- FDA or other U.S. or foreign regulatory actions affecting us or our industry;
- sales of our common stock by the company, our executive officers and directors or our stockholders in the future;
- future sales or issuances of equity or debt securities by us;

- lack of an active, liquid and orderly market in our common stock;
- fluctuations in our quarterly operating results; and
- the issuance of new or changed securities analysts' reports or recommendations regarding us.

In addition, the stock markets in general, and the markets for pharmaceutical, biopharmaceutical and biotechnology stocks in particular, have experienced extreme volatility that have been often unrelated to the operating performance of the issuer. These broad market fluctuations may adversely affect the trading price or liquidity of our common stock. In the past, when the market price of a stock has been volatile, holders of that stock have sometimes instituted securities class action litigation against the issuer. If any of our stockholders were to bring such a lawsuit against us, we could incur substantial costs defending the lawsuit and the attention of our management would be diverted from the operation of our business.

Our short operating history may make it difficult for stockholders to evaluate the success of our business to date and to assess our future viability.

We are a clinical-stage biopharmaceutical company with a limited operating history. We commenced active operations in 2014. Our operations to date have been limited to organizing and staffing our company, research and development activities, business planning and raising capital. In April 2018, we announced that we dosed the first patient in our Phase 1b/2a clinical trial of SYN1020 for treatment of hyperammonemia in patients with cirrhosis. Based on the data obtained in this clinical trial, the SYN1020 program was discontinued in August 2019. In April 2018 we dosed our first subject in a Phase 1/2a clinical trial of SYN1618 which is being developed for the treatment of patients with PKU, and in January 2020 we announced that we had dosed the first subject in our Phase 1 clinical trial of SYN1891 which is being developed for the treatment of patients with solid tumors and lymphoma. All of our other therapeutic programs are still in the preclinical development stage. We will need to transition from a company with a research focus to a company capable of supporting clinical development and commercial activities. We have not yet demonstrated our ability to successfully complete large-scale, pivotal clinical trials, obtain marketing approvals, manufacture a commercial-scale product, or arrange for a third-party to do so on our behalf, or conduct sales and marketing activities necessary for successful product commercialization. Typically, it takes many years to develop one new product candidate from the time it is discovered to the time that it becomes available for treating patients. We may encounter unforeseen expenses, difficulties, complications, delays and other known and unknown factors that may hinder our success in commercializing one or more of our product candidates. Further, drug development is a capital-intensive and highly speculative undertaking that involves a substantial degree of risk. You should consider our prospects in light of the costs, uncertainties, delays and difficulties frequently encountered by companies in the early stages of development and clinical trials. Any forward-looking statements regarding our future prospects, plans or viability may not be as accurate as they may be if we had a longer operating history or a history of successfully developing and commercializing pharmaceutical products.

Risks Related to the Development of Our Product Candidates

Clinical trials are costly, time consuming and inherently risky, and we may fail to demonstrate safety and efficacy to the satisfaction of applicable regulatory authorities.

Clinical development of a product candidate is expensive, time consuming and involves significant risk. We cannot guarantee that any clinical trials we undertake to conduct will be conducted as planned or completed on schedule or at all. A failure of one or more clinical trials can occur at any stage of development. Events that may prevent successful or timely completion of clinical development of our product candidates include but are not limited to:

- inability to generate satisfactory preclinical or other nonclinical data, including, toxicology, or other in vivo or in vitro data or diagnostics to support the initiation or continuation of clinical trials;
- delays in reaching agreement on acceptable terms with CROs and clinical trial sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and clinical trial sites;
- delays in obtaining required institutional review board approval at each clinical trial site;
- failure to permit the conduct of a clinical trial by regulatory authorities, after review of an investigational new drug or equivalent foreign application or amendment;
- delays in recruiting qualified patients in our clinical trials;
- failure by clinical sites or CROs or other third parties to adhere to clinical trial requirements;
- failure by us, clinical sites, CROs or other third parties to perform in accordance with the good clinical practices requirements of the FDA or applicable foreign regulatory guidelines;

- patients dropping out of the clinical trials;
- occurrence of adverse events, unacceptable side effects or toxicity issues associated with our product candidates;
- imposition by the FDA of a clinical hold or the requirement by other similar regulatory agencies that one or more clinical trials be delayed or halted;
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols or performing additional nonclinical studies;
- the ultimate affordability of the cost of clinical trials of our product candidates;
- negative or inconclusive results from our clinical trials that may result in us deciding, or regulators requiring us, to conduct additional clinical trials or abandon such clinical trials and/or clinical trials or development programs in other ongoing or planned indications for a product candidate; and
- delays in identifying or reaching agreement on acceptable terms with third-party manufacturers, delays in developing and transferring a reproducible, scalable manufacturing process, or delays or failure in manufacturing sufficient quantities of our product candidates for use in clinical trials.

Any inability to successfully complete clinical development and obtain regulatory approval for our product candidates could result in additional costs to us or impair our ability to generate revenue. In addition, if we make manufacturing or formulation changes to our product candidates, we may need to conduct additional preclinical studies and/or clinical trials, or the results obtained from such new formulation may not be consistent with previous results obtained. Clinical trial delays could also shorten any anticipated periods of patent exclusivity for our product candidates and may allow competitors to develop and bring products to market before we do which could impair our ability to successfully commercialize our product candidates and may harm our business and results of operations.

The approach we are taking to discover and develop novel therapeutics using synthetic biology to create novel medicines is unproven and may never lead to marketable products.

The scientific discoveries that form the basis for our efforts to generate and develop our product candidates are relatively recent. The scientific evidence to support the feasibility of developing drugs based on our approach is both preliminary and limited. Synthetic Biotic medicines represent a novel therapeutic modality and their successful development by us may require additional studies and efforts to optimize their therapeutic potential. Any product candidates that we develop may not demonstrate in patients the therapeutic properties ascribed to them in laboratory and other preclinical studies, and they may interact with human biological systems in unforeseen, ineffective or even harmful ways. If we are not able to successfully develop and commercialize product candidates based upon this technological approach, we may never become profitable and the value of our capital stock may decline.

Our Synthetic Biotic product candidates are based on a relatively novel technology, which makes it difficult to predict the time and cost of development and of subsequently obtaining regulatory approval, if at all.

We have concentrated our research and development efforts to date on a limited number of product candidates based on our Synthetic Biotic therapeutic platform and identifying our initial targeted disease indications. Our future success depends on our successful development of viable product candidates. There can be no assurance that we will not experience problems or delays in developing our product candidates and that such problems or delays will not cause unanticipated costs, or that any such development problems can be solved.

The clinical trial and manufacturing requirements of the FDA, the European Medicines Agency and other regulatory authorities, and the criteria these regulators use to determine the safety and efficacy of a product candidate, vary substantially according to the type, complexity, novelty and intended use and market of the product candidate. The regulatory approval process for novel product candidates such as Synthetic Biotic medicines may be more expensive and take longer than for other, better known or more extensively studied therapeutic modalities. It is difficult to determine how long it will take or how much it will cost to obtain regulatory approvals for our product candidates in either the United States or the European Union or how long it will take to commercialize our product candidates, even if approved for marketing. Approvals by the European Medicines Agency or national regulatory agencies may not be indicative of what the FDA, and vice versa, may require for approval and different or additional preclinical studies or clinical trials may be required to support regulatory approval in each respective jurisdiction. Delay or failure to obtain, or unexpected costs in obtaining, the regulatory approval necessary to bring a potential product candidate to market could decrease our ability to generate sufficient product revenue, and our business, financial condition, results of operations and prospects may be harmed.

We may not be successful in our efforts to use and expand our development platform to build a pipeline of product candidates.

A key element of our strategy is to use our targeted focus and experienced management and scientific team to create Synthetic Biotic medicines that can be deployed against a broad range of human diseases in order to build a pipeline of product candidates. Although our research and development efforts to date have resulted in potential product candidates, we may not be able to continue to identify and develop additional product candidates. Even if we are successful in continuing to build our pipeline, the potential product candidates that we identify may not be suitable for clinical development. For example, these potential product candidates may be shown to have harmful side effects or other characteristics that indicate that they are unlikely to be drugs that will receive marketing approval and achieve market acceptance. If we do not successfully develop and commercialize product candidates based upon our approach, we will not be able to obtain product revenue in future periods, which likely would result in significant harm to our financial position. There is no assurance that we will be successful in our preclinical and clinical development, and the process of obtaining regulatory approvals will, in any event, require the expenditure of substantial time and financial resources.

Our product candidates may cause undesirable side effects or have other properties that could delay or prevent their regulatory approval, limit the commercial viability of an approved label, or result in significant negative consequences following marketing approval, if any.

Undesirable side effects caused by our product candidates could cause us or regulatory authorities to interrupt, delay or terminate our clinical trials or result in a restrictive label or delay regulatory approval by the FDA or comparable foreign authorities. Undesirable side effects and negative results for other indications may negatively impact the development and potential for approval of our product candidates for their proposed indications.

Additionally, even if one or more of our product candidates receives marketing approval, and we or others later identify undesirable side effects caused by such products, potentially significant negative consequences could result, including but not limited to:

- regulatory authorities may withdraw approvals of or revoke licenses for such products;
- regulatory authorities may require additional warnings on the labels of such products;
- we may be required to create a REMS plan, which could include a medication guide outlining the risks of such side effects for distribution to patients, a communication plan for healthcare providers, and/or other elements to assure safe use;
- we could be sued and held liable for harm caused to patients; and
- our reputation may suffer.

Any of these events could prevent us from achieving or maintaining market acceptance of a product candidate, even if approved, and could significantly harm our business, results of operations, and prospects.

Our product development program may not uncover all possible adverse events that patients who take our product candidates may experience. The number of subjects exposed to our product candidates during clinical trials and the average exposure time in the clinical development program may be inadequate to detect rare adverse events, or chance findings, that may only be detected once the product is administered to more patients and for greater periods of time.

Clinical trials by their nature use a sample of the potential patient population. However, with a limited number of patients and limited duration of exposure, we cannot be fully assured that uncommon or severe side effects of our product candidates will be uncovered. Such side effects may only be uncovered with a significantly larger number of patients exposed to the drug. If such safety problems occur or are identified after a product candidate reaches the market, the FDA may require that we amend the labeling of the product or recall the product, or may even withdraw approval for the product. Any of these events could prevent us from achieving or maintaining market acceptance of a product candidate, even if approved, and could significantly harm our business, results of operations, and prospects.

We are heavily dependent on the success of our product candidates. Some of our product candidates have produced results in preclinical settings to date, but none of our product candidates has completed all required clinical trials, and we cannot give any assurance that we will generate data for any of our product candidates sufficient to receive regulatory approval in our planned indications, which will be required before they can be commercialized.

We have invested substantially all of our efforts and financial resources to identify, acquire and develop our portfolio of product candidates. Our future success is dependent on our ability to successfully further develop, obtain regulatory approval for, and commercialize one or more product candidates. We currently generate no revenue from sales of any products, and we may never be able to develop or commercialize a product candidate.

On August 20, 2019, we announced that we were discontinuing our first therapeutic program to enter clinical trials, SYN1020, an early stage clinical product candidate for the treatment of hyperammonemia. The decision to discontinue the program was based on top-line data from an interim analysis of a randomized, double-blind, placebo-controlled Phase 1b/2a study of the Synthetic Biotic medicine in 23 patients with cirrhosis and elevated blood ammonia. While SYN1020 was well tolerated in Phase 1b/2a study, the study showed it did not lower blood ammonia in patients with cirrhosis. As a result, we have become more dependent on the success of our SYN1618 and SYN1891 programs and new early development programs.

In addition, none of our product candidates has advanced into any pivotal clinical trial, for our proposed indications and it may be years before any pivotal clinical trials are initiated and completed, if at all. We are not permitted to market or promote any of our product candidates before we receive regulatory approval from the FDA or comparable foreign regulatory authorities, and we may never receive such regulatory approval for any of our product candidates. We cannot be certain that any of our product candidates will be successful in clinical trials or receive regulatory approval. Further, our product candidates may not receive regulatory approval even if they are successful in clinical trials. If we do not receive regulatory approvals for our product candidates, we may not be able to continue our operations.

If we fail to obtain or maintain orphan drug exclusivity for some of our products, our competitors may obtain approval to sell competing drugs to treat the same conditions and our revenues will be reduced.

As part of our business strategy, we have developed and may in the future develop product candidates that may be eligible for FDA and European Commission orphan drug designation. In October 2017, the FDA granted orphan drug designation to SYN1618 for the treatment of PKU. Under the Orphan Drug Act, the FDA may designate a product as an orphan drug if it is intended to treat, diagnose or prevent rare diseases or conditions that affect fewer than 200,000 people in the United States. In the EU, orphan drug designation may be granted to drugs intended to treat, diagnose or prevent a life-threatening or chronically debilitating disease having a prevalence of no more than five in 10,000 people in the EU. The company that first obtains FDA approval for a designated orphan drug for the associated rare disease receives marketing exclusivity for use of that drug for the stated condition for a period of seven years. Orphan drug exclusive marketing rights may be lost under several circumstances, including a later determination by the FDA that the request for designation was materially defective or if the manufacturer is unable to assure sufficient quantity of the drug. Similar regulations are in effect in the EU with a ten-year period of market exclusivity.

Because the extent and scope of patent protection for some of our product candidates may be limited, obtaining orphan drug designation is especially important for any product candidates that may be eligible for orphan drug designation. For eligible products, we plan to rely on the exclusivity period under the Orphan Drug Act to maintain a competitive position. If we do not obtain orphan drug designation for our product candidates that do not have broad patent protection, our competitors may then seek to sell a competing drug to treat the same condition and our revenues, if any, may be adversely affected thereby.

Even though we have obtained orphan drug designation for certain of our product candidates and intend to seek orphan drug designation for other product candidates, there is no assurance that we will be the first to obtain marketing approval for any particular rare indication. Further, even though we have obtained orphan drug designation for certain of our product candidates, or even if we obtain orphan drug designation for other potential product candidates, such designation may not effectively protect us from competition because different drugs can be approved for the same condition and the same drug can be approved for different conditions and potentially used off-label in the orphan indication. Even after an orphan drug is approved, the FDA can subsequently approve a competing drug for the same condition for several reasons, including, if the FDA concludes that the later drug is safer or 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.

Product development involves a lengthy and expensive process with an uncertain outcome, and results of earlier preclinical studies and clinical trials may not be predictive of future clinical trial results.

The results from preclinical studies or early clinical trials of a product candidate may not predict the results that will be obtained in subsequent subjects or in later stage clinical trials of that product candidate or any other product candidate. Flaws in the design of a clinical trial may not become apparent until the clinical trial is well advanced. We have limited experience in designing clinical trials and we may be unable to design and execute clinical trials to support regulatory approval of our product candidates. In addition, preclinical study and clinical trial data are often susceptible to varying interpretations and analyses. Product candidates that seemingly perform satisfactorily in preclinical studies and clinical trials may nonetheless fail to obtain regulatory approval. There is a high failure rate for drugs proceeding through clinical trials. A number of companies in the pharmaceutical and biotechnology industries have suffered significant setbacks in clinical development even after achieving promising results in earlier studies, and any such setbacks in our clinical development could negatively affect our business and operating results.

If we experience delays or difficulties in the enrollment of patients in clinical trials, our costs might be higher than expected and our receipt of necessary regulatory approvals could be delayed or prevented.

Clinical trials of a new product candidate require the enrollment of a sufficient number of patients suffering from the disease or condition the product candidate is intended to treat and who meet other eligibility criteria. Rates of patient enrollment are affected by many factors, including the size of the potential patient population, the age and condition of the patients, the stage and severity of disease or condition, the nature and requirements of the protocol, the proximity of patients to clinical sites, the availability of effective treatments for the relevant disease or condition, the perceived risks, benefits and convenience of administration of the product candidate being studied, the patient referral practices of physicians, our efforts to facilitate timely enrollment in clinical trials, and the eligibility criteria for the clinical trial. Delays or difficulties in patient enrollment or difficulties retaining trial participants, including as a result of the availability of existing or other investigational treatments, can result in increased costs, longer development times or termination of a clinical trial.

In addition, our success may depend, in part, on our ability to identify patients who qualify for our clinical trials, or are likely to benefit from any product candidate that we may develop, which will require those potential patients to undergo a screening assay for the presence or absence of a particular genetic sequence or clinical trait. Genetically defined diseases generally, and especially those for which our current product candidates are targeted, may have relatively low prevalence. For example, we estimate there are approximately 16,500 patients that may be diagnosed with PKU in the United States. If we, or any third parties that we engage to assist us, are unable to successfully identify patients with these diseases, or experience delays in doing so, then we may not realize the full commercial potential of any product candidate we develop.

We may face potential product liability claims, and, if successful claims are brought against us, we may incur substantial liability and costs. If the use or misuse of our product candidates harms patients, or is perceived to harm patients even when such harm is unrelated to our product candidates, our regulatory approvals, if any, could be revoked or otherwise negatively impacted and we could be subject to costly and damaging product liability claims. If we are unable to obtain adequate insurance or are required to pay for liabilities resulting from a claim excluded from, or beyond the limits of, our insurance coverage, such liability could adversely affect our financial condition.

The use or misuse of our product candidates in clinical trials and the sale of any products for which we may obtain marketing approval exposes us to the risk of potential product liability claims. Product liability claims might be brought against us by consumers, healthcare providers, pharmaceutical companies or others selling or otherwise coming into contact with our product candidates and approved products, if any. There is a risk that our product candidates may induce adverse events. If we cannot successfully defend against product liability claims, we could incur substantial liability and costs. Patients with the diseases targeted by our product candidates may already be in severe and advanced stages of disease and have both known and unknown significant pre-existing and potentially life-threatening health risks. During the course of treatment, patients may suffer adverse events, including death, for reasons that may be related to our product candidates. Such events could subject us to costly litigation, require us to pay substantial amounts of money to injured patients, delay, negatively impact or end our opportunity to receive or maintain regulatory approval to market our products, or require us to suspend or abandon our commercialization efforts. Even in a circumstance in which an adverse event is unrelated to our product candidates, the investigation into the circumstance may be time-consuming or inconclusive. These investigations may delay our regulatory approval process or impact and limit the type of regulatory approvals our product candidates receive or maintain. As a result of these factors, a product liability claim, even if successfully defended, could have a material adverse effect on our business, financial condition or results of operations.

Although we have product liability insurance, which covers any clinical trial we may conduct in the United States, our insurance may be insufficient to reimburse us for any expenses or losses we may suffer. We will also likely be required to increase our product liability insurance coverage for the advanced clinical trials that we plan to initiate. If we obtain marketing approval for any of our product candidates, we will need to expand our insurance coverage to include the sale of commercial products. There is no way to know if we will be able to continue to obtain product liability coverage and obtain expanded coverage we may require, in sufficient amounts to protect us against losses due to liability, on acceptable terms, or at all. We may not have sufficient resources to pay for any liabilities resulting from a claim excluded from, or beyond the limits of, our insurance coverage. Where we have provided indemnities in favor of third parties under our agreements with them, there is also a risk that these third parties could incur liability and bring a claim under such indemnities. An individual may bring a product liability claim against us alleging that one of our product candidates or products causes, or is claimed to have caused, an injury or is found to be unsuitable for consumer use. Any such product liability claims may include allegations of defects in manufacturing, defects in design, a failure to warn of dangers inherent in the product, negligence, strict liability, and a breach of warranties. Claims could also be asserted under state consumer protection acts. Any product liability claim brought against us, with or without merit, could result in:

- withdrawal of clinical trial volunteers, investigators, patients or trial sites or limitations on approved indications;
- the inability to commercialize, or if commercialized, decreased demand for, our product candidates;
- if commercialized, product recalls, withdrawals of labeling, marketing or promotional restrictions or the need for product modification;

- initiation of investigations by regulators;
- loss of revenues;
- substantial costs of litigation, including monetary awards to patients or other claimants;
- liabilities that substantially exceed our product liability insurance, which we would then be required to pay ourselves;
- an increase in our product liability insurance rates or the inability to maintain insurance coverage in the future on acceptable terms, if at all;
- the diversion of management’s attention from our business; and
- damage to our reputation and the reputation of our products and our technology.

Product liability claims may subject us to the foregoing and other risks, which could have a material adverse effect on our business, financial condition or results of operations.

We or third parties upon whom we depend may be adversely affected by natural disasters and/or health epidemics, and our business, financial condition and results of operations could be adversely affected.

Natural disasters could severely disrupt our operations and have a material adverse effect on our business operations. If a natural disaster, health epidemic, or other event beyond our control occurred that prevented us from using all or a significant portion of our office and/or lab spaces, that damaged critical infrastructure, such as the manufacturing facilities of our third-party contract manufacturers, or that otherwise disrupted operations, it may be difficult for us to continue our business for a substantial period of time. In December 2019, a novel strain of coronavirus was reported to have surfaced in Wuhan, China. In January 2020, this coronavirus spread to other parts of the world, including the United States and Europe, and efforts to contain the spread of this coronavirus intensified. On January 30, 2020, the World Health Organization declared the Coronavirus outbreak a “public health emergency of international concern.” The extent to which the coronavirus impacts our results will depend on future developments, which are highly uncertain and cannot be predicted, including new information which may emerge concerning the severity of the coronavirus and the actions to contain the coronavirus or treat its impact, among others.

Should the coronavirus continue to spread in the United States and Europe, our business operations could be delayed or interrupted. For instance, our clinical trials may suffer from lower than anticipated patient registration or enrollment and we may be forced to temporarily delay or pause ongoing trials. Further, if the spread of the coronavirus continues and our operations are impacted, we risk a delay, default and/or nonperformance under our existing agreements arising from force majeure. If either any of the foregoing were to occur, it could materially adversely affect our revenues, financial condition, profitability, and cash flows.

Risks Related to Regulatory Approval of Our Product Candidates and Other Legal Compliance Matters

We may seek breakthrough therapy designation for one or more of our product candidates, but we might not receive such designation, and even if we do, such designation may not lead to a faster development or regulatory review or approval process, and it does not increase the likelihood that our product candidates will receive marketing approval.

We may seek a breakthrough therapy designation from the FDA for some of our product candidates. A breakthrough therapy is defined as a drug or biological product that is intended, alone or in combination with one or more other drugs, to treat a serious or life-threatening disease or condition, and for which preliminary clinical evidence indicates that the drug or biological product may demonstrate substantial improvement over existing therapies on one or more clinically significant endpoints, such as substantial treatment effects observed early in clinical development. For drugs or biological products that have been designated as breakthrough therapies, interaction and communication between the FDA and the sponsor of the trial can help to identify the most efficient path for clinical development. Drugs designated as breakthrough therapies by the FDA could also be eligible for accelerated approval.

Designation as a breakthrough therapy is within the discretion of the FDA. Accordingly, even if we believe one of our product candidates meets the criteria for designation as a breakthrough therapy, the FDA may disagree and instead determine not to make such designation. In any event, the receipt of a breakthrough therapy designation for a product candidate may not result in a faster development process, review or approval compared to drugs considered for approval under conventional FDA procedures and does not assure ultimate approval by the FDA. In addition, even if one or more of our product candidates qualify and are designated as breakthrough therapies, the FDA may later decide that the drugs or biological products no longer meet the conditions for designation and the designation may be rescinded.

We may seek Fast Track designation for one or more of our product candidates, but we might not receive such designation, and even if we do, such designation may not actually lead to a faster development or regulatory review or approval process.

If a product candidate is intended for the treatment of a serious condition and nonclinical or clinical data demonstrate the potential to address unmet medical need for the condition, a product sponsor may apply for FDA Fast-Track designation. We were awarded Fast-Track designation for SYN1618 in April 2018. Fast-Track designation does not ensure that we will receive marketing approval for the product candidate or that approval will be granted within any particular timeframe. We may not experience a faster development or regulatory review or approval process with Fast-Track designation compared to conventional FDA procedures. In addition, the FDA may withdraw Fast-Track designation if it believes that the designation is no longer supported by data from our clinical development program. Fast-Track designation alone does not guarantee qualification for the FDA's priority review procedures.

Even if we obtain regulatory approval for a product candidate, we will remain subject to ongoing regulatory requirements.

If any of our product candidates are approved for marketing, we will be subject to ongoing regulatory requirements, including with respect to manufacturing, labeling, packaging, storage, advertising, promotion, sampling, record-keeping, conduct of post-marketing clinical trials, and submission of safety, efficacy and other post-approval information, including both federal and state requirements in the United States and requirements of comparable foreign regulatory authorities.

Manufacturers and manufacturers' facilities are required to continuously comply with FDA and comparable foreign regulatory authority requirements, including ensuring that quality control and manufacturing procedures conform to current Good Manufacturing Practices (GMP) regulations and corresponding foreign regulatory manufacturing requirements. As such, we and our contract manufacturers will be subject to continual review and inspections to assess compliance with GMP and adherence to commitments made in any BLA or marketing authorization application.

Any regulatory approvals that we receive for our product candidates may be subject to limitations on the approved indicated uses for which the product candidate may be marketed or to the conditions of approval, or contain requirements for potentially costly post-marketing testing, including Phase 4 clinical trials, and surveillance to monitor the safety and efficacy of the product candidate. We will be required to report adverse reactions and production problems, if any, to the FDA and comparable foreign regulatory authorities. Any new legislation addressing drug safety issues could result in delays in product development or commercialization, or increased costs to assure compliance. If our original marketing approval for a product candidate was obtained through an accelerated approval pathway, we could be required to conduct a successful post-marketing clinical trial in order to confirm the clinical benefit for our products. An unsuccessful post-marketing clinical trial or failure to complete such a trial could result in the withdrawal of marketing approval.

If a regulatory agency discovers previously unknown problems with a product, such as adverse events of unanticipated severity or frequency, or problems with the facility where the product is manufactured, or disagrees with the promotion, marketing or labeling of a product, the regulatory agency may impose restrictions on that product or us, including requiring withdrawal of the product from the market. If we fail to comply with applicable regulatory requirements, a regulatory agency or enforcement authority may, among other things:

- issue warning letters;
- impose civil or criminal penalties;
- suspend or withdraw regulatory approval or revoke a license;
- suspend any of our ongoing clinical trials;
- refuse to approve pending applications or supplements to approved applications submitted by us;
- impose restrictions on our operations, including closing our contract manufacturers' facilities; or
- require a product recall.

Any government investigation of alleged violations of law would be expected to require us to expend significant time and resources in response and could generate adverse publicity. Any failure to comply with ongoing regulatory requirements may significantly and adversely affect our ability to develop and commercialize our products and our value and operating results would be adversely affected.

Inadequate 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 business 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 can be affected by a variety of factors, including government budget and funding levels, ability to hire and retain key personnel and accept the 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 and/or approved by necessary government agencies, which would adversely affect our business. For example, over the last several years, 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. 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 capitalize and continue our operations.

Healthcare legislative reform measures may have a material adverse effect on our financial condition or results of operations.

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 was intended to substantially change the way health care is financed by both governmental health programs and private insurers, and significantly impact the U.S. pharmaceutical industry. The ACA, among other things, introduced 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 specified branded prescription drugs, and promotes a new Medicare Part D coverage gap discount program.

The ACA has been under scrutiny by the U.S. Congress almost since its passage, and certain sections of the ACA have not been fully implemented or effectively repealed. As a result, its longevity continues to be uncertain. In addition, ongoing initiatives in the U.S. have increased and will continue to increase pressure on drug pricing. The announcement or adoption of any such initiative could have an adverse effect on potential revenues from any product candidate that we may successfully develop.

It is anticipated that the ACA, as well as other healthcare reform measures that may be adopted in the future, may result in more rigorous coverage criteria and an additional downward pressure on the reimbursement our customers may receive for our products. Further, there have been judicial and Congressional challenges to certain aspects of the ACA, and it is expected there will be additional challenges and amendments to the ACA in the future, especially with the recent change in administration. Any reduction in reimbursement from Medicare and other government programs may result in a similar reduction in payments from private payors. The implementation of cost containment measures or other healthcare reforms may prevent us from being able to generate revenue, attain profitability or commercialize our products.

We may be subject, directly or indirectly, to federal and state healthcare fraud and abuse laws, false claims laws, and health information privacy and security laws. If we are unable to comply, or have not fully complied, with such laws, we could face substantial penalties.

If we obtain FDA approval for any of our product candidates and begin commercializing those products in the United States, our operations may be subject to various federal and state fraud and abuse laws, including, without limitation, the federal Anti-Kickback Statute, the federal False Claims Act, and physician sunshine laws and regulations. These laws may impact, among other things, our proposed sales, marketing, and education programs. In addition, we may be subject to patient privacy regulation by both the federal government and the states in which we conduct our business. The laws that may affect our ability to operate include:

- the federal Anti-Kickback Statute, which prohibits, among other things, persons from knowingly and willfully soliciting, receiving, offering or paying remuneration, directly or indirectly, to induce, or in return for, the purchase or recommendation of an item or service reimbursable under a federal healthcare program, such as the Medicare and Medicaid programs;

- federal civil and criminal false claims laws and civil monetary penalty laws, which prohibit, among other things, individuals or entities from knowingly presenting, or causing to be presented, claims for payment from Medicare, Medicaid, or other third-party payors that are false or fraudulent;
- the federal Health Insurance Portability and Accountability Act of 1996 (HIPAA), which created new federal criminal statutes that prohibit executing a scheme to defraud any healthcare benefit program and making false statements relating to healthcare matters;
- HIPAA, as amended by the Health Information Technology and Clinical Health Act, and its implementing regulations, which imposes specified requirements relating to the privacy, security, and transmission of individually identifiable health information;
- the federal physician sunshine requirements under the ACA require manufacturers of drugs, devices, biologics, and medical supplies to report annually to the U.S. Department of Health and Human Services information related to payments and other transfers of value to physicians, other healthcare providers, and teaching hospitals, and ownership and investment interests held by physicians and other healthcare providers and their immediate family members and applicable group purchasing organizations; and
- state law equivalents of each of the above federal laws, such as anti-kickback and false claims laws that may apply to items or services reimbursed by any third-party payor, including governmental and private payors, 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 and other potential referral sources; state 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 laws governing the privacy and security of health information in specified circumstances, many of which differ from each other in significant ways and may not have the same effect, thus complicating compliance efforts.

Because of the breadth of these laws and the narrowness of the statutory exceptions and safe harbors available, it is possible that some of our business activities could be subject to challenge under one or more of such laws. In addition, recent health care reform legislation has strengthened these laws. For example, the ACA, among other things, amends the intent requirement of the federal anti-kickback and criminal healthcare fraud statutes. A person or entity no longer needs to have actual knowledge of this statute or specific intent to violate it. Moreover, the ACA provides that the government may assert that 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 False Claims Act.

If our operations are found to be in violation of any of the laws described above or any other governmental regulations that apply to us, we may be subject to penalties, including civil and criminal penalties, damages, fines, exclusion from participation in government health care programs, such as Medicare and Medicaid, imprisonment, and the curtailment or restructuring of our operations, any of which could adversely affect our ability to operate our business and our results of operations.

We may be subject to, or may in the future become subject to, U.S. federal and state, and foreign laws and regulations imposing obligations on how we collect, use, disclose, store and process personal information. Our actual or perceived failure to comply with such obligations could result in liability or reputational harm and could harm our business. Ensuring compliance with such laws could also impair our efforts to maintain and expand our customer base, and thereby decrease our revenue.

In many activities, including the conduct of clinical trials, we are subject to laws and regulations governing data privacy and the protection of health-related and other personal information. These laws and regulations govern our processing of personal data, including the collection, access, use, analysis, modification, storage, transfer, security breach notification, destruction and disposal of personal data. We must comply with laws and regulations associated with the international transfer of personal data based on the location in which the personal data originates and the location in which it is processed. Although there are legal mechanisms to facilitate the transfer of personal data from the European Economic Area (EEA), and Switzerland to the United States, the decision of the European Court of Justice that invalidated the safe harbor framework has increased uncertainty around compliance with EU privacy law requirements. As a result of the decision, it was no longer possible to rely on safe harbor certification as a legal basis for the transfer of personal data from the European Union to entities in the United States. In February 2016, the European Commission announced an agreement with the Department of Commerce, or DOC, to replace the invalidated safe harbor framework with a new EU-U.S. "Privacy Shield." On July 12, 2016, the European Commission adopted a decision on the adequacy of the protection provided by the Privacy Shield. The Privacy Shield is intended to address the requirements set out by the European Court of Justice in its recent ruling by imposing more stringent obligations on companies, providing stronger monitoring and enforcement by the DOC and Federal Trade Commission and making commitments on the part of public authorities regarding access to information.

The privacy and security of personally identifiable information stored, maintained, received or transmitted, including electronically, is subject to significant regulation in the United States and abroad. While we strive to comply with all applicable privacy and security laws and regulations, legal standards for privacy continue to evolve and any failure or perceived failure to comply may result in proceedings or actions against us by government entities or others, or could cause reputational harm, which could have a material adverse effect on our business.

Numerous foreign, federal and state laws and regulations govern collection, dissemination, use and confidentiality of personally identifiable health information, including state privacy and confidentiality laws (including state laws requiring disclosure of breaches); federal and state consumer protection and employment laws; HIPAA; and European and other foreign data protection laws. These laws and regulations are increasing in complexity and number, may change frequently and sometimes conflict.

HIPAA establishes a set of national privacy and security standards for the protection of individually identifiable health information, including protected health information, or PHI, by health plans, certain healthcare clearinghouses and healthcare providers that submit certain covered transactions electronically, or covered entities, and their “business associates,” which are persons or entities that perform certain services for, or on behalf of, a covered entity that involve creating, receiving, maintaining or transmitting PHI. While we are not currently a covered entity or business associate under HIPAA, we may receive identifiable information from these entities. Failure to receive this information properly could subject us to HIPAA’s criminal penalties, which may include fines up to \$250,000 per violation and/or imprisonment. In addition, responding to government investigations regarding alleged violations of these and other laws and regulations, even if ultimately concluded with no findings of violations or no penalties imposed, can consume company resources and impact our business and, if public, harm our reputation.

In addition, various states, such as California and Massachusetts, have implemented similar privacy laws and regulations, such as the California Confidentiality of Medical Information Act, that impose restrictive requirements regulating the use and disclosure of health information and other personally identifiable information. In addition to fines and penalties imposed upon violators, some of these state laws also afford private rights of action to individuals who believe their personal information has been misused. California’s patient privacy laws, for example, provide for penalties of up to \$250,000 and permit injured parties to sue for damages. The interplay of federal and state laws may be subject to varying interpretations by courts and government agencies, creating complex compliance issues for us and our clients and potentially exposing us to additional expense, adverse publicity and liability. Further, as regulatory focus on privacy issues continues to increase and laws and regulations concerning the protection of personal information expand and become more complex, these potential risks to our business could intensify.

In addition, the interpretation and application of consumer, health-related, and data protection laws are often uncertain, contradictory, and in flux.

U.S.-based companies may certify compliance with the privacy principles of the Privacy Shield. Certification to the Privacy Shield, however, is not mandatory. If a U.S.-based company does not certify compliance with the Privacy Shield, it may rely on other authorized mechanisms to transfer personal data.

The privacy and data security landscape is still in flux. In October 2016, an action for annulment of the European Commission decision on the adequacy of Privacy Shield was brought before the European Court of Justice by three French digital rights advocacy groups, La Quadrature du Net, French Data Network and the Fédération FDN. This case, Case T738/16, is currently pending before the European Court of Justice. Should the European Court of Justice invalidate the Privacy Shield, it will no longer be possible to transfer data from the European Union to entities in the United States under a Privacy Shield certification, in which case other legal mechanisms would need to be put in place.

In addition, the European Parliament and the Council of the European Union adopted a comprehensive general data privacy regulation (“GDPR”) in 2016 to replace the current European Union Data Protection Directive and related country-specific legislation. The GDPR took effect in May 2018 and governs the collection and use of personal data in the European Union. The GDPR, which is wide-ranging in scope, will impose several requirements relating to the consent of the individuals to whom the personal data relates, the information provided to the individuals, the security and confidentiality of the personal data, data breach notification and the use of third party processors in connection with the processing 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, enhances enforcement authority and imposes large penalties for noncompliance, including the potential for fines of up to €20 million or 4% of the annual global revenues of the infringer, whichever is greater.

The legislative and regulatory landscape for privacy and data security continues to evolve, and there has been an increasing focus on privacy and data security issues which may affect our business. Failure to comply with current and future laws and regulations could result in government enforcement actions (including the imposition of significant penalties), criminal and civil liability for us and our officers and directors, private litigation and/or adverse publicity that negatively affects our business.

In the United States, California recently adopted the California Consumer Privacy Act of 2018, or CCPA, which came into effect beginning in January 2020. The CCPA has been characterized as the first “GDPR-like” privacy statute to be enacted in the United States because it mirrors a number of the key provisions of the EU General Data Protection Regulation. The CCPA establishes a new privacy framework for covered businesses by creating an expanded definition of personal information, establishing new data privacy rights for consumers in the State of California, imposing special rules on the collection of consumer data from minors, and creating a new and potentially severe statutory damages framework for violations of the CCPA and for businesses that fail to implement reasonable security procedures and practices to prevent data breaches.

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 our business, financial condition or results of operations.

Our research and development activities and our third-party manufacturers’ and suppliers’ activities involve the controlled storage, use, and disposal of hazardous materials, including the components of our product candidates and other hazardous compounds. We and our manufacturers and suppliers are subject to laws and regulations governing the use, manufacture, storage, handling, and disposal of these hazardous materials. In some cases, these hazardous materials and various wastes resulting from their use are stored at our and our manufacturers’ facilities pending their use and disposal. We cannot eliminate the risk of contamination, which could cause an interruption of our research and development efforts, commercialization efforts and business operations and 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 us and 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 specified materials and/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. Given the nature of the research and development work conducted by us, we do not currently carry biological or hazardous waste insurance coverage.

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

To develop, manufacture and sell certain products outside the United States, we must dedicate resources to comply with numerous laws and regulations in each jurisdiction in which we operate. The Foreign Corrupt Practices Act (FCPA), prohibits any United States individual or business from paying, offering, authorizing payment or offering 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 may be considered government employees or foreign officials. In other circumstances, certain payments to hospitals in connection with 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 non-United States nationals, of information classified for national security purposes, as well as certain products and technical data relating to those products. These laws may preclude us from developing, manufacturing, or selling certain products and product candidates outside of the U.S., 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 SEC also may suspend or bar issuers from trading securities on U.S. exchanges for violations of the FCPA’s accounting provisions and export control laws.

Our internal computer systems, or those of our collaborators or other contractors or consultants, may fail or suffer security breaches, which could result in a material disruption of our product development programs.

Our internal computer systems and those of our current and any future collaborators and other contractors or consultants are vulnerable to damage from computer viruses, unauthorized access, natural disasters, terrorism, war and telecommunication and electrical failures. 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, whether due to a loss of our trade secrets or other proprietary information or other similar disruptions. For example, the loss of preclinical or clinical trial data could result in delays in our regulatory approval efforts and significantly increase our costs to recover or reproduce the data. 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, our competitive position could be harmed, and the further development and commercialization of our product candidates could be delayed.

Ethical, legal and social concerns about synthetic biology and genetic engineering could limit or prevent the use of our technologies and limit our revenues.

Our technologies involve the use of synthetic biology and genetic engineering. Public perception about the safety and environmental hazards of, and ethical concerns over, synthetic biology and genetic engineering could influence public acceptance of our technologies, product candidates and processes. If we and our collaborators are not able to overcome the ethical, legal and social concerns relating to synthetic biology and genetic engineering, our technologies, product candidates and processes may not be accepted. These concerns could result in increased expenses, regulatory scrutiny and increased regulation, trade restrictions on imports of Synthetic Biotic medicines, delays or other impediments to our programs or the public acceptance and commercialization of Synthetic Biotic medicines. Further, there is a risk that Synthetic Biotic medicines made using our technologies could result in adverse health effects or other adverse events, which could also lead to negative publicity. We design and produce product candidates with characteristics comparable or disadvantaged to those found in naturally occurring organisms or enzymes in a controlled laboratory; however, the release of such organisms into uncontrolled environments could have unintended consequences. Any adverse effect resulting from such a release could have a material adverse effect on our business, financial condition or results of operations and we may have exposure to liability for any resulting harm.

Risks Related to Our Intellectual Property

We may not be successful in obtaining or maintaining necessary rights to Synthetic Biotic medicines, product candidates and processes for our development pipeline through acquisitions and in-licenses.

Presently, we have rights to certain intellectual property, through licenses from third parties and under patents and patent applications owned by us. The growth of our business will likely depend in part on our ability to obtain, maintain or enforce our and our licensors' intellectual property rights and to acquire or in-license additional proprietary rights. For example, our programs may involve additional product candidates or delivery systems that may require the use of additional proprietary rights held by third parties. Our ultimate product candidates may also require specific formulations to work effectively and efficiently. These formulations may be covered by intellectual property rights held by others. We may be unable to acquire or in-license any relevant third-party intellectual property rights that we identify as necessary or important to our business operations.

In addition, our product candidates may require specific formulations to work effectively and efficiently and these rights may be held by other third parties. We may be unable to develop, acquire or in-license compositions, methods of use, processes or other third-party intellectual property rights from third parties that we identify. The licensing and acquisition of third-party intellectual property rights is a competitive area, and a number of other companies may also be pursuing strategies to license or acquire third-party intellectual property rights that we may consider attractive. These companies could have a competitive advantage over us due to their size, cash resources and greater clinical development and commercialization capabilities.

For example, we have previously and may continue to collaborate with academic institutions to accelerate our preclinical research or development under written agreements with these institutions. Typically, these institutions provide an option to negotiate a license to any of the institution's rights in technology resulting from the collaboration. Regardless of such right of first negotiation for intellectual property, we may be unable to negotiate a license within the specified time frame or under terms that are acceptable to it. If we are unable to do so, the institution may offer the intellectual property rights to other parties, potentially blocking our ability to pursue our program.

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. If we are unable to successfully obtain rights to third-party intellectual property rights, our business, financial condition and prospects for growth could suffer.

We intend to rely on patent rights and the status of our product candidates, if approved, as biologics eligible for exclusivity under the Biologics Price Competition and Innovation Act (BPCIA). If Synlogic is unable to obtain or maintain exclusivity from the combination of these approaches, Synlogic may not be able to compete effectively in our markets.

We rely or will rely upon a combination of patents, trade secret protection, and confidentiality agreements to protect the intellectual property related to our technologies and product candidates. Our success depends in large part on our and our licensors' ability to obtain regulatory exclusivity and maintain patent and other intellectual property protection in the United States and in other countries with respect to our proprietary technology and products.

We have sought to protect our proprietary position by filing patent applications in the United States and abroad related to our product candidates that are important to our business. This process is expensive and time consuming, and we may not be able to file and prosecute all necessary or desirable patent applications at a reasonable cost or in a timely manner. It is also possible that we will fail to identify patentable aspects of our research and development output before it is too late to obtain patent protection.

The patent position of biotechnology and pharmaceutical companies generally is highly uncertain and involves complex legal and factual questions for which legal principles remain unsolved. The patent applications that we own or in-license may fail to result in issued patents with claims that cover our product candidates in the United States or in other foreign countries. There is no assurance that all potentially relevant prior art relating to our patents and patent applications has been found, which can invalidate a patent or prevent a patent from issuing from a pending patent application. Even if patents do successfully issue, and even if such patents cover our product candidates, third parties may challenge their validity, enforceability, or scope, which may result in such patents being narrowed, found unenforceable or invalidated. Furthermore, even if they are unchallenged, our patents and patent applications may not adequately protect our intellectual property, provide exclusivity for our product candidates, or prevent others from designing around our claims. Any of these outcomes could impair our ability to prevent competition from third parties, which may have an adverse impact on our business.

We, independently or together with our licensors, have filed several patent applications covering various aspects of our product candidates. We cannot offer any assurances about which, if any, patents will issue, the breadth of any such patent or whether any issued patents will be found invalid and unenforceable or will be threatened by third parties. Any successful opposition to these patents or any other patents owned by or licensed to us after patent issuance could deprive us of rights necessary for the successful commercialization of any product candidates that we may develop. Further, if we encounter delays in regulatory approvals, the period of time during which we could market a product candidate under patent protection could be reduced.

Even if we cannot obtain and maintain effective protection of exclusivity from our regulatory efforts and intellectual property rights, including patent protection, data exclusivity or orphan drug exclusivity, for our product candidates, we believe that our product candidates will be protected by exclusivity that prevents approval of a biosimilar in the United States for a period of twelve years from the time the product to which it claims similarity was first approved. However, The Biologics Price Competition and Innovation Act of 2009, Title VII, Subtitle A of the Patent Protection and Affordable Care Act, Pub.L.No.111-148, 124 Stat.119, Sections 7001-02 signed into law March 23, 2010, and codified in 42 U.S.C. §262 (the BPCIA), created an elaborate and complex patent dispute resolution mechanism for biosimilars that could prevent us from launching our product candidates in the United States or could substantially delay such launches. Current biosimilars litigation are addressing certain requirements of the BPCIA which is creating uncertainty over how certain terms of the BPCIA should be construed and this, presents uncertainty for both the biologics innovator and biosimilar party. The BPCIA mechanism required for biosimilar applicants may pose greater risk that patent infringement litigation will disrupt our activities and add increased expenses as well as divert management's attention. If a biosimilar version of one of our product candidates were approved in the United States, it could have a negative effect on our business.

We may not have sufficient patent term protections for our product candidates to effectively protect our business.

Patents have a limited term. In the United States, the statutory expiration of a patent is generally 20 years after it is filed. Although various extensions may be available, the life of a patent, and the protection it affords, is limited. Even if patents covering our product candidates are obtained, once the patent life has expired for a product candidate, we may be open to competition. In addition, upon issuance in the United States any patent term can be adjusted based on specified delays caused by the applicant(s) or the USPTO.

Patent term extensions under the Hatch-Waxman Act in the United States and under supplementary protection certificates in Europe may be available to extend the patent or data exclusivity terms of our product candidates. We will likely seek patent term extensions, and we cannot provide any assurances that any such patent term extensions will be obtained and, if so, for how long. As a result, we may not be able to maintain exclusivity for our product candidates for an extended period after regulatory approval, if any, which would negatively impact our business, financial condition, results of operations and prospects. If we do not have sufficient patent terms or regulatory exclusivity to protect our product candidates, our business and results of operations will be adversely affected.

Changes in U.S. patent law could diminish the value of patents in general, thereby impairing our ability to protect our products, and recent patent reform legislation could increase the uncertainties and costs surrounding the prosecution of our patent applications and the enforcement or defense of our issued patents.

As is the case with other biotechnology companies, our success is heavily dependent on patents. Obtaining and enforcing patents in the biotechnology industry involves both technological and legal complexity, and is therefore costly, time-consuming and inherently uncertain. In addition, the United States has recently enacted and is currently implementing wide-ranging patent reform legislation. Recent U.S. Supreme Court rulings have narrowed the scope of patent protection available in specified circumstances and weakened the rights of patent owners in specified situations. In addition to increasing uncertainty with regard to our ability to obtain patents in the future, this combination of events has created uncertainty with respect to the value of patents, once obtained. Depending on decisions by the U.S. Congress, the federal courts, and the USPTO, the laws and regulations governing patents could change in unpredictable ways that would weaken our ability to obtain new patents or to enforce our existing patents and patents that we might obtain in the future.

If we are unable to maintain effective proprietary rights for our product candidates or any future product candidates, we may not be able to compete effectively in our proposed markets.

In addition to the protection afforded by patents, we rely on trade secret protection and confidentiality agreements to protect proprietary know-how that is not patentable or that we elect not to patent. We also utilize processes for which patents are difficult to enforce. In addition, other elements of our products, and many elements of our product candidate discovery and development processes involve proprietary know-how, information or technology that is not covered by patents. Trade secrets may be difficult to protect. We seek to protect our proprietary technology and processes, in part, by entering into confidentiality agreements with our employees, consultants, collaborators, advisors, independent contractors or other third parties. We also seek to preserve the integrity and confidentiality of our data and trade secrets, including by maintaining physical and electronic security of our premises and our information technology systems. While 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, competitors may otherwise gain access to our trade secrets or independently develop substantially equivalent information and techniques. Furthermore, the laws of some foreign countries do not protect proprietary rights to the same extent or in the same manner as the laws of the United States. As a result, we may encounter significant problems in protecting and defending our intellectual property both in the United States and abroad. If we are unable to prevent unauthorized material disclosure of our intellectual property to third parties, or misappropriation of our intellectual property by third parties, we may not be able to establish or maintain a competitive advantage in our market, which could materially adversely affect our business, operating results, and financial condition.

Although we expect all of our employees and consultants to assign their inventions to us, and all of our employees, consultants, collaborators, advisors, independent contractors and any third parties who have access to our proprietary know-how, information, or technology to enter into confidentiality agreements, we cannot provide any assurances that all such agreements have been duly executed or that our trade secrets and other confidential proprietary information will not be disclosed or that competitors will not otherwise gain access to our trade secrets or independently develop substantially equivalent information and techniques. Misappropriation or unauthorized disclosure of our trade secrets could impair our competitive position and may have a material adverse effect on our business, financial condition or results of operations. Additionally, if the steps taken to maintain our trade secrets are deemed inadequate, we may have insufficient recourse against third parties for misappropriating the trade secret.

Third-party claims of intellectual property infringement may prevent or delay our development and commercialization efforts.

Our commercial success depends in part on our ability to develop, manufacture, market and sell our product candidates and use our proprietary technology without infringing the patent rights of third parties. Numerous third-party U.S. and non-U.S. issued patents and pending applications exist in the area of Synthetic Biotic medicines. We are aware of U.S. and foreign patents and pending patent applications owned by third parties that cover similar therapeutic uses as the product candidates we are developing. We are currently monitoring these patents and patent applications. We may in the future pursue available proceedings in the U.S. and foreign patent offices to challenge the validity of these patents and patent applications. In addition, or alternatively, we may consider whether to seek to negotiate a license of rights to technology covered by one or more of such patents and patent applications. If any patents or patent applications cover our product candidates or technologies, we may not be free to manufacture or market our product candidates as planned, absent such a license, which may not be available to us on commercially reasonable terms, or at all.

It is also possible that we have failed to identify relevant third-party patents or applications. For example, applications filed before November 29, 2000 and applications filed after that date that will not be filed outside the United States remain confidential until patents issue. Moreover, it is difficult for industry participants, including us, to identify all third-party patent rights that may be relevant to our product candidates and technologies because patent searching is imperfect due to differences in terminology among patents, incomplete databases and the difficulty in assessing the meaning of patent claims. We may fail to identify relevant patents or patent applications or may identify pending patent applications of potential interest but incorrectly predict the likelihood that such

patents may issue with claims of relevance to our technology. In addition, we may be unaware of one or more issued patents that would be infringed by the manufacture, sale or use of a current or future product candidate, or we may incorrectly conclude that a third-party patent is invalid, unenforceable or not infringed by our activities. Additionally, pending patent applications that have been published can, subject to specified limitations, be later amended in a manner that could cover our technologies, our product candidates or the use of our product candidates.

There have been many lawsuits and other proceedings filed by third parties involving patent and other intellectual property rights in the biotechnology and pharmaceutical industries, including patent infringement lawsuits, interferences, oppositions, and reexamination, post-grant review and equivalent proceedings before the USPTO and corresponding foreign patent offices. Numerous U.S. and foreign issued patents and pending patent applications, which are owned by third parties, exist in the fields in which we are developing product candidates. As the biotechnology and pharmaceutical industries expand and more patents are issued, the risk increases that our product candidates may be subject to claims of infringement of the patent rights of third parties.

Parties making claims against us may obtain injunctive or other equitable relief, which could effectively block our ability to further develop and commercialize one or more of our product candidates. Defense of these claims, regardless of their merit, would involve substantial litigation expense and would be a substantial diversion of employee resources from our business. In the event of a successful claim of infringement against us, we may have to pay substantial damages, including treble damages and attorneys' fees for willful infringement, pay royalties, redesign our infringing products or obtain one or more licenses from third parties, which may be impossible or require substantial time and monetary expenditure.

We depend, in part, on our licensors to file, prosecute, maintain, defend and enforce patents and patent applications that are material to our business.

While we normally seek and gain the right to fully prosecute the patent applications relating to our product candidates, there may be times when the patent applications enabling our product candidates are controlled by our licensors. If any of our existing or future licensors fail to appropriately and broadly prosecute and maintain patent protection for patents covering any of our product candidates, our ability to develop and commercialize those product candidates may be adversely affected and we may not be able to prevent competitors from making, using, importing, and selling competing products. In addition, even where we now have the right to control patent prosecution of patents and patent applications we have licensed from third parties, we may still be adversely affected or prejudiced by actions or inactions of our licensors in effect from actions prior to us assuming control over patent prosecution.

If we fail to comply with obligations in the agreements under which we license intellectual property and other rights from third parties or otherwise experience disruptions to our business relationships with our licensors, we could lose license rights that are important to our business.

We are a party to certain intellectual property license agreements and expect to enter into additional license agreements in the future. Our existing agreements impose, and future license agreements may impose, certain obligations, including the payment of milestones and royalties based on revenues from sales of our products utilizing the technologies licensed from our licensors, and such obligations could adversely affect the overall profitability for us of any products that we may seek to commercialize. In addition, we will need to outsource and rely on third parties for many aspects of the clinical development, sales and marketing of our product candidates covered under our license agreements. Delay or failure by these third parties could adversely affect the continuation of our license agreements with our third-party licensors. If we fail to comply with our obligations under these agreements, or we are subject to a bankruptcy, these agreements may be subject to termination by the licensor which could have a material adverse effect on our business.

We may be involved in lawsuits to protect or enforce our patents or the patents of our licensors, which could be expensive, time consuming, and unsuccessful.

Competitors may infringe our patents or the patents of our licensors. To cease such infringement or unauthorized use, we or one of our licensing partners may be required to file patent infringement claims against a third-party to enforce one of our patents which can be expensive, time-consuming and unpredictable. In addition, in an infringement proceeding or a declaratory judgment action against us, a court may decide that one or more of our patents is not valid or is unenforceable, or may refuse to stop the other party from using the technology at issue on the grounds that our patents do not cover the technology in question. An adverse result in any litigation or defense proceeding could put one or more of our patents at risk of being invalidated, held unenforceable or interpreted narrowly and could put our patent applications at risk of not issuing. Defense of these claims, regardless of their merit, would involve substantial litigation expense and would be a substantial diversion of employee resources from our business.

If we or one of our licensing partners were to initiate legal proceedings against a third-party to enforce a patent covering one of our product candidates, the defendant could counterclaim that the patent covering our product candidate is invalid and/or unenforceable. In patent litigation in the United States, defendant counterclaims alleging invalidity and/or unenforceability are commonplace, and there are numerous grounds upon which a third-party can assert invalidity or unenforceability of a patent. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, including lack of novelty, obviousness, written description, clarity 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 also raise similar claims before administrative bodies in the United States or other jurisdictions, even outside the context of litigation. Such mechanisms include re-examination, inter partes review, post-grant review and equivalent proceedings in foreign jurisdictions, such as opposition or derivation proceedings. Such proceedings could result in revocation or amendment to our patents in such a way that they no longer cover and protect our product candidates. The outcome following legal assertions of invalidity and unenforceability is unpredictable. With respect to the validity of our patents, for example, we cannot be certain that there is no invalidating prior art of which we, our patent counsel, and the patent examiner were unaware during prosecution. If a defendant were to prevail on a legal assertion of invalidity, unpatentability and/or unenforceability, we may lose at least part, and perhaps all, of the patent protection on our product candidates. Such a loss of patent protection could have a material adverse impact on our business.

Interference or derivation proceedings provoked by third parties or brought by us or declared by the USPTO may be necessary to determine the priority of inventions or correct inventorship with respect to our patents or patent applications or those of our licensors. An unfavorable outcome could result in a loss of our current patent rights and could require us to cease using the related technology or to attempt to license rights to us from the prevailing party. Our business could be harmed if the prevailing party does not offer us a license on commercially reasonable terms. Our defense of litigation, derivation or interference proceedings may result in a decision adverse to our interests and, even if successful, may result in substantial costs and distract our management and other employees. In addition, we may be unable to raise the funds necessary to conduct our clinical trials, continue our research programs, license necessary technology from third parties, or enter into development partnerships that would help us bring our product candidates to market.

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. There could also be public announcements of the results of hearings, motions, or other interim proceedings or developments. Any disclosure of confidential information could adversely affect our business. 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.

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

We may in the future be subject to claims that former employees, consultants, collaborators, advisors, independent contractors or other third parties have an interest in our patents or other intellectual property as an inventor or co-inventor or other claims challenging the inventorship of our patents or ownership of our intellectual property (including patents and intellectual property that we in-license). Therefore, our rights to these patents may not be exclusive and third parties, including competitors, may have access to intellectual property that is important to our business. In addition, co-owners from whom we do not yet have a license or assignment may raise claims surrounding inventorship or ownership of patents that ultimately issue from this patent family, potentially resulting in issued patents to which we would not have rights under our existing license agreements. Further, in jurisdictions outside the United States, a license may not be enforceable unless all the owners of the intellectual property agree or consent to the license. In addition, we may have inventorship disputes arising from conflicting obligations of consultants or others who are involved in developing our product candidates. Litigation may be necessary to defend against these and other claims challenging inventorship of our patents. 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, valuable intellectual property. Such an outcome could have a material adverse effect on our business. 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.

We may be subject to claims that our employees, consultants, collaborators, advisors, independent contractors or other third parties have wrongfully used or disclosed confidential information of third parties or that our employees have wrongfully used or disclosed alleged trade secrets of their former employers.

We have received confidential and proprietary information from third parties. In addition, we employ individuals who were previously employed at universities, academic research institutions and at other biotechnology or pharmaceutical companies, including our competitors or potential competitors. Although we have written agreements with and make every effort to ensure that our employees, consultants, collaborators, advisors, independent contractors or other third parties do not use the proprietary information or intellectual property rights of others in their work for us, we may in the future be subject to claims that our employees, consultants, collaborators, advisors, independent contractors or other third parties have inadvertently or intentionally used or disclosed confidential information of these third parties. 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, which could adversely impact our business. 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.

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

We have limited intellectual property rights outside the United States. Filing, prosecuting, and defending patents on product candidates in all countries throughout the world would be prohibitively expensive, and intellectual property rights in some countries outside the United States can have a different scope and strength and be less extensive than those in the United States. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as federal and state laws in the United States. Consequently, we may not be able to prevent third parties (including competitors) 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, further, may export otherwise infringing products to territories where we have patent protection, but where enforcement rights are not as strong as those 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.

Many companies have encountered significant problems in protecting and defending intellectual property rights in foreign jurisdictions. The legal systems of some countries, particularly some developing countries, do not favor the enforcement of patents, trade secrets, and other intellectual property protection, particularly those relating to biopharmaceutical products, which could make it difficult in those jurisdictions for us to stop the infringement or misappropriation of our patents or other intellectual property rights, or the marketing of competing products in violation of our proprietary rights. Proceedings to enforce our patents and other intellectual property rights in foreign jurisdictions, whether or not successful, could result in substantial costs and divert our efforts and attention from other aspects of our business. Furthermore, such proceedings could put our patents at risk of being invalidated, held unenforceable or interpreted narrowly and could put our patent applications at risk of not issuing and could provoke third parties to assert claims of infringement or misappropriation 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 rights around the world may be inadequate to obtain a significant commercial advantage from the intellectual property that we develop or license.

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

We have filed for trademark registration of certain marks relating to our current branding. If our trademarks and trade names are not adequately protected, we may not be able to build name recognition in our markets of interest and our business may be adversely affected. Our 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 may adopt trade names or trademarks similar to ours, thereby impeding our ability to build brand identity and possibly leading to market confusion. 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 unregistered trademarks or trade names. Over the long term, if we are unable to successfully register our trademarks and trade names and 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 impact our financial condition or results of operations.

Risks Related to Our Reliance on Third Parties

We rely, and expect to continue to rely, on third parties to conduct some aspects of our product formulation, research, preclinical, and clinical studies, and those third parties may not perform satisfactorily, including by failing to meet deadlines for the completion of such formulation, research or testing.

We do not independently conduct all aspects of our drug discovery activities, compound development or preclinical studies of product candidates. We currently rely, and expect to continue to rely, on third parties to conduct some aspects of our research and

development and preclinical studies. Any of these third parties may terminate their engagements with us at any time. If we need to enter into alternative arrangements, it would delay our product development activities. Our reliance on these third parties for research and development activities reduces our control over these activities but does not relieve us of our responsibilities. For example, for product candidates that we develop and commercialize on our own, we will remain responsible for ensuring that each of our studies that support our clinical trial applications and our clinical trials are conducted in accordance with the study plan and protocols for the trial. If these third parties do not successfully carry out their contractual duties, meet expected deadlines or conduct our studies in accordance with regulatory requirements or our stated study plans and protocols, we will not be able to complete, or may be delayed in completing, the necessary preclinical studies to enable us or our strategic alliance partners to select viable product candidates for clinical trial application submissions and will not be able to, or may be delayed in our efforts to, successfully develop and commercialize such product candidates.

We rely on third-party supply and manufacturing partners for drug supplies for our late-stage clinical activities, and may do the same for any commercial supplies of our product candidates.

We rely on third-party supply and manufacturing partners to supply the materials and components to manufacture late-stage clinical trial drug supplies. We have not yet manufactured or formulated any product candidate on a commercial scale and may not be able to do so for any of our product candidates. We will work to develop and optimize our manufacturing process, and we cannot be sure that the process will result in therapies that are safe, potent or effective.

There can be no assurance that our supply of research and development, preclinical and clinical development drugs and other materials will not be limited, interrupted, restricted in certain geographic regions or of satisfactory quality or continue to be available at acceptable prices. In particular, any replacement of any product formulation manufacturer we may engage could require significant effort and expertise because there may be a limited number of qualified replacements.

Synthetic Biotic medicines are complex and difficult to manufacture. We could experience production or technology transfer problems that result in delays in our development or commercialization schedules or otherwise adversely affect our business. Issues with the manufacturing process, even minor deviations from the normal process, could result in insufficient yield, product deficiencies or manufacturing failures that result in lot failures, insufficient inventory, and product recalls.

Many factors common to the manufacturing of most biologics and drugs could also cause production interruptions, including raw materials shortages, raw material failures, growth media failures, equipment malfunctions, facility contamination, labor problems, natural disasters, disruption in utility services, terrorist activities, or acts of god beyond our control. We also may encounter problems in hiring and retaining the experienced specialized personnel needed to operate our manufacturing process, which could result in delays in our production or difficulties in maintaining compliance with applicable regulatory requirements.

Any problems in our manufacturing processes or facilities could make us a less attractive collaborator for academic research institutions and other parties, which could limit our access to additional attractive development programs, result in delays in our clinical development or marketing schedules and harm our business.

The manufacturing process for a product candidate is subject to FDA and foreign regulatory authority review. Suppliers and manufacturers must meet applicable manufacturing requirements and undergo rigorous facility and process validation tests required by regulatory authorities in order to comply with regulatory standards, such as GMP regulations. Any of our suppliers or manufacturers could fail to comply with such requirements or to perform our obligations to us in relation to quality, timing or otherwise, or if our supply of components or other materials could become limited or interrupted for other reasons. Under these circumstances, we may choose or be forced to manufacture the materials ourselves, for which we currently do not have the capabilities or resources, manufacture in collaboration with a third-party at their facilities, or enter into an agreement with another third-party, which we may not be able to do on reasonable terms, if at all. In some cases, the technical skills or technology required to manufacture our product candidates may be unique or proprietary to the original manufacturer and we may have difficulty, or there may be contractual restrictions prohibiting us from transferring such skills or technology to another third-party and a feasible alternative may not exist. These factors would increase our reliance on such manufacturer or require us to obtain a license from such manufacturer in order to have another third-party manufacture our product candidates. If we are required to change manufacturers for any reason, we will be required to verify that the new manufacturer maintains facilities and procedures that comply with quality standards and with all applicable regulations and guidelines. The delays associated with the verification of a new manufacturer could negatively affect our ability to develop product candidates in a timely manner or within budget.

We may rely on third-party manufacturers if we receive regulatory approval for any product candidate. To the extent that we have existing, or enter into future, manufacturing arrangements with third parties, we will depend on these third parties to perform their obligations in a timely manner consistent with contractual and regulatory requirements, including those related to quality control and assurance. If we are unable to obtain or maintain third-party manufacturing for product candidates, or to do so on commercially reasonable terms, we may not be able to develop and commercialize our product candidates successfully. Our or a third-party's failure to execute on our manufacturing requirements could adversely affect our business in a number of ways, including:

- an inability to initiate or continue clinical trials of product candidates under development, which may impact our potential economic benefits;
- delay in submitting regulatory applications, or receiving regulatory approvals, for product candidates;
- loss of the cooperation of a collaborator;
- subjecting our product candidates to additional inspections by regulatory authorities;
- requirements to cease distribution or to recall batches of our product candidates; and
- in the event of approval to market and commercialize a product candidate, an inability to meet commercial demands for our products.

We enter into various contracts in the normal course of our business in which we indemnify the other party to the contract. In the event we have to perform under these indemnification provisions, it could have a material adverse effect on our business, financial condition and results of operations.

In the normal course of business, we periodically enter into academic, commercial, service, collaboration, licensing, consulting and other agreements that contain indemnification provisions. With respect to our academic and other research agreements, we typically indemnify the institution and related parties from losses arising from claims relating to the products, processes or services made, used, sold or performed pursuant to the agreements for which we have secured licenses, and from claims arising from our or our sublicensees' exercise of rights under the agreement. With respect to our collaboration agreements, we indemnify our collaborators from any third-party product liability claims that could result from the production, use or consumption of the product, as well as for alleged infringements of any patent or other intellectual property right by a third-party. With respect to consulting agreements, we indemnify consultants from claims arising from the good faith performance of their services.

Should our obligation under an indemnification provision exceed applicable insurance coverage or should we be denied insurance coverage, our business, financial condition and results of operations could be adversely affected. Similarly, if we are relying on a collaborator to indemnify us and the collaborator is denied insurance coverage or the indemnification obligation exceeds the applicable insurance coverage, and if the collaborator does not have other assets available to indemnify us, our business, financial condition and results of operations could be adversely affected.

To the extent we are able to enter into collaborative arrangements or strategic alliances, we may be exposed to risks related to those collaborations and alliances.

We are currently party to agreements with AbbVie and Ginkgo. Biotechnology companies sometimes become dependent upon collaborative arrangements or strategic alliances to complete the development and commercialization of product candidates. If we

elect to enter into collaborative arrangements or strategic alliances, these arrangements may place the development of our product candidates outside our control, may require us to relinquish important rights or may otherwise be on terms unfavorable to us.

Dependence on collaborative arrangements or strategic alliances would subject us to a number of risks, including the risk that:

- we may not be able to control the amount and timing of resources that our collaborators may devote to the relevant product candidates;
- our collaborators may experience financial difficulties;
- we may be required to relinquish important rights, such as marketing and distribution rights;
- business combinations or significant changes in a collaborator's business strategy may also adversely affect a collaborator's willingness or ability to complete our obligations under any arrangement;
- a collaborator could independently move forward with a competing drug candidate developed either independently or in collaboration with others, including our competitors; and
- collaborative arrangements are often terminated or allowed to expire, which would delay the development and may increase the cost of developing our drug candidates.

We may attempt to form collaborations in the future with respect to our product candidates, but we may not be able to do so, which may cause us to alter our development and commercialization plans.

We may attempt to form strategic collaborations, create joint ventures or enter into licensing arrangements with third parties with respect to our programs or platform that we believe will complement or augment our existing business. We may face significant competition in seeking appropriate strategic collaborators, and the negotiation process to secure appropriate terms is time consuming and complex. We may not be successful in our efforts to establish such a strategic collaboration for any product candidates and programs on terms that are acceptable to us, or at all. This may be because our product candidates and programs may be deemed to be at too early of a stage of development for collaborative effort, our research and development pipeline may be viewed as insufficient, the competitive or intellectual property landscape may be viewed as too intense or risky, and/or third parties may not view our product candidates and programs as having sufficient potential for commercialization, including the likelihood of an adequate safety and efficacy profile.

Any delays in identifying suitable collaborators and entering into agreements to develop and/or commercialize our product candidates could delay the development or commercialization of our product candidates, which may reduce their competitiveness even if they reach the market. Absent a strategic collaborator, we would need to undertake development and/or commercialization activities at our own expense. If we elect to fund and undertake development and/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 are unable to do so, we may not be able to develop our product candidates or bring them to market and our business may be materially and adversely affected.

Risks Related to Commercialization of Our Product Candidates

If any of our product candidates is approved for marketing and commercialization and we are unable to develop sales, marketing and distribution capabilities on our own or enter into agreements with third parties to perform these functions on acceptable terms, we will be unable to successfully commercialize any such future products.

We currently have no sales, marketing or distribution capabilities or experience. If any of our product candidates is approved for marketing and commercialization, we will need to develop internal sales, marketing and distribution capabilities to commercialize such products, which would be expensive and time-consuming, or enter into collaborations with third parties to perform these services. If we decide to market our products directly, we will need to commit significant financial and managerial resources to develop a marketing and sales force with technical expertise and supporting distribution, administration and compliance capabilities. If we rely on third parties with such capabilities to market our products or decide to co-promote products with collaborators, we will need to establish and maintain marketing and distribution arrangements with third parties, and there can be no assurance that we will be able to enter into such arrangements on acceptable terms or at all. In entering into third-party marketing or distribution arrangements, any revenue we receive will depend upon the efforts of third parties and there can be no assurance that such third parties will establish adequate sales and distribution capabilities or be successful in gaining market acceptance of any approved product. If we are not successful in commercializing any product approved for marketing and commercialization in the future, either on our own or through third parties, our business, financial condition, results of operations and prospects may be adversely affected.

If the market opportunities for our product candidates are smaller than we believe they are, we may not meet our revenue expectations and, assuming approval of a product candidate, our business may suffer. Because the patient populations in the market for our product candidates may be small, we must be able to successfully identify patients and acquire a significant market share to achieve profitability and growth.

Given the small number of patients who have the diseases that we are targeting, our eligible patient population and pricing estimates may differ significantly from the actual market addressable by our product candidates. Our projections of both the number of people who have applicable diseases, as well as the subset of people with these diseases who have the potential to benefit from treatment with our product candidates, are based on our beliefs and estimates. These estimates have been derived from a variety of sources, including scientific literature, patient foundations, or market research, and may prove to be incorrect. Further, new studies may change the estimated incidence or prevalence of these diseases. The number of patients may turn out to be lower than expected. The potentially addressable patient population for each of our product candidates may be limited or may not be amenable to treatment with our product candidates, and new patients may become increasingly difficult to identify or gain access to, which would adversely affect our business, financial condition, results of operations and prospects.

We face substantial competition and our competitors may discover, develop or commercialize products faster or more successfully than us.

The development and commercialization of new products is highly competitive. We face competition from major pharmaceutical companies, specialty pharmaceutical companies, biotechnology companies, universities and other research institutions worldwide with respect to our product candidates that we may seek to develop or commercialize in the future. For example, BioMarin, Inc., Censa Pharmaceuticals, Inc., Nestlé Health Science S.A. / Codexis, Inc., Homology Medicines, Inc., American Gene Technologies International Inc., Moderna, Inc., Sangamo Therapeutics, Inc., Sanofi S.A., Generation Bio Co., Agios, Inc., Trucode Gene Repair, Inc., SOM Biotech SL and other discovery stage companies have developed or are developing product candidates for the treatment of PKU. Allena Pharmaceuticals, Inc, Novome Biotechnologies, Inc., Oxidien Pharmaceuticals L.L.C. and others are developing product candidates for enteric hyperoxaluria. Acer Therapeutics Inc. has a clinical stage program in MSUD. Aduro Biotech, Inc., Merck & Co. Inc., Spring Bank Pharmaceuticals, Inc., GlaxoSmithKline plc., Bristol Myers Squibb Company have STING agonists in clinical development. Our competitors may succeed in developing, acquiring or licensing technologies and products that are more effective or less costly than the product candidates that we are currently developing or that we may develop, which could render our product candidates obsolete and noncompetitive. In addition to the competition we face from alternative therapies for the diseases we intend to target with our product candidates, we are also aware of several companies that are also working specifically to develop engineered bacteria as cellular drug therapies, such as Precigen, Inc. Further there are several companies working to develop other similar products. Third-party payors, including governmental and private insurers, may also encourage the use of generic products.

If our competitors obtain marketing approval from the FDA or comparable foreign regulatory authorities for their product candidates more rapidly than us, it could result in our competitors establishing a strong market position before we are able to enter the market.

Many of our competitors have materially greater name recognition and substantially greater financial, manufacturing, marketing, research and drug development resources than we do. Additional mergers and acquisitions in the biotechnology and pharmaceutical industries may result in even more resources being concentrated in our competitors. Large pharmaceutical companies in particular have extensive expertise in preclinical and clinical testing and in obtaining regulatory approvals for drugs. In addition, academic institutions, government agencies, and other public and private organizations conducting research may seek patent protection with respect to potentially competitive products or technologies. These organizations may also establish exclusive collaborative or licensing relationships with our competitors. Failure of our product candidates to effectively compete against established treatment options or in the future with new products currently in development would harm our business, financial condition, results of operations and prospects.

The commercial success of any of our current or future product candidates will depend upon the degree of market acceptance by physicians, patients, third-party payors, and others in the medical community.

Even with approvals from the FDA and comparable foreign regulatory authorities, the commercial success of our products will depend in part on the health care providers, patients, and third-party payors accepting our product candidates as medically useful, cost-effective, and safe. Any product that we bring to the market may not gain market acceptance by physicians, patients and third-party payors. The degree of market acceptance of any of our products will depend on a number of factors, including but not limited to:

- the efficacy of the product as demonstrated in clinical trials and potential advantages over competing treatments;
- the safety and side effect profile of the product as demonstrated in clinical trials and potential advantages over competing treatments;
- the prevalence and severity of the disease targeted;
- the clinical indications for which approval is granted, including any limitations or warnings contained in a product's approved labeling;
- the convenience and ease of administration;
- the cost of treatment;
- the willingness of the patients and physicians to accept products engineered from bacteria and these therapies;
- the perceived ratio of risk and benefit of these therapies by physicians, patients, and payors, and the willingness of physicians to recommend these therapies to patients based on such risks and benefits;
- the marketing, sales and distribution support for the product;
- the publicity concerning the products or competing products and treatments; and
- the pricing and availability of third-party insurance coverage and reimbursement.

Even if a product displays a favorable efficacy and safety profile upon approval, market acceptance of the product remains uncertain. Efforts to educate the medical community and third-party payors on the benefits of the products may require significant investment and resources and may never be successful. If our products fail to achieve an adequate level of acceptance by physicians, patients, third-party payors, and other health care providers, we will not be able to generate sufficient revenue to become or remain profitable.

We may not be successful in any efforts to identify, license, discover, develop, or commercialize additional product candidates.

Although a substantial amount of our effort will focus on the clinical testing, potential approval, and commercialization of our existing product candidates, the success of our business is also expected to depend in part upon our ability to identify, license, discover, develop, or commercialize additional product candidates. Research programs to identify new product candidates require substantial technical, financial, and human resources. We may focus our efforts and resources on potential programs or product candidates that ultimately prove to be unsuccessful. Our research programs or licensing efforts may fail to yield additional product candidates for clinical development and commercialization for a number of reasons, including but not limited to the following:

- our research or business development methodology or search criteria and process may be unsuccessful in identifying potential product candidates;
- we may not be able or willing to assemble sufficient resources to acquire or discover additional product candidates;
- our product candidates may not succeed in preclinical or clinical testing;

- our potential product candidates may be shown to have harmful side effects or may have other characteristics that may make the products unmarketable or unlikely to receive marketing approval;
- competitors may develop alternatives that render our product candidates obsolete or less attractive;
- product candidates we develop may be covered by third parties' patents or other exclusive rights;
- the market for a product candidate may change during development or commercialization so that such a product may become unreasonable to continue to develop or commercialize;
- a product candidate may not be capable of being produced in commercial quantities at an acceptable cost, or at all; and
- a product candidate may not be accepted as safe and effective by patients, the medical community, or third-party payors.

If any of these events occur, we may be forced to abandon our development efforts for one or more product candidates, or we may not be able to identify, license, discover, develop, or commercialize additional product candidates, which would have a material adverse effect on our business, financial condition or results of operations and could potentially cause us to cease operations.

Failure to obtain or maintain adequate reimbursement or insurance coverage for products, if any, could limit our ability to market those products and decrease our ability to generate revenue.

The pricing, coverage, and reimbursement of our approved products, if any, must be sufficient to support our commercial efforts and other development programs and the availability and adequacy of coverage and reimbursement by third-party payors, including governmental and private insurers, are essential for most patients to be able to afford expensive treatments. Sales of our approved products, if any, will depend substantially, both domestically and abroad, on the extent to which the costs of our approved products, if any, will be paid for or reimbursed by health maintenance, managed care, pharmacy benefit and similar healthcare management organizations, or government payors and private payors. If coverage and reimbursement are not available, or are available only in limited amounts, we may have to subsidize or provide products for free or we may not be able to successfully commercialize our products.

In addition, there is significant uncertainty related to the insurance coverage and reimbursement for newly approved products. In the United States, the principal decisions about coverage and reimbursement for new drugs are typically made by the Centers for Medicare & Medicaid Services (CMS), an agency within the U.S. Department of Health and Human Services, as CMS decides whether and to what extent a new drug will be covered and reimbursed under Medicare. Private payors tend to follow the coverage reimbursement policies established by CMS to a substantial degree. It is difficult to predict what CMS will decide with respect to reimbursement for novel product candidates such as ours and what reimbursement codes our product candidates may receive if approved.

Outside the United States, international operations are generally subject to extensive governmental price controls and other price-restrictive regulations, and we believe the increasing emphasis on cost-containment initiatives in Europe, Canada, and other countries has and will continue to put pressure on the pricing and usage of products. In many countries, the prices of products are subject to varying price control mechanisms as part of national health systems. Price controls or other changes in pricing regulation could restrict the amount that we are able to charge for our products, if any. Accordingly, in markets outside the United States, the potential revenue from the sale of our products may be insufficient to generate commercially reasonable revenue and profits.

Moreover, increasing efforts by governmental and private payors in the United States and abroad to limit or reduce healthcare costs may result in restrictions on coverage and the level of reimbursement for new products and, as a result, they may not cover or provide adequate payment for our products. We expect to experience pricing pressures in connection with products due to the increasing trend toward managed healthcare, including the increasing influence of health maintenance organizations and additional legislative changes. The downward pressure on healthcare costs in general, particularly prescription drugs has and is expected to continue to increase in the future. As a result, profitability of our products, if any, may be more difficult to achieve even if they receive regulatory approval.

Risks Related to Our Business Operations and Employees

Our failure to attract and retain senior management and key scientific personnel may prevent us from successfully developing our product candidates or any future product candidate, conducting our clinical trials and commercializing any products.

Our success depends in part on our continued ability to attract, retain and motivate highly qualified management, clinical and scientific personnel. We believe that our future success is highly dependent upon the contributions of our senior management, particularly our president and chief executive officer, chief medical officer, as well as our senior scientists and other members of our senior management team. The loss of services of any of these individuals could delay or prevent the successful development of our product pipeline, completion of our planned clinical trials or the commercialization of the products we develop.

Although we have not historically experienced significant difficulties attracting and retaining qualified employees, we could experience such problems in the future. For example, competition for qualified personnel in the biotechnology and pharmaceuticals field is intense due to the limited number of individuals who possess the skills and experience required by our industry. We will need to hire additional personnel as we expand our clinical development and commercial activities. We may not be able to attract and retain quality personnel on acceptable terms, or at all.

Our employees, independent contractors, principal investigators, CROs, consultants and collaborators may engage in misconduct or other improper activities, including noncompliance with regulatory standards and requirements and insider trading.

We are exposed to the risk that our employees, independent contractors, consultants and collaborators may engage in fraudulent conduct or other illegal activity. Misconduct by these parties could include intentional, reckless and/or negligent conduct or unauthorized activities that violate: (1) regulations of regulatory authorities in jurisdictions where we are performing activities in relation to our product candidates, including those laws requiring the reporting of true, complete and accurate information to such authorities; (2) manufacturing regulations and standards; (3) fraud and abuse and anti-corruption laws and regulations; or (4) laws that require the reporting of true and accurate financial information and data. In particular, sales, marketing and business arrangements in the healthcare industry are subject to extensive laws and regulations intended to prevent fraud, bias, misconduct, kickbacks, self-dealing and other abusive practices, and these laws may differ substantially from country to country. These laws and regulations may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, sales commission, customer incentive programs and other business arrangements. These activities also include the improper use of information obtained in the course of clinical trials, which could result in regulatory sanctions and serious harm to our reputation. It is not always possible to identify and deter misconduct by employees and other third parties, and the precautions we take to detect and prevent this activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting ourselves from governmental investigations or other actions or lawsuits stemming from a failure to be in compliance with such laws or regulations. If any such actions are instituted against us, and we are not successful in defending itself or asserting our rights, those actions could have a significant impact on our business including the imposition of significant civil, criminal and administrative penalties, damages, monetary fines, possible exclusion from participation in subsidized healthcare programs in a given country, 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.

Our employment agreements with our executive officers may require us to pay severance benefits to any of those persons who are terminated in connection with a change of control, which could harm our business, financial condition or results of operations.

Our executive officers are parties to employment agreements providing for aggregate cash payments of up to approximately \$1.1 million at December 31, 2019 for severance and other benefits in the event of a termination of employment in connection with a change of control. The payment of these severance benefits could harm our business, financial condition and results of operations. In addition, these potential severance payments may discourage or prevent third parties from seeking a business combination with us.

Risks Related to Our Common Stock

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

Based on the beneficial ownership of our common stock as of March 5, 2020, our executive officers and directors, together with holders of 5% or more of our common stock outstanding and their respective affiliates, beneficially own approximately 49.4% of our common stock. Accordingly, these stockholders have significant influence over the outcome of corporate actions requiring stockholder approval, including the election of directors, consolidation or sale of all or substantially all of our assets or any other significant corporate transaction. The interests of these stockholders may not be the same as or may even conflict with your interests. For example, these stockholders could delay or prevent a change of control, even if such a change of control would benefit our other stockholders, which could deprive our stockholders of an opportunity to receive a premium for their common stock as part of a sale of the company or our assets and might affect the prevailing market price of our common stock. The significant concentration of stock ownership may adversely affect the trading price of our common stock due to investors' perception that conflicts of interest may exist or arise.

We are an "emerging growth company" and we cannot be certain if the reduced disclosure 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, and may take advantage of certain 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, reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements and exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and stockholder approval of any golden parachute payments not previously approved. 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.

In addition, Section 102 of the JOBS Act also provides that an “emerging growth company” can take advantage of the extended transition period provided in Section 7(a)(2)(B) of the Securities Act for complying with new or revised accounting standards. An “emerging growth company” can therefore delay the adoption of certain accounting standards until those standards would otherwise apply to private companies. However, we are choosing to “opt out” of such extended transition period, and as a result, we will comply with new or revised accounting standards on the relevant dates on which adoption of such standards is required for non-emerging growth companies. Section 107 of the JOBS Act provides that our decision to opt out of the extended transition period for complying with new or revised accounting standards is irrevocable.

Future sales of our common stock or securities convertible or exchangeable for our common stock may depress our stock price.

If our existing stockholders or holders of our options sell, or indicate an intention to sell, substantial amounts of our common stock in the public market, the trading price of our common stock could decline. The perception in the market that these sales may occur could also cause the trading price of our common stock to decline. As of March 5, 2020 there were a total of 32,250,814 shares of our common stock outstanding.

Our quarterly operating results may fluctuate significantly or may fall below the expectations of investors or securities analysts, each of which may cause our stock price to fluctuate or decline.

We expect our operating results to be subject to quarterly fluctuations. Our net loss and other operating results will be affected by numerous factors, including:

- variations in the level of our operating expenses;
- receipt, modification or termination of government contracts or grants, and the timing of payments we receive under these arrangements;
- Our execution of any collaborative, licensing or similar arrangements, and the timing of payments we may make under these arrangements; and
- any intellectual property infringement lawsuit or opposition, interference or cancellation proceeding in which we may become involved.

If our quarterly operating results fall below the expectations of investors or securities analysts, the price of our common stock could decline substantially. Furthermore, any quarterly fluctuations in our operating results may, in turn, cause the price of the company’s stock to fluctuate substantially. We believe that quarterly comparisons of our financial results are not necessarily meaningful and should not be relied upon as an indication of our future performance.

Provisions of our charter documents or Delaware law could delay or prevent an acquisition of us, even if the acquisition would be beneficial to our stockholders, and could make it more difficult for you to change management.

Provisions in our amended and restated certificate of incorporation and our amended and restated bylaws may discourage, delay or prevent a merger, acquisition or other change in control that our stockholders may consider favorable, including transactions in which our stockholders might otherwise receive a premium for their shares. In addition, these provisions may frustrate or prevent any attempt by our stockholders to replace or remove our current management by making it more difficult to replace or remove our Board of Directors. These provisions include:

- a classified board of directors so that not all directors are elected at one time;
- a prohibition on stockholder action through written consent;
- no cumulative voting in the election of directors;
- the exclusive right of our Board of Directors to elect a director to fill a vacancy created by the expansion of our Board of Directors or the resignation, death or removal of a director;
- a requirement that special meetings of our Stockholders be called only by our Board of Directors, the chairman of our Board of Directors, the chief executive officer or, in the absence of a chief executive officer, the president;
- an advance notice requirement for stockholder proposals and nominations;
- the authority of our Board of Directors to issue preferred stock with such terms as our Board of Directors may determine; and
- a requirement of approval of not less than 66 2/3% of all outstanding shares of our capital stock entitled to vote to amend any bylaws by stockholder action, or to amend specific provisions of our certificate of incorporation.

In addition, Delaware law prohibits a publicly held Delaware corporation from engaging in a business combination with an interested stockholder, generally a person who, together with its affiliates, owns or within the last three years has owned 15% or more of the company's voting stock, for a period of three years after the date of the transaction in which the person became an interested stockholder, unless the business combination is approved in a prescribed manner. Accordingly, Delaware law may discourage, delay or prevent a change in control of the company.

In addition, our amended and restated certificate of incorporation, to the fullest extent permitted by law, provides that the Court of Chancery of the State of Delaware will be the exclusive forum for: any derivative action or proceeding brought on our behalf; any action asserting a breach of fiduciary duty; any action asserting a claim against us arising pursuant to the Delaware General Corporation Law, or the DGCL, our amended and restated certificate of incorporation, or our amended and restated bylaws; or any action asserting a claim against us that is governed by the internal affairs doctrine. This exclusive forum provision does not apply to suits brought to enforce a duty or liability created by the Exchange Act. It could apply, however, to a suit that falls within one or more of the categories enumerated in the exclusive forum provision and asserts claims under the Securities Act, inasmuch as Section 22 of the Securities Act creates concurrent jurisdiction for federal and state courts over all suits brought to enforce any duty or liability created by the Securities Act or the rule and regulations thereunder. There is uncertainty as to whether a court would enforce such provision with respect to claims under the Securities Act, and our stockholders will not be deemed to have waived our compliance with the federal securities laws and the rules and regulations thereunder.

This choice of forum provision may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for disputes with us or any of our directors, officers, or other employees, which may discourage lawsuits with respect to such claims. Alternatively, if a court were to find the choice of forum provisions contained in our restated certificate of incorporation to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could harm our business, results of operations and financial condition.

Provisions in our charter and other provisions of Delaware law could limit the price that investors are willing to pay in the future for shares of our common stock.

We do not anticipate paying any cash dividends on our common stock in the foreseeable future; therefore, capital appreciation, if any, of our common stock will be your sole source of gain for the foreseeable future.

We have never declared or paid cash dividends on our common stock. We do not anticipate paying any cash dividends on our common stock in the foreseeable future. We currently intend to retain all available funds and any future earnings to fund our operations. In addition, the terms of any future debt financing arrangement may contain terms prohibiting or limiting the amount of dividends that may be declared or paid on our common stock. As a result, capital appreciation, if any, of our common stock will be your sole source of gain for the foreseeable future.

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 will depend, in part, on the research and reports that securities or industry analysts publish about us or our business. If one or more of the analysts who cover us downgrade our common stock or publish inaccurate or unfavorable research about our business, our stock price would likely decline. In addition, if our operating results fail to meet the forecast of analysts, our stock price would likely decline. If one or more of these analysts cease coverage of us or fail to publish reports on us regularly, demand for our common stock could decrease, which might cause our stock price and trading volume to decline.

Changes in, or interpretations of, accounting rules and regulations could result in unfavorable accounting charges or require us to change our compensation policies.

Accounting methods and policies for biopharmaceutical companies, including policies governing revenue recognition, research and development and related expenses and accounting for stock-based compensation, are subject to further review, interpretation and guidance from relevant accounting authorities, including the SEC. Changes to, or interpretations of, accounting methods or policies may require us to reclassify, restate or otherwise change or revise our financial statements, including those contained in this periodic report.

Item 1B. Unresolved Staff Comments.

None.

Item 2. Properties.

Our corporate headquarters and operations are located in Cambridge, Massachusetts. We currently lease laboratory and office space at 301 Binney Street in Cambridge. Our 301 Binney Street lease expires in 2028. We believe that our facilities are suitable and adequate for our needs for the foreseeable future.

Item 3. Legal Proceedings.

From time to time, we are subject to various legal proceedings, claims and administrative proceedings that arise in the ordinary course of our business activities. Although the results of the litigation and claims cannot be predicated with certainty, as of the date of this report, we do not believe we are party to any claim, proceeding or litigation the outcome of which, if determined adversely to us, would individually or in the aggregate be reasonably expected to have a material adverse effect on our business. Regardless of the outcome, litigation can have an adverse impact on us because of defense and settlement costs, diversion of management resources and other factors.

Item 4. Mine Safety Disclosures.

Not applicable.

PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities.

Market Information

Our common stock has been traded on The Nasdaq Capital Market under the symbol "SYBX" since August 28, 2017, prior to which it was traded under the symbol "MIRN".

Stockholders

As of March 5, 2020, there were approximately 240 stockholders of record of our common stock.

Dividends

We have never declared or paid any dividends to our stockholders since our inception and we do not plan to declare or pay cash dividends in the foreseeable future. We currently anticipate that we will retain any future earnings for the operation and expansion of our business.

Unregistered Sales of Securities

Not applicable.

Issuer Purchases of Equity Securities

None.

Item 6. Selected Financial Data.

We are a smaller reporting company as defined by Rule 12b-2 of the Exchange Act and are not required to provide the information required under this item.

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations.

Forward-Looking Information

The Risk Factors in Part I, Item 1A of this Annual Report on Form 10-K, the audited financial statements and accompanying notes, included elsewhere in this Annual Report on Form 10-K, and this Management's Discussion and Analysis of Financial Condition and Results of Operations should be read together. In addition to historical information, this discussion and analysis contains forward-looking statements within the meaning of Section 27A of the Securities Act, and Section 21E of the Exchange Act. Operating results are not necessarily indicative of results that may occur for the full fiscal year or any other future period. The term "Private Synlogic" refers to Synlogic, Inc. prior to the consummation of the Merger described herein. The term "Mirna" refers to Mirna Therapeutics, Inc. prior to the consummation of the Merger described herein. Unless otherwise indicated, references to the terms "Synlogic," "the Company," "we," "our" and "us" refer to Private Synlogic prior to the consummation of the Merger described herein and Synlogic, Inc. (formerly known as Mirna Therapeutics, Inc.) upon the consummation of the Merger described herein.

Overview

Recent Developments

Ginkgo

In 2017, we established a technology collaboration with Ginkgo Bioworks, Inc. ("Ginkgo"), a privately held high-throughput synthetic biology company. In June 2019, we expanded our collaboration and entered into an agreement with Ginkgo for the research and development of engineered microbial therapeutic products. The Company issued to Ginkgo 6,340,771 shares of common stock and accompanying Pre-Funded warrants (the "Pre-Funded Warrants") to purchase up to an aggregate of 2,548,117 shares of common stock, at a combined purchase price per share and Pre-Funded Warrant of \$9.00. The Pre-Funded Warrants have an exercise price of \$9.00 per share, with \$8.99 of such exercise price paid at the closing of the offering. The net proceeds to us were approximately \$79.9 million. Under the agreement we made a prepayment to Ginkgo of \$30.0 million for its foundry services that will be provided to us over an initial term of five years. The prepayment was recorded to prepaid expenses and has been amortized as the services are performed. Upon the expiration of such initial term and, if applicable, such additional period, any portion of the prepayment that has not been used to purchase services from Ginkgo will be retained by Ginkgo.

Business

We are a clinical-stage biopharmaceutical company focused on advancing our proprietary drug discovery and development platform to create Synthetic Biotic™ medicines. Our Synthetic Biotic medicines apply the principles and tools of synthetic biology to engineer beneficial therapeutic characteristics into microbes, transforming them into efficient and targeted biologic engines. We believe that many patients with serious diseases are underserved today based on the limitations of conventional therapeutic approaches, such as small or large molecules. Synthetic Biotic medicines have the potential to address unmet medical need by performing therapeutic mechanisms not achievable by other drug modalities. Synthetic Biotic medicines are designed to be programmed to metabolize, or consume, a toxic substance, compensate for damaged metabolic pathways in patients, or produce one or more therapeutic factors. Our platform has generated a portfolio of Synthetic Biotic medicines designed to impact both genetic and acquired metabolic diseases, as well as oncology and inflammatory disorders. In a clinical trial with our lead program SYN1618, we have demonstrated consumption of a phenylalanine (Phe), an amino acid that accumulates in a rare metabolic disorder known as phenylketonuria (PKU), and are expanding our pipeline based on learnings from this program.

We believe we have the core competencies in synthetic biology and manufacturing, as well as translational medicine, regulatory experience and clinical development to successfully discover and develop our Synthetic Biotic medicines. In June 2019, we announced an expanded collaboration with Ginkgo Bioworks (Ginkgo) to complement our in-house expertise in strain design and development. Ginkgo uses software and automation to program and optimize microbial strains at a large scale. Ginkgo's technology provides us with a synthetic biology-based cell programming platform for testing thousands of microbial strains to accelerate progression of early preclinical leads to drug candidates optimized for clinical development.

While we believe that our Synthetic Biotic platform has potential to address a broad range of diseases, our initial internal pipeline focus is on rare metabolic diseases. We will consider leveraging partnerships to advance programs for other diseases including oncology and inflammatory disorders. Our most advanced programs target rare metabolic diseases that could potentially be treated by oral delivery of Synthetic Biotic medicines. These include conditions caused by a genetic mutation characterized by a dysfunctional metabolic pathway including PKU and maple syrup urine disease (MSUD), as well as acquired metabolic diseases caused by organ dysfunction, such as enteric hyperoxaluria. When delivered orally, Synthetic Biotic medicines are designed to function in the gut to consume a disease-causing toxic metabolite with the intended consequence of reducing its systemic levels. We believe that success in our metabolic disease programs will enable us to demonstrate the potential of our Synthetic Biotic medicines while bringing meaningful change to the lives of patients suffering from these debilitating conditions.

Our most advanced product candidate for the treatment of metabolic dysfunction is SYN1618, an oral therapy intended for the treatment of PKU, a rare metabolic disease in which Phe accumulates in the body as a result of genetic defects. Elevated levels of Phe are toxic to the brain and can lead to neurological dysfunction. SYN1618 is designed to function in the gut of patients to reduce excess Phe, with the goal of lowering levels in the blood and other tissues. SYN1618 has received both Fast Track designation and orphan drug designation for PKU from the FDA. We initiated a Phase 1/2a clinical trial of an early liquid formulation of SYN1618 in April 2018 and announced top-line data from healthy volunteers evaluated in this study in September 2018. In July 2019, we announced data that demonstrated that SYN1618 was safe and well-tolerated and achieved proof-of-mechanism of strain activity in both healthy volunteers and patients with PKU. We have also evaluated a new lyophilized formulation of SYN1618 in a bridging study in healthy volunteers. The study of this more patient- and commercialization-appropriate presentation of SYN1618 demonstrated improved tolerability over the early liquid formulation. We expect to initiate a Phase 2 clinical trial of the lyophilized formulation in patients with PKU in the first half of 2020 to evaluate its potential for blood Phe-lowering and to validate our pharmacodynamic and pre-clinical modeling.

The strain design and engineering, translational research, clinical and regulatory planning and scalable manufacturing of our PKU program has informed development of future clinical candidates. We are also developing pre-clinical product candidates to address other metabolic conditions including enteric hyperoxaluria and maple syrup urine disease (MSUD). Enteric hyperoxaluria is a form of secondary hyperoxaluria caused by increased absorption of oxalate as a result of certain intestinal diseases, including Crohn's disease and short bowel syndrome or as a result of surgical procedures such as bariatric weight-loss surgery. The disorder can lead to a range of conditions of increasing severity from urinary tract infections to recurrent kidney stones and renal failure. MSUD is an inherited, rare metabolic disease characterized by a deficiency of enzymes required to break down certain amino acids. The most common and severe form of the disease is the classic type, which becomes apparent soon after birth and, if left untreated, can lead to seizures, coma, and death. Variant forms of the disorder become apparent later in infancy or childhood and are typically milder, but also lead to delayed development and other health problems if not treated.

In August 2019, we announced that we were discontinuing the development of SYN1020, an early stage clinical product candidate for the treatment of hyperammonemia. The decision to discontinue the program was based on top-line data from an interim analysis of a randomized, double-blind, placebo-controlled Phase 1b/2a study of the Synthetic Biotic medicine in 23 patients with cirrhosis and elevated blood ammonia. While SYN1020 was well tolerated in Phase 1b/2a study, the study showed it did not lower blood ammonia in patients with cirrhosis.

We have also developed a portfolio of Synthetic Biotic medicines to treat certain cancers which are designed to modify the tumor microenvironment, activate the immune system and result in tumor reduction. We envision that multiple engineered functions could be combined in one Synthetic Biotic medicine. These Synthetic Biotic medicines could also be used in combination with other cancer therapies such as check-point inhibitors. Our first Synthetic Biotic clinical immuno-oncology (IO) candidate is SYN1891, an intratumorally administered Synthetic Biotic medicine engineered to act as a dual innate and adaptive immune activator. SYN1891 has been designed to activate the immune response in tumors via the E.coli Nissle chassis and production of cyclic di-AMP, an activator of the Stimulator of Interferon Genes, also referred to as the STING pathway. In January 2020, we announced that we had treated the first subject in a Phase 1 clinical trial of SYN1891 in patients with advanced solid tumors and lymphoma. The clinical trial is designed to identify a maximum tolerated dose (MTD) of SYN1891 delivered as a monotherapy and we expect to have data from this arm of the study in 2020. Once an MTD is identified, we will evaluate treatment of patients with a combination of SYN1891 and the checkpoint inhibitor atezolizumab (Tecentriq), provided through a supply agreement with Roche.

We are also leveraging our proprietary technology platform to develop Synthetic Biotic medicines to treat a broader range of human diseases. To achieve this goal, we collaborate with key disease experts who have developed robust models of relevant diseases and to inform our translational medicine strategy. These collaborators bring complementary expertise in preclinical development, clinical development and commercialization. Inflammatory bowel disease (IBD) is an attractive target for our technology as Synthetic Biotic medicines can be designed to locally deliver combinations of complementary therapeutics to potentially address the unmet medical need for maintenance of disease remissions. We have a collaboration with AbbVie S.à.r.l. (AbbVie) to develop Synthetic Biotic medicines for the treatment of types of IBD, including Crohn's disease and ulcerative colitis. We may enter into additional strategic partnerships in the future to maximize the value of our programs and our Synthetic Biotic platform.

We currently operate in one reportable business segment—the discovery and development of Synthetic Biotic medicines. To date, we have dedicated substantially all of our activities to the research and development of our product candidates. As of March 2020, we have received approximately \$322.8 million in proceeds to date as we financed our operations through approximately \$110.7 million in aggregate net proceeds from the sale of Private Synlogic preferred stock and Synlogic, LLC preferred units, approximately \$0.4 million in a convertible promissory note with one of our investors, which was converted into Private Synlogic preferred stock, approximately \$8.5 million in payments received under the AbbVie Agreement, approximately \$40.4 million from our merger with Mirna, net of transaction costs, approximately \$82.7 million in total net proceeds from the sale of our common stock in our common

stock offerings in January and April 2018, approximately \$79.9 million in total net proceeds from the sale of our common stock and Pre-Funded Warrants in June 2019 and \$0.2 million from exercises of stock options.

We have not generated any revenue to date from product sales and have incurred significant operating losses since our inception. We have incurred net losses of approximately \$51.4 million and \$48.4 million for the years ended December 31, 2019 and 2018, respectively. As of December 31, 2019 and 2018, we had an accumulated deficit of approximately \$171.1 million and \$119.8 million, respectively, and we expect to incur losses for the foreseeable future as we develop our product candidates. We expect our expenses and capital requirements will increase substantially in connection with our ongoing activities, as we:

- complete preclinical studies, initiate and complete clinical trials for product candidates;
- contract to manufacture product candidates;
- advance research and development related activities to expand our product pipeline;
- seek regulatory approval for our product candidates;
- maintain, expand and protect our intellectual property portfolio;
- hire additional staff, including clinical, scientific, and management personnel;
- expand our existing infrastructure and secure space in a facility to support continued growth in our research and development efforts; and
- add operational and finance personnel to support product development efforts and to support operating as a public company.

We do not expect to generate product revenue unless and until we successfully complete clinical development and obtain regulatory approvals for our product candidates, either alone or in collaboration with third parties. Additionally, we expect to utilize third-party contract research organizations (CROs) and contract manufacturing organizations (CMOs) to carry out our clinical development and manufacturing activities, and we do not yet have a commercial organization. If we obtain regulatory approval for any of our product candidates, we expect to incur significant expenses related to developing our internal commercialization capability to support product sales, marketing and distribution. Accordingly, we anticipate that we will seek to fund our operations through public or private equity or debt financings, collaborations or licenses, finance lease transactions or other available financing transactions. However, we may be unable to raise additional funds through these or other means when needed. Because of the numerous risks and uncertainties associated with product development, we are unable to predict the timing or amount of increased expenses or when or if it will be able to achieve or maintain profitability. Even if we are able to generate product revenue, we may not become profitable.

Financial Overview

Revenue

Revenue to date is generated from our collaboration agreement with AbbVie. The collaboration agreement contains multiple deliverables, which include an exclusive option for AbbVie to acquire IBDCo and research and development milestones. See Note 10, "Collaboration Agreements" in the notes to the consolidated financial statements appearing elsewhere in this Annual Report on Form 10-K for a full discussion of this arrangement. We expect our revenue to fluctuate for the foreseeable future as it is principally based on the achievement of research and development milestones under our collaboration agreement with AbbVie.

Research and Development Expense

Research and development expense consists of expenses incurred in connection with the discovery and development of our product candidates, including the conduct of preclinical and clinical studies and product development, which are expensed as they are incurred. These expenses consist primarily of:

- compensation, benefits and other employee related expenses;
- supplies to support our internal research and development efforts;
- research and development related facility and depreciation costs; and
- third-party contract costs relating to research, process and formulation development, preclinical and clinical studies and regulatory operations.

The lengthy process of securing regulatory approvals for new drugs requires the expenditure of substantial resources. Any delay or failure to obtain regulatory approvals would materially adversely affect our product candidate development efforts and our business overall. Given the inherent uncertainties of pharmaceutical product development, we cannot estimate with any degree of certainty the likelihood, timing or cost of obtaining regulatory approval and marketing our product candidates and thus, when, if ever, our product candidates will generate revenues and cash flows.

The successful development of our product candidates is highly uncertain and subject to a number of risks. Refer to the risk factors under the heading *Risks Related to the Development of Our Product Candidates* in Part II, Item 1A, found elsewhere in this Annual Report on Form 10-K.

We invest carefully in our pipeline, and the commitment of funding for each subsequent stage of our development programs is dependent upon the receipt of clear, supportive data. We anticipate that we will make determinations as to which additional programs to pursue and how much funding to direct to each program on an ongoing basis in response to the scientific and clinical data of each product candidate, as well as the competitive landscape and ongoing assessments of such product candidate's commercial potential. We expect our research and development costs will be substantial for the foreseeable future. We expect costs associated with our SYN1618 and SYN1891 programs to increase as the programs progress through clinical trials.

We track direct research and development expenses, consisting principally of external costs, such as costs associated with contract research organizations and manufacturing of preclinical and clinical drug product and other outsourced research and development expenses to specific product programs. Costs related to specific product candidates are tracked upon the selection of a product candidate. We do not allocate employee and consulting-related costs, costs associated with our platform and facility expenses, including depreciation or other indirect costs, to specific product candidate programs because these costs are deployed across multiple product candidate programs under research and development and, as such, are separately classified. The table below summarizes our research and development expenses by categories of costs for the periods presented (in thousands):

	Year ended December 31,	
	2019	2018
SYNB1020	\$ 2,606	\$ 2,924
SYNB1618	8,194	6,245
SYNB1891	2,527	—
External pre-development candidate expenses and unallocated expenses	3,538	5,728
Internal research and development expenses	25,040	23,137
	<u>\$ 41,905</u>	<u>\$ 38,034</u>

General and Administrative Expense

General and administrative expense consists primarily of compensation, benefits and other employee-related expenses for personnel in our administrative, finance, legal, information technology, investor relations, business development and human resource functions. Other costs include the legal costs of pursuing patent protection of our intellectual property, general and administrative related facility and information technology infrastructure costs and professional fees for accounting and legal services. We anticipate increases in expenses related to legal fees, accounting fees, costs for director and officer liability insurance, fees for investor relations services and costs associated with implementing and complying with corporate governance, internal controls and similar requirements applicable to public companies. We charge all general and administrative expenses to operations as incurred.

Other Income (Expense)

Interest and investment income consists primarily of income earned on investments. Interest expense consists of expense related to our finance leases. Other expense consists primarily of gains and losses on foreign currency invoices.

Critical Accounting Policies and Estimates

Our discussion and analysis of our financial condition and results of operations is based upon our consolidated financial statements prepared in accordance with generally accepted accounting principles in the U.S. (GAAP). The preparation of these financial statements requires us to make certain estimates and assumptions that affect the reported amounts of assets and liabilities, the reported amounts of revenues and expenses during the reported periods and related disclosures. These estimates and assumptions, including those related to revenue recognition and research and development expenses are monitored and analyzed by us for changes in facts and circumstances, and material changes in these estimates could occur in the future. These critical estimates and assumptions are based on our historical experience, our observance of trends in the industry, and various other factors that are believed to be

reasonable under the circumstances and form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from our estimates under different assumptions or conditions.

We believe that the application of the following accounting policies, each of which require significant judgments and estimates on the part of management, are the most critical to aid in fully understanding and evaluating our reported financial results. Our significant accounting policies are more fully described in Note 2, "Summary of Significant Accounting Policies", to our consolidated financial statements appearing elsewhere in this Annual Report on Form 10-K.

Revenue Recognition

Effective January 1, 2018, we adopted Accounting Standards Codification (ASC) Topic 606, *Revenue from Contracts with Customers* (ASC 606) using the modified retrospective transition method. See Note 2 "Summary of Significant Accounting Policies", to our consolidated financial statements appearing elsewhere in this Annual Report on Form 10-K. Under this method, results for reporting periods beginning on and after January 1, 2018 are presented under ASC 606, while prior period amounts are not adjusted and continue to be reported in accordance with ASC Topic 605, *Revenue Recognition* (ASC 605).

We evaluate collaboration agreements with respect to FASB ASC Topic 808, *Collaborative Arrangements*, considering the nature and contractual terms of the arrangement and the nature of our business operations to determine the classification of the transactions. When we are an active participant in the activity and exposed to significant risks and rewards dependent on the commercial success of the collaboration, we will record our transactions on a gross basis in the consolidated financial statements and describe the rights and obligations under the collaborative arrangement in the notes to the consolidated financial statements.

Under ASC 606, an entity recognizes revenue when its customer obtains control of promised goods or services, in an amount that reflects the consideration which the entity expects to receive in exchange for those goods or services. To determine revenue recognition for arrangements that an entity determines are within the scope of ASC 606, the entity performs the following five-step analysis: (i) identify the contract(s) with a customer; (ii) identify the performance obligations in the contract; (iii) determine the transaction price; (iv) allocate the transaction price to the performance obligations in the contract; and (v) recognize revenue when (or as) the entity satisfies a performance obligation. We only apply the five-step analysis to contracts when it is probable that we will collect the consideration we are entitled to in exchange for the goods or services we transfer to the customer. At contract inception, once the contract is determined to be within the scope of ASC 606, we assess the goods or services promised within each contract and determine those that are performance obligations and assesses whether each promised good or service is distinct. We then recognize as revenue the amount of the transaction price that is allocated to the respective performance obligation when (or as) the performance obligation is satisfied.

We may enter into collaboration agreements for research and development services, under which we may license certain rights to our product candidates to third parties. The terms of these arrangements typically include payment to us of one or more of the following: non-refundable, upfront license fees; reimbursement of certain costs; customer option exercise fees; development, regulatory and commercial milestone payments; and royalties on net sales of licensed products. Variable consideration is constrained until it is deemed not be at significant risk of reversal.

In determining the appropriate amount of revenue to be recognized as we fulfill our obligations under each of our agreements for which the collaboration partner is also a customer, we perform the following steps: (i) identification of the promised goods or services in the contract; (ii) determination of whether the promised goods or services are performance obligations including whether they are distinct in the context of the contract; (iii) measurement of the transaction price, including the constraint on variable consideration; (iv) allocation of the transaction price to the performance obligations; and (v) recognition of revenue when (or as) we satisfy each performance obligation. As part of the accounting for these arrangements, we must use significant judgment to determine: a) the number of performance obligations based on the determination under step (ii) above; b) the transaction price under step (iii) above; and c) the contract term and pattern of satisfaction of the performance obligations under step (v) above. We use significant judgment to determine whether milestones or other variable consideration, except for royalties, should be included in the transaction price as described further below. The transaction price is allocated to the goods and services we expect to provide. We use estimates to determine the timing of satisfaction of performance obligations, which may include the use of full time equivalent time as a measure of satisfaction of performance obligations.

Amounts received prior to satisfying the revenue recognition criteria are recorded as deferred revenue in our consolidated balance sheets. Amounts expected to be recognized as revenue within the 12 months following the balance sheet date are classified as current deferred revenue. Amounts not expected to be recognized as revenue within the 12 months following the balance sheet date are classified as deferred revenue, net of current portion.

Licenses of Intellectual Property

In assessing whether a promise or performance obligation is distinct from the other promises, we consider factors such as the research, manufacturing and commercialization capabilities of the customer and the availability of the associated expertise in the general marketplace. In addition, we consider whether the customer can benefit from a promise for its intended purpose without the receipt of the remaining promises, whether the value of the promise is dependent on the unsatisfied promise, whether there are other vendors that could provide the remaining promise, and whether it is separately identifiable from the remaining promise. For licenses that are combined with other promises, we utilize judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, the appropriate method of measuring progress for purposes of recognizing revenue. We evaluate the measure of progress each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition.

Research and Development Services

If an arrangement is determined to contain a promise or obligation for us to perform research and development services, we must determine whether these services are distinct from the other promises in the arrangement. In assessing whether the services are distinct from the other promises, we consider the capabilities of the customer to perform these same services. In addition, we consider whether the customer can benefit from a promise for its intended purpose without the receipt of the remaining promise, whether the value of the promise is dependent on the unsatisfied promise, whether there are other vendors that could provide the remaining promise, and whether it is separately identifiable from the remaining promise. For research and development services that are combined with other promises, we utilize judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, the appropriate method of measuring progress for purposes of recognizing revenue. We evaluate the measure of progress each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition.

Customer Options

If an arrangement is determined to contain customer options that allow the customer to acquire additional goods or services, the goods and services underlying the customer options are not considered to be performance obligations at the outset of the arrangement, as they are contingent upon option exercise. We evaluate the customer options for material rights, that is, the option to acquire additional goods or services for free or at a discount. If the customer options are determined to represent a material right, the material right is recognized as a separate performance obligation at the outset of the arrangement. We allocate the transaction price to material rights based on an alternative approach when the goods or services are both (i) similar to the original goods and services in the contract and (ii) provided in accordance with the terms of the original contract. Under this alternative, we allocate the total amount of consideration expected to be received from the customer to the total goods or services expected to be provided to the customer. Amounts allocated to a material right are not recognized as revenue until the option is exercised and the performance obligation is satisfied.

Milestone Payments

At the inception of each arrangement that includes milestone payments, we evaluate whether a significant reversal of cumulative revenue provided in conjunction with achieving the milestones is probable and estimate the amount to be included in the transaction price using the most likely amount method. If it is probable that a significant reversal of cumulative revenue would not occur, the associated milestone value is included in the transaction price. Milestone payments that are not within our control or the licensee, such as regulatory approvals, are not considered probable of being achieved until those approvals are received. For other milestones, we evaluate factors such as the scientific, clinical, regulatory, commercial, and other risks that must be overcome to achieve the particular milestone in making this assessment. There is considerable judgment involved in determining whether it is probable that a significant reversal of cumulative revenue would not occur. At the end of each subsequent reporting period, we reevaluate the probability of achievement of all milestones subject to constraint and, if necessary, adjusts our estimate of the overall transaction price. Any such adjustments are recorded on a cumulative catch-up basis, which would affect revenues and earnings in the period of adjustment.

Royalties

For arrangements that include sales-based royalties, including milestone payments based on a level of sales, and the license is deemed to be the predominant item to which the royalties relate, we recognizes revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied). To date, we have not recognized any royalty revenue resulting from any of our licensing arrangements.

Contract Costs

We recognize as an asset the incremental costs of obtaining a contract with a customer if the costs are expected to be recovered. As a practical expedient, we recognize the incremental costs of obtaining a contract as an expense when incurred if the amortization period of the asset that we otherwise would have recognized is one year or less. To date, we have not incurred any incremental costs of obtaining a contract with a customer.

Research and Development Expense

All research and development expenses are expensed as incurred. Research and development expenses comprise costs incurred in performing research and development activities, including compensation, benefits and other employee costs; equity-based compensation expense; laboratory and clinical supplies and other direct expenses; facilities expenses; overhead expenses; fees for contractual services, including preclinical studies, clinical trials, clinical manufacturing and raw materials; and other external expenses. Nonrefundable advance payments for research and development activities are capitalized and expensed over the related service period or as goods are received. When third-party service providers' billing terms do not coincide with our period-end, we are required to make estimates of our obligations to those third parties, including clinical trial costs, contractual service costs and costs for supply of our drug candidates, incurred in a given accounting period and record accruals at the end of the period. We base our estimates on our knowledge of the research and development programs, services performed for the period and the expected duration of the third-party service contract, where applicable.

Results of Operations

The following discussion summarizes the key factors our management believes are necessary for an understanding of our consolidated financial results.

	Year ended December 31,	
	2019	2018
	(in thousands)	
Revenue	\$ 2,224	\$ 2,520
Operating expenses:		
Research and development	41,905	38,034
General and administrative	14,728	15,716
Total operating expenses	56,633	53,750
Loss from operations	(54,409)	(51,230)
Other income (expense):		
Interest and investment income	3,062	2,843
Interest expense	(21)	(43)
Other expense	(5)	(5)
Other income (expense), net	3,036	2,795
Net loss	\$ (51,373)	\$ (48,435)

Year Ended December 31, 2019 Compared to Year Ended December 31, 2018

Revenue

	Years Ended		Change	
	December 31,		\$	%
	2019	2018		
	(dollars in thousands)			
Revenue	\$ 2,224	\$ 2,520	\$ (296)	(12)%

Revenue was \$2.2 million for the year ended December 31, 2019 compared to \$2.5 million for the year ended December 31, 2018. Revenue for the years ended December 31, 2019 and 2018 was related to the recognition of deferred revenue from services performed and payments received under the AbbVie collaboration.

Operating Expenses

	Years Ended		Change	
	December 31,		\$	%
	2019	2018		
	(dollars in thousands)			
Operating expenses:				
Research and development	\$ 41,905	\$ 38,034	\$ 3,871	10%
General and administrative	14,728	15,716	(988)	(6)%
Total operating expenses	\$ 56,633	\$ 53,750	\$ 2,883	5%

Research and Development Expense

Research and development expense was \$41.9 million for the year ended December 31, 2019 compared to \$38.0 million for the year ended December 31, 2018. The increase of \$3.9 million was primarily due to an increase of \$1.8 million of non-clinical costs, \$1.7 million of research and development support costs, \$1.0 million in clinical development costs associated with our SYN1891 clinical trial and \$0.2 million of manufacturing related costs for SYN1891, \$0.5 million in clinical development costs associated with our SYN1618 program, and \$0.2 million in compensation, benefits and other employee-related expenses associated with increased headcount. These increases were partially offset by decreases of \$1.1 million of manufacturing costs associated with our SYN1618 program and \$0.1 million of manufacturing costs associated with our SYN1020 program, \$0.2 million of professional services, and \$0.1 million in clinical development costs associated with SYN1020.

General and Administrative Expense

General and administrative expense was \$14.7 million for the year ended December 31, 2019 compared to \$15.7 million for the year ended December 31, 2018. The decrease of \$1.0 million was due primarily to a decrease of \$1.3 million in compensation, benefits and other employee-related expenses associated with decreased headcount, as well as a decrease of \$0.5 million in support costs. The decreases were partially offset by an increase of \$0.7 million in professional services and a \$0.1 million increase in corporate fees.

Other Income (Expense)

	Years Ended		Change	
	December 31,		\$	%
	2019	2018		
	(dollars in thousands)			
Other income (expense):				
Interest and investment income	\$ 3,062	\$ 2,843	\$ 219	8%
Interest expense	(21)	(43)	22	(51)%
Other expense	(5)	(5)	—	—
Other income (expense), net	\$ 3,036	\$ 2,795	\$ 241	9%

Other income (expense) for the year ended December 31, 2019 was \$3.1 million compared to \$2.8 million for the corresponding period in 2018. The increase of \$0.2 million was related to an increase in interest and investment income resulting from higher cash balances and higher interest rates generated by our investment account. Additionally, interest expense decreased during the year as the finance leases established during 2017 were paid down.

Liquidity and Capital Resources

We have incurred losses since our inception on March 14, 2014 and, as of December 31, 2019, we had an accumulated deficit of approximately \$171.1 million. We have financed our operations to date primarily through the sale of preferred stock, common stock, preferred units, warrants, payments received under our AbbVie collaboration agreement, interest earned on investments, and cash received in the Merger. In June 2019, we issued to Ginkgo 6,340,771 shares of common stock and accompanying Pre-Funded warrants (the "Pre-Funded Warrants") to purchase an aggregate of 2,548,117 shares of common stock, at a combined purchase price per share and Pre-Funded Warrant of \$9.00. The Pre-Funded Warrants have an exercise price of \$9.00 per share, with \$8.99 of such exercise price paid at the closing of the offering. The net proceeds to us were approximately \$79.9 million. At December 31, 2019, we had approximately \$119.6 million in cash, cash equivalents, and short-term marketable securities and \$7.50 million of long-term marketable securities. Our cash and cash equivalents include amounts held in money market funds and corporate debt securities, stated at cost plus unrealized gain and loss, which approximates fair market value. Our available-for-sale securities include amounts held in corporate debt securities and U.S. government agency securities and treasuries. We invest cash in excess of immediate requirements in accordance with our investment policy, which limits the amounts we may invest in any one type of investment and requires all investments held by us to maintain minimum ratings from Nationally Recognized Statistical Rating Organizations so as to primarily achieve liquidity and capital preservation.

During the year ended December 31, 2019 our cash, cash equivalents and marketable securities balance increased approximately \$4.4 million. This increase was primarily due to the \$79.9 million in net proceeds received from Ginkgo related to the issuance of common stock and Pre-Funded Warrants, combined with a decrease of \$30.0 million paid to Ginkgo for prepaid foundry services and a decrease due to the cash used to operate our business, including payments related to, among other things, research and development

and general and administrative expenses as we continue to invest in our primary drug candidates and support the development of our proprietary platform. We also made capital purchases and made payments on our finance leases.

The following table sets forth the major sources and uses of cash, cash equivalents and restricted cash for each of the periods below:

	Years ended December 31,	
	2019	2018
	(in thousands)	
Net cash, cash equivalents and restricted cash (used in) provided by		
Operating activities	\$ (75,468)	\$ (42,470)
Investing activities	10,796	(87,201)
Financing activities	79,604	82,483
Net increase (decrease) in cash, cash equivalents and restricted cash	<u>\$ 14,932</u>	<u>\$ (47,188)</u>

Cash Flows from Operating Activities

Net cash, cash equivalents and restricted cash used in operating activities was approximately \$75.5 million for the year ended December 31, 2019. The primary use of cash was our net loss of approximately \$51.4 million and a decrease in working capital of \$31.0 million, of which \$30.0 million related to prepaid research and development expenses, as a result of our June 2019 services agreement with Ginkgo, decreases in accounts payable and accrued expenses, and an increase in operating lease liability and right of use asset, as a result of the adoption of ASU 2016-02: *Leases* (Topic 842) effective January 1, 2019, offset by an increase in deferred revenue. Net loss was partially offset by \$6.9 million of non-cash items primarily including depreciation and equity-based compensation.

Net cash, cash equivalents and restricted cash used in operating activities was approximately \$42.5 million for the year ended December 31, 2018. The primary use of cash was our net loss of approximately \$48.4 million and an increase in working capital of \$0.6 million, primarily related to decreases in accounts payable and accrued expenses and deferred revenue offset by an increase in deferred rent from our 301 Binney Street facility. Net loss was partially offset by \$5.3 million of non-cash items primarily including depreciation and equity-based compensation.

Cash Flows from Investing Activities

Net cash provided by investing activities for the year ended December 31, 2019 was \$10.8 million and resulted primarily from the purchases of marketable securities of \$145.4 million and purchases of property and equipment of \$1.3 million. These uses were partially offset by the proceeds of maturity of marketable securities of \$157.5 million.

Net cash used in investing activities for the year ended December 31, 2018 was approximately \$87.2 million and resulted primarily from the purchases of securities of \$172.9 million and the purchases of property and equipment of \$5.7 million. These uses were partially offset by proceeds from the maturity of marketable securities of \$91.3 million.

Cash Flows from Financing Activities

Net cash provided by financing activities for the year ended December 31, 2019 totaled \$79.6 million related to net proceeds of \$79.9 million from the sale of our common stock and Pre-Funded Warrants in June 2019 offset by payments on our finance leases.

Net cash provided by financing activities for the year ended December 31, 2018 totaled \$82.5 million as a result of \$53.8 million in net proceeds from the sale of our common stock in January 2018, \$28.9 million in net proceeds from the sale of our common stock in April 2018 and proceeds from exercises of stock options of \$0.2 million, partially offset by \$0.4 million in payments on our capital leases.

Funding Requirements

To date, we have not commercialized any products and have not achieved profitability. We anticipate that we will continue to incur substantial net losses for the next several years as we further develop our product candidates, invest in our proprietary platform technology and operate as a publicly traded company.

We have generated revenue from our AbbVie collaboration, but have not generated any product revenue since our inception and do not expect to generate any product revenue unless we receive regulatory approval for our product candidates. We believe that our cash on hand as of December 31, 2019 will be sufficient to meet our anticipated cash requirements for at least the next 12 months from the date of this filing. Our forecast of the period of time through which our financial resources will be adequate to support our operations is a forward-looking statement that involves risks and uncertainties, and actual results could vary materially and negatively

as a result of a number of factors, including the factors discussed in the section entitled “Risk Factors” in this Annual Report on Form 10-K. We have based our estimates on assumptions that may prove to be wrong, and we could utilize our available capital resources sooner than we currently expect.

Due to the numerous risks and uncertainties associated with the development of our product candidates, we are unable to estimate precisely the amounts of capital outlays and operating expenditures necessary to complete the development of, and to obtain regulatory approval for, our product candidates. Our funding requirements will depend on many factors, including, but not limited to, the following:

- the success of our research and development efforts;
- the initiation, progress, timing, costs and results of clinical trials for our product candidates;
- the time and costs involved in obtaining regulatory approvals for our product candidates;
- the progress, timing and costs involved in developing manufacturing processes and agreements with third-party manufacturers;
- the rate of progress and cost of our commercialization activities;
- the expenses we incur in marketing and selling our product candidates;
- the revenue generated by sales of our product candidates;
- the emergence of competing or complementary technological developments;
- the costs of filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights;
- the terms and timing of any additional collaborative, licensing or other arrangements that we may establish;
- the acquisition of businesses, products and technologies;
- our need to implement additional infrastructure and internal systems; and
- our need to add personnel and financial and management information systems to support our product development and potential future commercialization efforts, and to enable us to operate as a public company.

As an early-stage company, we are subject to a number of risks common to other life science companies, including, but not limited to, the ability to raise additional capital, development by our competitors of new technological innovations, risk of failure in preclinical studies, the safety and efficacy of our product candidates in clinical trials, the regulatory approval process, the ability to efficiently manufacture our products, market acceptance of our products once approved, lack of marketing and sales history, dependence on key personnel and protection of proprietary technology. Our therapeutic programs are currently pre-commercial, spanning discovery through early development and will require significant additional research and development efforts, including extensive preclinical and clinical testing and regulatory approval prior to commercialization of any product candidates. These efforts require significant amounts of additional capital, adequate personnel infrastructure and extensive compliance-reporting capabilities. There can be no assurance that our research and development will be successfully completed, that adequate protection for our intellectual property will be obtained, that any products developed will obtain necessary regulatory approval or that any approved products will be commercially viable. Even if our product development efforts are successful, it is uncertain when, if ever, we will generate revenue from product sales. We may never achieve profitability, and unless and until we do, we will continue to need to raise additional capital or obtain financing from other sources, such as strategic collaborations or partnerships. If we cannot expand our operations or otherwise capitalize on our business opportunities because we lack sufficient capital, our business, financial condition and results of operations could be materially adversely affected.

Contractual Commitments and Obligations

Our commitments for operating leases relate to our lease of office and laboratory space at 301 Binney Street in Cambridge, Massachusetts and the GMP clean-room space leased from the Azzur Group, LLC, in Waltham, Massachusetts.

In July 2017, we entered into an agreement to lease approximately 41,346 square feet of laboratory and office space at 301 Binney Street in Cambridge, Massachusetts. Annual rent is approximately \$3.1 million. The ten-year lease commenced in January 2018 and contains provisions for a free-rent period, annual rent increases and an allowance for tenant improvements. Additionally, we have paid for a tenant improvement investment of approximately \$2.9 million. In conjunction with the lease, we established a letter of credit of approximately \$1.0 million.

On December 7, 2018, Synlogic Operating Company, Inc., a wholly-owned subsidiary of Synlogic, Inc. (the “Company”), entered into a Statement of Work (the “SOW”) with Azzur Group, LLC (“Azzur”) pursuant to a Master Contract Services Agreement (the “Master Services Agreement”), dated September 8, 2018, between the Company and Azzur.

Pursuant to the SOW, Azzur has agreed to provide the Company with access to, and the use of, an approximately 700 square foot cleanroom space to be constructed in Waltham, Massachusetts (the “Azzur Suite”), for a period of 44 months, from May 1, 2019 to December 31, 2022 (the “Term”). Azzur has also agreed to provide the Company with storage space and personnel support at the Azzur Suite. The total estimated project cost during the Term for access to, and use of, the cleanroom and storage space, and the personnel support and other services, is \$4.8 million.

The Company may terminate the SOW on four months’ prior written notice at any time during the Term. In addition, either party may terminate the Master Services Agreement (including the SOW) due to a breach by the other party and failure to cure. The Company is reasonably certain not to exercise the termination option through December 31, 2022.

As we are a clinical stage company, having entered the clinic for our first Phase 1 clinical trial in June 2017, we expect our most significant clinical trial expenditures will be with CROs and CMOs. These contracts generally are cancellable, with notice, at our option and do not have cancellation penalties.

Off-Balance Sheet Arrangements

We do not have any relationships with unconsolidated entities or financial partnerships, such as entities often referred to as structured finance or special purpose entities, that would have been established for the purpose of facilitating off-balance sheet arrangements (as that term is defined in Item 303 (a)(4)(ii) of Regulation S-K) or other contractually narrow or limited purposes. As such, we are not exposed to any financing, liquidity, market or credit risk that could arise if we had engaged in those types of relationships. We enter into guarantees in the ordinary course of business related to the guarantee of our performance and the performance of our subsidiaries.

JOBS Act

Section 107 of the JOBS Act provides that an emerging growth company can take advantage of the extended transition period provided in Section 7(a)(2)(B) of the Securities Act for complying with new or revised accounting standards. Thus, an emerging growth company can delay the adoption of certain accounting standards until those standards would otherwise apply to private companies. We have irrevocably elected not to avail ourselves of this extended transition period and, as a result, we will adopt new or revised accounting standards on the relevant dates on which adoption of such standards is required for other companies.

Recent Accounting Pronouncements

Please read Note 2, “Summary of Significant Accounting Policies” to the consolidated financial statements included elsewhere in this Annual Report on Form 10-K.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk.**Interest Rate Risk**

We are a smaller reporting company as defined by Rule 12b-2 of the Exchange Act and are not required to provide this information required under this item.

Item 8. Consolidated Financial Statements and Supplementary Data.

Our consolidated financial statements, together with the independent registered public accounting firm report thereon, appear at pages F-1 through F-28 respectively, of this Annual Report on Form 10-K.

Item 9. Changes in and Disagreements With Accountants on Accounting and Financial Disclosure.

None.

Item 9A. Controls and Procedures.**Definition and limitations of disclosure controls**

Our disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, as amended (the Exchange Act) are controls and other procedures that are designed to ensure that information required to be disclosed in our reports filed under the Exchange Act, such as this report, is recorded, processed, summarized and reported within the time periods specified in the SEC's rules and forms. Disclosure controls and procedures are also designed to ensure that such information is accumulated and communicated to our management, including our principal executive officer and principal financial officer, as appropriate to allow timely decisions regarding required disclosure. Our management evaluates these controls and procedures on an ongoing basis.

There are inherent limitations to the effectiveness of any system of disclosure controls and procedures. These limitations include the possibility of human error, the circumvention or overriding of the controls and procedures and reasonable resource constraints. In addition, because we have designed our system of controls based on certain assumptions, which we believe are reasonable, about the likelihood of future events, our system of controls may not achieve its desired purpose under all possible future conditions. Accordingly, our disclosure controls and procedures provide reasonable assurance, but not absolute assurance, of achieving their objectives.

Evaluation of Disclosure Controls and Procedures

Our principal executive officer and principal financial officer, after evaluating the effectiveness of our disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) as of the end of the period covered by this Form 10-K, have concluded that, based on such evaluation, our disclosure controls and procedures were effective to ensure that information required to be disclosed by us in the reports that we file or submit under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the SEC's rules and forms, and is accumulated and communicated to our management, including our principal executive and principal financial officers, or persons performing similar functions, as appropriate to allow timely decisions regarding required disclosure.

Changes in Internal Control

There have not been any changes in our internal controls over financial reporting identified in connection with the evaluation of such internal control that occurred during our fiscal year ended December 31, 2019 that have materially affected, or are reasonably likely to materially affect, our internal controls over financial reporting.

Management's Report on Internal Control Over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act, as amended. Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Our management assessed the effectiveness of our internal control over financial reporting as of December 31, 2019. In making this assessment, management used the criteria set forth by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in Internal Control-Integrated Framework. Based on our assessment, management believes that, as of December 31, 2019, our internal control over financial reporting is effective based on those criteria.

Inherent Limitations on the Effectiveness of Controls

A control system, no matter how well conceived and operated, can provide only reasonable, not absolute, assurance that the objectives of the controls are met. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues or misstatements, if any, within a company have been detected. Accordingly, our controls and procedures are designed to provide reasonable, not absolute, assurance that the objectives of our control system are met. Projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Item 9B. Other Information.

None.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

The response to this item is incorporated by reference from the discussion responsive thereto under the captions “Management and Corporate Governance Matters,” “Section 16(a) Beneficial Ownership Reporting Compliance,” and “Code of Conduct and Ethics” in the Company’s Proxy Statement for the 2020 Annual Meeting of Stockholders.

Item 11. Executive Compensation.

The response to this item is incorporated by reference from the discussion responsive thereto under the caption “Executive Officer and Director Compensation” in the Company’s Proxy Statement for the 2020 Annual Meeting of Stockholders.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.

The response to this item is incorporated by reference from the discussion responsive thereto under the caption “Security Ownership of Certain Beneficial Owners and Management” in the Company’s Proxy Statement for the 2020 Annual Meeting of Stockholders.

Item 13. Certain Relationships and Related Transactions, and Director Independence.

The response to this item is incorporated by reference from the discussion responsive thereto under the captions “Certain Relationships and Related Person Transactions” and “Management and Corporate Governance” in the Company’s Proxy Statement for the 2020 Annual Meeting of Stockholders.

Item 14. Principal Accounting Fees and Services.

The response to this item is incorporated by reference from the discussion responsive thereto under the caption “Independent Registered Public Accounting Firm” in the Company’s Proxy Statement for the 2020 Annual Meeting of Stockholders.

PART IV

Item 15. Exhibits, Financial Statement Schedules.

Item 15(a). The following documents are filed as part of this Annual Report on Form 10-K:

Item 15(a)(1) and (2) See “Consolidated Financial Statements and Supplementary Data” at Item 8 to this Annual Report on Form 10-K. Other financial statement schedules have not been included because they are not applicable, or the information is included in the financial statements or notes thereto.

Item 15(a)(3) The following exhibits are filed as part of, or incorporated by reference into, this Annual Report on Form 10-K.

Exhibit Index

Exhibit Number	Exhibit Description	Filed with this Report	Incorporated by Reference herein from Form or Schedule	Filing Date	SEC File/Reg. Number
2.1 [^]	Agreement and Plan of Merger and Reorganization, dated as of May 15, 2017, by and among Mirna Therapeutics, Inc., Meerkat Merger Sub, Inc. and Synlogic, Inc.		8-K (Exhibit 2.1)	05/16/2017	001-37566
3.1	Amended and Restated Certificate of Incorporation		8-K (Exhibit 3.1)	10/6/2015	001-37566
3.2	Certificate of Amendment (Reverse Stock Split) to the Amended and Restated Certificate of Incorporation, dated August 25, 2017		8-K (Exhibit 3.1)	08/28/2017	001-37566
3.3	Certificate of Amendment (Name Change) to the Amended and Restated Certificate of Incorporation		8-K (Exhibit 3.2)	08/28/2017	001-37566
3.4	Amended and Restated Bylaws		8-K (Exhibit 3.2)	10/6/2015	001-37566
4.1	Form of Common Stock Certificate		S-1/A (Exhibit 4.2)	09/18/2015	333-206544
4.2	Pre-Funded Warrant		8-K (Exhibit 4.1)	06/12/2019	001-37566
4.3	Description of Securities	X			
10.1#	2015 Equity Incentive Award Plan		10-K (Exhibit 10.1)	03/20/2018	001-37566
10.2#	Form of Stock Option Grant Notice and Stock Option Agreement under the 2015 Equity Incentive Award Plan.		S-1/A (Exhibit 10.9(B))	09/11/2015	333-206544
10.3#	Form of Restricted Stock Award Agreement and Restricted Stock Unit Award Grant Notice under the 2015 Equity Incentive Award Plan.		S-1/A (Exhibit 10.9(C))	09/11/2015	333-206544
10.4#	2017 Stock Incentive Plan		10-K (Exhibit 10.4)	03/20/2018	001-37566
10.5#	Form of Stock Option Grant Notice and Stock Option Agreement under 2017 Stock Incentive Plan.		10-Q (Exhibit 10.17)	11/13/2017	00-37566
10.6#	Non-Employee Director Compensation Program.		10-K (Exhibit 10.6)	03/20/2018	001-37566
10.7#	Form of Indemnification Agreement between the Company and each of its directors and officers		S-1/A (Exhibit 10.13)	09/11/2015	333-206544
10.8#	Offer Letter by and between Synlogic and Jose Carlos Gutierrez-Ramos, Ph.D., dated as of March 20, 2015		8-K (Exhibit 10.2)	08/28/2017	001-37566

Exhibit Number	Exhibit Description	Filed with this Report	Incorporated by Reference herein from Form or Schedule	Filing Date	SEC File/Reg. Number
10.9#	First Amendment to Offer Letter by and between Synlogic and Jose Carlos Gutierrez-Ramos, Ph.D., dated as of May 8, 2017		8-K (Exhibit 10.3)	08/28/2017	001-37566
10.10#	Letter Agreement dated as of May 9, 2018, between Synlogic, Inc. and Jose-Carlos Gutiérrez-Ramos		10-Q (Exhibit 10.2)	05/15/2018	001-37566
10.11#	Amendment to Option Agreements dated as of June 5, 2018, between Synlogic, Inc. and Jose-Carlos Gutiérrez-Ramos		10-Q (Exhibit 10.2)	08/9/2018	001-37566
10.12#	Offer Letter by and between Synlogic and Todd Shegog, dated as of June 17, 2016		8-K (Exhibit 10.4)	08/28/2017	001-37566
10.13#	First Amendment to Offer Letter by and between Synlogic and Todd Shegog, dated as of May 8, 2017		8-K (Exhibit 10.5)	8/28/2017	001-37566
10.14#	Offer Letter by and between Synlogic and Aoife M. Brennan, MB, BCh, BAO, MMSc, dated as of June 22, 2016		8-K (Exhibit 10.6)	08/28/2017	001-37566
10.15#	First Amendment to Offer Letter by and between Synlogic and Aoife M. Brennan, MB, BCh, BAO, MMSc, dated as of November 7, 2016		8-K (Exhibit 10.7)	08/28/2017	001-37566
10.16#	Second Amendment to Offer Letter by and between Synlogic and Aoife M. Brennan, MB, BCh, BAO, MMSc, dated as of May 8, 2017		8-K (Exhibit 10.8)	08/28/2017	001-37566
10.17#	Third Amendment to Offer Letter dated as of June 5, 2018, between Synlogic, Inc. and Aoife Brennan, MB, BCh, BAO, MMSc		10-Q (Exhibit 10.1)	08/9/2018	001-37566
10.18#	Amended and Restated Letter Agreement by and between Synlogic, Inc. and Aoife M. Brennan, MB, BCh, BAO, MMSc, dated as of October 1, 2018		10-Q (Exhibit 10.1)	11/13/2018	001-37566
10.19#	Amended and Restated Letter Agreement by and between Paul Miller, Ph.D., dated as of May 16, 2017		8-K (Exhibit 10.9)	8/28/2017	001-37566
10.20#	Employment Agreement, dated as of September 4, 2017, by and between the Company and Andrew W. Gengos.		8-K (Exhibit 10.1)	10/10/2017	001-37566
10.21#	Separation Agreement by and between the Company and Paul Lammers, dated as of August 20, 2017.		8-K (Exhibit 10.10)	8/28/2017	001-37566
10.22#	Separation Agreement by and between the Company and Alan Fuhrman, dated as of August 20, 2017.		8-K (Exhibit 10.11)	8/28/2017	001-37566
10.23#	Separation Agreement by and between the Company and Andrew Gengos, dated as of December 17, 2018.		10-Q (Exhibit 10.1)	05/9/2019	001-37566
10.24†^	Agreement and Plan of Merger by and among AbbVie S.à.r.l., Suffolk Merger Sub, Inc., Synlogic IBDCo, Inc., Synlogic, LLC, Synlogic, Inc. and the founders named therein, dated as of July 16, 2015; as amended by a First Amendment to Agreement and Plan of Merger, dated as of December 14, 2015		8-K (Exhibit 10.12)	8/28/2017	001-37566
10.25†^	Second Amendment to Agreement and Plan of Merger by and among AbbVie S.à.r.l., Synlogic IBDCo, Inc. and Synlogic Operating Company, Inc., dated as of September 27, 2018		10-Q (Exhibit 10.2)	11/13/2018	001-37566

Exhibit Number	Exhibit Description	Filed with this Report	Incorporated by Reference herein from Form or Schedule	Filing Date	SEC File/Reg. Number
10.26†^	Third Amendment to Agreement and Plan of Merger and First Amendment to License Agreement by and among AbbVie S.à.r.l., Synlogic IBDCo, Inc. and Synlogic Operating Company, Inc., dated as of December 18, 2018		10-K (Exhibit 10.25)	03/12/2019	001-37566
10.27†	License Agreement by and between Synlogic, Inc. and Synlogic IBDCo, Inc., dated as of July 16, 2015		8-K (Exhibit 10.13)	8/28/2017	001-37566
10.28	Sales Agreement, dated as of October 13, 2017 by and between the registrant and Cowen and Company, LLC		8-K (Exhibit 1.1)	10/16/2017	001-37566
10.29	Form of Subscription Agreement, dated as of April 6, 2018, by and among Synlogic, Inc. and certain investors.		8-K (Exhibit 10.1)	04/6/2018	001-37566
10.30†	Master Contract Services Agreement, dated as of September 8, 2018, between Synlogic, Inc. and Azzur Group (d/b/a Azzur of New England LLC).		10-K (Exhibit 10.29)	03/12/2019	001-37566
10.31†	Statement of Work dated September 10, 2018 pursuant to Master Contract Services Agreement between Synlogic, Inc. and Azzur Group (d/b/a Azzur of New England LLC).		10-K (Exhibit 10.30)	03/12/2019	001-37566
10.32†	Statement of Work dated December 7, 2018 pursuant to Master Contract Services Agreement between Synlogic, Inc. and Azzur Group (d/b/a Azzur of New England LLC).		10-K (Exhibit 10.31)	03/12/2019	001-37566
10.33	Subscription Agreement dated June 11, 2019 by and between the Company and Ginkgo Bioworks, Inc.		8-K (Exhibit 10.1)	06/12/2019	001-37566
10.34†	Foundry Terms of Service Agreement dated June 11, 2019 by and between Synlogic Operating Company Inc. and Ginkgo Bioworks, Inc.		10-Q (Exhibit 10.2)	08/08/2019	001-37566
10.35	Consulting Agreement effective as of October 13, 2019 by and between the Company and Danforth Advisors, LLC, as amended		8-K (Exhibit 10.1)	10/24/2019	001-37566
10.36	Non-Employee Director Compensation Program		8-K (Exhibit 10.1)	1/31/2020	001-37566
10.37	Synlogic, Inc. 2015 Employee Stock Purchase Plan, as amended		8-K (Exhibit 10.1)	12/20/2019	001-37566
21.1	Subsidiaries of the registrant	X			
23.1	Consent of Independent Registered Accounting Firm	X			
24.1	Power of Attorney (included in the signature page hereto)	X			
31.1	Certification of Chief Executive Officer required by Rule 13a-14(a) or Rule 15d-14(a).	X			
31.2	Certification of Chief Financial Officer required by Rule 13a-14(a) or Rule 15d-14(a).	X			
32.1	Certification required by Rule 13a-14(b) or Rule 15d-14(b) and Section 1350 of Chapter 63 of Title 18 of the United States Code (18 U.S.C. §1350).	X			
32.2	Certification required by Rule 13a-14(b) or Rule 15d-14(b) and Section 1350 of Chapter 63 of Title 18 of the United States Code (18 U.S.C. §1350).	X			
101.INS	XBRL Instance Document	X			

Exhibit Number	Exhibit Description	Filed with this Report	Incorporated by Reference herein from Form or Schedule	Filing Date	SEC File/Reg. Number
101.SCH	XBRL Taxonomy Extension Schema Document	X			
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document	X			
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document	X			
101.LAB	XBRL Taxonomy Extension Label Linkbase Document	X			
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document	X			

^ The schedules and exhibits to this exhibit have been omitted pursuant to Item 601(b)(2) of Regulation S-K. A copy of any omitted schedule and/or exhibit will be furnished to the SEC upon request.

Management contract or compensatory plans or arrangements.

† Confidential treatment has been requested or granted as to certain portions, which portions have been omitted and filed separately with the SEC.

Item 16. Form 10-K Summary.

None.

Index to Consolidated Financial Statements of Synlogic, Inc.

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Report of Independent Registered Public Accounting Firm

To the Stockholders and Board of Directors
Synlogic, Inc.:

Opinion on the Consolidated Financial Statements

We have audited the accompanying consolidated balance sheets of Synlogic, Inc. and subsidiaries (the Company) as of December 31, 2019 and 2018, the related consolidated statements of operations and comprehensive loss, stockholders' equity, and cash flows for the years then ended, and the related notes (collectively, the consolidated financial statements). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2019 and 2018, and the results of its operations and its cash flows for the years then ended, in conformity with U.S. generally accepted accounting principles.

Change in Accounting Principle

As discussed in Note 2 to the consolidated financial statements, the Company has changed its method of accounting for leases as of January 1, 2019 due to the adoption of Accounting Standards Update 2016-02, *Leases* (Topic 842).

Basis for Opinion

These consolidated financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these consolidated 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 regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the consolidated 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 consolidated 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 consolidated 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 consolidated financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ KPMG LLP

We have served as the Company's auditor since 2015.

Boston, Massachusetts
March 12, 2020

SYNOLOGIC, INC. AND SUBSIDIARIES

Consolidated Balance Sheets

(In thousands, except share amounts)

	<u>December 31,</u> <u>2019</u>	<u>December 31,</u> <u>2018</u>
Assets		
Current assets:		
Cash and cash equivalents	\$ 26,184	\$ 11,252
Short-term marketable securities	93,387	111,477
Prepaid expenses and other current assets	13,675	1,609
Total current assets	<u>133,246</u>	<u>124,338</u>
Long-term marketable securities	7,502	—
Property and equipment, net	13,021	14,841
Right of use asset - operating lease	17,263	—
Restricted cash	1,097	1,097
Prepaid research and development, net of current portion	16,381	—
Other assets	64	64
Total assets	<u>\$ 188,574</u>	<u>\$ 140,340</u>
Liabilities and Stockholders' Equity		
Current liabilities:		
Accounts payable	\$ 2,165	\$ 2,421
Accrued expenses	3,946	4,993
Deferred revenue	544	268
Deferred rent	—	393
Lease liability - operating lease	2,000	—
Finance lease obligations	208	266
Total current liabilities	<u>8,863</u>	<u>8,341</u>
Long-term liabilities:		
Deferred rent, net of current portion	—	7,691
Lease liability - operating lease, net of current portion	22,804	—
Finance lease obligations, net of current portion	2	210
Total long-term liabilities	<u>22,806</u>	<u>7,901</u>
Commitments and contingencies (Note 14)		
Stockholders' Equity		
Common stock, \$0.001 par value		
250,000,000 shares authorized as of December 31, 2019 and December 31, 2018.		
32,266,814 shares issued and outstanding as of December 31, 2019 and		
25,401,479 shares issued and outstanding as of December 31, 2018.	33	25
Additional paid-in capital	327,900	243,903
Accumulated other comprehensive loss	110	(65)
Accumulated deficit	(171,138)	(119,765)
Total stockholders' equity	<u>156,905</u>	<u>124,098</u>
Total liabilities and stockholders' equity	<u>\$ 188,574</u>	<u>\$ 140,340</u>

See accompanying notes to the consolidated financial statements.

SYNOLOGIC, INC. AND SUBSIDIARIES

Consolidated Statements of Operations and Comprehensive Loss

(In thousands, except share and per share amounts)

	Years ended December 31,	
	2019	2018
Revenue	\$ 2,224	\$ 2,520
Operating expenses:		
Research and development	41,905	38,034
General and administrative	14,728	15,716
Total operating expenses	<u>56,633</u>	<u>53,750</u>
Loss from operations	(54,409)	(51,230)
Other income (expense):		
Interest and investment income	3,062	2,843
Interest expense	(21)	(43)
Other expense	(5)	(5)
Other income (expense), net	<u>3,036</u>	<u>2,795</u>
Net loss	<u>\$ (51,373)</u>	<u>\$ (48,435)</u>
Net loss per share - basic and diluted	<u>\$ (1.70)</u>	<u>\$ (2.03)</u>
Weighted-average common stock outstanding - basic and diluted	<u>30,284,068</u>	<u>23,882,685</u>
Comprehensive loss:		
Net loss	\$ (51,373)	\$ (48,435)
Net unrealized gain (loss) on marketable securities	175	(56)
Comprehensive loss	<u>\$ (51,198)</u>	<u>\$ (48,491)</u>

See accompanying notes to the consolidated financial statements.

SYNOLOGIC, INC. AND SUBSIDIARIES
Consolidated Statements of Stockholders' Equity
(In thousands, except share amounts)

	Common stock \$0.001 par value		Additional paid-in capital	Accumulated other comprehensive income (loss)	Accumulated deficit	Total equity
	Shares	Amount				
Balance at December 31, 2017	16,272,617	\$ 16	\$ 156,685	\$ (9)	\$ (71,654)	\$ 85,038
Effect of adoption of ASU 2014-09 (ASC 606)	—	—	—	—	324	324
Sale of common shares	9,179,500	\$ 9	82,657	—	—	82,666
Exercise of options	19,830	—	244	—	—	244
Cancellation of restricted stock	(70,468)	—	—	—	—	-
Equity-based compensation expense	—	—	4,317	—	—	4,317
Unrealized gain (loss) on securities	—	—	—	(56)	—	(56)
Net loss	—	—	—	—	(48,435)	(48,435)
Balance at December 31, 2018	25,401,479	\$ 25	\$ 243,903	\$ (65)	\$ (119,765)	\$ 124,098
Proceeds from issuance of common stock, net of issuance costs	6,340,771	7	56,990	—	—	56,997
Proceeds from issuance of pre-funded common stock warrants, net of issuance costs	—	—	22,874	—	—	22,874
Issuance of restricted stock	585,600	1	(1)	—	—	-
Cancellation of restricted stock	(61,036)	—	—	—	—	-
Equity-based compensation expense	—	—	4,134	—	—	4,134
Unrealized gain (loss) on securities	—	—	—	175	—	175
Net loss	—	—	—	—	(51,373)	(51,373)
Balance at December 31, 2019	32,266,814	\$ 33	\$ 327,900	\$ 110	\$ (171,138)	\$ 156,905

See accompanying notes to the consolidated financial statements

SYNLOGIC, INC. AND SUBSIDIARIES

Consolidated Statements of Cash Flows

(In thousands)

	<u>Year Ended December 31, 2019</u>	<u>Year Ended December 31, 2018</u>
Cash flows from operating activities:		
Net loss	\$ (51,373)	\$ (48,435)
Adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation	2,702	2,421
Loss on disposal of property and equipment	—	8
Equity-based compensation expense	4,134	4,317
Accretion/amortization of investment securities	(1,282)	(1,401)
Reduction in carrying amount of operating lease right of use asset	1,370	—
Changes in operating assets and liabilities:		
Prepaid expenses and other current assets	(12,263)	(45)
Prepaid research and development, net of current portion	(16,381)	—
Other assets	—	168
Accounts payable and accrued expenses	(935)	(257)
Deferred revenue	276	(520)
Deferred rent	—	1,274
Operating lease liabilities	(1,716)	—
Net cash, cash equivalents and restricted cash used in operating activities	(75,468)	(42,470)
Cash flows from investing activities:		
Purchases of marketable securities	(145,418)	(172,887)
Proceeds from maturity of marketable securities	157,465	91,340
Purchases of property and equipment	(1,251)	(5,654)
Net cash, cash equivalents and restricted cash provided by (used in) investing activities	10,796	(87,201)
Cash flows from financing activities:		
Payments on finance lease obligations	(266)	(427)
Proceeds from exercise of stock options	—	244
Proceeds from sale of common stock, net of issuance costs	56,996	82,666
Proceeds from sale of pre-funded warrants, net of issuance costs	22,874	—
Net cash, cash equivalents and restricted cash provided by financing activities	79,604	82,483
Net increase (decrease) in cash, cash equivalents and restricted cash	14,932	(47,188)
Cash, cash equivalents and restricted cash at beginning of period	12,349	59,537
Cash, cash equivalents and restricted cash at end of period	\$ 27,281	\$ 12,349
Supplemental disclosure of non-cash investing and financing activities:		
Landlord funded allowance for tenant improvements	\$ —	\$ 1,654
Property and equipment purchases included in accounts payable and accrued expenses	\$ (369)	\$ 169
Assets acquired under operating lease obligation	\$ 2,714	—
Cash paid for interest	\$ 21	\$ 43
Purchase under capital lease	\$ —	\$ 12

See accompanying notes to the consolidated financial statements.

Notes to Consolidated Financial Statements

(1) Nature of Business**Organization**

Synlogic, Inc., together with its wholly owned and consolidated subsidiaries (“Synlogic” or the “Company”), is a clinical-stage biopharmaceutical company focused on advancing its drug discovery and development platform for Synthetic Biotic™ medicines. Synthetic Biotic medicines are generated from Synlogic’s proprietary drug discovery and development platform applying the principles and tools of synthetic biology to engineer beneficial microbes to perform or deliver critical therapeutic functions to treat metabolic and inflammatory diseases and cancer. As living medicines, Synthetic Biotic medicines can be designed to sense a local disease context within a patient’s body and to respond by metabolizing a toxic substance, compensating for missing or damaged metabolic pathways in patients, or by delivering combinations of therapeutic factors. Synlogic’s goal is to lead in the discovery and development of Synthetic Biotic therapies as living medicines capable of robust and precise pathway complementation and delivery of therapeutic benefit. Since incorporation, the Company has devoted substantially all of its efforts to the research and development of its product candidates.

Synlogic, Inc. (“Private Synlogic” when referred to prior to the Merger (as defined below)) was founded and began operations on March 14, 2014, as TMC Therapeutics, Inc., located in Cambridge, Massachusetts. On July 15, 2014, TMC Therapeutics, Inc. changed its name to Synlogic, Inc. On July 2, 2015, the common and preferred stockholders of Private Synlogic executed the Synlogic, LLC Contribution Agreement (the “Contribution Agreement”), pursuant to which such common and preferred stockholders contributed such stockholders’ equity interests in Private Synlogic in exchange for common and preferred units in a newly formed parent company named Synlogic, LLC. In addition, Synlogic IBDCo, Inc. (“IBDCo”) was formed as a subsidiary of Synlogic, LLC (the “2015 Reorganization”). In conjunction with the 2015 Reorganization, Private Synlogic entered into a license, option and merger agreement with AbbVie S.à.r.l. (“AbbVie”), for the development of treatments for inflammatory bowel disease (“IBD”).

In May 2017, Private Synlogic completed a reorganization (“2017 Reorganization”) pursuant to which Synlogic, LLC merged with and into Private Synlogic, with Private Synlogic continuing as the surviving corporation. Pursuant to the 2017 Reorganization, the common units and preferred units of Synlogic, LLC, together consisting of Class A preferred units, contingently redeemable Class A preferred units and Class B preferred units, were exchanged for common stock and preferred stock of Private Synlogic, respectively. Additionally, Private Synlogic issued equity awards under the Synlogic 2017 Stock Incentive Plan (“2017 Plan”) to replace the canceled incentive units pursuant to the termination of the Synlogic, LLC 2015 Equity Incentive Plan (“2015 LLC Plan”).

On August 28, 2017, Synlogic, Inc., formerly known as Mirna Therapeutics, Inc. (NASDAQ: MIRN) (“Mirna”), completed its business combination with Private Synlogic pursuant to the Agreement and Plan of Merger and Reorganization, dated as of May 15, 2017, by and among Mirna, Meerkat Merger Sub, Inc. (“Merger Sub”), and Private Synlogic (the “Merger Agreement”), pursuant to which Merger Sub merged with and into Private Synlogic, with Private Synlogic surviving as a wholly owned subsidiary of Mirna (the “Merger”). Immediately after completion of the Merger, Mirna changed its name to “Synlogic, Inc.” (NASDAQ: SYBX).

Risks and Uncertainties

At December 31, 2019, the Company had approximately \$119.6 million in cash, cash equivalents, and short-term marketable securities, \$7.5 million of long-term marketable securities, \$1.1 million of restricted cash and an accumulated deficit of approximately \$171.1 million. Since its inception through December 31, 2019, the Company has primarily financed its operations through the issuance of preferred stock, units and warrants, the sale of its common stock, the AbbVie collaboration, and cash received in the Merger. In the absence of positive cash flows from operations, the Company is highly dependent on its ability to find additional sources of funding in the form of debt or equity financing. Management believes that the Company has sufficient cash to fund its operations through at least twelve months from the issuance of these financial statements.

As an early-stage company, the Company is subject to a number of risks common to other life science companies, including, but not limited to, raising additional capital, development by its competitors of new technological innovations, risk of failure in preclinical and clinical studies, safety and efficacy of its product candidates in clinical trials, the risk of relying on external parties such as contract research organizations (“CROs”) and contract manufacturing organizations (“CMOs”), the regulatory approval process, market acceptance of the Company’s products once approved, lack of marketing and sales history, dependence on key personnel and protection of proprietary technology. The Company’s therapeutic programs are currently pre-commercial, spanning discovery through early development and will require significant additional research and development efforts, including extensive preclinical and clinical testing and regulatory approval, prior to commercialization of any product candidates. These efforts require significant amounts of additional capital, adequate personnel, infrastructure, and extensive compliance-reporting capabilities. There can be no assurance that the Company’s research and development will be successfully completed, that adequate protection for the Company’s intellectual property will be obtained, that any products developed will obtain necessary regulatory approval or that any approved products will be commercially viable. Even if the Company’s product development efforts are successful, it is uncertain when, if ever, the Company will generate revenue from product sales. The Company may never achieve profitability, and unless and until it does, it will continue to need to raise additional capital or obtain financing from other sources, such as strategic collaborations or partnerships.

Notes to Consolidated Financial Statements (continued)

(2) Summary of Significant Accounting Policies***Basis of Presentation***

The accompanying consolidated financial statements have been prepared in accordance with accounting principles generally accepted in the United States (“U.S.”) (“U.S. GAAP” or “GAAP”).

Principles of Consolidation

The accompanying consolidated financial statements include the accounts of Synlogic and its wholly owned subsidiaries. All intercompany accounts and transactions have been eliminated in consolidation.

Use of Estimates

The preparation of financial statements in accordance with GAAP requires management to make estimates and assumptions that affect the reported amounts of assets, liabilities, revenues and expenses, and related disclosure of contingent assets and liabilities at the date of the consolidated financial statements and the reported amounts of expenses during the reporting period. On an on-going basis, the Company’s management evaluates its estimates, including those related to revenue recognition, income taxes including the valuation allowance for deferred tax assets, research and development accruals and prepaids, accrued expenses, investments, contingencies and equity-based compensation. The Company bases its estimates on historical experience and on various other assumptions that are believed to be reasonable, the results of which form the basis for making judgments about the carrying values of assets and liabilities. Actual results could differ from those estimates. Changes in estimates are reflected in reported results in the period in which they become known.

Cash Equivalents

The Company considers all highly liquid investment instruments with a remaining maturity when purchased of three months or less to be cash equivalents. Investments qualifying as cash equivalents primarily consist of money market funds, corporate debt securities and commercial paper. Cash equivalents are stated at cost plus accrued interest, which approximates fair value. The amount of cash equivalents included in cash and cash equivalents was approximately \$13.5 million and \$0.3 million at December 31, 2019 and 2018, respectively.

Concentration of Credit Risk

Financial instruments that potentially subject the Company to concentrations of credit risk include amounts held as cash, cash equivalents, marketable securities and restricted cash. The Company uses high quality, accredited financial institutions to maintain its balances, and accordingly, such funds are subject to minimal credit risk. The Company has not experienced any losses in such accounts and management believes that the Company is not exposed to significant credit risk due to the financial position of the depository institutions in which those deposits are held. The Company has no financial instruments with off-balance sheet risk of loss.

Restricted Cash

The Company held cash of approximately \$1.0 million at December 31, 2019 and 2018 in a letter of credit to secure its lease at the 301 Binney Street facility. In addition, the Company held cash of \$50,000 at December 31, 2019 and 2018 in a separate restricted bank account as collateral for the Company’s credit cards. The Company has classified these deposits as long-term restricted cash on its balance sheet.

The following table provides a reconciliation of cash, cash equivalents, and restricted cash reported within the statement of financial position that sum to the total of the same such amounts shown in the statement of cash flows (in thousands).

	December 31, 2019	December 31, 2018
Cash and cash equivalents	\$ 26,184	\$ 11,252
Restricted cash included in other long-term assets	1,097	1,097
Total cash, cash equivalents, and restricted cash shown in the consolidated statement of cash flows	<u>\$ 27,281</u>	<u>\$ 12,349</u>

Notes to Consolidated Financial Statements (continued)

Fair Value

The Company is required to disclose information on all assets and liabilities reported at fair value that enables an assessment of the inputs used in determining the reported fair values. Accounting Standards Codification (“ASC”) Topic 820, *Fair Value Measurements and Disclosures*, establishes a fair value hierarchy for those instruments measured at fair value that distinguishes between assumptions based on market data (observable inputs) and the Company’s own assumptions (unobservable inputs). The hierarchy consists of three levels:

- Level 1 – Utilize observable inputs such as quoted prices in active markets for identical assets or liabilities;
- Level 2 – Utilize data points that are either directly or indirectly observable, such as quoted prices, interest rates and yield curves;
- Level 3 – Utilize unobservable data points in which there is little or no market data, which require the Company to develop its own assumptions for the asset or liability.

The Company evaluates transfers between levels at the end of each reporting period. There were no transfers of assets or liabilities between Level 1, Level 2 or Level 3 during the years ended December 31, 2019 and 2018.

Available-for-Sale Securities

The Company classifies all short-term investments with an original maturity when purchased of greater than three months as available-for-sale. Available-for-sale securities are carried at fair value, with the unrealized gains and losses reported in other comprehensive income (loss). The amortized cost of debt securities in this category is adjusted for amortization of premiums and accretion of discounts to maturity. Such amortization is included in interest and investment income. Realized gains and losses, and declines in value judged to be other than temporary on available-for-sale securities, are included in interest and investment income.

The cost of securities sold is based on the specific identification method. Interest and dividends on securities classified as available-for-sale are included in interest and investment income. To determine whether an other-than-temporary impairment exists, the Company considers whether it has the ability and intent to hold the investment until a market price recovery, and whether evidence indicating the recoverability of the cost of the investment outweighs evidence to the contrary.

Property and Equipment

Property and equipment, including leasehold improvements, are recorded at cost and depreciated over their estimated useful lives using the straight-line method. Repairs and maintenance costs are expensed as incurred, whereas major improvements are capitalized as additions to property and equipment.

Depreciation begins at the time the asset is placed in service. Depreciation is provided over the following estimated useful lives:

Asset classification	Useful life
Computer and office equipment	3 years
Furniture and fixtures	5 years
Laboratory equipment	5 years
Leasehold improvements	Lesser of useful life or remaining lease term

Impairment of Long-Lived Assets

Long-lived assets are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of the asset may not be recoverable. When such events occur, the Company compares the carrying amounts of the assets to their undiscounted expected future cash flows. If this comparison indicates that there is impairment, the amount of impairment is calculated as the difference between the carrying value and fair value of the asset. To date, no such impairments have been recognized.

Notes to Consolidated Financial Statements (continued)

Research and Development Costs

Costs incurred in the research and development of the Company's product candidates are expensed as incurred. The Company defers and capitalizes nonrefundable advance payments made by the Company for research and development activities until the related goods are received or the related services are performed.

Research and development expenses are comprised of costs incurred in performing research and development activities, including salary and benefits, equity-based compensation expense, laboratory supplies and other direct expenses, facilities expenses, overhead expenses, contractual services and other outside expenses.

When third-party service providers' billing terms do not coincide with the Company's period-end, the Company is required to make estimates of its obligations to those third parties, including clinical trial costs, contractual services costs and costs for supply of its drug candidates, incurred in a given accounting period and record accruals at the end of the period. The Company bases its estimates on its knowledge of the research and development programs, services performed for the period and the expected duration of the third-party service contract, where applicable.

Revenue recognition

The Company generates revenue through a collaboration and license arrangement with a strategic partner for the development and commercialization of product candidates.

The Company evaluates collaboration agreements with respect to FASB ASC Topic 808, *Collaborative Arrangements*, considering the nature and contractual terms of the arrangement and the nature of its business operations to determine the classification of the transactions. When the Company is an active participant in the activity and exposed to significant risks and rewards dependent on the commercial success of the collaboration, it will record its transactions on a gross basis in the consolidated financial statements and describe the rights and obligations under the collaborative arrangement in the notes to the consolidated financial statements.

Under ASC 606, an entity recognizes revenue when its customer obtains control of promised goods or services, in an amount that reflects the consideration which the entity expects to receive in exchange for those goods or services. To determine revenue recognition for arrangements that an entity determines are within the scope of ASC 606, the entity performs the following five-step analysis: (i) identify the contract(s) with a customer; (ii) identify the performance obligations in the contract; (iii) determine the transaction price; (iv) allocate the transaction price to the performance obligations in the contract; and (v) recognize revenue when (or as) the entity satisfies a performance obligation. The Company only applies the five-step analysis to contracts when it is probable that the entity will collect the consideration it is entitled to in exchange for the goods or services it transfers to the customer. At contract inception, once the contract is determined to be within the scope of ASC 606, the Company assesses the goods or services promised within each contract and determines those that are performance obligations and assesses whether each promised good or service is distinct. The Company then recognizes as revenue the amount of the transaction price that is allocated to the respective performance obligation when (or as) the performance obligation is satisfied.

The Company may enter into collaboration agreements for research and development services, under which the Company may license certain rights to its product candidates to third parties. The terms of these arrangements typically include payment to the Company of one or more of the following: non-refundable, upfront license fees; reimbursement of certain costs; customer option exercise fees; development, regulatory and commercial milestone payments; and royalties on net sales of licensed products. Variable consideration is constrained until it is deemed not be at significant risk of reversal.

In determining the appropriate amount of revenue to be recognized as it fulfills its obligations under each of its agreements for which the collaboration partner is also a customer, the Company performs the following steps: (i) identification of the promised goods or services in the contract; (ii) determination of whether the promised goods or services are performance obligations including whether they are distinct in the context of the contract; (iii) measurement of the transaction price, including the constraint on variable consideration; (iv) allocation of the transaction price to the performance obligations; and (v) recognition of revenue when (or as) the Company satisfies each performance obligation. As part of the accounting for these arrangements, the Company must use significant judgment to determine: a) the number of performance obligations based on the determination under step (ii) above; b) the transaction price under step (iii) above; and c) the contract term and pattern of satisfaction of the performance obligations under step (v) above. The Company uses significant judgment to determine whether milestones or other variable consideration, except for royalties, should be included in the transaction price as described further below. The transaction price is allocated to the goods and services the Company expects to provide. The Company uses estimates to determine the timing of satisfaction of performance obligations, which may include the use of full time equivalent time as a measure of satisfaction of performance obligations.

Notes to Consolidated Financial Statements (continued)

Amounts received prior to satisfying the revenue recognition criteria are recorded as deferred revenue in the Company's consolidated balance sheets. Amounts expected to be recognized as revenue within the 12 months following the balance sheet date are classified as current deferred revenue. Amounts not expected to be recognized as revenue within the 12 months following the balance sheet date are classified as deferred revenue, net of current portion.

Licenses of Intellectual Property

In assessing whether a promise or performance obligation is distinct from the other promises, the Company considers factors such as the research, manufacturing and commercialization capabilities of the customer and the availability of the associated expertise in the general marketplace. In addition, the Company considers whether the customer can benefit from a promise for its intended purpose without the receipt of the remaining promises, whether the value of the promise is dependent on the unsatisfied promise, whether there are other vendors that could provide the remaining promise, and whether it is separately identifiable from the remaining promise. For licenses that are combined with other promises, the Company utilizes judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, the appropriate method of measuring progress for purposes of recognizing revenue. The Company evaluates the measure of progress each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition.

Research and Development Services

If an arrangement is determined to contain a promise or obligation for the Company to perform research and development services, the Company must determine whether these services are distinct from the other promises in the arrangement. In assessing whether the services are distinct from the other promises, the Company considers the capabilities of the customer to perform these same services. In addition, the Company considers whether the customer can benefit from a promise for its intended purpose without the receipt of the remaining promise, whether the value of the promise is dependent on the unsatisfied promise, whether there are other vendors that could provide the remaining promise, and whether it is separately identifiable from the remaining promise. For research and development services that are combined with other promises, the Company utilizes judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, the appropriate method of measuring progress for purposes of recognizing revenue. The Company evaluates the measure of progress each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition.

Customer Options

If an arrangement is determined to contain customer options that allow the customer to acquire additional goods or services, the goods and services underlying the customer options are not considered to be performance obligations at the outset of the arrangement, as they are contingent upon option exercise. The Company evaluates the customer options for material rights, that is, the option to acquire additional goods or services for free or at a discount. If the customer options are determined to represent a material right, the material right is recognized as a separate performance obligation at the outset of the arrangement. The Company allocates the transaction price to material rights based on an alternative approach when the goods or services are both (i) similar to the original goods and services in the contract and (ii) provided in accordance with the terms of the original contract. Under this alternative, the Company allocates the total amount of consideration expected to be received from the customer to the total goods or services expected to be provided to the customer. Amounts allocated to a material right are not recognized as revenue until the option is exercised and the performance obligation is satisfied.

Milestone Payments

At the inception of each arrangement that includes milestone payments, the Company evaluates whether a significant reversal of cumulative revenue provided in conjunction with achieving the milestones is probable and estimates the amount to be included in the transaction price using the most likely amount method. If it is probable that a significant reversal of cumulative revenue would not occur, the associated milestone value is included in the transaction price. Milestone payments that are not within the control of the Company or the licensee, such as regulatory approvals, are not considered probable of being achieved until those approvals are received. For other milestones, the Company evaluates factors such as the scientific, clinical, regulatory, commercial, and other risks that must be overcome to achieve the particular milestone in making this assessment. There is considerable judgment involved in determining whether it is probable that a significant reversal of cumulative revenue would not occur. At the end of each subsequent reporting period, the Company reevaluates the probability of achievement of all milestones subject to constraint and, if necessary, adjusts its estimate of the overall transaction price. Any such adjustments are recorded on a cumulative catch-up basis, which would affect revenues and earnings in the period of adjustment.

Notes to Consolidated Financial Statements (continued)

Royalties

For arrangements that include sales-based royalties, including milestone payments based on a level of sales, and the license is deemed to be the predominant item to which the royalties relate, the Company recognizes revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied). To date, the Company has not recognized any royalty revenue resulting from any of its licensing arrangements.

Contract Costs

The Company recognizes as an asset the incremental costs of obtaining a contract with a customer if the costs are expected to be recovered. As a practical expedient, the Company recognizes the incremental costs of obtaining a contract as an expense when incurred if the amortization period of the asset that we otherwise would have recognized is one year or less. To date, the Company has not incurred any incremental costs of obtaining a contract with a customer.

Equity-Based Compensation

The Company measures equity-based compensation to employees, nonemployees and directors based on the grant date fair value of the awards and recognizes the associated expense in the financial statements over the requisite service period of the award, which is generally the vesting period. The fair value of each option was estimated on the date of grant or remeasurement using the Black-Scholes option-pricing model. Expected volatility for the Company's common stock was determined based on an average of the historical volatility of the Company and the historical volatility of a peer-group of similar public companies. The expected term of options granted for employees was calculated using the simplified method, which represented the average of the contractual term of the option and the weighted-average vesting period of the option. The assumed dividend yield is based upon the Company's expectation of not paying dividends in the foreseeable future. The risk-free interest rate is based upon the U.S. Treasury yield curve commensurate with the expected term at the time of grant or remeasurement. Forfeitures are recognized as they occur.

The Company records the expense for equity grants subject to performance-based milestone vesting over the remaining service period when management determines that achievement of the milestone is probable. Management evaluates when the achievement of a performance-based milestone is probable based on the relative satisfaction of the performance conditions as of the reporting date.

The Company classifies equity-based compensation expense in its consolidated statements of operations and comprehensive loss in the same manner in which the award recipient's payroll costs are classified or in which the award recipients' service payments are classified.

Income Taxes

The Company accounts for income taxes using the asset and liability method, which requires the recognition of deferred tax assets and liabilities for the expected future tax consequences of events that have been recognized in the financial statements or in the Company's tax returns. Deferred taxes are determined based on the difference between the financial reporting and tax basis of assets and liabilities using enacted tax rates in effect in the years in which the differences are expected to reverse. Changes in deferred tax assets and liabilities are recorded in the provision for income taxes. The Company assesses the likelihood that its deferred tax assets will be recovered from future taxable income and, to the extent it believes based upon the weight of available evidence, that it is more likely than not that all or a portion of deferred tax assets will not be realized, a valuation allowance is established through a charge to income tax expense. Potential for recovery of deferred tax assets is evaluated by estimating the future taxable profits expected and considering prudent and feasible tax planning strategies.

Uncertain tax positions represent tax positions for which reserves have been established. The Company accounts for uncertainty in income taxes recognized in the consolidated financial statements by applying a two-step process to determine the amount of tax benefit to be recognized. First, the tax position must be evaluated to determine the likelihood that it will be sustained upon external examination by the taxing authorities. If the tax position is deemed more likely than not to be sustained, the tax position is then assessed to determine the amount of benefit to be recognized in the financial statements. The amount of the benefit that may be recognized is the largest amount that has a greater than 50% likelihood of being realized upon ultimate settlement. The provision for income taxes includes the effects of any resulting tax reserves, or unrecognized tax benefits, that are considered appropriate as well as the related net interest and penalties.

Notes to Consolidated Financial Statements (continued)

Net Loss Per Share

Basic net loss per share is computed using the weighted-average number of shares of common stock outstanding during the period. Diluted net loss per share is computed using the sum of the weighted-average number of shares of common stock outstanding during the period and if dilutive, the weighted-average number of potential shares of common stock, including unvested restricted common stock and outstanding stock options.

Segment Information

Operating segments are defined as components of an enterprise about which separate discrete financial information is available for evaluation by the chief operating decision maker, or decision-making group, in deciding how to allocate resources and in assessing performance. The Company operates in one operating segment: discovery and development of synthetic biology therapeutics for the treatment of rare, infectious and other diseases. The Company's chief executive officer, as chief operating decision maker, manages and allocates resources to the operations of the Company on a total company basis. All of the Company's equipment, leasehold improvements and other fixed assets are physically located within the United States, and all agreements with its partners are denominated in U.S. dollars, except where noted.

Recently Adopted Accounting Pronouncements*Leases*

In February 2016, the FASB issued ASU 2016-02 – *Leases* (Topic 842), which replaces the existing accounting guidance for leases. This standard requires entities that lease assets to recognize the assets and liabilities for the rights and obligations created by those leases on the balance sheet. The standard is effective for fiscal years and the interim periods within those fiscal years beginning after December 15, 2018. The guidance is required to be applied by the modified retrospective transition approach and early adoption is permitted. In July 2018, the FASB issued ASU 2018-11 *Leases – Targeted Improvements*, intended to ease the implementation of the new lease standard for financial statement preparers by, among other things, allowing for an additional transition method. In lieu of presenting transition requirements to comparative periods, as previously required, an entity may now elect to show a cumulative effect adjustment on the date of adoption without the requirement to recast prior period financial statements or disclosures presented in accordance with Topic 842. The Company adopted the new standard using the cumulative effect adjustment transition option effective January 1, 2019, which is the initial date of application per ASU 2018-11.

The Company elected the available package of practical expedients which allows the Company to not reassess previous accounting conclusions around whether arrangements are or contain leases, the classification of our leases, and the treatment of initial direct costs. The Company made an accounting policy election to keep leases with an initial term of 12 months or less off of the balance sheet.

The Company adopted Topic 842 as of January 1, 2019. The Company uses judgement to assess if an arrangement is a lease at contract inception. An arrangement is a lease if the contract involves the use of a distinct identified asset, the lessor does not have substantive substitution rights and the Company obtains control of the asset throughout the period by obtaining substantially all of the economic benefit of the asset and the right to direct the use of the asset. Leases classified as operating leases are included in operating lease right-of-use ("ROU") assets, current operating lease liabilities and noncurrent operating lease liabilities in our consolidated balance sheet. Finance leases are included in property and equipment and finance lease obligations, in our consolidated balance sheet.

ROU assets represent the right to use an underlying asset for the lease term and lease liabilities represent the obligation to make lease payments arising from the lease. ROU assets and lease liabilities are recognized at the lease commencement date based on the estimated present value of lease payments over the lease term. The Company utilizes its incremental borrowing rate to determine the present value of lease payments. The incremental borrowing rate is the rate incurred to borrow similar funds, on a collateralized basis, over a comparable term in a similar economic environment.

For new and amended leases beginning in 2019 and after, the Company has elected to account for the lease and non-lease components for leases as a single component for classes of all underlying assets and allocate all of the contract consideration to the lease component only. Lease cost for operating leases is recognized on a straight-line basis over the lease term and is included in operating expenses on the statements of operations and comprehensive loss. Variable lease payments are included in lease operating expenses.

Notes to Consolidated Financial Statements (continued)

The lease term includes options to extend the lease when it is reasonably certain that option will be exercised. Leases with a term of 12 months or less are not recorded on the Company's consolidated balance sheet.

The adoption had a material impact on the consolidated balance sheet related to the recognition of a transition adjustment on January 1, 2019 of a right-of-use asset of \$15.9 million and lease liability of \$24.0 million for an operating lease and the derecognition of deferred rent originally accounted for under legacy guidance. The adoption did not have a material impact on the consolidated statement of operations. Refer to Note 13, "Leases" for further information on the adoption of this standard and the Company's accounting for leases.

Recently Issued Accounting Pronouncements

In June 2016, the FASB issued ASU 2016-13 - *Measurement of Credit Losses on Financial Statements*. The new standard requires that expected credit losses relating to financial assets measured on an amortized cost basis and available-for-sale debt securities be recorded through an allowance for credit losses. It also limits the amount of credit losses to be recognized for available-for-sale debt securities to the amount by which carrying value exceeds fair value and also requires the reversal of previously recognized credit losses if fair value increases. In November 2019, the FASB issued ASU 2019-10 - *Financial Instruments - Credit Losses (Topic 326), Derivatives and Hedging (Topic 815), and Leases (Topic 842): Effective Dates*, which amended the effective date for certain companies. The standard is effective for public companies eligible to be smaller reporting companies for annual and interim periods beginning after December 15, 2022. Early adoption is available. The Company is currently evaluating the potential impact ASU 2016-13, and related updates, will have on its consolidated financial statements and disclosures.

In August 2018, the FASB issued ASU 2018-13 - *Fair Value Measurement - Disclosure Framework* (Topic 820). The standard modifies the disclosure requirements for fair value measurements. The standard is effective for public companies for annual and interim periods beginning after December 15, 2019. Early adoption is permitted for any removed or modified disclosures. Management is currently assessing the impact adoption will have on the Company, but it is not expected to have a material impact on the Company's financial statement disclosures.

In August 2018, the FASB issued ASU 2018-15 - *Customer's Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement that is a Service Contract*. The standard requires implementation costs incurred by customers in cloud computing arrangements to be deferred over the noncancelable term of the cloud computing arrangements plus any optional renewal periods (1) that are reasonably certain to be exercised by the customer or (2) for which exercise of the renewal option is controlled by the cloud service provider. The effective date of this pronouncement is for fiscal years beginning after December 15, 2019, and interim periods within those fiscal years, and early adoption is permitted. The standard can be adopted either using the prospective or retrospective transition approach. The Company is currently evaluating the impact of this pronouncement on the Company's consolidated financial statements and disclosures.

In November 2018, the FASB issued ASU 2018-18 - *Collaborative Arrangements (Topic 808): Clarifying the Interaction Between Topic 808 and Topic 606*, which, among other things, provides guidance on how to assess whether certain collaborative arrangement transactions should be accounted for under Topic 606. The amendments in this ASU are effective for fiscal years, and interim periods within those fiscal years, beginning after December 15, 2019, with early adoption permitted. The Company is in the process of evaluating the impact the standard will have on its financial statements.

(3) Fair Value of Financial Instruments

The tables below present information about the Company's assets that are measured at fair value on a recurring basis as of December 31, 2019 and 2018 and indicate the fair value hierarchy of the valuation techniques the Company utilized to determine such fair value, as described under Note 2, *Summary of Significant Accounting Policies*.

The Company's investment portfolio includes many fixed income securities that do not always trade on a daily basis. As a result, the pricing services used by the Company applied other available information as applicable through processes such as benchmark yields, benchmarking of like securities, sector groupings and matrix pricing to prepare evaluations. In addition, model processes were used to assess interest rate impact and develop prepayment scenarios. These models take into consideration relevant credit information, perceived market movements, sector news and economic events. The inputs into these models may include benchmark yields, reported trades, broker-dealer quotes, issuer spreads and other relevant data.

Notes to Consolidated Financial Statements (continued)

At December 31, 2019 and 2018, the Company has classified assets measured at fair value on a recurring basis as follows (in thousands):

Description	Fair Value Measurements at Reporting Date Using			
	December 31, 2019	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Money market funds	\$ 3,240	\$ 3,240	\$ —	\$ —
Commercial paper (included in cash and cash equivalents)	4,249	—	4,249	—
Commercial paper (included in marketable securities)	20,501	—	20,501	—
Corporate debt securities (included in cash and cash equivalents)	6,005	—	6,005	—
Corporate debt securities (included in marketable securities)	71,383	—	71,383	—
U.S. government agency securities and treasuries	9,005	—	9,005	—
Total	\$ 114,383	\$ 3,240	\$ 111,143	\$ —

Description	Fair Value Measurements at Reporting Date Using			
	December 31, 2018	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Money market funds	\$ 265	\$ 265	\$ —	\$ —
Commercial paper (included in short-term investments)	57,453	—	57,453	—
Corporate debt securities (included in short-term investments)	50,052	—	50,052	—
U.S. government agency securities and treasuries	3,972	1,987	1,985	—
Total	\$ 111,742	\$ 2,252	\$ 109,490	\$ —

Cash equivalents, prepaid expenses and other current assets, accounts payable and accrued expenses at December 31, 2019 and December 31, 2018 are carried at amounts that approximate fair value due to their short-term maturities. Finance lease obligations at December 31, 2019 and December 31, 2018 approximate fair value as they bear interest at a rate approximating a market interest rate.

(4) Available-for-Sale Investments

The following tables summarize the available-for-sale securities held at December 31, 2019 and 2018 (in thousands):

December 31, 2019	Amortized cost	Gross unrealized gains	Gross unrealized losses	Fair Value
Commercial paper	\$ 20,484	\$ 18	\$ (1)	\$ 20,501
Corporate debt securities	71,288	96	(1)	71,383
U.S. government agency securities	9,005	2	(2)	9,005
Total	\$ 100,777	\$ 116	\$ (4)	\$ 100,889

December 31, 2018	Amortized cost	Gross unrealized gains	Gross unrealized losses	Fair Value
Commercial paper	\$ 53,549	\$ —	\$ (47)	\$ 53,502
Corporate debt securities	54,022	4	(23)	54,003
U.S. government agency securities	3,971	1	—	3,972
Total	\$ 111,542	\$ 5	\$ (70)	\$ 111,477

Notes to Consolidated Financial Statements (continued)

The contractual maturity of all securities held at December 31, 2019 was 14 months or less. There were 9 investments in an unrealized loss position at December 31, 2019, none of which had been in an unrealized loss position for more than twelve months. The aggregate fair value of the securities in an unrealized loss position at December 31, 2019 and 2018 was \$24.8 million and \$96.5 million, respectively. The Company reviews its investments for other-than-temporary impairment whenever the fair value of an investment is less than amortized cost and evidence indicates that an investment's carrying amount is not recoverable within a reasonable period of time. To determine whether an impairment is other-than-temporary, the Company considers whether it has the ability and intent to hold the investment until a market price recovery and considers whether evidence indicating the cost of the investment is recoverable outweighs evidence to the contrary. The Company did not hold any securities with an other-than-temporary impairment at December 31, 2019.

Gross realized gains and losses on the sales of investments have not been material to the Company's consolidated statement of operations.

(5) Prepaid Expenses and Other Current Assets

Prepaid expenses and other current assets consist of the following (in thousands):

	December 31, 2019	December 31, 2018
Prepaid insurance	\$ 648	\$ 502
Prepaid research and development	11,989	122
Other prepaid	390	597
Other current assets	648	388
	<u>\$ 13,675</u>	<u>\$ 1,609</u>

(6) Property and Equipment, net

Property and equipment, net consists of the following (in thousands):

	December 31, 2019	December 31, 2018
Laboratory equipment	\$ 7,523	\$ 7,111
Computer and office equipment	782	781
Furniture and fixtures	421	413
Leasehold improvements	9,514	9,484
Construction in progress	412	39
	<u>18,652</u>	<u>17,828</u>
Less accumulated depreciation	<u>(5,631)</u>	<u>(2,987)</u>
	<u>\$ 13,021</u>	<u>\$ 14,841</u>

At December 31, 2019 and 2018, leasehold improvements include \$6.6 million of lessor-paid tenant improvements for which the Company was deemed to be the accounting owner of the tenant improvements primarily because it was responsible for project cost overruns. Depreciation expense on property and equipment was \$2.7 million and \$2.4 million in 2019 and 2018, respectively.

Notes to Consolidated Financial Statements (continued)

(7) Accrued Expenses

Accrued expenses consists of the following (in thousands):

	December 31, 2019	December 31, 2018
Payroll related	\$ 2,372	\$ 2,906
Professional fees	444	306
Research and development	1,005	1,585
Other	125	196
	<u>\$ 3,946</u>	<u>\$ 4,993</u>

(8) Common Stock

The Company's common stock has the following characteristics:

- The holders of shares of common stock are entitled to one vote for each share of common stock held at all meetings of stockholders.
- The holders of shares of common stock are entitled to receive dividends, if and when, declared by the Company's board of directors. Since inception, no cash dividends have been declared.

The Company holds forfeiture rights relating to 586,929 shares of common stock. The forfeiture right lapses over time and is triggered when a holder ceases providing services to the Company. As of December 31, 2019, 147,617 shares of common stock have been forfeited back to the Company.

The Company holds repurchase rights which are at a price equal to the initial purchase price by the founders of Private Synlogic, adjusted by the Merger Exchange Ratio. The repurchase right lapses over time and is exercisable should the founders cease providing services to the Company prior to the end of a four-year period which began in April or May 2014, as the case may be. All repurchase rights terminated during 2018. As of December 31, 2018, the Company had exercised its repurchase right on 41,819 shares of common stock.

In January 2018, the Company sold 5,899,500 shares of its common stock through a firm commitment, underwritten public offering at a price to the public of \$9.75 per share. As a result of the offering, including the exercise of the overallotment option, the Company received aggregate net proceeds, after underwriting discounts and commissions and other estimated offering expenses, of approximately \$53.8 million.

In April 2018, the Company sold 3,280,000 shares of its common stock at a price of \$9.15 per share in a registered direct offering. After fees and other offering expenses, the Company received approximately \$28.9 million in net proceeds from the offering.

In June 2019, the Company issued to Ginkgo Bioworks ("Ginkgo") 6,340,771 shares of common stock and accompanying Pre-Funded warrants (the "Pre-Funded Warrants") to purchase up to an aggregate of 2,548,117 shares of common stock, at a combined purchase price per share and Pre-Funded Warrant of \$9.00. The Pre-Funded Warrants have an exercise price of \$9.00 per share, with \$8.99 of such exercise price paid at the closing of the offering. The proceeds, net of issuance costs, were approximately \$79.9 million, \$57.0 million related to the proceeds from sale of the common stock and \$22.9 million related to the proceeds from sale of the Pre-Funded warrants. The Pre-Funded Warrants may be exercised at any time until all of the Pre-Funded Warrants are exercised in full to the extent that, after giving effect to such issuance after exercise, Ginkgo would not beneficially own in excess of 19.99% of the number of shares of common stock outstanding immediately after giving effect to the issuance. The Pre-Funded Warrants were classified as a component of permanent equity and were recorded at the issuance date using a relative fair value allocation method. The Pre-Funded Warrants are equity classified because they are freestanding financial instruments that are legally detachable and separately exercisable from the equity instruments, are immediately exercisable, do not embody an obligation for the Company to repurchase its shares, and permit the holders to receive a fixed number of common shares upon exercise. In addition, such warrants do not provide any guarantee of value or return. In addition, in connection with the issuance to Ginkgo of common stock and Pre-Funded warrants, the Company expanded its existing collaboration and entered into an agreement with Ginkgo for the research and development of engineered microbial therapeutic products. (See Note 10).

Notes to Consolidated Financial Statements (continued)

The Company has a sales agreement with Cowen and Company, LLC (“Cowen”) with respect to an at-the-market (“ATM”) offering program under which the Company may offer and sell, from time to time at its sole discretion, shares of its common stock through Cowen as its sales agent. In an ATM offering, exchange-listed companies incrementally sell newly issued shares into the secondary trading market through a designated broker-dealer at prevailing market prices. No sales of common stock were made pursuant to the ATM during 2018 and 2019.

(9) Equity-based Compensation and Equity Incentive Plans***Equity Plans***

The Company has a number of equity plans, two of which are currently active.

The 2015 Equity Incentive Award Plan (“2015 Plan”) was adopted by Mirna in 2015 and remains active after the Merger, now functioning as the primary equity plan for the Company. Following the Merger, there were 647,893 shares authorized under the 2015 Plan. The 2015 Plan includes an “evergreen provision” that allows for an annual increase in the number of shares of common stock available for issuance under the 2015 Plan, which annual increase will be added on the first day of each fiscal year from 2016 through 2025, inclusive, and will be equal to the lesser of (i) five percent of the shares outstanding on the last day of the immediately preceding fiscal year and (ii) such smaller number of shares as determined by the Board of Directors. The 2015 Plan provides for the granting of a variety of stock-based compensation awards, including stock options, stock appreciation rights, restricted stock awards, restricted stock unit awards, deferred stock awards, dividend equivalent awards, stock payment awards, performance awards and other stock-based awards.

The 2017 Stock Incentive Plan was adopted by Private Synlogic in 2017 at the time of the 2017 Reorganization and provides for the grant of incentive stock options, non-qualified stock options, restricted and unrestricted stock awards and other stock-based awards. Under the 2017 Plan, 1,753,061 shares were initially authorized and reserved for issuance. Pursuant to the 2017 Reorganization, Private Synlogic issued restricted common stock awards under the 2017 Plan to replace the canceled incentive units pursuant to the termination of the 2015 LLC Plan (“2015 LLC Plan”). In addition, Private Synlogic also issued stock options to certain employees prior to the Merger. Pursuant to the Merger Agreement, each restricted common stock award of Private Synlogic under the 2017 Plan that was outstanding immediately prior to the Merger and each option to purchase common stock of Private Synlogic under the 2017 Plan that was outstanding and unexercised immediately prior to the Merger was converted into and became restricted common stock and options to purchase shares of the Company’s common stock, respectively, based on the Exchange Ratio of 0.5532 and the Company assumed the 2017 Plan.

The 2015 Employee Stock Purchase Plan (“ESPP”) was adopted by Mirna in 2015 and allows eligible employees to purchase shares of the Company’s common stock at a discount through payroll deductions of up to 15% of their eligible compensation, subject to any plan limitations. The ESPP generally provides for set offering periods, and at the end of each offering period, employees are able to purchase shares at 85% of the lower of the fair market value of the Company’s common stock on the first trading day of the offering period or on the last trading day of the offering period. The Company suspended the ESPP in 2017. On December 19, 2019, the board of directors (the “Board”) of the Company resolved by written consent to reactivate the 2015 ESPP and approved an amendment to the ESPP to (i) reduce the permitted payroll deduction and number of shares of the Company’s common stock that a participant may purchase per calendar year and offering period under the ESPP and (ii) establish a period for enrollment for eligible participants. The reactivation of the 2015 ESPP was effective immediately. The Company’s executive officers are eligible to participate in the 2015 ESPP.

As of December 31, 2019, there were 676,388 shares available for future grant under the Company’s two active equity incentive plans, the 2017 Plan and the 2015 Plan.

Notes to Consolidated Financial Statements (continued)

Stock Options

The weighted average assumptions used in the Black-Scholes option-pricing model for stock options issued to employees and non-employees under its two active equity plans, the 2015 Plan and the 2017 Plan, during the years ended December 31, 2019 and 2018 were:

Employees:	Year ended December 31,	
	2019	2018
Expected term	6.2 years	6.2 years
Weighted-average, risk-free interest rate	2.2%	2.8%
Expected volatility	71.1%	70.8%
Dividend yield	—	—

The following table summarizes stock option activity, as adjusted for the Exchange Ratio under the 2015 and 2017 Plans.

	Stock options outstanding			Aggregate intrinsic value (a) (in thousands)
	Number of options	Weighted average exercise price	Weighted average remaining contractual term (in years)	
Outstanding at December 31, 2018	1,739,884	\$ 11.92	9.0	\$ —
Granted	1,427,030	7.07		—
Cancelled or Forfeited	(880,495)	11.02		25
Outstanding at December 31, 2019	2,286,419	9.24	8.7	\$ 43
Vested or expected to vest at December 31, 2019	2,286,419	9.24	8.7	\$ 43
Exercisable at December 31, 2019	845,102	11.43	8.1	\$ —

(a) The aggregate intrinsic value is calculated as the difference between the exercise price of the options and the fair market value of the underlying common stock for the options that were in the money at December 31, 2019. 132,500 options were in the money at December 31, 2019.

The weighted average grant date fair value per share of options granted during the years ended December 31, 2019 and 2018 was approximately \$4.59 and \$6.35, respectively. The total fair value of awards that vested during the years ended December 31, 2019 and 2018 was \$3.9 million and \$3.3 million, respectively.

As of December 31, 2019, there was approximately \$6.8 million of unrecognized share-based compensation for unvested stock option grants which is expected to be recognized over a weighted average period of 2.4 years. The total unrecognized share-based compensation cost will be adjusted for actual forfeitures as they occur.

Restricted Common Stock

During the year ended December 31, 2019, 585,600 shares of restricted common stock were granted. During the year ended December 31, 2018, no shares of restricted common stock were granted.

Notes to Consolidated Financial Statements (continued)

The following table shows restricted common stock activity:

	Restricted stock awards	
	Number of shares	Weighted average grant date fair value (per share)
Unvested at December 31, 2018	118,679	\$ 13.54
Granted	585,600	2.49
Vested	(56,314)	13.55
Forfeited	(61,036)	9.19
Unvested at December 31, 2019	586,929	\$ 2.97

The total fair value of shares that vested during the years ended December 31, 2019 and 2018 was \$0.1 million and \$1.3 million, respectively.

As of December 31, 2019, there was approximately \$1.2 million of unrecognized share-based compensation related to restricted stock awards granted, which is expected to be recognized over a weighted average period of 1.2 years. The total unrecognized share-based compensation cost will be adjusted for actual forfeitures as they occur.

Equity Compensation

The Company has recorded total equity-based compensation expense of approximately \$4.1 million and \$4.3 million, during the years ended December 31, 2019 and 2018, respectively. Equity compensation during the years ended December 31, 2019 and 2018 is derived from stock options and restricted stock awards. Equity-based compensation during the year ended December 31, 2018 also includes \$0.7 million related to modifications in equity awards in connection with the separation of the Company's former Chief Executive Officer.

The following table summarizes equity-based compensation expense within the Company's consolidated statements of operations and comprehensive loss for the years ended December 31, 2019 and 2018 (in thousands):

	Years ended December 31,	
	2019	2018
Research and development	\$ 1,377	\$ 1,333
General and administrative	2,757	2,984
	<u>\$ 4,134</u>	<u>\$ 4,317</u>

The following table summarizes equity-based compensation expense by type of award for the years ended December 31, 2019 and 2018 (in thousands):

	Years ended December 31,	
	2019	2018
Stock options	\$ 3,789	\$ 3,361
Restricted stock awards	345	956
	<u>\$ 4,134</u>	<u>\$ 4,317</u>

(10) Collaboration Agreements

Ginkgo Collaboration

In 2017, the Company established a technology collaboration with Ginkgo. In June 2019, in connection with the issuance to Ginkgo of an aggregate of 6,340,771 shares of common stock and Pre-Funded warrants to purchase an aggregate of 2,548,117 common stock (See Note 9), the Company expanded its collaboration and entered into an agreement with Ginkgo for the research and development of engineered microbial therapeutic products. Under the 2019 expanded agreement, the Company made a prepayment to Ginkgo of \$30.0 million for its foundry services that will be provided to the Company over an initial term of five years. The prepayment of foundry services is recorded in Prepaid expenses and other current assets and Prepaid research and development, net of current portion on the December 31, 2019 consolidated balance sheet. Upon the expiration of such initial term and, if applicable, an additional period, any portion of the prepayment that has not been used to purchase services from Ginkgo will be retained by Ginkgo.

Notes to Consolidated Financial Statements (continued)

AbbVie Collaboration Agreement

In July 2015, the Company entered into the AbbVie Agreement under which the Company granted AbbVie an exclusive option to purchase IBDCo and, in exchange, agreed to collaborate in researching and developing an Investigational New Drug (“IND”) candidate for the treatment of IBD. The AbbVie Agreement sets forth the Company’s and AbbVie’s respective obligations for development and delivery of an IND candidate package using reasonable commercial efforts.

In exchange for the exclusive option to acquire IBDCo, initial research and development services for drug discovery and pre-clinical development, and participation on the joint research committee (“JRC”), AbbVie agreed to pay IBDCo an upfront, nonrefundable cash payment of \$2.0 million, which IBDCo received in December 2015. AbbVie also agreed to pay IBDCo up to \$16.5 million in milestone payments associated with specified research and pre-clinical events, which were determined to represent customer options for accounting purposes, as well as an option exercise fee upon the execution of their option to buy IBDCo and other royalty and milestone payments. The upfront cash payment and any payments for option fees and royalties are non-refundable, non-creditable and not subject to set-off.

The research and development will be performed by the Company over four phases of research defined in the research plan. The Company is eligible to receive payments from AbbVie upon the election to continue the research and development at the achievement of certain milestone events. The JRC will make a determination as to the continuation of the collaboration at the achievement of research and pre-clinical milestones, except for the final milestone, which AbbVie has the discretion to determine achievement without the approval of the JRC. If the parties make the determination to continue on with the AbbVie Agreement upon achievement of each milestone event, then AbbVie will pay the consideration associated with that milestone and the collaboration will continue through the remaining term of the option to purchase IBDCo, which was initially considered to be approximately 54 months. However, AbbVie has the right to terminate the contract at any time with 90 days’ notice.

The Company assessed this arrangement in accordance with ASC 606 and concluded that the contract counterparty, AbbVie, is a customer. The Company identified the following material promises at the outset of the arrangement: (1) a non-exclusive royalty-free research and development license; (2) research and development services for pre-clinical activities under the research plan through to the first research and development phase (or an estimated 17 months); (3) three option rights for AbbVie to continue the collaboration as related to three phases of research and development; (4) participation on the JRC; and (5) the transfer of ownership of IBDCo upon exercise of the option to buy IBDCo. The Company determined that the license and research and development activities were not distinct from one another. Participation on the JRC to oversee the research and development activities was determined to be quantitatively and qualitatively immaterial and therefore is excluded from performance obligations. As such, the Company determined that the license and research and development services should be combined into a single performance obligation.

The Company evaluated the milestone payments, which represent customer options as described above, and the option to purchase IBDCo, to determine whether they provide AbbVie with any material rights. The Company concluded that the options were not issued at a significant and incremental discount, and therefore do not provide material rights. As such, they were excluded as performance obligations at the outset of the arrangement. If AbbVie elects to exercise the options, the additional consideration will be added to the transaction price and allocated to the resulting performance obligations.

Based on these assessments, the Company identified one performance obligation at the outset of the AbbVie Agreement, which consists of: (1) the non-exclusive license and (2) the research and development activities through the first research and development phase.

At the outset of the arrangement, the transaction price included only the \$2.0 million up-front consideration received which was allocated to the single performance obligation. The option exercise fees (\$16.5 million for the milestones and the IBDCo purchase option exercise fee) that may be received are excluded from the transaction price until each customer option is exercised. The Company reevaluates the transaction price at the end of each reporting period and as uncertain events are resolved or other changes in circumstances occur, and, if necessary, adjust its estimate of the transaction price.

In May 2017, the Company completed the research and development services for the first phase of the research plan and was paid \$2.0 million to commence the second phase of the research plan. At this time, the \$2.0 million was added to the transaction price and allocated to a new performance obligation consisting of the underlying license and research and development services to be performed over the second phase of the research plan.

Notes to Consolidated Financial Statements (continued)

On September 27, 2018, AbbVie and the Company signed an amendment (the “Second Amendment”) to the AbbVie Agreement. The Amendment clarified the requirements necessary to complete the second phase which resulted in additional time and effort in the second phase of the research plan. Additionally, the Amendment split the next milestone payment under the AbbVie Agreement into two payments: a milestone payment of \$2.0 million earned by the Company upon execution of the Amendment and the remaining milestone payment of the balance due upon the successful achievement of specified research and pre-clinical events and the advancement to the third phase of the research plan.

On December 18, 2018, AbbVie and the Company signed an amendment (the “Third Amendment”) to the AbbVie Agreement. The Third Amendment provides that in the event AbbVie determines that it is necessary to enter into license agreements with certain third parties in a particular country or other jurisdiction which, but for such license, would be infringed by the manufacture, use or sale of any product governed by the AbbVie Agreement, AbbVie would be entitled to deduct certain expenses related to such license agreements from particular payments made to the Company.

The Company determined that the Amendment represented a modification to the AbbVie Agreement. The additional research and development services are not distinct from the remaining research and development services under the second phase of the research plan of the AbbVie Agreement. The Amendment was accounted for as part of the original AbbVie Agreement and the services form part of the single performance obligation that was partially satisfied as of the date of the contract modification. As a result, the transaction price for the current performance obligation associated with the second phase of the research plan increased by \$2.0 million. The impact of the contract modification on the transaction price and the measure of progress toward completion of the performance obligation was recognized as an adjustment to revenue upon execution of the Amendment on a cumulative catch-up basis. The cumulative catch-up adjustment to revenue, as a result of the contract modification, was \$1.8 million during 2018.

Revenue associated with performance obligations under the AbbVie Agreement are recognized as the research and development services are provided using an input method, according to the full-time equivalents incurred. The research and development activities are expected to be performed over a period of approximately 54 months. The transfer of control occurs over time and, in management’s judgment, is the best measure of progress towards satisfying the performance obligation. The amounts received that have not yet been recognized as revenue are recorded in deferred revenue on the Company’s consolidated balance sheet.

On February 28, 2019, the JRC concluded that the remaining milestone of \$2.5 million under the Second Amendment was achieved upon the achievement of specified research and pre-clinical events under the second phase of the research plan and the advancement to the third phase of the research plan. Revenue associated with performance obligations under the AbbVie Agreement is recognized as the research and development services are provided using an input method, according to the full-time equivalents incurred. The transfer of control occurs over time and, in management’s judgment, is the best measure of progress towards satisfying the performance obligation. The amounts received that have not yet been recognized as revenue are recorded in deferred revenue on the Company’s consolidated balance sheet.

Revenue associated with performance obligations under the AbbVie Agreement are recognized as the research and development services are provided using an input method, according to the full-time equivalents incurred. The research and development activities are expected to be performed over a period of approximately 54 months. The transfer of control occurs over time and, in management’s judgment, is the best measure of progress towards satisfying the performance obligation. The amounts received that have not yet been recognized as revenue are recorded in deferred revenue on the Company’s consolidated balance sheet.

For the years ended December 31, 2019 and 2018, the Company recognized \$ 2.2 million and \$2.5 million, respectively, as collaboration revenue in the Company’s consolidated statements of operations and comprehensive loss. Deferred revenue amounted to \$0.5 million as of December 31, 2019, all of which is included in current liabilities.

Notes to Consolidated Financial Statements (continued)

(11) Net Loss per Share

The following table sets forth the computation of basic and diluted net loss per share (in thousands, except for share and per share amounts):

	2019	2018
Numerator:		
Net loss	\$ (51,373)	\$ (48,435)
Denominator:		
Weighted-average common shares outstanding - basic and diluted	30,284,068	23,882,685
Net loss per share - basic and diluted	\$ (1.70)	\$ (2.03)

The Company's potentially dilutive shares, which include outstanding stock options and unvested restricted common stock, are considered to be common share equivalents and are only included in the calculation of diluted net loss per share when their effect is dilutive.

The following potential common shares, presented based on amounts outstanding at each period end, were excluded from the calculation of the diluted net loss per share attributable to common stockholders for the period indicated because including them would have had an anti-dilutive effect.

	As of December 31,	
	2019	2018
Unvested restricted common stock awards	586,929	118,679
Outstanding options to purchase common stock	2,286,419	1,739,884

(12) Income Taxes

During the years ended December 31, 2019 and 2018, the Company recorded no income tax benefits for the net operating losses incurred due to its uncertainty of reclaiming a benefit for those losses.

Deferred taxes are recognized for temporary differences between the basis of assets and liabilities for financial statement and income tax purposes. Deferred tax assets consist of the following (in thousands):

	December 31,	
	2019	2018
Deferred tax assets:		
Net operating loss carryforwards	\$ 46,362	\$ 33,275
Tax credit carryforwards	4,262	4,365
Accrued expenses	37	103
Deferred rent	—	2,209
Lease liabilities	6,776	—
Equity compensation	1,481	784
Amortizable intangibles	1,214	1,339
Other	138	78
Gross deferred tax assets	60,270	42,153
Deferred tax liabilities:		
Property and equipment	(1,720)	(1,863)
Right of use assets	(4,716)	—
Gross deferred tax liabilities	(6,436)	(1,863)
Valuation allowance	(53,834)	(40,290)
Net deferred tax assets	\$ —	\$ —

Notes to Consolidated Financial Statements (continued)

Management of the Company has evaluated the positive and negative evidence bearing upon the realizability of the Company's deferred tax assets, which are comprised principally of net operating loss carryforwards, and determined that it is more likely than not that the Company will not recognize the benefits of the deferred tax assets. As a result, a full valuation allowance of approximately \$53.8 million and \$40.3 million was established at December 31, 2019 and 2018, respectively.

A reconciliation of the statutory federal income tax rate to the Company's effective income tax rate is as follows (dollars in thousands):

	Years ended December 31,	
	2019	2018
	Tax Rate	Tax Rate
U.S. federal statutory rate	21%	21%
State income taxes, net of federal benefit	6%	6%
Other permanent differences	(1)%	(1)%
Tax credits	0%	3%
Other items	0%	(1)%
Net change in valuation allowance	(26)%	(28)%
Effective income tax rate	—	—

A roll-forward of the valuation allowance for the years ended December 31, 2019 and 2018 is as follows (in thousands):

	Years ended December 31,	
	2019	2018
Balance at beginning of year	\$ (40,290)	\$ (26,515)
Increase in valuation allowance	(13,544)	(13,775)
Balance at end of year	\$ (53,834)	\$ (40,290)

As of December 31, 2019 and 2018, the Company had federal net operating loss carryforwards that may be available to reduce future taxable income of approximately \$172.9 million and \$125.5 million, respectively. Of the \$172.9 million of federal net operating loss carryforwards, \$79.4 million begin to expire in 2034. The remaining \$93.5 of federal net operating loss carryforwards do not expire. The Company also had state net operating loss carryforwards that may be available to reduce future taxable income of approximately \$159.0 million and \$109.4 million, for the periods ended December 31, 2019 and 2018, respectively. The state net operating loss carryforwards begin to expire in 2029. In addition, at December 31, 2019, the Company had federal and state research and development tax credit carryforwards available to reduce future tax liabilities of approximately \$2.5 million and \$1.8 million, respectively.

Pursuant to Section 382 of the Internal Revenue Code of 1986 ("IRC"), certain substantial changes in the Company's ownership may result in a limitation on the amount of net operating loss ("NOL") carryforwards and research and development credit ("R&D credit") carryforwards that may be used in future years. Utilization of the NOL and R&D credit carryforwards may be subject to a substantial annual limitation under Section 382 of the IRC due to ownership change limitations that have occurred previously or that could occur in the future. These ownership changes may limit the amount of NOL and R&D credit carryforwards that can be utilized annually to offset future taxable income and tax, respectively. The Company has not completed a study to assess whether an ownership change has occurred, or whether there have been multiple ownership changes since its formation, due to a significant complexity and related costs associated with such a study. There could be additional ownership changes in the future that may result in additional limitations on the utilization of NOL carryforwards and credits.

The Company is required to determine whether a tax position of the Company is more likely than not to be sustained upon examination, including resolution of any related appeals or litigation processes, based on the technical merits of the position. For tax positions meeting the more likely than not threshold, the tax amount recognized in the financial statements is reduced by the largest benefit that has a greater than fifty percent likelihood of being realized upon the ultimate settlement with the relevant taxing authority. The Company has not recognized any liability for unrecognized tax benefits as of December 31, 2019.

The Company files tax returns, on an entity-level basis, as prescribed by the tax laws of the jurisdictions in which it operates. In the normal course of business, the Company is subject to examination by federal and state jurisdictions, where applicable. There are currently no pending tax examinations. Tax years from 2016 to the present are open to examination under the statute. The Company's policy is to record interest and penalties related to income taxes as part of the tax provision. There are no interest or penalties accrued at December 31, 2019 and 2018.

Notes to Consolidated Financial Statements (continued)

(13) Leases**Operating Leases**

In July 2017, the Company entered into an agreement to lease approximately 41,346 square feet of laboratory and office space at 301 Binney Street in Cambridge, Massachusetts. Annual rent is approximately \$3.1 million. The ten-year lease commenced in January 2018 and contains provisions for a free-rent period, annual rent increases and an allowance for tenant improvements. The Company is responsible for real estate taxes, maintenance, and other operating expenses applicable to the leased premises. The Company has paid for tenant improvements of approximately \$2.9 million. Additionally, the Company has capitalized approximately \$6.6 million of landlord-funded tenant improvements. The Company was deemed to be the accounting owner of the tenant improvements primarily because it was responsible for project cost overruns, and as such, the amounts were recorded as a leasehold improvement. The landlord-funded tenant improvement allowance is being amortized as a reduction to lease expense ratably over the lease term. In conjunction with the lease, the Company established a letter of credit of approximately \$1.0 million secured by cash balances included in restricted cash. Variable payments based on our portion of the operating expenses, including real estate taxes and insurance, are recorded as a period expense when incurred. The Company has an option to extend the term by five years and an option to terminate the agreement if a similar agreement is executed with the landlord or an affiliate of the landlord. Neither option is reasonably certain of exercise and both are excluded from the lease liability calculation.

On December 7, 2018, Synlogic Operating Company, Inc., a wholly-owned subsidiary of Synlogic, Inc., entered into a Statement of Work (the "SOW") with Azzur Group, LLC ("Azzur") pursuant to a Master Contract Services Agreement (the "Master Services Agreement"), dated September 8, 2018, between the Company and Azzur.

Pursuant to the SOW, Azzur has agreed to provide the Company with access to, and the use of, an approximately 700 square foot cleanroom space to be constructed in Waltham, Massachusetts (the "Azzur Suite"), for a period of 44 months, from May 1, 2019 to December 31, 2022 (the "Term"). Azzur has also agreed to provide the Company with storage space and personnel support at the Azzur Suite. The total estimated project cost during the Term for access to, and use of, the cleanroom and storage space, and the personnel support and other services, is up to \$4.8 million.

The Company may terminate the SOW on four months' prior written notice at any time during the Term. In addition, either party may terminate the Master Services Agreement (including the SOW) due to a breach by the other party and failure to cure. The Company is reasonably certain not to exercise the termination option through December 31, 2022. Therefore, the Company used a term of May 1, 2019 through December 31, 2022 for purposes of the calculation of the ROU asset and lease liability.

The Company adopted Topic 842 as of January 1, 2019. Leases classified as operating leases are included in operating lease ROU assets, current operating lease liabilities and noncurrent operating lease liabilities in our December 31, 2019 consolidated balance sheet. The operating lease right-of-use asset and operating lease liability represents the Binney Street lease and the Azzur Suite lease. Finance leases are made up of laboratory and office equipment. Cash paid for amounts included in the present value of operating lease liabilities was \$3.7 million during the year ended December 31, 2019 which is included in operating cash flows.

The components of lease cost for operating and finance leases for the year ended December 31, 2019 were:

Operating leases	\$ (in thousands)
Operating lease cost	\$ 3,344
Short-term lease cost	330
Variable lease cost	1,092
	<u>4,766</u>
Finance leases	
Depreciation on finance leases	188
Interest on finance leases	21
	<u>209</u>
Total lease cost	\$ 4,975

Notes to Consolidated Financial Statements (continued)

The right-of-use asset for the operating lease is disclosed on the consolidated balance sheet. The right-of-use asset for finance leases are classified within property and equipment, net, the total right-of-use asset for finance leases is \$0.9 million.

The weighted average remaining lease term and the weighted average discount rate for operating and finance leases at December 31, 2019 was:

	Operating Lease	Finance Leases
Weighted average discount rate	8.0%	6.1%
Weighted average remaining lease term (years)	8.2	0.8

The following table reconciles the undiscounted cash flows for the operating and finance leases at December 31, 2019 to the operating and finance lease liabilities recorded on the balance sheet: December 31, 2019

Maturity of lease liabilities	Operating Leases		Finance Leases	
	(in thousands)			
2020	\$	3,892	\$	214
2021		4,236		2
2022		4,389		—
2023		3,574		—
2024		3,681		—
Thereafter		14,386		—
Total lease payments		34,158		216
Less: imputed interest		9,354		6
Total lease liabilities	\$	24,804	\$	210
Current lease liabilities		2,000		208
Long-term lease liabilities		22,804		2

(14) Commitments and Contingencies

In the ordinary course of business, the Company may be subject to legal proceedings, claims and litigation as the Company operates in an industry susceptible to patent legal claims. The Company accounts for estimated losses with respect to legal proceedings and claims when such losses are probable and estimable. Legal costs associated with these matters are expensed when incurred. The Company is not currently a party to any material legal proceedings.

(15) Employee Benefits

The Company has a defined contribution 401(k) plan for eligible employees. Employees are eligible to participate in the plan beginning on their date of hire. Under the terms of the plan, employees may make voluntary contributions as a percentage of compensation. The Company started to match employee contributions effective January 1, 2019. The Company matched 50% of the employee contributions to the 401(k) plan up to a maximum of 4% of the participating employee's eligible earnings, resulting in a maximum company match of 2% of the participating employee's eligible earnings, and subject to certain additional statutory dollar limitations.

(16) Related-Party Transactions

In June 2019, the Company expanded its collaboration and entered into an agreement with Ginkgo for the research and development of engineered microbial therapeutic products. See Note 10, *Ginkgo Collaboration*.

Under the agreement the Company made a prepayment to Ginkgo of \$30.0 million for its foundry services that will be provided to the Company over an initial term of five years. At December 31, 2019, the Company had remaining balances of \$11.5 million and \$15.7 million of current and non-current pre-paid research and development costs related to this transaction, respectively. For the year ended December 31, 2019, the Company used \$2.8 million of the pre-paid research and development expenses.

Notes to Consolidated Financial Statements (continued)

(17) Selected Quarterly Data (Unaudited)

The following tables contain quarterly financial information for 2019 and 2018 (in thousands). The Company believes that the following information reflects all normal recurring adjustments necessary for a fair presentation of the information for the periods presented. The operating results for any quarter are not necessarily indicative of results for any future period.

	2019 Quarter Ended			
	March 31	June 30	September 30	December 31
Revenue	\$ 338	\$ 350	\$ 305	\$ 1,231
Operating expenses	14,035	13,445	14,443	14,710
Loss from operations	(13,697)	(13,095)	(14,138)	(13,479)
Net loss	(12,946)	(12,344)	(13,285)	(12,798)
Net loss per share - basic and diluted	\$ (0.51)	\$ (0.45)	\$ (0.39)	\$ (0.37)

	2018 Quarter Ended			
	March 31	June 30	September 30	December 31
Revenue	\$ 354	\$ 254	\$ 1,801	\$ 111
Operating expenses	11,990	15,606	13,335	12,819
Loss from operations	(11,636)	(15,352)	(11,534)	(12,708)
Net loss	(11,165)	(14,591)	(10,748)	(11,931)
Net loss per share - basic and diluted	\$ (0.55)	\$ (0.59)	\$ (0.43)	\$ (0.47)

**DESCRIPTION OF THE REGISTRANT'S SECURITIES
REGISTERED PURSUANT TO SECTION 12 OF
THE SECURITIES EXCHANGE ACT OF 1934, AS AMENDED**

Synlogic, Inc. (the "Company" or "we") has one class of securities registered under Section 12 of the Securities Exchange Act of 1934, as amended: our common stock, par value \$0.001 per share.

DESCRIPTION OF COMMON STOCK

We are authorized to issue 250,000,000 shares of common stock, par value \$0.001 per share, and 5,000,000 shares of preferred stock, par value \$0.001 per share.

The following summary of certain provisions of our common stock does not purport to be complete. You should refer to our restated certificate of incorporation and our amended and restated bylaws, both of which are incorporated by reference as exhibits to the Company's Annual Report on Form 10-K of which this Exhibit is a part. The summary below is also qualified by provisions of applicable law.

General

Holders of our common stock are entitled to one vote for each share held on all matters submitted to a vote of stockholders and do not have cumulative voting rights. An election of directors by our stockholders shall be determined by a plurality of the votes cast by the stockholders entitled to vote on the election. Holders of common stock are entitled to receive proportionately any dividends as may be declared by our board of directors, subject to any preferential dividend rights of any series of preferred stock that we may designate and issue in the future. All shares of common stock outstanding as of the date of the Company's Annual Report on Form 10-K are fully paid and nonassessable.

In the event of our liquidation or dissolution, the holders of common stock are entitled to receive proportionately our net assets available for distribution to stockholders after the payment of all debts and other liabilities and subject to the prior rights of any outstanding preferred stock. Holders of common stock have no preemptive, subscription, redemption or conversion rights. There are no redemption or sinking fund provisions applicable to the common stock. Our outstanding shares of common stock are validly issued, fully paid and nonassessable. The rights, preferences and privileges of holders of common stock are subject to and may be adversely affected by the rights of the holders of shares of any series of preferred stock that we may designate and issue in the future.

Transfer Agent and Registrar

The transfer agent and registrar for our common stock is American Stock Transfer & Trust Company, LLC, with offices at 6201 15th Avenue, Brooklyn, New York 11219.

Stock Exchange Listing

Our common stock is listed for quotation on The Nasdaq Capital Market under the symbol "SYBX."

**CERTAIN PROVISIONS OF DELAWARE LAW AND OF THE COMPANY'S
CERTIFICATE OF INCORPORATION AND BYLAWS**

Anti-Takeover Provisions

We are subject to Section 203 of the Delaware General Corporation Law. Subject to certain exceptions, Section 203 prevents a publicly held Delaware corporation from engaging in a "business combination" with any "interested stockholder" for three years following the date that the person became an interested stockholder, unless the interested stockholder attained such status with the approval of our board of directors or unless the business

combination is approved in a prescribed manner. A “business combination” includes, among other things, a merger or consolidation involving us and the “interested stockholder” and the sale of more than 10% of our assets. In general, an “interested stockholder” is any entity or person beneficially owning 15% or more of our outstanding voting stock and any entity or person affiliated with or controlling or controlled by such entity or person.

Charter Documents

Our restated certificate of incorporation and amended and restated bylaws divide our board of directors into three classes with staggered three year terms. The provision for a classified board could prevent a party who acquires control of a majority of Synlogic’s outstanding voting stock from obtaining control of the Synlogic Board of Directors until the second annual stockholders meeting following the date the acquirer obtains the controlling stock interest. Synlogic’s classified board provision could discourage a potential acquirer from making a tender offer or otherwise attempting to obtain control of Synlogic and could increase the likelihood that incumbent directors will retain their positions. Synlogic’s restated certificate of incorporation provides that, subject to the special rights of holders of one or more series of preferred stock, directors may be removed at any time, but only for cause by the affirmative vote of the holders of at least 66 and 2/3% of the voting power of all outstanding voting stock of Synlogic.

Synlogic’s restated certificate of incorporation provides that certain amendments of Synlogic’s certificate of incorporation and amendments by Synlogic stockholders of Synlogic’s amended and restated bylaws require the approval of at least 66 and 2/3% of the voting power of all outstanding stock. These provisions could discourage a potential acquirer from making a tender offer or otherwise attempting to obtain control of Synlogic and could delay changes in management.

Synlogic’s amended and restated bylaws establish an advance notice procedure for stockholder proposals to be brought before an annual meeting of Synlogic stockholders, including proposed nominations of persons for election to the Synlogic Board of Directors. At an annual meeting, stockholders may only consider proposals or nominations specified in the notice of meeting or brought before the meeting by or at the direction of the Synlogic Board of Directors. Stockholders may also consider a proposal or nomination by a person who was a stockholder at the time of giving notice and at the time of the meeting, who is entitled to vote at the meeting and who has complied with the notice requirements of Synlogic’s amended and restated bylaws in all respects provided that such proposal is properly made in accordance with Rule 14a-8 under the Exchange Act. The amended and restated bylaws do not give the Synlogic Board of Directors the power to approve or disapprove stockholder nominations of candidates or proposals regarding other business to be conducted at a special or annual meeting of the stockholders. However, Synlogic’s amended and restated bylaws may have the effect of precluding the conduct of business at a meeting if the proper procedures are not followed. These provisions may also discourage or deter a potential acquirer from conducting a solicitation of proxies to elect the potential acquirer’s own slate of directors or otherwise attempting to obtain control of Synlogic.

Synlogic’s amended and restated bylaws provide that a special meeting of Synlogic stockholders may be called at any time by the Synlogic Board of Directors. Because Synlogic stockholders do not have the right to call a special meeting, a Synlogic stockholder cannot force stockholder consideration of a proposal over the opposition of the Synlogic Board of Directors by calling a special meeting of stockholders prior to such time as a majority of the Synlogic Board of Directors believed the matter should be considered and such Synlogic stockholder would only be able to force consideration of such proposal at the next annual meeting, *provided* that the requestor met the notice requirements. The restriction on the ability of Synlogic stockholders to call a special meeting means that a proposal to replace one or more directors on the Synlogic Board of Directors also could be delayed until the next annual meeting.

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Synlogic’s amended and restated bylaws do not allow stockholders to act by written consent without a meeting. Without the availability of stockholder action by written consent, a holder controlling a majority of Synlogic’s capital stock would not be able to amend Synlogic’s amended and restated bylaws or remove directors without holding a stockholders’ meeting.

SUBSIDIARIES OF SYNLOGIC, INC.

Subsidiary

Jurisdiction

Synlogic IBDCo, Inc.
Synlogic Operating Company, Inc.
Synlogic Securities Corporation

Delaware
Delaware
Massachusetts

Consent of Independent Registered Public Accounting Firm

The Board of Directors
Synlogic, Inc.

We consent to the incorporation by reference in the registration statements (Nos. 333-220841, 333-223798, 333-210466, 333-207299 and 333-230224) on Form S-8 and (No. 333-226730, 333-220948 and 333-233139) on Form S-3 of Synlogic, Inc., of our report dated March 12, 2020, with respect to the consolidated balance sheets of Synlogic, Inc. as of December 31, 2019 and 2018, the related consolidated statements of operations and comprehensive loss, stockholders' equity, and cash flows for the years then ended, and the related notes (collectively, the consolidated financial statements), which report appears in the December 31, 2019 annual report on Form 10-K of Synlogic, Inc. Our report refers to a change in accounting principle related to the adoption of Accounting Standards Update 2016-02, *Leases* (Topic 842).

/s/ KPMG LLP
Boston, Massachusetts
March 12, 2020

CERTIFICATIONS UNDER SECTION 302

I, Aoife Brennan, certify that:

1. I have reviewed this annual report on Form 10-K of Synlogic, Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:
 - a) designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
 - b) designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - c) evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - d) disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - a) all significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - b) any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 12, 2020

By: _____ /s/ AOIFE BRENNAN

Aoife Brennan
President and Chief Executive Officer
(Principal Executive Officer)

**CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

In connection with the Annual Report of Synlogic, Inc. (the "Company") on Form 10-K for the period ending December 31, 2019 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Aoife Brennan, President and Chief Executive Officer of the Company, certify, pursuant to 18 U.S.C. § 1350, as adopted pursuant to § 906 of the Sarbanes-Oxley Act of 2002, that:

- (1) The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and
- (2) The information contained in the Report fairly presents, in all material respects, the financial condition and result of operations of the Company.

Date: March 12, 2020

By: _____ /s/ AOIFE BRENNAN
Aoife Brennan
***President and Chief Executive Officer
(Principal Executive Officer)***

A signed original of this written statement required by Section 906 has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.

**CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

In connection with the Annual Report of Synlogic, Inc. (the "Company") on Form 10-K for the period ending December 31, 2019 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Gregg Beloff, Interim Chief Financial Officer, certify, pursuant to 18 U.S.C. § 1350, as adopted pursuant to § 906 of the Sarbanes-Oxley Act of 2002, that:

- (1) The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and
- (2) The information contained in the Report fairly presents, in all material respects, the financial condition and result of operations of the Company.

Date: March 12, 2020

By: _____ /s/ GREGG BELOFF
Gregg Beloff
Interim Chief Financial Officer
(Principal Financial Officer and Principal Accounting Officer)

A signed original of this written statement required by Section 906 has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.