

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

FORM 10-K

ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the fiscal year ended December 31, 2019

TRANSITION REPORT PURSUANT TO SECTIONS 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the transition period from _____ to _____

Commission file number 001-32188

ORAGENICS, INC.

(Exact name of registrant as specified in its charter)

Florida
(State or Other Jurisdiction of
Incorporation or Organization)

4902 Eisenhower Blvd., Suite 125
Tampa, FL
(Address of Principal Executive Offices)

59-3410522
(IRS Employer
Identification No.)

33634
(Zip Code)

813-286-7900
(Issuer's Telephone Number, Including Area Code)

SECURITIES REGISTERED PURSUANT TO SECTION 12(b) OF THE ACT:

Title of each class	Trading Symbol	Name of each exchange on which registered
Common Stock \$0.001 par value per share	OGEN	NYSE AMERICAN

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 Section 15(d) of the Exchange 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 if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of Registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K.

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

Non-accelerated filer

Accelerated filer

Smaller reporting company

Emerging growth company

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act.

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

The aggregate market value of the voting and non-voting common equity stock held by non-affiliates of the registrant, was approximately \$21,567,137 computed based upon a last sales price of \$0.49 as reported by the NYSE American as of June 28, 2019.

As of February 25, 2020, there were 46,124,803 shares of the registrant's Common Stock outstanding.

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FORWARD LOOKING STATEMENTS AND CERTAIN CONSIDERATIONS

This report, along with other documents that are publicly disseminated by us, contains or might contain forward-looking statements within the meaning of the Securities Exchange Act of 1934, as amended (the “Exchange Act”). All statements included in this report and in any subsequent filings made by us with the Securities and Exchange Commission (the “SEC”) other than statements of historical fact, that address activities, events or developments that we or our management expect, believe or anticipate will or may occur in the future are forward-looking statements. These statements represent our reasonable judgment on the future based on various factors and using numerous assumptions and are subject to known and unknown risks, uncertainties and other factors that could cause our actual results and financial position to differ materially. We claim the protection of the safe harbor for forward-looking statements provided in the Private Securities Litigation Reform Act of 1995, Section 27A of the Securities Act and Section 21E of the Exchange Act. Examples of forward-looking statements include: (i) projections of revenue, earnings, capital structure and other financial items, (ii) statements of our plans and objectives, (iii) statements of expected future economic performance, and (iv) assumptions underlying statements regarding us or our business. Forward-looking statements can be identified by, among other things, the use of forward-looking language, such as “believes,” “expects,” “estimates,” “may,” “will,” “should,” “could,” “seeks,” “plans,” “intends,” “anticipates” or “scheduled to” or the negatives of those terms, or other variations of those terms or comparable language, or by discussions of strategy or other intentions.

Forward-looking statements are subject to known and unknown risks, uncertainties and other factors that could cause the actual results to differ materially from those contemplated by the statements. The forward-looking information is based on various factors and was derived using numerous assumptions. Important factors that could cause our actual results to be materially different from the forward-looking statements include the following risks and other factors discussed under the Item 1A “Risk Factors” in this Annual Report on Form 10-K. These factors include:

- the timing, progress and results of clinical trials of our Oral Mucositis therapy and other product candidates, including statements regarding the timing of initiation and completion of preclinical studies or clinical trials or related preparatory work, the period during which the results of the trials will become available and our research and development programs;
- the timing of any submission of filings for regulatory approval of our product candidates and our ability to obtain and maintain regulatory approvals for our product candidates for any indication;
 - our expectations regarding the potential benefits, activity, effectiveness and safety of our product candidates;
 - our expectations regarding the size of the patient populations, market acceptance and opportunity for and clinical utility of our product candidates, if approved for commercial use;
 - our manufacturing capabilities and strategy, including the, scalability and commercial viability of our manufacturing methods and processes;
 - our expectations regarding the scope of any approved indications for our product candidates;
 - our ability to successfully commercialize our product candidates;
 - the potential benefits of and our ability to maintain our relationships and collaborations with Precigen and other potential collaboration or strategic relationships;
 - our ability to use our Oral Mucositis and Lantibiotic platforms to develop future product candidates;
 - our estimates of our expenses, ongoing losses, future revenue, capital requirements and our needs for or ability to obtain additional funding;
 - our ability to identify, recruit and retain key personnel;
 - our ability to protect and enforce our intellectual property position for our product candidates, and the scope of such protection;
 - our financial performance;
 - our inability to achieve success in our identification of lantibiotic homologs or the manufacture and nonclinical testing of our lantibiotic product candidates.
- we are subject to extensive and costly regulation by worldwide health authorities, which must approve our product candidates in development and could restrict or delay the future commercialization of certain of our product candidates.
 - our ability to successfully complete preclinical and clinical development of, and obtain regulatory approval of our product candidates and commercialize any approved products on our expected timeframes or at all.
 - the safety, efficacy and benefits of our product candidates.
 - the content and timing of submissions to and decisions made by the FDA and other regulatory agencies.
 - the effects of government regulation and regulatory developments, and our ability and the ability of the third parties with whom we engage to comply with applicable regulatory requirements.
 - the capacities and performance of our suppliers and manufacturers and other third parties over whom we have limited control.
 - our ability to maintain our listing on the NYSE American.
 - our competitive position and the development of and projections relating to our competitors or our industry; and
 - the impact of laws and regulations.

We caution investors that actual results or business conditions may differ materially from those projected or suggested in forward-looking statements as a result of various factors including, but not limited to, those described above and in the Risk Factors section of this report. We cannot assure you that we have identified all the factors that create uncertainties. Moreover, new risks emerge from time to time and it is not possible for our management to predict all risks, nor can we assess the impact of all risks on our business or the extent to which any risk, or combination of risks, may cause actual results to differ from those contained in any forward-looking statements. Readers should not place undue reliance on forward-looking statements. Except as required by applicable law, we undertake no obligation to publicly release the result of any revision of these forward-looking statements to reflect events or circumstances after the date they are made or to reflect the occurrence of unanticipated events.

PART I

ITEM 1. BUSINESS.

This description contains certain forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from the results discussed in the forward-looking statements as a result of certain of the risks set forth herein. We assume no obligation to update any forward-looking statements contained herein.

Overview

We are focused on developing effective treatments for oral mucositis and becoming a leader in developing novel antibiotics against infectious disease.

Our Oral Mucositis Product Candidate-Clinical

In June of 2015, we entered into a worldwide Exclusive Channel Collaboration Agreement (“Oral Mucositis ECC”) with Precigen, Inc. (“Precigen”) (formerly known as Intrexon Corporation) and Intrexon Actobiotics NV, a wholly-owned subsidiary of Intrexon, pursuant to which we obtained certain exclusive rights to AG013 as a potential treatment of oral mucositis, or OM for cancer patients, which we intend to continue to develop. AG013, is an oral rinsing solution system designed to deliver human Trefoil Factor 1 (hTFF1) to protect and regenerate damaged mucosal lining of the oral cavity.

OM results in a painful inflammation and mucosal ulceration in the lining of the oral cavity, throat and esophagus and is one of the most commonly reported adverse events associated with cancer chemotherapy. Approximately 770,000 patients annually in the US are at an increased risk of developing OM according to cancer statistics provided by the Center for Disease Control (CDC) in 2017. OM has a negative effect on patient well-being and if severe, negatively affects adherence to a patient’s cancer treatment regimen. At present, we are not aware of any drug that is approved to prevent the condition broadly and current therapies are primarily palliative in nature, only addressing symptom relief but not treating the underlying causes of the condition.

AG013 has been granted Orphan Drug status in the European Union. In November of 2016, the United States Food and Drug Administration (the “FDA”) granted Fast Track designation for AG013, and we believe it may be eligible for Biologic License Application (“BLA”) exclusivity as well. The FDA’s fast track therapy designation program is intended to facilitate the development and expedite the review of drug candidates intended for the treatment of serious or life-threatening conditions and that demonstrate the potential to address unmet medical needs for those conditions. Under this program, FDA can, for example, review portions of a New Drug Application or BLA for a drug candidate before the entire application is complete, thus potentially beginning the review process at an earlier time. In Europe, orphan status for AG013 allows us to discuss an accelerated development program with the European Medicines Agency (EMA) which may influence the duration of the program prior to marketing approval.

In a Phase 1b clinical trial in 25 cancer patients with OM, AG013 was safe and well tolerated. Data published in the journal Cancer showed a 35% reduction of the duration of ulcerative OM in the AG013-treated patients versus the placebo-treated patients. Furthermore, close to 30% of the patients treated with AG013 were full responders while all placebo-treated patients developed ulcerative OM. Additionally, in a Phase 1 pharmacokinetic (PK) study in 10 healthy volunteers, AG013 bacteria adhered to the buccal mucosa and actively secrete protein locally, resulting in homogeneous exposure of the entire mucosal surface up to 24 hours after administration of the rinse system.

We developed a Phase 2 protocol for AG013 with the FDA under the fast track designation. In August of 2016, we received feedback from the FDA in response to our Type C meeting and the pursuit of a Phase 2 trial on AG013 for the treatment of oral mucositis in head and neck cancer patients. We filed an Investigational New Drug (“IND”) update in March 2017 and we initiated the Phase 2 study with AG013 in the United States in 2017 and in Europe in 2018. The Phase 2 trial was a double-blind, placebo-controlled, 2-arm, multi-center trial in which approximately 200 patients were randomized in a 1:1 ratio to receive either a placebo or AG013 following meals, beginning on the first day of chemoradiation therapy and continuing through the course of cancer treatment. The study enrolled patients receiving chemoradiation for treatment of head and neck cancer for 7 to 9 weeks. The clinical trial was conducted at clinical sites across the United States and Europe. The purpose of the Phase 2 study (NCT03234465) is to evaluate the efficacy (preventing the occurrence and shortening the duration of severe oral mucositis (“SOM”), safety and tolerability of topically administered AG013 rinse system compared to the placebo for reducing the incidence and severity of OM in patients undergoing traditional chemoradiation for the treatment of head and neck cancer. Key efficacy measures include collection of data regarding the duration, time to development, and overall incidence of grades 3 and 4 OM (World Health Organization scale used) during the active treatment phase, beginning from the start of chemoradiation therapy until 2 weeks following its completion.

On December 2, 2019 we announced completion of enrollment in our Phase 2 clinical trial. We expect to release top line results from the trial in the first half of 2020.

An interim safety analysis was requested by the FDA on patients from our Phase 2 clinical trial of AG013 for the treatment of OM. We completed enrollment of the interim safety analysis cohort, which included 24 randomized patients in our Phase 2 clinical trial of AG013 for the treatment OM. Nineteen of those patients were included in the unblinded safety evaluation, of which 10 received AG013. We announced positive results from our interim safety analysis in May, 2018. The study provided information that, we believe, likely indicates that the overall incidence of severe OM is less than would be anticipated in the general head and neck cancer population.

Safety was evaluated on the basis of treatment-emergent adverse events, vital signs, weight, physical examinations, clinical laboratory assessments and the presence of AG013 in whole blood. Tolerability measures (taste, consistency and smell) were collected from the patient diaries. In addition, the reasons for study treatment discontinuation were also summarized. Following review of the data by an independent Data Safety Monitoring Board (DSMB), it was concluded that the clinical trial can proceed with no changes to the study. The data analysis indicated that the distribution of adverse events was similar between AG013 and placebo. The serious adverse events reported were consistent with those commonly reported in a head and neck cancer population receiving traditional chemoradiation therapy treatments and included fevers, neutropenia, anemia, nausea and vomiting, infections and oral (mouth and throat) pain and there were no reports of AG013 related bacteremia or sepsis. Of patients that discontinued participation in the clinical study during the initial 24 patient interim analysis review, 4 patients experienced adverse events, including 3 patients who developed nausea and vomiting, 2 patients that were non-compliant with the study procedures and 3 patients developed severe OM.

The DSMB met again in December 2019 and reviewed safety data on the first 150 patients who completed the trial and determined that the clinical trial could continue with no adjustments or further review.

On September 30, 2019, we made a poster presentation at the European Society for Medical Oncology Congress where we announced initial blinded blended data from our Phase 2, placebo-controlled, clinical trial of AG013 in oral mucositis. The presentation described the methods and initial blinded results from the ongoing Phase 2 clinical trial for our lead oral mucositis product candidate, AG013. The initial blinded data, submitted in the abstract, reflected the results for 42 of the 71 enrolled and randomized patients across 48 study sites who had completed their treatment course and demonstrated that in the blinded, combined placebo and active treatment groups, there was sufficient evidence of efficacy and safety to continue the study. Additional data accumulated since poster submission, indicated the blinded efficacy evaluation, which included any patient with SOM after week one of treatment and those receiving a cumulative dose of 55 Gy (week 6 of treatment), demonstrated an overall SOM incidence of 47%, which we believe is lower than would be expected based on historical data in the head and neck cancer population receiving this chemoradiation regimen. The overall rate of SOM was reported in only 13.1 % (110 of 842) of evaluable visits. The overall safety profile continues to be consistent with those adverse events that normally occur in cancer patients receiving chemoradiation therapy. The study, however, remains blinded and individual treatment responses remain to be identified.

Our Antibiotic Product Candidate-Preclinical

Members of our scientific team discovered that a certain bacterial strain produces MU1140, a molecule belonging to the novel class of antibiotics known as lantibiotics. Lantibiotics, such as MU1140, are highly modified peptide antibiotics made by a small group of Gram-positive bacterial species. Approximately 60 lantibiotics have been discovered, to date. We believe lantibiotics are generally recognized by the scientific community to be potent antibiotic agents.

In nonclinical testing, MU1140 has shown activity against all Gram-positive bacteria against which it has been tested, including those responsible for a number of healthcare associated infections, or HAIs. A high percentage of hospital-acquired infections are caused by highly resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) or multidrug-resistant Gram-negative bacteria. We believe the need for novel antibiotics is increasing as a result of the growing resistance of target pathogens to existing FDA approved antibiotics on the market.

Lantibiotics have been difficult to investigate for their clinical usefulness as therapeutic agents in the treatment of infectious diseases due to a general inability to produce or synthesize sufficient quantities of pure amounts of these molecules. Traditional fermentation methods can only produce minute amounts of the lantibiotic.

In June 2012, we entered into the Lantibiotic Exclusive Channel Collaboration agreement (“Lantibiotic ECC”) with Precigen for the development and commercialization of the native strain of MU1140 and related homologs using Precigen’s advanced transgene and cell engineering platforms. Through our work with Precigen, we have been able to produce a significant increase in the fermentation titer of MU1140 compared to standard fermentation methods and have discovered a new purification process for MU1140. Our work with Precigen generated a substantial number of homologs of MU1140. In January Precigen consummated a reorganization of its ongoing API fermentation operations and assets into ILH Holdings, Inc. which at the time was an affiliate of Precigen. In connection with the reorganization, Precigen assigned the Lantibiotic ECC and related stock issuance agreements to ILH Holdings. Following such reorganization, Precigen divested certain of its assets to TS Biotechnology Holdings, LLC which included ILH Holdings and shares of Oragenics securities held by Precigen. As a result of such change by Precigen we expect to continue our research and development and collaboration efforts with ILH Holdings to develop potential derivatives of the MU1140 molecule using genetically modified bacteria.

In our pre-clinical studies to support a potential IND filing with the FDA, we tested a total of six homologs of MU1140 for certain compound characteristics, including but not limited to: drug activity (based on minimum inhibitory concentration or “MIC”) equal or better than “standard of care” drugs against certain drug-resistant bacteria, safety, toxicity, stability, and manufacturability. An animal study specifically evaluated homolog efficacy in relation to survival, measurable amounts of *Clostridium difficile* (“*C. diff*”) colony forming units, and toxin levels. Three homologs demonstrated promising results with one homolog, OG253 achieving a 100% survival rate throughout the entire study in contrast to an approximately 30% survival rate for the vancomycin positive control.

Based on these early results, we selected a lead candidate, OG253, for which we had a pre-IND meeting with the FDA in November of 2015 regarding the pursuit of an IND for OG253. Following additional research and development on second generation lantibiotics, in August of 2016, we opted to select a second generation lantibiotic, OG716, for treatment of *C. diff* as our new lead candidate. OG716 is a new, orally-active homolog, that has exhibited positive results in an animal model for potential treatment of *C. diff*. Generated from our MU1140 platform, this new lantibiotic showed promising efficacy in reducing clinically relevant *C. diff* infections as measured by increased animal survival and decreased relapse as well as reduced production of toxins A & B and *C. diff* spores.

The timing of the filing of an IND regarding OG716 is subject to our having sufficient available human and financing capital given all of our anticipated needs and expected requirements in connection with our ongoing research and development initiatives. We will continue to advance the OG716 program to the IND filing based on the availability of both human and financial capital. Based upon the current funding available we will continue to conduct some of the requisite studies. While we commenced certain of these studies at the end of 2019, we expect to focus on efficient and cost-effective manufacturing of the product to support and be able to conduct further broad-based studies.

Product Candidates.

We are currently developing AG013 in connection with the treatment of Oral Mucositis and a product candidate, OG716, as an antibiotic, as well as other homolog antibiotic product candidates. We have an exclusive worldwide license from Precigen and its wholly owned subsidiary, Intrexon Actobiotics NV to use their intellectual property to develop AG013 for the treatment of oral mucositis in patients undergoing treatment for cancer. Effective January 1, 2018, Precigen assigned its interest in the license agreement to a wholly owned subsidiary, Precigen ActoBio Inc. (formerly known as ActoBio Therapeutics, Inc.). We also have an exclusive, worldwide license from ILH Holdings (as an assignee of Precigen) to use its technology to develop lantibiotics. We seek to protect our product candidates through patents and patent applications pursuant to the terms of our license agreements.

Product/Candidate	Description	Application	Status
AG013	Treatment of Oral Mucositis	Treatment of oral mucositis in cancer patients	Enrollment completed. Awaiting top-line results.
OG716	A homolog of MU1140: Member of lantibiotic class of antibiotics	Healthcare-associated infections	Nonclinical testing

Our Oral Mucositis (OM) – Product Candidate

On June 9, 2015, we entered into our Oral Mucositis ECC with Precigen and Intrexon Actobiotics NV, a wholly-owned subsidiary of Precigen, through which we intend to research, develop and commercialize products, including the continued development and commercialization of AG013, for use in the treatment of oral mucositis in humans through the administration of an effector via genetically modified bacteria, but, in any case, excluding the delivery of anti-cancer effectors for the purpose of treatment or prophylaxis of cancer (collectively, the “Program”). Contemporaneously with the Oral Mucositis ECC, we also entered into a Stock Issuance Agreement (the “SIA”) with Precigen which provided for the payment of a technology access fee and the potential future issuance by us of our common stock to Precigen upon the achievement of designated development milestones. We issued a Convertible Note in the amount of \$5,000,000 as payment of the technology access fee associated with the Oral Mucositis ECC which was payable, at our option, in cash or shares of our common stock. The convertible note, including accrued interest, was repaid in December 2015 through the issuance of 338,101 shares of our common stock.

In November of 2017 the Oral Mucositis ECC was amended to: (i) consolidate the development milestone payments into one payment of \$27,500,000 being due six months after receiving FDA approval of a New Drug Application (or equivalent regulatory action in a foreign jurisdiction); (ii) reduce the sublicense revenue percentage we would have had to pay from 50% to 25% of sublicensing revenue; and (iii) revise the field in which we have exclusive rights to our Oral Mucositis product candidate for the treatment of Oral Mucositis to clarify that we have an exclusive right for the treatment of Oral Mucositis in humans regardless of etiology. The November amendment superseded an amendment to the Oral Mucositis ECC in May 2017. Effective January 1, 2018, Precigen assigned its interest in the Oral Mucositis ECC and related SIA to its wholly owned subsidiary, ActoBio Therapeutics, Inc.

Market Opportunity

In the United States, upwards of 770,000 patients with cancer, including breast, colorectal, non-small cell lung, head & neck, and stem cell cancers will receive cytotoxic chemotherapy and are at increased risk of developing oral mucositis (CDC, 2017). The incidence of oral mucositis in cancer populations varies based on the type of cancer and chemotherapy regimen and treatment duration used to treat the cancer. For example, oral mucositis almost always occurs in patients with head and neck cancer treated with chemotherapy and radiation therapy (greater than 80% incidence of mucositis) and is common in patients undergoing high dose chemotherapy and hematopoietic cell transplantation, where the incidence and severity of oral mucositis depends greatly on the nature of the conditioning regimen used for myeloablation.

AG013 has been granted Orphan Drug status in the European Union. In November of 2016, the United States Food and Drug Administration (the “FDA”) granted Fast Track designation for AG013, and we believe it may be eligible for Biologic License Application (“BLA”) exclusivity as well. The FDA’s fast track therapy designation program is intended to facilitate the development and expedite the review of drug candidates intended for the treatment of serious or life-threatening conditions and that demonstrate the potential to address unmet medical needs for those conditions. Under this program, FDA can, for example, review portions of a New Drug Application or BLA for a drug candidate before the entire application is complete, thus potentially beginning the review process at an earlier time.

Our Solution

To continue research and development of AG013 as an effective treatment for oral mucositis.

Our Strategy

In collaboration with Precigen and subject to our ability to raise additional capital to pursue further development of AG013, we expect to further the research and development of AG013 toward the goal of moving AG013 forward in its clinical development.

Regulatory Status

In a Phase 1b clinical trial in 25 cancer patients with OM, AG013 was safe and well tolerated. Data published in the journal *Cancer* showed a 35% reduction of the duration of ulcerative OM in the AG013-treated patients versus the placebo-treated patients. Furthermore, close to 30% of the patients treated with AG013 were full responders while all placebo-treated patients developed ulcerative OM. Additionally, in a Phase 1 pharmacokinetic (PK) clinical trial in 10 healthy volunteers, AG013 bacteria adhered to the buccal mucosa and actively secreted protein locally, resulting in homogeneous exposure to the entire mucosal surface up to 24 hours after administration of a rinse. AG013 has been granted Orphan Drug status in the European Union and we believe it may be eligible for Biologic License Application exclusivity. In November 2016, the U.S. FDA granted Fast Track designation for AG013.

We developed a Phase 2 protocol for AG013 with the FDA under the fast track designation. In August of 2016, we received feedback from the FDA in response to our Type C meeting and the pursuit of a Phase 2 trial on AG013 for the treatment of oral mucositis in head and neck cancer patients. We filed an Investigational New Drug (“IND”) update in March 2017 and we initiated the Phase 2 study with AG013 in the United States in 2017 and in Europe in 2018. The Phase 2 trial is a double-blind, placebo-controlled, 2-arm, multi-center trial in which approximately 200 patients were randomized in a 1:1 ratio to receive either a placebo or AG013 following meals, beginning on the first day of chemoradiation therapy and continuing through the course of cancer treatment. The study enrolled patients receiving chemoradiation for treatment of head and neck cancer for 7 to 9 weeks. The clinical trial was conducted at clinical sites across the United States and Europe. The purpose of the Phase 2 study (NCT03234465) is to evaluate the efficacy (preventing the occurrence and shortening the duration of severe oral mucositis (“SOM”), safety and tolerability of topically administered AG013 rinse compared to the placebo for reducing the incidence and severity of OM in patients undergoing traditional chemoradiation for the treatment of head and neck cancer. Key efficacy measures include collection of data regarding the duration, time to development, and overall incidence of OM (World Health Organization scale used) during the active treatment phase, beginning from the start of chemoradiation therapy until 2 weeks following its completion. On December 2, 2019 we announced completion of enrollment in our Phase 2 clinical trial. As of February 27, 2020, all 200 randomized patients, have completed the Phase 2 clinical trial. We expect to release top line results from the trial early in the second quarter of 2020.

Manufacturing

We use contract manufacturing firms to produce our investigational product candidate AG013 in accordance with “current good manufacturing practices” (cGMP) guidelines outlined by the International Conference of Harmonization (ICH) and FDA.

OG716, Homologs of MU1140 and Other Lantibiotics

In the course of research and development, MU1140 was found to be a potent antibiotic that is naturally produced by the parent of the SMaRT strain. MU1140 shows antibacterial activity against all Gram-positive bacteria against which it has been tested, including those responsible for a variety of healthcare-associated infections, or HAIs.

On June 5, 2012, we entered into the Lantibiotic ECC with Precigen. In November of 2017 we amended the Lantibiotic ECC to: (i) consolidate the development milestone payments into one payment of \$25,000,000, being due six months after receiving FDA approval of a New Drug Application, (ii) reduce the sublicense revenue percentage we would have had to pay from 50% to 25% of sublicensing revenue, (iii) reduce the royalty rate from 25% of Product Profit to 10% of Net Sales, (iv) revise the form of milestone payments from being share based or cash at our election to only cash, and (v) commit that Diligent Efforts (as defined in the Lantibiotic ECC) in pursuing the Lantibiotic Program would be deemed satisfied in 2018 provided that at least \$1,200,000 was budgeted for the advancement of the Lantibiotic Program. In January Precigen consummated a reorganization of its ongoing API fermentation operations and assets into ILH Holdings, Inc. which at the time was an affiliate of Precigen. In connection with the reorganization, Precigen assigned the Lantibiotic ECC and related stock issuance agreements to ILH Holdings. Following such reorganization, Precigen divested certain of its assets to TS Biotechnology Holdings, LLC which included ILH Holdings and shares of Orogenics securities held by Precigen.

Through this collaboration we intend to develop lantibiotics, a novel class of broad-spectrum antibiotics, as active pharmaceutical ingredients toward the goal of commercialization for the treatment of infectious diseases in humans. We previously selected a lead candidate, OG253, and had a pre-IND meeting with the FDA in November of 2015 regarding the pursuit of an IND on OG253. Following additional research and development on second generation lantibiotics, in August of 2016, we selected a second generation lantibiotic, OG716, for treatment of *C. diff*. OG716 is a new, orally-active homolog, that has exhibited positive results in an animal model for potential treatment of *C. diff*. Generated from our MU1140 platform, this new lantibiotic showed promising efficacy in reducing clinically relevant *C. diff* infections as measured by increased animal survival and decreased relapse as well as reduced production of *C. diff* spores and toxin levels when compared to a vancomycin positive control. We had our pre-IND meeting with FDA for OG716 during the third quarter of 2017. We have transferred manufacturing to a contract manufacturer and conducted our initial rat toxicology program in support of our anticipated upcoming IND filing. The timing of the filing of an IND regarding OG716 is subject to our having sufficient available capital given all of our anticipated needs and expected requirements in connection with our ongoing research and development initiatives. We currently expect the IND for a first-in-human clinical trial of OG716 to be filed with the FDA based on our ability to complete the requisite studies, contingent on sufficient funding. Based upon the funding available we expect to conduct some of the requisite studies. While we commenced certain of these studies at the end of 2019, we expect to focus on efficient and cost-effective manufacturing of the product to support and be able to conduct further broad-based studies.

Market Opportunity

The most common gram (+) HAIs are caused by drug-resistant bacteria, including methicillin-resistant *Staphylococcus aureus*, or MRSA; vancomycin-resistant *Enterococcus faecalis*, or VRE; and *Clostridium difficile*, or *C. diff*. According to the Centers for Disease Control and Prevention, or CDC, HAIs are estimated to occur in approximately 5% of all acute-care hospitalizations. The CDC also estimates that the total direct medical cost to the U.S. healthcare system from HAIs is between \$28.4 billion to \$45 billion annually. Cubicin, a Gram positive lipopeptide antibiotic which was launched in the US market in November 2003 by the biotechnology company Cubist, had 2012 global sales of \$926.4 million. In 2013, Cubist announced the acquisition of two companies Optimer and Trius each of which was for consideration over \$800M. In 2015, Cubist was acquired by Merck for a total transaction value of \$9.5 billion.

The need for novel antibiotics is increasing due to an increased pattern of resistance development by target pathogens to existing FDA approved antibiotics on the market. The CDC has estimated that up to 77% of certain nosocomial pathogenic bacteria are resistant to drugs of last resort (vancomycin-resistant *E. faecium* and vancomycin, respectively, in this example). HAIs are not exclusively a problem in the United States as the rest of the world has also seen a dramatic rise in HAIs during the last decade. We believe novel antibiotics have become increasingly scarce as major pharmaceutical companies focus more research and development resources on lifestyle drugs and fewer resources on specialty pharmaceuticals such as antibiotics. Between 1983 and 1987, 16 new antibiotics were approved by the FDA. Twenty years later, over an equivalent time period from 2003 to 2007, only five new antibiotics were approved by the FDA, of which only two possessed a novel mechanism of action. Since 2008, there have been no new antibiotic classes approved by FDA.

Lantibiotics such as MU1140 are highly modified peptide antibiotics made by a small group of Gram-positive bacterial species. Approximately 60 lantibiotics have been discovered since the first lantibiotic, nisin, was discovered. Lantibiotics are generally known to be potent antibiotic agents; however, attempts to investigate their clinical usefulness have generally met with failure due to the inability to produce sufficient pure amounts of any of these molecules to be able to test them as a therapeutic agent for the treatment of infectious diseases. Standard fermentation methods, such as those used to make a variety of other antibiotics, have historically resulted in the production of only minute amounts of the lantibiotic.

Our Solution

To develop homologs of MU1140 paired with high producing strains to the point of partnership, and to develop additional lantibiotics in connection with our work on MU1140. MU1140 has demonstrated activity against a wide variety of disease-causing Gram-positive bacteria, including MRSA, VRE, *C. diff*, *Mycobacterium tuberculosis* and *Bacillus anthracis*.

Our Strategy

In collaboration with ILH Holdings, we are developing and testing recombinantly derived homologs of the native MU1140 molecule with improved therapeutic profiles and physical-chemical characteristics. The data generated in collaboration with ILH Holdings over the past few years enabled us to engineer hundreds of homologs of MU1140, and select those homolog candidates with improved profiles, including homologs of higher activity and stability, lower toxicity and with a scalable manufacturability. The best homolog candidates were further developed internally and through the use of several Contract Research Organizations (“CROs”). We believe that this strategy represented the best and most efficient path to produce sufficient quantities of MU1140 homologs, to support continued research, selection of a lead candidate, nonclinical studies, clinical studies and ultimately commercialization. We selected a lead candidate, OG716, in 2016 targeted toward combating *C. diff* infections. In addition, we intend to continue research activities to identify additional MU1140 homologs to treat other HAIs.

Regulatory Status

We have performed nonclinical testing on MU1140 which demonstrated the molecule’s novel mechanism of action. We began additional nonclinical activities on MU1140 under the Lantibiotic ECC and activities have expanded with new identified homologs as available. These nonclinical activities are expected to include toxicity results, pharmacokinetic studies, and efficacy studies in animals for selected candidates, including our lead candidate OG716 under development for *Clostridium difficile* associated diarrhea. This work is being done primarily through the use of outside contractors. Pursuit of clinical trials toward the goal of ultimately obtaining regulatory approval will depend upon further successful advancements in our research efforts and our efforts to have additional product manufactured. Developments from these efforts will dictate our regulatory path. We initially selected a lead candidate, OG253 and had a pre-IND meeting with the FDA in November of 2015 regarding the pursuit of an IND for OG253. Following additional research and development on second generation lantibiotics, in August of 2016, we selected a second generation lantibiotic homolog, OG716, for treatment of *C. diff*. We had a pre-IND meeting with FDA for OG716 during the third quarter of 2017. We expect to continue our research and development activities on OG716 subject to the availability of adequate financing as we move towards the filing of an IND.

Manufacturing

While we have been able to produce a significant increase in the fermentation titer of our lead compound OG716, we continue to work to improve on the manufacturing through collaborations with fermentation and purification experts and third party CROs. We will need to further optimize and scale up the production/purification scheme internally and through third party vendors. The need to examine many new homologs of MU1140 has resulted in the need to reproduce the fermentation and purification steps on each individual homolog candidate being studied. Each homolog requires different optimizations for both the fermentation and purification steps and in some cases requires a new approach. As such, our work on the research and development of new lantibiotic homologs using genetically modified bacteria continues. We believe these developments represent progress toward our goal of commercial production of sufficient quantities of our MU1140 homologs, including our lead compound OG716 and deliver a step in validating the lantibiotics platform targeting infectious diseases.

We are working with a third-party manufacturer to produce additional quantities of designated homologs including our lead compound OG716, based upon the developments achieved from our work with our collaboration partners and outside contractors. The production of additional quantities of designated homologs including OG716, that are needed for the consumption and pursuit of our nonclinical testing activities supporting the IND filing are currently ongoing. We will continue to explore improved methods of manufacturing to improve our yields and ultimately, potentially reduce our cost of manufacture.

Our Lantibiotic ECC

On June 5, 2012, we entered into the Lantibiotic ECC with Precigen that governs a “channel collaboration” arrangement in which we will use Precigen’s advanced transgene and cell engineering platforms for the development and production of lantibiotics, a class of peptide antibiotics that are naturally produced in Gram-positive bacteria and contain the characteristic polycyclic thioether amino acids lanthionine and methyllanthionine (collectively, the “Lantibiotics Program”). The Lantibiotic ECC and Lantibiotic Stock Issuance Agreement were assigned to and assumed by ILH Holdings, Inc., (“ILH”) a wholly owned subsidiary of Precigen, Precigen subsequently sold the majority of its bioengineering assets, inclusive of ILH, to TS Biotechnology LLC, an entity managed by Third Security. In addition, Precigen sold its holdings in our securities to TS Biotechnology. The Lantibiotic ECC provides for the establishment of committees comprised of our representatives and representatives from ILH Holdings, Inc. (“Collaboration Partner”) following the assignment by Precigen that will govern activities related to the Lantibiotics Program in the areas of project establishment, chemistry, manufacturing and controls matters, clinical and regulatory matters, commercialization efforts and intellectual property matters. The Joint Steering Committee establishes projects for the Lantibiotics Program and establishes the priorities, as well as approved the budgets for projects. In November of 2017 in connection with our Series B Preferred Financing, we amended the Lantibiotic ECC to revise the payments, we are obligated to make to our Collaboration Partner as described below.

The Lantibiotic ECC grants us an exclusive worldwide license to use patents and other intellectual property of Precigen in connection with the research, development, use, importing, exporting, manufacture, sale, and offer for sale of drug products involving the direct administration to humans or companion animals of a lantibiotic for the prevention or treatment of infectious disease (“Oragenics Products”). Such license is exclusive with respect to any clinical development, selling, offering for sale or other commercialization of Oragenics Products, and otherwise is non-exclusive. Subject to limited exceptions, we may not sublicense the rights described without Precigen’s written consent.

Under the Lantibiotic ECC, and subject to certain exceptions, we are responsible for, among other things, funding the further anticipated development of lantibiotics toward the goal of commercialization, conducting nonclinical and clinical development of candidate lantibiotics, as well as for other aspects of manufacturing and the commercialization of the product(s). Among other things, our Collaboration Partner is responsible for technology discovery efforts, cell-engineering development, certain aspects of the manufacturing process, and costs of filing, prosecution and maintenance of our Collaboration Partner’s patents. Under the Lantibiotic ECC our Collaboration Partner has the option to perform any manufacturing activities in connection with the Lantibiotic Program that relate to the use of our Collaboration Partner material, the manufacture of bulk drug products, the manufacturing of bulk quantities, other components of Oragenics Products, or any earlier steps in the manufacturing process for Oragenics Products. To the extent our Collaboration Partner so elects, a separate manufacturing and supply agreement may be entered into between our Collaboration Partner and the Company.

Pursuant to the terms of the Lantibiotic ECC, as amended, we are obligated to pay our Collaboration Partner on a quarterly basis 10% of net sales derived in that quarter from the sale of products developed from the Lantibiotic ECC, calculated on an Oragenics Product-by-Oragenics Product basis and we will pay our Collaboration Partner on a quarterly basis 25% of revenue obtained in that quarter from a sublicensor in the event of a sublicensing arrangement.

We have agreed to indemnify and hold our Collaboration Partner -harmless from any damages caused as a result of (i) our negligence or willful misconduct, (ii) the use, handling, storage, or transport of our Collaboration Partner Materials (as defined in the Lantibiotic ECC), (iii) our breach of a material representation, warranty or covenant in the Lantibiotic ECC, or (iv) the design, development, manufacture, regulatory approval, handling, storage, transport, distribution, sale or other disposition of any Oragenics Product.

Our Collaboration Partner may terminate the Lantibiotic ECC if we fail to use diligent efforts to develop and commercialize Oragenics Products or if we elect not to pursue the development of a Lantibiotics Program identified by our Collaboration Partner that is a “Superior Therapy” as defined in the Lantibiotic ECC. We may voluntarily terminate the Lantibiotic ECC at any time upon 90 days written notice to our Collaboration Partner.

Upon termination of the Lantibiotic ECC, we may continue to develop and commercialize any Oragenics Product that has been, at the time of termination:

- (i) commercialized by us;
- (ii) approved by regulatory authorities;

(iii) a subject of an application for regulatory approval that is pending before the applicable regulatory authority; or

(iv) the subject of at least an ongoing Phase 1, Phase 2 or Phase 3 clinical trial in the Field (in the case of a termination by our Collaboration Partner due to an uncured material breach by the Company or a voluntary termination by us).

Our obligation to pay 10% of net sales, 25% of sublicense revenue and the milestone payments described below with respect to these “retained” products as well as to use diligent efforts to develop and commercialize these “retained” Orogenics Products will survive termination of the Lantibiotic ECC.

In addition, in partial consideration for each party’s execution and delivery of the Lantibiotic ECC, we entered into a Stock Issuance Agreement with our Collaboration Partner. Pursuant to the Stock Issuance Agreement, we issued to our Collaboration Partner 439,243 shares of our common stock as an initial technology access fee, in consideration for the execution and delivery of the Lantibiotic ECC and granted our Collaboration Partner certain equity participation rights and registration rights.

The registration rights granted to our Collaboration Partner in the Stock Issuance Agreement by us consisted of “piggyback registration” rights which permit our Collaboration Partner to participate in any firm commitment underwritten offering of securities by us, subject to underwriter cutbacks and lockups. In addition, we are precluded from granting registration rights in connection with a private placement unless (i) all shares held by our Collaboration Partner are, at the time of such private placement, included on a registration statement, or (ii) we agree, in connection with such private placement, to grant our Collaboration Partner the right to include on the registration statement a number of our Collaboration Partner’s Company shares equal to one half of the number of shares to be registered on behalf of the other holders or prospective holders.

Pursuant to the Stock Issuance Agreement, our Collaboration Partner is also entitled, at its election, to participate in future securities offerings by us that constitute “qualified financings” and purchase securities equal to 30% of the number of shares of common stock or other securities sold in such offering (exclusive of our Collaboration Partner’s purchase). For this purpose, a “qualified financing” means a sale of common stock or equity securities convertible into common stock in a public or private offering, raising gross proceeds of at least \$1,000,000, where the sale of shares is either registered under the Securities Act of 1933, as amended, at the time of issuance or we agree to register the resale of such shares.

In November of 2017, the Stock Issuance Agreement was also amended. Under the terms of the amendment, we have agreed to make certain payments, in cash, to our Collaboration Partner upon our achievement of designated milestones. The milestone events and amounts payable are as follows:

- (i) a one-time payment of twenty-five million United States dollars (\$25,000,000) within six (6) months of the achievement of the Regulatory Approval Milestone Event meaning receiving approval from the FDA of a New Product Application (or equivalent regulatory action in a foreign jurisdiction) for an Orogenics Product;
- (ii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Indication Milestone Event meaning receiving approval from the FDA of a Supplemental FDA Application (or an equivalent filing with another equivalent regulatory agency) which Supplemental FDA Application sought approval of an indication for use of the Orogenics Product other than the current regulatory-approved indication; and
- (iii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Product Milestone Event meaning the receiving of approval from the FDA of a New Product that is deemed to be a different drug product than the first Orogenics Product that was clinically pursued under the Lantibiotics Program.

On July 21, 2016, the Lantibiotics ECC was amended to revise the definition of Field in view of a provisional patent application filing between our Collaboration Partner and Orogenics and to further clarify Orogenics’ rights under the Lantibiotic ECC to genetically modified *Streptococcus mutans* that express Lantibiotic(s).

None of the Lantibiotic ECC milestones had been achieved as of December 31, 2019.

The Oral Mucositis ECC

On June 9, 2015, we entered into an Oral Mucositis ECC with Precigen and Intrexon Actobiotics NV, a wholly-owned subsidiary of Precigen, through which we intend to research, develop and commercialize products, including the continued development and commercialization of AG013, for use in the treatment of oral mucositis in humans through the administration of an effector via genetically modified bacteria, but, in any case, excluding the delivery of anti-cancer effectors for the purpose of treatment or prophylaxis of cancer (collectively, the “Program”). Contemporaneously with the Oral Mucositis ECC, we and Precigen also entered into a Stock Issuance Agreement (the “SIA”) which authorized the issuance of the Technology Access Fee and the future stock issuance of our Common Stock to Precigen upon the achievement of designated milestones. We issued a Convertible Note in the amount of \$5,000,000 as payment of the technology access fee associated with the Oral Mucositis ECC which was payable, at our option, in cash or shares of our common stock. The convertible note, including accrued interest, was repaid in December 2015 through the issuance of 338,101 shares of our common stock. In November of 2017 we amended the Oral Mucositis ECC to revise the payments we are obligated to make to Precigen, as described below, and we revised the field in which we have exclusive rights to our Oral Mucositis product candidate for the treatment of Oral Mucositis to clarify that we have an exclusive right for the treatment of Oral Mucositis in humans regardless of etiology.

The Oral Mucositis ECC governs the “channel collaboration” arrangement in which we will use Precigen’s proprietary technology relating to the identification, design and production of genetically modified bacteria for the purpose of developing the Program.

The Oral Mucositis ECC provides for the establishment of committees comprised from us and Precigen representatives that will govern activities in the areas of project establishment, chemistry, manufacturing and controls, clinical and regulatory matters, commercialization efforts, and intellectual property.

The Oral Mucositis ECC grants us an exclusive worldwide license to utilize Precigen’s and Actobiotics’ intellectual property to develop and commercialize products, including the continued development and commercialization of AG013, for use in the treatment of oral mucositis in humans through the administration of an effector via genetically modified bacteria, but, in any case, excluding the delivery of anti-cancer effectors for the purpose of treatment or prophylaxis of cancer (the “Field”). It also grants us an exclusive license in the Field under all Information Controlled by Actobiotics (or otherwise by Precigen) and existing as of the Effective Date relating to the regulatory approval of AG013, including regulatory filings, data, clinical trial reports, and rights thereunder.

Under the Oral Mucositis ECC, and subject to certain exceptions, we are responsible for, among other things, funding the further anticipated development of products toward the goal of commercialization, conducting preclinical and clinical development of candidate products, as well as for other aspects of manufacturing and the commercialization of the product(s). Among other things, Precigen is responsible for technology discovery efforts, cell-engineering development, and certain aspects of the manufacturing process.

Pursuant to the terms of the Oral Mucositis ECC, as amended, we are obligated to pay Precigen on a quarterly basis 12% of the net sales derived from the sale of products developed from the exclusive channel collaboration. We are also obligated to pay Precigen on a quarterly basis 25% of revenue obtained in that quarter from a sublicensee in the event of a sublicensing arrangement.

We have agreed to indemnify and hold Precigen harmless from any damages caused as a result of (i) our negligence or willful misconduct, (ii) the use, handling, storage, or transport of Precigen Materials (as defined in the Oral Mucositis ECC) or materials that are Actobiotics IP (as defined in the Oral Mucositis ECC), (iii) our breach of a material representation, warranty or covenant in the Oral Mucositis ECC, or (iv) the design, development, manufacture, regulatory approval, handling, storage, transport, distribution, sale or other disposition of any Oragenics Product.

We may voluntarily terminate the Oral Mucositis ECC upon 90 days written notice to Precigen. Precigen may also terminate the Oral Mucositis ECC if we breach and fail to cure the breach within 60 days or we do not pursue development of a Superior Therapy identified by Precigen that is a “Superior Therapy” as defined in the Oral Mucositis ECC.

Upon termination of the ECC, we may continue to develop and commercialize any Oragenics Product that, at the time of termination that satisfies at least one of the following criteria:

- (i) the particular Oragenics Product is being sold by us triggering profit sharing payments under the Oral Mucositis ECC to Precigen;
- (ii) the particular Oragenics Product has received regulatory approval;

- (iii) the particular Oragenics Product is a subject of an application for regulatory approval in the Field covered by the ECC that is pending before the applicable regulatory authority;
- (iv) the particular Oragenics Product is AG013, and such Oragenics Product has been the subject of at least one completed Phase 2 clinical trial (as such is defined by relevant FDA guidelines) during the Term; or
- (v) the particular Oragenics Product other than AG013 and such Oragenics Product is the subject of at least an ongoing Phase 1, Phase 2 or Phase 3 clinical trial in the Field.

Our obligation to pay 12% of net sales, 25% of sublicensing revenue and the milestone payments described below with respect to these “retained” products as well as to use diligent efforts to develop and commercialize these “retained” Oragenics Products will survive termination of the Oral Mucositis ECC.

In November of 2017, the Stock Issuance Agreement was also amended. Under the terms of the amended Oral Mucositis ECC (including the May 2017 amendment which was superseded by the November amendment) and amended Stock Issuance Agreement agreed to make certain payments to Precigen upon our achievement of designated milestones in the form of shares of our common stock (based upon the fair market value of the shares otherwise required to be issued) unless the issuance of such shares would reasonably likely cause Precigen to consolidate our financial statements with Precigen’s financial statements, or at our option make a cash payment to Precigen. The milestone events and amounts payable are as follows:

- (i) a one-time payment of twenty-seven million five hundred thousand United States dollars (\$27,500,000) within six (6) months of the achievement of the Regulatory Approval Milestone Event meaning receiving approval from the FDA of a New Product Application for an Oragenics Product (or equivalent regulatory action in a foreign jurisdiction);
- (ii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Indication Milestone Event meaning receiving approval from the FDA of a Supplemental FDA Application (or an equivalent filing with another equivalent regulatory agency) which Supplemental FDA Application sought approval of an indication for use of the Oragenics Product other than the current regulatory-approved indication; and
- (iii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Product Milestone Event meaning receiving approval from the FDA of a New Product that is deemed to be a different drug product that the first Oragenics Product that was clinically pursued under the Program.

None of the Oral Mucositis ECC milestones had been achieved as of December 31, 2019.

Effective January 1, 2018, Precigen assigned its interest in the Oral Mucositis ECC and Stock Issuance Agreement to its wholly owned subsidiary, ActoBio Therapeutics, Inc.

Brexit and the Regulatory Framework in the United Kingdom

In June 2016, the United Kingdom (the “UK”) electorate voted in a referendum to leave the European Union (the “EU”), which is commonly referred to as “Brexit”. In March 2017, the UK government formally notified the European Council of its intention to leave the EU after it triggered Article 50 of the Lisbon Treaty to begin the two-year negotiation process establishing the terms of the exit and outlining the future relationship between the UK and the EU. Formal negotiations officially started in June 2017. The UK withdrew from the EU on January 31, 2020. The outcome after Brexit also continues to be uncertain, which may pose certain implications to our research, commercial and general business operations in the UK and the EU, including the approval and supply of our products. At present, it is still unclear whether and to what extent the UK will remain aligned to the EU system of medicines regulation, depending on the ultimate outcome of the negotiations. However, both the UK and the EU have issued detailed guidance for the industry on how medicines, medical devices and clinical trials will be separately regulated in their respective territories in the event of a ‘hard Brexit’, meaning an outcome where no negotiated settlement is reached.

Our preparation for Brexit, including for a potential ‘hard Brexit’, includes the changes necessary to meet the relevant requirements in the EU and the UK after Brexit, especially in the regulatory, research, manufacturing and supply chain areas. The principal aim is to ensure the continuity of supply to patients in Europe (EU and the UK) participating in our AG013 clinical program.

Other Product Candidates and Technologies

We have historically developed other product candidates and potential product candidates. For example, we developed a weight loss candidate, LPT3-04, and a topical treatment to prevent dental carries which we refer to as SMaRT Replacement Therapy. We outlicensed LPT3-04 to a third party and continue to monitor our licensee's performance under the license. We do not expect the LPT3-04 license to have a material effect on our business or operations. While we retain certain intellectual property rights with respect to homologs through our (i) prior relationship with Texas A&M University Systems and (ii) ILH Holdings (as assignee of Precigen) that could allow for the continued research and development of compounds for the SMaRT replacement Therapy, we do not intend to pursue further development of SMaRT Replacement Therapy and as such we do not consider these rights to be a material part of our business and operations.

Government Regulations

In the United States, foods (including dietary supplements), drugs (including biological products), medical devices, cosmetics, tobacco products and radiation-emitting products are subject to extensive regulation by the FDA. The FDC Act and other federal and state statutes and regulations govern, among other things, the manufacture, distribution and sale of these products. These laws and regulations prescribe criminal and civil penalties that can be assessed, and violation of these laws and regulations can result in enforcement action by the FDA and other regulatory agencies.

FDA Regulation of Drugs-New Drug Approval Process

Pharmaceutical products are subject to extensive regulation by the FDA. The FDC Act, and other federal and state statutes and regulations, govern, among other things, the research, development, testing, manufacture, storage, recordkeeping, approval, labeling, promotion and marketing, distribution, post-approval monitoring and reporting, sampling, and import and export of pharmaceutical products. Failure to comply with applicable U.S. requirements may subject a company to a variety of administrative or judicial sanctions, such as FDA refusal to approve pending NDAs or BLAs, warning or untitled letters, product recalls, product seizures, total or partial suspension of production or distribution, injunctions, fines, civil penalties and criminal prosecution.

Pharmaceutical product development for a new product or certain changes to an approved product in the United States typically involves the following steps before a biological product or new drug may be marketed in the United States:

- preclinical laboratory tests, animal studies and formulation studies in compliance with the FDA's Good Laboratory Practice and Good Manufacturing Practice regulations;
- submission to the FDA of an Investigational New Drug application (IND) for human clinical testing, which must become effective before human clinical trials may commence;
- performance of adequate and well-controlled clinical trials in three phases, as described below, to establish the safety and efficacy of the drug for each indication according to Good Clinical Practices;
- submission of an NDA or Biologics License Application (BLA) to the FDA for review;
- random inspections of clinical sites to ensure validity of clinical safety and efficacy data;
- satisfactory completion of an FDA inspection of the manufacturing facility or facilities at which the drug is produced to assess compliance with current good manufacturing practices;
- FDA approval of the NDA or BLA; and
- payment of user and establishment fees, if applicable.

Satisfaction of FDA pre-market approval requirements typically takes many years and the actual time required may vary substantially based upon the type, complexity and novelty of the product or disease

Preclinical tests include laboratory evaluation of product chemistry, formulation and toxicity, as well as animal trials to assess the characteristics and potential safety and efficacy of the product. The conduct of the preclinical tests must comply with federal regulations and requirements, including good laboratory practices. The results of preclinical testing are submitted to the FDA as part of an IND along with other information, including information about product chemistry, manufacturing and controls, and a proposed clinical trial protocol. Long term preclinical tests, such as animal tests of reproductive toxicity and carcinogenicity, may continue after the IND is submitted.

A 30-day waiting period after the submission of each IND is required prior to the commencement of clinical testing in humans. If the FDA has neither commented on nor questioned the IND within this 30-day period, the clinical trial proposed in the IND may begin.

Clinical trials involve the administration of the investigational new drug to healthy volunteers or patients under the supervision of a qualified investigator. Clinical trials must be conducted: (i) in compliance with federal regulations; (ii) in compliance with good clinical practice, or GCP, an international standard meant to protect the rights and health of patients and to define the roles of clinical trial sponsors, administrators, and monitors; as well as (iii) under protocols detailing the objectives of the trial, the parameters to be used in monitoring safety, and the effectiveness criteria to be evaluated. Each protocol involving testing on U.S. patients and subsequent protocol amendments must be submitted to the FDA as part of the IND.

The FDA may order the temporary, or permanent, discontinuation of a clinical trial at any time, or impose other sanctions, if it believes that the clinical trial is not being conducted in accordance with FDA requirements or presents an unacceptable risk to the clinical trial patients. The trial protocol and informed consent information for patients in clinical trials must also be submitted to an institutional review board or IRB for approval. An IRB may also require the clinical trial at the site to be halted, either temporarily or permanently, for failure to comply with the IRB's requirements, or may impose other conditions.

Clinical trials to support NDAs or BLAs for marketing approval are typically conducted in three sequential phases, but the phases may overlap. In Phase 1, the initial introduction of the drug into healthy human subjects or patients, the drug is tested to assess metabolism, pharmacokinetics, pharmacological actions, side effects associated with increasing doses, and, if possible, early evidence on effectiveness. Phase 2 usually involves trials in a limited patient population to determine the effectiveness of the drug for a particular indication, dosage tolerance, and optimum dosage, and to identify common adverse effects and safety risks. If a compound demonstrates evidence of effectiveness and an acceptable safety profile in Phase 2 evaluations, Phase 3 trials are undertaken to obtain the additional information about clinical efficacy and safety in a larger number of patients, typically at geographically dispersed clinical trial sites, to permit the FDA to evaluate the overall benefit-risk relationship of the drug and to provide adequate information for the labeling of the drug. In most cases the FDA requires two adequate and well-controlled Phase 3 clinical trials to demonstrate the efficacy of the drug. A single Phase 3 clinical trial with other confirmatory evidence may be sufficient in rare instances where the trial is a large multicenter trial demonstrating internal consistency and a statistically very persuasive finding of a clinically meaningful effect on mortality, irreversible morbidity or prevention of a disease with a potentially serious outcome and confirmation of the result in a second trial would be practically or ethically impossible.

The length of time and related costs necessary to complete clinical trials varies significantly and may be difficult to predict. Clinical trial results are frequently susceptible to varying interpretations that may delay, limit or prevent regulatory approvals. Additional factors that can cause delay or termination of our clinical trials, or cause the costs of these clinical trials to increase, include:

- slow patient enrollment due to the nature of the protocol, the proximity of patients to clinical sites, the eligibility criteria for the trial, competition with clinical trials for other drug candidates or other factors;
- inadequately trained or insufficient personnel at the trial site to assist in overseeing and monitoring clinical trials;
- delays in approvals from a trial site's IRB;
- longer than anticipated treatment time required to demonstrate effectiveness or determine the appropriate product dose;
- lack of sufficient supplies of the drug candidate for use in clinical trials;
- adverse medical events or side effects in treated patients; and
- lack of effectiveness of the drug candidate being tested.

Any drug is likely to produce some toxicities or undesirable side effects in animals and in humans when administered at sufficiently high doses and/or for sufficiently long periods of time. Unacceptable toxicities or side effects may occur at any dose level, and at any time in the course of animal studies designed to identify unacceptable effects of a drug candidate, known as toxicological studies, or in clinical trials of our drug candidates. The appearance of any unacceptable toxicity or side effect could cause us or regulatory authorities to interrupt, limit, delay or abort the development of any of our drug candidates, and could ultimately prevent their marketing approval by the FDA or foreign regulatory authorities for any or all targeted indications.

The FDA's fast track and breakthrough therapy designation programs are intended to facilitate the development and expedite the review of drug candidates intended for the treatment of serious or life-threatening conditions and that demonstrate the potential to address unmet medical needs for these conditions. Under these programs, FDA can, for example, review portions of an NDA or BLA for a drug candidate before the entire application is complete, thus potentially beginning the review process at an earlier time.

We cannot guarantee that the FDA will grant any of our requests for fast track or breakthrough therapy designations, that any such designations would affect the time of review or that the FDA will approve the NDA or BLA submitted for any of our drug candidates, whether or not these designations are granted. Additionally, FDA approval of a fast track/breakthrough product can include restrictions on the product's use or distribution (such as permitting use only for specified medical conditions or limiting distribution to physicians or facilities with special training or experience). Approval of such designated products can be conditioned on additional clinical trials after approval.

In addition, the manufacturer of an investigational drug in a Phase 2 or Phase 3 clinical trial for a serious or life-threatening disease is required to make available, such as by posting on its website, its policy on evaluating and responding to requests for expanded access.

After completion of the required clinical testing, an NDA or BLA is prepared and submitted to the FDA. FDA approval of the NDA or BLA is required before marketing of the product may begin in the U.S. The NDA or the BLA must include the results of all preclinical, clinical and other testing and a compilation of data relating to the product's pharmacology, chemistry, manufacture and controls. The cost of preparing and submitting an NDA is substantial. The submission of most NDAs and BLAs is additionally subject to a substantial application user fee, currently exceeding \$2,942,965 for fiscal year 2020. Beginning in fiscal year 2018, this annual program fee replaces the annual product and establishment fees. These fees typically increase annually.

The FDA has 60 days from its receipt of an NDA or BLA to determine whether the application will be filed based on the agency's threshold determination that it is sufficiently complete to permit substantive review. If the NDA or BLA submission is filed, the FDA reviews the NDA or BLA to determine, among other things, whether the proposed product is safe and effective for its intended use. The FDA has agreed to certain performance goals in the review of NDAs or BLAs. Most such applications for standard review drug products are reviewed within ten to twelve months; most applications for priority review drugs are reviewed in six to eight months. Priority review can be applied to drugs that the FDA determines offer major advances in treatment, or provide a treatment where no adequate therapy exists. For biologics, priority review is further limited to drugs intended to treat a serious or life-threatening disease relative to the currently approved products. The review process for both standard and priority review may be extended by the FDA for three additional months to consider certain late-submitted information, or information intended to clarify information already provided in the submission.

The FDA may also refer applications for novel drug products, or drug products that present difficult questions of safety or efficacy, to an advisory committee – typically a panel that includes clinicians and other experts – for review, evaluation and a recommendation as to whether the application should be approved. The FDA is not bound by the recommendation of an advisory committee, but it generally follows such recommendations. Before approving an NDA or BLA, the FDA will typically inspect one or more clinical sites to assure compliance with GCP. Additionally, the FDA will inspect the facility or the facilities at which the drug is manufactured. The FDA will not approve the product unless compliance with cGMPs is satisfactory and the NDA or BLA contains data that provide substantial evidence that the drug is safe and effective in the indication studied.

After the FDA evaluates the NDA or BLA and the manufacturing facilities, it issues either an approval letter or a complete response letter. A complete response letter generally outlines the deficiencies in the submission and may require substantial additional testing, or information, in order for the FDA to reconsider the application. If, or when, those deficiencies have been addressed to the FDA's satisfaction in a resubmission of the NDA or BLA, the FDA will issue an approval letter. The FDA has committed to reviewing such resubmissions in two or six months depending on the type of information included.

An approval letter authorizes commercial marketing of the drug with specific prescribing information for specific indications. As a condition of NDA or BLA approval, the FDA may require a risk evaluation and mitigation strategy, or REMS, to help ensure that the benefits of the drug outweigh the potential risks. REMS can include medication guides, communication plans for healthcare professionals, and elements to assure safe use, or ETASU. ETASU can include, but are not limited to, special training or certification for prescribing or dispensing, dispensing only under certain circumstances, special monitoring and the use of patient registries. The requirement for a REMS can materially affect the potential market and profitability of the drug. Moreover, product approval may require substantial post-approval testing and surveillance to monitor the drug's safety or efficacy. Once granted, product approvals may be withdrawn if compliance with regulatory standards is not maintained or problems are identified following initial marketing.

Changes to some of the conditions established in an approved application, including changes in indications, labeling, or manufacturing processes or facilities, require submission and FDA approval of a new NDA or BLA supplement before the change can be implemented. An NDA or BLA supplement for a new indication typically requires clinical data similar to that in the original application, and the FDA uses the same procedures and actions in reviewing NDA or BLA supplements as it does in reviewing NDAs or BLAs.

The required testing, data collection, analysis and compilation of an IND and a BLA or NDA are labor intensive and costly and may take a great deal of time. Tests may have to be redone or new tests performed in order to comply with FDA requirements. It can take considerable time (e.g. 5-10 years) and resources to achieve enrollment sufficient to commence such trials and complete Phase 2 or 3 clinical trials. Moreover, there is no guarantee a product will be approved.

In Canada, the Therapeutic Products Directorate and the Biologics and Genetic Therapies Directorate of HC ensure that clinical trials are properly designed and undertaken and that subjects are not exposed to undue risk. Regulations define specific Investigational New Drug Submission (or IND) application requirements, which must be complied with before a new drug can be distributed for trial purposes. The Directorates currently review the safety, efficacy and quality data submitted by the sponsor and approve the distribution of the drug to the investigator. The sponsor of the trial is required to maintain accurate records, report adverse drug reactions, and ensure that the investigator adheres to the approved protocol. Trials in humans should be conducted according to generally accepted principles of good clinical practice. Management believes that these standards provide assurance that the data and reported results are credible and accurate, and that the rights, integrity, and privacy of clinical trial subjects are protected.

Sponsors wishing to conduct clinical trials in Phases I to III of development must apply under a 30-day default system. Applications must contain the information described in the regulations, including: a clinical trial attestation; a protocol; statements to be contained in each informed consent form, that set out the risks posed to the health of clinical trial subjects as a result of their participation in the clinical trial; an investigator's brochure; applicable information on excipients (delivery vehicles); and chemistry and manufacturing information.

The sponsor can proceed with the clinical trial if the Directorates have not objected to the sale or importation of the drug within 30 days after the date of receipt of the clinical trial application and Research Ethics Board approval for the conduct of the trial at the site has been obtained. Additional information is available on Health Canada's website [_ www.hc-sc.gc.ca](http://www.hc-sc.gc.ca).

Outside the United States and Canada, our ability to market a product is contingent upon receiving a marketing authorization from the appropriate regulatory authorities. The requirements governing the conduct of clinical trials, marketing authorization, pricing and reimbursement vary widely from country to country. At present, foreign marketing authorizations are applied for at a national level, although within the European Union (EU) registration procedures are available to companies wishing to market a product in more than one EU member state. If the regulatory authority is satisfied that adequate evidence of safety, quality and efficacy has been presented, a marketing authorization may be granted. This foreign regulatory approval process involves all of the risks associated with FDA approval discussed above and may also include additional risks.

The Orphan Drug Act provides incentives to manufacturers to develop and market drugs for rare diseases and conditions affecting fewer than 200,000 persons in the United States at the time of application for orphan drug designation. The first developer to receive FDA marketing approval for an orphan drug is entitled to a seven-year exclusive marketing period in the United States for the orphan drug indication. However, a drug that the FDA considers to be clinically superior to, or different from, another approved orphan drug, even though for the same indication, may also obtain approval in the United States during the seven-year exclusive marketing period.

Under the FDA Modernization Act of 1997, designation as a Fast Track product for a new drug or biological product means that the FDA will take such actions as are appropriate to expedite the development and review of the application for approval of such product.

Legislation similar to the Orphan Drug Act has been enacted in other countries outside of the United States, including the EU. The orphan legislation in the EU is available for therapies addressing conditions that affect five or fewer out of 10,000 persons, are life-threatening or chronically debilitating conditions and for which no satisfactory treatment is authorized. The market exclusivity period is for ten years, although that period can be reduced to six years if, at the end of the fifth year, available evidence establishes that the product does not justify maintenance of market exclusivity.

Pediatric Information

Under the Pediatric Research Equity Act, or PREA, NDAs, BLAs or supplements to NDAs or BLAs must contain data to assess the safety and effectiveness of the drug for the claimed indications in all relevant pediatric subpopulations and to support dosing and administration for each pediatric subpopulation for which the drug is safe and effective. The FDA may grant full or partial waivers, or deferrals, for submission of data. Unless otherwise required by regulation, PREA does not apply to any drug for an indication for which orphan designation has been granted, except a product with a new active ingredient that is a molecularly targeted cancer product intended for the treatment of an adult cancer and directed at a molecular target determined by FDA to be substantially relevant to the growth or progression of a pediatric cancer that is subject to an NDA submitted on or after August 18, 2020.

The Best Pharmaceuticals for Children Act, or BPCA, provides NDA holders a six-month extension of any exclusivity – patent or non-patent – for a drug if certain conditions are met. For BLAs, the BPCA provides a six-month extension for non-patent exclusivity if certain conditions are met. Conditions for exclusivity include the FDA's determination that information relating to the use of a new drug in the pediatric population may produce health benefits in that population, the FDA making a written request for pediatric studies, and the applicant agreeing to perform, and reporting on, the requested studies within the statutory timeframe. Applications under the BPCA are treated as priority applications, with all of the benefits that designation confers.

Disclosure of Clinical Trial Information

Sponsors of clinical trials of FDA-regulated products, including drugs, are required to register and disclose certain clinical trial information. Information related to the product, patient population, phase of investigation, study sites and investigators, and other aspects of the clinical trial is then made public as part of the registration. Sponsors are also obligated to discuss the results of their clinical trials after completion. Disclosure of the results of these trials can be delayed in certain circumstances for up to two years after the date of completion of the trial. Competitors may use this publicly available information to gain knowledge regarding the progress of development programs.

The Hatch-Waxman Amendments

Orange Book Listing

In seeking approval for a drug through an NDA, applicants are required to list with the FDA each patent with claims covering the applicant's product or method of using the product. Upon approval of a drug, each of the patents listed in the application for the drug is then published in the FDA's Approved Drug Products with Therapeutic Equivalence Evaluations, commonly known as the Orange Book. Drugs listed in the Orange Book can, in turn, be cited by potential generic competitors in support of approval of an abbreviated new drug application, or ANDA. An ANDA provides for marketing of a drug product that has the same active ingredients in the same strengths and dosage form as the listed drug and has been shown to be bioequivalent to the listed drug. Other than the requirement for bioequivalence testing, ANDA applicants are not required to conduct, or submit results of, pre-clinical or clinical tests to prove the safety or effectiveness of their drug product. Drugs approved in this way are commonly referred to as "generic equivalents" to the listed drug, and can often be substituted by pharmacists under prescriptions written for the original listed drug.

The ANDA applicant is required to certify to the FDA concerning any patents listed for the approved product in the FDA's Orange Book. Specifically, the applicant must certify that: (i) the required patent information has not been filed; (ii) the listed patent has expired; (iii) the listed patent has not expired, but will expire on a particular date and approval is sought after patent expiration; or (iv) the listed patent is invalid or will not be infringed by the new product. The ANDA applicant may also elect to submit a section viii statement certifying that its proposed ANDA labeling does not contain (or carves out) any language regarding the patented method-of-use rather than certify to a listed method-of-use patent. If the applicant does not challenge the listed patents, the ANDA application will not be approved until all the listed patents claiming the referenced product have expired.

A certification that the new product will not infringe the already approved product's listed patents, or that such patents are invalid, is called a Paragraph IV certification. If the ANDA applicant has provided a Paragraph IV certification to the FDA, the applicant must also send notice of the Paragraph IV certification to the NDA and patent holders once the ANDA has been received by the FDA. The NDA and patent holders may then initiate a patent infringement lawsuit in response to the notice of the Paragraph IV certification. The filing of a patent infringement lawsuit within 45 days of the receipt of a Paragraph IV certification automatically prevents the FDA from approving the ANDA until the earlier of 30 months, expiration of the patent, settlement of the lawsuit or a decision in the infringement case that is favorable to the ANDA applicant.

The ANDA application also will not be approved until any applicable non-patent exclusivity listed in the Orange Book for the referenced product has expired.

Exclusivity

Exclusivity provisions under the FDC Act also can delay the submission or the approval of certain applications. The FDC Act provides a five-year period of non-patent exclusivity within the United States to the first applicant to gain approval of an NDA for a new chemical entity, or NCE. A drug is entitled to NCE exclusivity if it contains a drug substance no active moiety of which has been previously approved by the FDA. During the exclusivity period, the FDA may not accept for review an ANDA or file a 505(b)(2) NDA submitted by another company for another version of such drug where the applicant does not own or have a legal right of reference to all the data required for approval. However, an application may be submitted after four years if it contains a Paragraph IV certification. The FDC Act also provides three years of market exclusivity for an NDA, including a 505(b)(2) NDA, or supplement to an existing NDA if new clinical investigations, other than bioavailability studies, that were conducted or sponsored by the applicant are deemed by the FDA to be essential to the approval of the application, for example, for new indications, dosages or strengths of an existing drug. This three-year exclusivity covers only the conditions for use associated with the new clinical investigations and does not prohibit the FDA from approving ANDAs for drugs for the original conditions of use, such as the originally approved indication. Five-year and three-year exclusivity will not delay the submission or approval of a full NDA; however, an applicant submitting a full NDA would be required to conduct or obtain a right of reference to all the non-clinical studies and adequate and well-controlled clinical trials necessary to demonstrate safety and effectiveness.

Patent Term Extension

After NDA approval, the owner of relevant drug patent may apply for up to a five-year patent term extension. Only one patent may be extended for each regulatory review period, which is composed of two parts: a testing phase, and an approval phase. The allowable patent term extension is calculated as half of the drug's testing phase – the time between the day the IND becomes effective and NDA submission – and all of the review phase – the time between NDA submission and approval up to a maximum of five years. The time can be shortened if the FDA determines that the applicant did not pursue approval with due diligence. The total patent term after the extension may not exceed 14 years.

For patents that might expire during the application phase, the patent owner may request an interim patent extension. An interim patent extension increases the patent term by one year and may be renewed up to four times. For each interim patent extension granted, the post-approval patent extension is reduced by one year. The director of the U.S. Patent and Trademark Office must determine that approval of the drug covered by the patent for which a patent extension is being sought is likely. Interim patent extensions are not available for a drug for which an NDA has not been submitted.

Section 505(b)(2) New Drug Applications

Most drug products obtain FDA marketing approval pursuant to an NDA or an ANDA. A third alternative is a special type of NDA, commonly referred to as a Section 505(b)(2), or 505(b)(2), NDA, which enables the applicant to rely, in part, on studies not conducted by, or for, the applicant and for which the applicant has not obtained a right of reference or use, such as the FDA's findings of safety and/or effectiveness for a similar previously approved product, or published literature, in support of its application.

505(b)(2) NDAs often provide an alternate path to FDA approval for new or improved formulations or new uses of previously approved products. Section 505(b)(2) permits the filing of an NDA where at least some of the information required for approval comes from studies not conducted by, or for, the applicant and for which the applicant has not obtained a right of reference. If the 505(b)(2) applicant can establish that reliance on the FDA's previous approval is scientifically appropriate, it may eliminate the need to conduct certain preclinical or clinical trials of the new product. The FDA may also require companies to perform additional studies or measurements to support the change from the approved product. The FDA may then approve the new product candidate for all, or some, of the label indications for which the referenced product has been approved, as well as for any new indication sought by the Section 505(b)(2) applicant.

To the extent that the Section 505(b)(2) applicant is relying on studies conducted for an already approved product, the applicant is required to certify to the FDA concerning any patents listed for the approved product in the Orange Book to the same extent that an ANDA applicant would. Thus approval of a 505(b)(2) NDA can be stalled until all the listed patents claiming the referenced product have expired, until any non-patent exclusivity, such as exclusivity for obtaining approval of a new chemical entity, listed in the Orange Book for the referenced product has expired, and, in the case of a Paragraph IV certification and subsequent patent infringement suit, until the earlier of 30 months, settlement of the lawsuit or a decision in the infringement case that is favorable to the Section 505(b)(2) applicant.

Post-Approval Requirements

Once an NDA or BLA is approved, a product will be subject to certain post-approval requirements. For instance, the FDA closely regulates the post-approval marketing and promotion of drugs, including standards and regulations for direct-to-consumer advertising, off-label promotion, industry-sponsored scientific and educational activities and promotional activities involving the internet. Drugs may be marketed only for the approved indications and in accordance with the provisions of the approved labeling.

Adverse event reporting and submission of periodic reports are required following FDA approval of an NDA or BLA. The FDA also may require post-marketing testing, known as Phase 4 testing, REMS, and surveillance to monitor the effects of an approved product, or the FDA may place conditions on an approval that could restrict the distribution or use of the product. In addition, quality-control, drug manufacture, packaging and labeling procedures must continue to conform to cGMPs after approval. Drug manufacturers and certain of their subcontractors are required to register their establishments with the FDA and certain state agencies. Registration with the FDA, subjects entities to periodic unannounced inspections by the FDA, during which the agency inspects manufacturing facilities to assess compliance with cGMPs. Accordingly, manufacturers must continue to expend time, money and effort in the areas of production and quality-control to maintain compliance with cGMPs. Regulatory authorities may withdraw product approvals or request product recalls if a company fails to comply with regulatory standards, if it encounters problems following initial marketing or if previously unrecognized problems are subsequently discovered. In addition, prescription drug manufacturers in the United States must comply with applicable provisions of the Drug Supply Chain Security Act and provide and receive product tracing information, maintain appropriate licenses, ensure they only work with other properly licensed entities, and have procedures in place to identify and properly handle suspect and illegitimate products.

Failure to comply with the applicable FDA requirements may subject manufacturers and distributors to administrative or judicial sanctions. These sanctions could include, among other things, warning letters, product seizures, total or partial suspension of production or distribution, injunctions, civil money penalties, fines, restitution, disgorgement, or civil or criminal penalties. Further, the FDA has authority to issue mandatory recalls for medical devices and biologics, and we may need to undertake a voluntary recall for any of our products.

In addition to regulations enforced by the FDA, we are also subject to regulation under the Occupational Safety and Health Act, the Environmental Protection Act, the Toxic Substances Control Act, the Resource Conservation and Recovery Act and other federal, state and local regulations. Our research and development activities involve the controlled use of hazardous materials, chemicals, biological materials and radioactive compounds.

Biologics

Biological products used for the prevention, treatment or cure of a disease or condition of a human being are subject to regulation under the FDC Act, except the section of the FDC Act which governs the approval of NDAs. Biological products are approved for marketing under provisions of the Public Health Service Act, or PHSA, via a BLA. However, the application process and requirements for approval of BLAs are very similar to those for NDAs, and biologics are associated with similar approval risks and costs as drugs. To help reduce the increased risk of the introduction of adventitious agents, the PHSA emphasizes the importance of manufacturing controls for products whose attributes cannot be precisely defined. The PHSA also provides authority to the FDA to immediately suspend licenses in situations where there exists a danger to public health, to prepare or procure products in the event of shortages and critical public health needs, and to authorize the creation and enforcement of regulations to prevent the introduction or spread of communicable diseases in the US and between states.

After a BLA is approved, the product may also be subject to official lot release as a condition of approval. As part of the manufacturing process, the manufacturer is required to perform certain tests on each lot of the product before it is released for distribution. If the product is subject to official release by the FDA, the manufacturer submits samples of each lot of product to the FDA together with a release protocol showing a summary of the history of manufacture of the lot and the results of all of the manufacturer's tests performed on the lot. The FDA may also perform certain confirmatory tests on lots of some products, such as viral vaccines, before releasing the lots for distribution by the manufacturer. In addition, the FDA conducts laboratory research related to the regulatory standards on the safety, purity, potency, and effectiveness of biological products. As with drugs, after approval of biologics, manufacturers must address any safety issues that arise, are subject to recalls or a halt in manufacturing, and are subject to periodic inspection after approval.

The Biologics Price Competition and Innovation Act of 2009, or BPCIA, creates an abbreviated approval pathway for biological products shown to be highly similar to or interchangeable with an FDA-licensed reference biological product. Biosimilarity sufficient to reference a prior FDA-approved product requires that there be no differences in conditions of use, route of administration, dosage form, and strength, and no clinically meaningful differences between the biological product and the reference product in terms of safety, purity and potency. Biosimilarity must be shown through analytical studies, animal studies, and at least one clinical trial, absent a waiver by the Secretary. A biosimilar product may be deemed interchangeable with a prior approved product if it meets the higher hurdle of demonstrating that it can be expected to produce the same clinical results as the reference product and, for products administered multiple times, the biologic and the reference biologic may be switched after one has been previously administered without increasing safety risks or risks of diminished efficacy relative to exclusive use of the reference biologic. To date, only four biosimilar products and no interchangeable products have been approved under the BPCIA. Complexities associated with the larger, and often more complex, structures of biological products, as well as the process by which such products are manufactured, particularly with respect to interchangeability, are still being evaluated by the FDA.

A reference biologic is granted twelve years of exclusivity from the time of first licensure of the reference product, and no application for a biosimilar can be submitted for four years from the date of licensure of the reference product. The first biologic product submitted under the abbreviated approval pathway that is determined to be interchangeable with the reference product has exclusivity against a finding of interchangeability for other biologics for the same condition of use for the lesser of (i) one year after first commercial marketing of the first interchangeable biosimilar, (ii) eighteen months after the first interchangeable biosimilar is approved if there is no patent challenge, (iii) eighteen months after resolution of a lawsuit over the patents of the reference biologic in favor of the first interchangeable biosimilar applicant, or (iv) 42 months after the first interchangeable biosimilar's application has been approved if a patent lawsuit is ongoing within the 42-month period.

Regulation Outside the United States

In order to market any product outside of the United States, a company must also comply with numerous and varying regulatory requirements of other countries and jurisdictions regarding quality, safety and efficacy and governing, among other things, clinical trials, marketing authorization, commercial sales and distribution of drug products. Whether or not it obtains FDA approval for a product, the company would need to obtain the necessary approvals by the comparable foreign regulatory authorities before it can commence clinical trials or marketing of the product in those countries or jurisdictions. The approval process ultimately varies between countries and jurisdictions and can involve additional product 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.

Regulation and Marketing Authorization in the European Union

The process governing approval of medicinal products in the European Union follows essentially the same lines as in the United States and, likewise, generally involves satisfactorily completing each of the following:

- preclinical laboratory tests, animal studies and formulation studies all performed in accordance with the applicable EU Good Laboratory Practice regulations;
- submission to the relevant national authorities of a clinical trial application, or CTA, which must be approved before human clinical trials may begin;
- performance of adequate and well-controlled clinical trials to establish the safety and efficacy of the product for each proposed indication;
- submission to the relevant competent authorities of a marketing authorization application, or MAA, which includes the data supporting safety and efficacy as well as detailed information on the manufacture and composition of the product in clinical development and proposed labeling;
- satisfactory completion of an inspection by the relevant national authorities of the manufacturing facility or facilities, including those of third parties, at which the product is produced to assess compliance with strictly enforced current cGMP;
- potential audits of the non-clinical and clinical trial sites that generated the data in support of the MAA; and
- review and approval by the relevant competent authority of the MAA before any commercial marketing, sale or shipment of the product.

Preclinical Studies

Preclinical tests include laboratory evaluations of product chemistry, formulation and stability, as well as studies to evaluate toxicity in animal studies, in order to assess the potential safety and efficacy of the product. The conduct of the preclinical tests and formulation of the compounds for testing must comply with the relevant EU regulations and requirements. The results of the preclinical tests, together with relevant manufacturing information and analytical data, are submitted as part of the CTA.

Clinical Trial Approval

Requirements for the conduct of clinical trials in the European Union including GCP are implemented in the Clinical Trials Directive 2001/20/EC and the GCP Directive 2005/28/EC. Pursuant to Directive 2001/20/EC and Directive 2005/28/EC, as amended, a system for the approval of clinical trials in the European Union has been implemented through national legislation of the member states. Under this system, approval must be obtained from the competent national authority of an EU member state in which a study is planned to be conducted, or in multiple member states if the clinical trial is to be conducted in a number of member states. To this end, a CTA is submitted, which must be supported by an investigational medicinal product dossier, or IMPD, and further supporting information prescribed by Directive 2001/20/EC and Directive 2005/28/EC and other applicable guidance documents. Furthermore, a clinical trial may only be started after a competent ethics committee has issued a favorable opinion on the clinical trial application in that country.

In April 2014, the EU legislators passed the new Clinical Trials Regulation, (EU) No 536/2014, which will replace the current Clinical Trials Directive 2001/20/EC. To ensure that the rules for clinical trials are identical throughout the European Union, the new EU clinical trials legislation was passed as a regulation that is directly applicable in all EU member states. All clinical trials performed in the European Union are required to be conducted in accordance with the Clinical Trials Directive 2001/20/EC until the new Clinical Trials Regulation (EU) No 536/2014 becomes applicable. According to the current plans of the European Medicines Agency, or EMA, the new Clinical Trials Regulation will become applicable in 2019. The Clinical Trials Directive 2001/20/EC will, however, still apply three years from the date of entry into application of the Clinical Trials Regulation to (i) clinical trials applications submitted before the entry into application and (ii) clinical trials applications submitted within one year after the entry into application if the sponsor opts for old system.

The new Regulation (EU) No 536/2014 aims to simplify and streamline the approval of clinical trial 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 that will spare sponsors from submitting broadly identical information separately to various bodies and different member states.
- A harmonized procedure for the assessment of applications for clinical trials, which is divided in two parts. Part I is assessed jointly by all member states concerned. Part II is assessed separately by each member state concerned.
- Strictly defined deadlines for the assessment of clinical trial application.
- The involvement of the ethics committees in the assessment procedure in accordance with the national law of the member state concerned but within the overall timelines defined by the Regulation (EU) No 536/2014.

Marketing Authorization

Authorization to market a product in the member states of the European Union proceeds under one of four procedures: a centralized authorization procedure, a mutual recognition procedure, a decentralized procedure or a national procedure.

Centralized Authorization Procedure

The centralized procedure enables applicants to obtain a marketing authorization that is valid in all EU member states based on a single application. Certain medicinal products, including products developed by means of biotechnological processes, must undergo the centralized authorization procedure for marketing authorization, which, if granted by the European Commission, is automatically valid in all 28 EU member states. The EMA and the European Commission administer this centralized authorization procedure pursuant to Regulation (EC) No 726/2004.

Pursuant to Regulation (EC) No 726/2004, this procedure is mandatory for:

- medicinal products developed by means of one of the following biotechnological processes:
- recombinant DNA technology;
- controlled expression of genes coding for biologically active proteins in prokaryotes and eukaryotes including transformed mammalian cells; and
- hybridoma and monoclonal antibody methods;

- advanced therapy medicinal products as defined in Article 2 of Regulation (EC) No. 1394/2007 on advanced therapy medicinal products;
- medicinal products for human use containing a new active substance that, on the date of effectiveness of this regulation, was not authorized in the European Union, and for which the therapeutic indication is the treatment of any of the following diseases:
- acquired immune deficiency syndrome;
- cancer;
- neurodegenerative disorder;
- diabetes;
- auto-immune diseases and other immune dysfunctions; and
- viral diseases;
- medicinal products that are designated as orphan medicinal products pursuant to Regulation (EC) No 141/2000.

The centralized authorization procedure is optional for other medicinal products if they contain a new active substance or if the applicant shows that the medicinal product concerned constitutes a significant therapeutic, scientific or technical innovation or that the granting of authorization is in the interest of patients in the European Union.

Administrative Procedure

Under the centralized authorization procedure, the EMA's Committee for Human Medicinal Products, or CHMP, serves as the scientific committee that renders opinions about the safety, efficacy and quality of medicinal products for human use on behalf of the EMA. The CHMP is composed of experts nominated by each member state's national authority for medicinal products, with an expert appointed to act as Rapporteur for the co-ordination of the evaluation with the possible assistance of a further member of the Committee acting as a Co-Rapporteur. After approval, the Rapporteur(s) continue to monitor the product throughout its life cycle. The CHMP has 210 days to adopt an opinion as to whether a marketing authorization should be granted. The process usually takes longer in case additional information is requested, which triggers clock-stops in the procedural timelines. The process is complex and involves extensive consultation with the regulatory authorities of member states and a number of experts. When an application is submitted for a marketing authorization in respect of a drug that is of major interest from the point of view of public health and in particular from the viewpoint of therapeutic innovation, the applicant may pursuant to Article 14(9) Regulation (EC) No 726/2004 request an accelerated assessment procedure. If the CHMP accepts such request, the time-limit of 210 days will be reduced to 150 days but it is possible that the CHMP can revert to the standard time-limit for the centralized procedure if it considers that it is no longer appropriate to conduct an accelerated assessment. Once the procedure is completed, a European Public Assessment Report, or EPAR, is produced. If the opinion is negative, information is given as to the grounds on which this conclusion was reached. After the adoption of the CHMP opinion, a decision on the MAA must be adopted by the European Commission, after consulting the E.U. member states, which in total can take more than 60 days.

Conditional Approval

In specific circumstances, EU 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 and/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.

Marketing Authorization under Exceptional Circumstances

Under Article 14(8) Regulation (EC) No 726/2004, products for which the applicant can demonstrate that comprehensive data (in line with the requirements laid down in Annex I of Directive 2001/83/EC, as amended) cannot be provided (due to specific reasons foreseen in the legislation) might be eligible for marketing authorization under exceptional circumstances. This type of authorization is reviewed annually to reassess the risk-benefit balance. The fulfillment of any specific procedures/obligations imposed as part of the marketing authorization under exceptional circumstances is aimed at the provision of information on the safe and effective use of the product and will normally not lead to the completion of a full dossier/approval.

Market Authorizations Granted by Authorities of E.U. Member States

In general, if the centralized procedure is not followed, there are three alternative procedures as prescribed in Directive 2001/83/EC:

- The decentralized procedure allows applicants to file identical applications to several EU member states and receive simultaneous national approvals based on the recognition by EU member states of an assessment by a reference member state.
- The national procedure is only available for products intended to be authorized in a single EU member state.
- A mutual recognition procedure similar to the decentralized procedure is available when a marketing authorization has already been obtained in at least one E.U. member state.

A marketing authorization may be granted only to an applicant established in the European Union.

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.

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 EU 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).

Regulatory Data Protection

EU legislation also provides for a system of regulatory data and market exclusivity. According to Article 14(11) of Regulation (EC) No 726/2004, as amended, and Article 10(1) of Directive 2001/83/EC, as amended, upon receiving marketing authorization, new chemical entities approved on the basis of complete independent data package benefit from eight years of data exclusivity and an additional two years of market exclusivity. Data exclusivity prevents regulatory authorities in the European Union from referencing the innovator's data to assess a generic (abbreviated) application. During the additional two-year period of market exclusivity, a generic marketing authorization can be submitted, and the innovator's data may be referenced, but no generic medicinal product can be marketed until the expiration of the market exclusivity. The overall ten-year period will be extended to a maximum of 11 years if, during the first eight years of those ten years, the marketing authorization holder, or MAH, 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. Even if a compound is considered to be a new chemical entity and the innovator is able to gain the period of data exclusivity, another company nevertheless could also market another version of the drug if such company obtained marketing authorization based on an MAA with a complete independent data package of pharmaceutical test, preclinical tests and clinical trials. However, products designated as orphan medicinal products enjoy, upon receiving marketing authorization, a period of ten years of orphan market exclusivity. Depending upon the timing and duration of the EU marketing authorization process, products may be eligible for up to five years' supplementary protection certificates, or SPCs, pursuant to Regulation (EC) No 469/2009. Such SPCs extend the rights under the basic patent for the drug.

Regulatory Requirements After a Marketing Authorization has been Obtained

If we obtain authorization for a medicinal product in the European Union, we will be required to comply with a range of requirements applicable to the manufacturing, marketing, promotion and sale of medicinal products:

Pharmacovigilance and other requirements

We will, for example, have to comply with the EU's stringent pharmacovigilance or safety reporting rules, pursuant to which post-authorization studies and additional monitoring obligations can be imposed. Other requirements relate, for example, to the manufacturing of products and APIs in accordance with good manufacturing practice standards. EU regulators may conduct inspections to verify our compliance with applicable requirements, and we will have to continue to expend time, money and effort to remain compliant. Non-compliance with EU requirements regarding safety monitoring or pharmacovigilance, and with requirements related to the development of products for the pediatric population, can also result in significant financial penalties in the European Union. Similarly, failure to comply with the EU's requirements regarding the protection of individual personal data can also lead to significant penalties and sanctions. Individual EU member states may also impose various sanctions and penalties in case we do not comply with locally applicable requirements.

Manufacturing

The manufacturing of authorized drugs, for which a separate manufacturer's license is mandatory, must be conducted in strict compliance with the EMA's Good Manufacturing Practices, or GMP, requirements and comparable requirements of other regulatory bodies in the European Union, which mandate the methods, facilities and controls used in manufacturing, processing and packing of drugs to assure their safety and identity. The EMA enforces its current GMP requirements through mandatory registration of facilities and inspections of those facilities. The EMA may have a coordinating role for these inspections while the responsibility for carrying them out rests with the member states competent authority under whose responsibility the manufacturer falls. Failure to comply with these requirements could interrupt supply and result in delays, unanticipated costs and lost revenues, and could subject the applicant to potential legal or regulatory action, including but not limited to warning letters, suspension of manufacturing, seizure of product, injunctive action or possible civil and criminal penalties.

Marketing and Promotion

The marketing and promotion of authorized drugs, including industry-sponsored continuing medical education and advertising directed toward the prescribers of drugs and/or the general public, are strictly regulated in the European Union under Directive 2001/83/EC. The applicable regulations aim to ensure that information provided by holders of marketing authorizations regarding their products is truthful, balanced and accurately reflects the safety and efficacy claims authorized by the EMA or by the competent authority of the authorizing member state. Failure to comply with these requirements can result in adverse publicity, warning letters, corrective advertising and potential civil and criminal penalties.

Patent Term Extension

In order to compensate the patentee for delays in obtaining a marketing authorization for a patented product, a supplementary certificate, or SPC, may be granted extending the exclusivity period for that specific product by up to five years. Applications for SPCs must be made to the relevant patent office in each E.U. member state and the granted certificates are valid only in the member state of grant. An application has to be made by the patent owner within six months of the first marketing authorization being granted in the European Union (assuming the patent in question has not expired, lapsed or been revoked) or within six months of the grant of the patent (if the marketing authorization is granted first). In the context of SPCs, the term "product" means the active ingredient or combination of active ingredients for a medicinal product and the term "patent" means a patent protecting such a product or a new manufacturing process or application for it. The duration of an SPC is calculated as the difference between the patent's filing date and the date of the first marketing authorization, minus five years, subject to a maximum term of five years.

A six-month pediatric extension of an SPC may be obtained where the patentee has carried out an agreed pediatric investigation plan, the authorized product information includes information on the results of the studies and the product is authorized in all member states of the European Union.

Brexit and the Regulatory Framework in the United Kingdom

On June 23, 2016, the electorate in the United Kingdom, or U.K. voted in favor of leaving the E.U., which is commonly referred to as “Brexit.” Thereafter, on March 29, 2017, the country formally notified the E. U. of its intention to withdraw pursuant to Article 50 of the Lisbon Treaty. The withdrawal of the U.K. from the E.U. took effect on January 31, 2020. Since the regulatory framework for pharmaceutical products in the U.K. covering quality, safety and efficacy of pharmaceutical products, clinical trials, marketing authorization, commercial sales and distribution of pharmaceutical products is derived from E.U. directives and regulations, Brexit could materially impact the future regulatory regime which applies to products and the approval of product candidates in the U.K. It remains to be seen how, if at all, Brexit will impact regulatory requirements for product candidates and products in the U.K.

Pharmaceutical Coverage, Pricing and Reimbursement

Significant uncertainty exists as to the coverage and reimbursement status of products approved by the FDA and other government authorities. Sales of products will depend, in part, on the extent to which the costs of the products will be covered by third-party payors, including government health programs in the United States such as Medicare and Medicaid, commercial health insurers and managed care organizations. 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.

In order to secure coverage and reimbursement for any product that might be approved for sale, a company may need to conduct expensive pharmacoeconomic studies in order to demonstrate the medical necessity and cost-effectiveness of the product, in addition to the costs required to obtain FDA or other comparable regulatory approvals. 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.

There has been an increased focus on drug pricing in recent years in the United States. Although there are no direct government price controls over private sector purchases in the United States, there are rebates and other financial requirements for federal and state health care programs. The Medicare Modernization Act, enacted in December 2003, established the Medicare Part D outpatient prescription drug benefit, which is provided primarily through private entities that attempt to negotiate price concessions from pharmaceutical manufacturers. The health care reform legislation enacted in 2010, known as the Affordable Care Act, requires drug manufacturers to pay 50% of the Medicare Part D coverage gap, also known as the “donut hole,” on prescriptions for branded products filled when the beneficiary reaches this coverage. The Deficit Reduction Act of 2005 resulted in changes to the way drug prices are reported to the government and the formula using such information to calculate the required Medicaid rebates. The Affordable Care Act increased the minimum basic Medicaid rebate for branded prescription drugs from 15.1% to 23.1% and requires pharmaceutical manufacturers to pay states rebates on prescription drugs dispensed to Medicaid managed care enrollees. In addition, the Affordable Care Act increased the additional Medicaid rebate on “line extensions” (such as extended release formulations) of solid oral dosage forms of branded products, revised the definition of average manufacturer price by changing the classes of purchasers included in the calculation, and expanded the entities eligible for discounted pricing under the federal 340B drug pricing program. Current orphan drugs are excluded from the expanded 340B hospitals eligible for discounts.

The Affordable Care Act imposes a significant annual fee on companies that manufacture or import branded prescription drug products. The fee (which is not deductible for federal income tax purposes) is based on the manufacturer’s market share of sales of branded drugs and biologics (excluding orphan drugs) to, or pursuant to coverage under, specified U. S. government programs. The Affordable Care Act also contains a number of provisions, including provisions governing the way that health care is financed by both governmental and private insurers, enrollment in federal health care programs, reimbursement changes, the increased use of comparative effectiveness research in health care decision-making, and enhancements to fraud and abuse requirements and enforcement, that are affecting existing government health care programs and will result in the development of new programs. The Affordable Care Act also contains requirements for manufacturers to publicly report certain payments or other transfers of value made to physicians and teaching hospitals. We are unable to predict the future course of federal or state health care legislation and regulations, including regulations that will be issued to implement provisions of the Affordable Care Act. The Affordable Care Act and further changes in the law or regulatory framework that reduce our revenues or increase our costs could also have a material adverse effect on our business, financial condition and results of operations and cash flows.

Public and private health care payers control costs and influence drug pricing through a variety of mechanisms, including through negotiating discounts with the manufacturers and through the use of tiered formularies and other mechanisms that provide preferential access to certain drugs over others within a therapeutic class. Payers also set other criteria to govern the uses of a drug that will be deemed medically appropriate and therefore reimbursed or otherwise covered. Payers may require physicians to seek approval from them before a product will be reimbursed or covered, commonly referred to as prior authorization. In particular, many public and private health care payers limit reimbursement and coverage to the uses of a drug that are either approved by the FDA or appear in a recognized drug compendium. Drug compendia are publications that summarize the available medical evidence for particular drug products and identify which uses of a drug are supported or not supported by the available evidence, whether or not such uses have been approved by the FDA. For example, in the case of Medicare Part D coverage for oncology drugs, the Medicare Modernization Act, with certain exceptions, provides for Medicare coverage of unapproved uses of an FDA-approved drug if the unapproved use is reasonable and necessary and is supported by one or more citations in CMS-approved compendia, such as the National Comprehensive Cancer Network Drugs and Biologics Compendium. Different pricing and reimbursement schemes exist in other countries. For example, in the European Union, governments influence the price of pharmaceutical products through their pricing and reimbursement rules and control of national health care systems that fund a large part of the cost of such products to consumers. The approach taken varies from member state to member state. Some jurisdictions operate positive or negative list systems under which products may only be marketed once a reimbursement price has been agreed. Other member states allow companies to fix their own prices for medicines, but monitor and control company profits and may limit or restrict reimbursement. The downward pressure on health care costs in general, and prescription drugs in particular, has become very intense. As a result, increasingly high barriers are being erected to the entry of new products, as exemplified by the actions of the National Institute for Clinical Excellence in the United Kingdom, which evaluates the data supporting new medicines and passes reimbursement recommendations to the government. In addition, in some countries cross-border imports from low-priced markets (parallel imports) exert a commercial pressure on pricing within a country.

In the European Union, pricing and reimbursement schemes vary widely from country to country. Some countries provide that drug products may be marketed only after a reimbursement price has been agreed. Some countries may require the completion of additional studies that compare the cost-effectiveness of our drug candidate to currently available therapies (so called health technology assessment) in order to obtain reimbursement or pricing approval. For example, the European Union provides options for its member states to restrict the range of drug products for which their national health insurance systems provide reimbursement and to control the prices of medicinal products for human use. E.U. member states may approve a specific price for a drug product or it may instead adopt a system of direct or indirect controls on the profitability of the company placing the drug 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. 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 E.U. 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.

Healthcare Law and Regulation

Healthcare providers, physicians and third-party payors play a primary role in the recommendation and prescription of drug products that are granted marketing approval. Arrangements with third-party payors and customers are subject to broadly applicable fraud and abuse and other healthcare laws and regulations. Such restrictions under applicable federal and state healthcare laws and regulations, include the following:

- the federal Anti-Kickback Statute prohibits, among other things, persons from knowingly and willfully soliciting, offering, receiving or providing 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 healthcare 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 healthcare benefit program or making false statements relating to healthcare matters;

- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health 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 false statements statute prohibits knowingly and willfully falsifying, concealing or covering up a material fact or making any materially false statement in connection with the delivery of or payment for healthcare benefits, items or services;
- the federal transparency requirements under the Health Care Reform Law requires manufacturers of drugs, devices, biologics and medical supplies to report to the Department of Health and Human Services information related to payments and other transfers of value to physicians and teaching hospitals 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 healthcare items or services reimbursed by non-governmental third-party payors, including private insurers.

An increasing number of states have enacted legislation requiring pharmaceutical and biotechnology companies to file periodic reports of expenses relating to the marketing and promotion of drug products and gifts and payments to individual healthcare practitioners in these states; to make periodic public disclosures on sales, marketing, pricing, clinical trials and other activities; to report information pertaining to and justifying price increases; or to register their sales representatives. Other states prohibit various marketing-related activities, such as the provision of certain kinds of gifts or meals; price gouging; or pharmacies and other healthcare entities from providing certain physician prescribing data to pharmaceutical and biotechnology companies for use in sales and marketing. In addition, states such as California, Connecticut, Nevada, and Massachusetts require pharmaceutical companies to implement compliance programs and/or marketing codes. 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.

Environmental, Health and Safety Matters

The manufacturing facilities of the third-parties that develop our product candidates are subject to extensive environmental, health and safety laws and regulations in a number of jurisdictions, governing, among other things: the use, storage, registration, handling, emission and disposal of chemicals, waste materials and sewage; chemicals, air, water and ground contamination; air emissions and the cleanup of contaminated sites, including any contamination that results from spills due to our failure to properly dispose of chemicals, waste materials and sewage.

These laws, regulations and permits could potentially require the expenditure by us of significant amounts for compliance or remediation. If the third-party manufacturers fail to comply with such laws, regulations or permits, we may be subject to fines and other civil, administrative or criminal sanctions, including the revocation of permits and licenses necessary to continue our business activities. In addition, we may be required to pay damages or civil judgments in respect of third-party claims, including those relating to personal injury (including exposure to hazardous substances we use, store, handle, transport, manufacture or dispose of), property damage or contribution claims. Some environmental, health and safety laws allow for strict, joint and several liability for remediation costs, regardless of comparative fault. We may be identified as a responsible party under such laws. Such developments could have a material adverse effect on our business, financial condition and results of operations.

In addition, laws and regulations relating to environmental, health and safety matters are often subject to change. In the event of any changes or new laws or regulations, we could be subject to new compliance measures or to penalties for activities that were previously permitted.

Our Intellectual Property

We rely upon a combination of licenses, patents, trade secrets, know-how, and licensing opportunities to develop our business. Our future prospects depend on our ability to protect our intellectual property. We also need to operate without infringing the proprietary rights of third parties.

Patents

We attempt to protect our technology and products through patents and patent applications pursuant to the terms of our license agreements. We have an exclusive, worldwide license from ILH Holdings Inc. (as an assignee of Precigen) to use its technology to develop lantibiotics. We also have an exclusive worldwide license from Precigen's wholly owned subsidiaries, ActoBio Therapeutics, Inc. and Actobiotics NV to use their intellectual property to develop AG013 for the treatment of oral mucositis.

We co-own the intellectual property for certain homologs of our MU1140 product candidate with the Texas A&M University System. Following a review of our research and development activities and a determination to focus our financial resources on our research activities for OG716 and AG013, we provided a notice to Texas A&M of the termination of our license agreement with Texas A&M which took effect in January 2019. We retain co-ownership of the intellectual property relating to the Texas A&M license agreement.

The effect of issued patents is that they provide patent protection for the claims covered by the patents. While the expiration of a product patent normally results in a loss of market exclusivity for the covered product or product candidate, commercial benefits may continue to be derived from: (i) later-granted patents on processes and intermediates related to the most economical method of manufacture of the active ingredient of such product; (ii) patents relating to the use of such product; (iii) patents relating to novel compositions and formulations; and (iv) in the United States and certain other countries, market exclusivity that may be available under relevant law. The effect of patent expiration on products or product candidates also depends upon many other factors such as the nature of the market and the position of the product in it, the growth of the market, the complexities and economics of the process for manufacture of the active ingredient of the product and the requirements of new drug provisions of the Federal Food, Drug and Cosmetic Act or similar laws and regulations in other countries.

We believe that protection of discoveries in connection with our development activities, our proprietary products, technologies, processes and know-how and all of our intellectual property are important to our business. To achieve a competitive position, we rely on trade secrets, non-patented proprietary know-how and continuing technological innovation, where patent protection is not believed to be appropriate or attainable. In addition, as outlined above, we have a number of patent licenses from third parties, some of which may be important to our business. There can be no assurance that any of our patents, licenses or other intellectual property rights will afford us any protection from competition.

Trademarks

Our trademarks are important to our business. We currently use the following unregistered trademarks: SMaRT Replacement Therapy™, MU1140™, and LPT3-04™. We currently have pending with the U.S. PTO, applications for registration of the mark of ORAGENICS™ (therapeutic products; anti-infectives). We also have rights to use other names essential to our business. Federally registered trademarks have a perpetual life, as long as they are maintained and renewed on a timely basis and used properly as trademarks, subject to the rights of third parties to seek cancellation of the trademarks if they claim priority or confusion of usage. We regard our trademarks and other proprietary rights as valuable assets and believe they have significant value to us.

Protection of Trade Secrets

We attempt to protect our trade secrets, including the processes, concepts, ideas and documentation associated with our technologies, through the use of confidentiality agreements and non-competition agreements with our current employees and with other parties to whom we have divulged such trade secrets. There can be no assurance that these agreements will not be breached, that we will have adequate remedies for any breach, that others will not independently develop equivalent proprietary information or that other third parties will not otherwise gain access to our trade secrets and other intellectual property. If our employees or other parties breach our confidentiality agreements and non-competition agreements or if these agreements are not sufficient to protect our technology or are found to be unenforceable, our competitors could acquire and use information that we consider to be our trade secrets and we may not be able to compete effectively. Most of our competitors have substantially greater financial, marketing, technical and manufacturing resources than we have and we may not be profitable if our competitors are also able to take advantage of our trade secrets.

We may find it necessary to initiate litigation to enforce our patent rights, to protect our intellectual property or to determine the scope and validity of the proprietary rights of others. Litigation is costly and time-consuming, and there can be no assurance that our litigation expenses will not be significant in the future or that we will prevail in any such litigation.

Government Grants

We have previously received funding from government agencies under the National Science Foundation's and National Institute of Health's Small Business Innovation Research, or SBIR, grants. Eligibility of public companies to receive such grants is based on size and ownership criteria which are under review by the Small Business Administration, or SBA. As a result, our eligibility may change in the future and additional funding from this source may not be available. In addition, although we seek to protect the competitive benefits we derive from our patents, proprietary information, and other intellectual property, we may not have the right to prohibit the U.S. government from using certain technologies developed or acquired by us due to federal research grants or to prohibit third-party companies, including our competitors, from using those technologies in providing products and services to the U.S. government. The U.S. government could have the right to royalty-free use of technologies that we may develop under such grants. We may commercially exploit those government-funded technologies and may assert our intellectual property rights against other non-government users of technology developed by us, but we may not be successful in our efforts to do so.

Employees

We have seven full-time employees. We enjoy good relations with our employees. None of our employees are a member of any labor union, and we are not a party to any collective bargaining agreement.

Corporate Information

We were incorporated in November 1996 and commenced operations in 1999. We consummated our initial public offering in June 2003. Our corporate office is located at 4902 Eisenhower Boulevard, Suite 125, Tampa, Florida 33634.

Available Information

Our website is www.oragenics.com. On our website we make available at no cost our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and amendments to those reports filed or furnished as soon as reasonably practicable after we electronically file such material with, or furnish them to, the United States Securities and Exchange Commission ("SEC"). The information contained on our website is not a part of this annual report on Form 10-K.

ITEM 1A. RISK FACTORS.

An investment in our common stock involves a high degree of risk. You should carefully consider the risks described below before making an investment decision in our securities. These risk factors are effective as of the date of this Form 10-K and shall be deemed to be modified or superseded to the extent that a statement contained in our future filings modifies or replaces such statement. All of these risks may impair our business operations. The forward-looking statements in this Form 10-K involve risks and uncertainties and actual results may differ materially from the results we discuss in the forward-looking statements. If any of the following risks actually occur, our business, financial condition or results of operations could be materially adversely affected. In that case, the trading price of our stock could decline, and you may lose all or part of your investment.

Risks Related to Our Business

We have incurred significant losses since our inception and expect to continue to experience losses for the foreseeable future.

We have incurred significant net losses and negative cash flow in each year since our inception, including net losses of approximately \$15.6 million and \$9.9 million for the years ended December 31, 2019, and 2018, respectively. As of December 31, 2019, our accumulated deficit was approximately \$127.4 million. We have devoted a significant amount of our financial resources to research and development, including our nonclinical development activities and clinical trials. We expect that the costs associated with our exclusive channel partnerships with ILH Holdings, Inc. (an assignee of Precigen) in the area of lantibiotics ("Lantibiotics Program") and with Precigen's subsidiary ActoBio Therapeutics, Inc. in the area of Oral Mucositis ("Oral Mucositis Program") and the development and commercialization of our product candidates under the Lantibiotics Program (which includes MU1140 homologs) using ILH's advanced transgene and cell engineering platforms will continue to increase the level of our overall expenses significantly going forward. As a result, we expect to continue to incur substantial net losses and negative cash flow for the foreseeable future. These losses and negative cash flows have had, and will continue to have, an adverse effect on our shareholders' equity and working capital. Because of the numerous risks and uncertainties associated with product development and commercialization, we are unable to accurately predict the timing or amount of substantial expenses or when, or if, we will be able to generate the revenue necessary to achieve or maintain profitability.

We will need to raise additional capital in the future to complete the development and commercialization of our product candidates and operate our business.

Developing and commercializing biopharmaceutical products, including conducting nonclinical studies and clinical trials and establishing manufacturing capabilities, is expensive. We anticipate that our cash resources as of December 31, 2019 will be sufficient to fund our operations as presently structured through the second quarter of 2021. However, changes may occur that would consume our existing capital prior to that time, including the scope and progress of our efforts to develop and commercialize our product candidates. Our actual costs may ultimately vary from our current expectations, which could materially impact our use of capital and our forecast of the period of time through which our financial resources will be adequate to support our operations. Our current cash, cash equivalents and short-term investments are not sufficient to fully implement our business strategy and sustain our operations over a longer period of time. Accordingly, we will need to seek additional sources of financing and such additional financing may not be available on favorable terms, if at all. Until we can generate a sufficient amount of product revenue, if ever, we expect to finance future cash needs through public or private equity offerings, debt financings or corporate collaboration and licensing arrangements. If we do not succeed in raising additional funds on acceptable terms, we may be unable to complete existing nonclinical and planned clinical trials or obtain approval of our product candidates from the FDA and other regulatory authorities. We expect capital outlays and operating expenditures to increase over the next several years as we expand our infrastructure, and research and development activities. Specifically, we need to raise additional capital to, among other things:

- complete the Phase 2 clinical trial on our AG013 product candidate;
- expand our clinical laboratory operations;
- fund our clinical validation study activities;
- expand our research and development activities; and
- finance our capital expenditures and general and administrative expenses.

Our present and future funding requirements will depend on many factors, including:

- the level of research and development investment budgeted to develop our current and future product candidates;
- costs of filing, prosecuting, defending and enforcing patent claims and other intellectual property rights;
- our need or decision to acquire or license complementary technologies or acquire complementary businesses;
- changes in test development plans needed to address any difficulties in product candidate selection for commercialization;
- competing technological and market developments;
- our interaction and relationship with the FDA, or other, regulatory agencies; and
- changes in regulatory policies or laws that affect our operations.

Additional capital may not be available on satisfactory terms, or at all. Furthermore, if we raise additional funds by issuing equity securities, dilution to our existing stockholders could result. Any equity securities issued also may provide for rights, preferences or privileges senior to those of holders of our common stock. If we raise additional funds by issuing debt securities, these debt securities would have rights, preferences and privileges senior to those of holders of our common stock, and the terms of the debt securities issued could impose significant restrictions on our operations. If we raise additional funds through collaborations and licensing arrangements, we might be required to relinquish significant rights to our technologies or our products under development, or grant licenses on terms that are not favorable to us, which could lower the economic value of those programs to us. If adequate funds are not available, we may have to scale back our operations or limit our research and development activities, which may cause us to grow at a slower pace, or not at all, and our business could be adversely affected.

In addition, we could be forced to discontinue product development and commercialization of one or more of our product candidates, forego sales and marketing efforts, and/or forego licensing attractive business opportunities.

Our auditor has previously expressed substantial doubt about our ability to continue as a going concern and absent additional financing we may be unable to remain a going concern.

In light of our recurring losses, accumulated deficit and negative cash flow as described in our notes to our audited financial statements, the report of our independent registered public accounting firm on our financial statements for the year ended December 31, 2017 contained an explanatory paragraph raising substantial doubt about our ability to continue as a going concern. Our financial statements did not include any adjustments that may have been necessary in the event we were unable to continue as a going concern. Had we been unable to establish to the satisfaction of our independent registered public accounting firm that the net proceeds from our financing efforts will be sufficient to allow for the removal of this going concern qualification, we may need to significantly modify our operational plans for us to continue as a going concern. We believe we can continue our current level of operations with the cash we have on hand, inclusive of the net proceeds we received from our March 25, 2019 underwritten public offering, without additional financing through the second quarter of 2021. Absent sufficient additional financing, we may be unable to remain a going concern.

If we are unable to successfully develop our product candidates, our operating results and competitive position could be harmed. Research and development involves a lengthy and complex process, and we may not be successful in our efforts to develop and commercialize our product candidates. The further development and ultimate commercialization of product candidates for lantibiotics and oral mucositis are keys to our growth strategy.

A key element of our strategy is to discover, develop, validate and commercialize a portfolio of additional antibiotic product candidates to combat multi drug resistant organism, or MDRO, outbreaks and the associated costs to patients, inpatient facilities and the health care industry and to develop, validate and commercialize a product candidate to treat oral mucositis. We cannot assure you that we will be able to successfully complete development of, or commercialize any of our planned future product candidates, or that they will be clinically usable. The product development process involves a high degree of risk and may take up to several years or more. Our new product development efforts may fail for many reasons, including:

- failure of future tests at the research or development stages;
- lack of clinical validation data to support the effectiveness of the test;
- delays resulting from the failure of third-party suppliers or contractors to meet their obligations in a timely and cost-effective manner;
- regulatory delays at the FDA;
- failure to obtain or maintain necessary certifications, licenses, clearances or approvals to market or perform the test; or
- lack of commercial acceptance by the health care marketplace.

Few research and development projects result in commercial products, and success in early clinical trials often is not replicated in later trials. At any point, we may abandon development of new products, or we may be required to expend considerable resources repeating clinical studies or trials, which would adversely impact the timing for generating potential revenues from those new products. In addition, as we advance the development of new products through to the commercialization stage, we will have to make additional investments in our sales and marketing operations, which may be prematurely or unnecessarily incurred if the commercial launch of a product is abandoned or delayed.

We may be unable to refine a method to produce MU1140 homologs in large-scale commercial quantities. If we cannot, we will be unable to generate significant revenues from sales of our MU1140 homologs product candidate.

Our antibiotic product candidates, all homologs of MU1140, are produced by our strain of *S. mutans* and variants thereof. In March 2005 we successfully developed a methodology for producing MU1140 in quantities sufficient to undertake its nonclinical testing. In June of 2012 we entered into an exclusive collaboration agreement with Precigen Corporation to use its advanced transgene and cell engineering platforms to achieve sufficient production quantities of MU1140. In 2016 we were able to transition manufacturing of OG716 to a third-party manufacturer capable of fermenting quantities sufficient to conduct nonclinical studies. If we are not able to further adequately scale up fermentation and purification methodologies for large-scale manufacture, we will be unable to partner and generate revenues from this product candidate and our business, financial condition and results of operations will be materially adversely affected. The manufacturing of MU1140 homologs, including OG716 or any other possible antibiotic product candidates based on lantibiotics, is a highly exacting and complex process. Manufacturing MU1140 homologs, including OG716, or any other antibiotic candidates derived from lantibiotics on a commercial scale has not yet been achieved to our knowledge, so there are additional risks that such efforts will not be successful. The Precigen technology may not be feasible to efficiently develop methodologies to enable large scale manufacturing of a MU1140 homolog or other antibiotic product candidates. Third-party manufacturers must have additional technical skills and must take multiple steps to attempt to control the manufacturing processes. If we are unable to produce MU1140 homologs in large-scale commercial quantities, we will be unable to generate significant revenues from sales of our MU1140 product candidate and our financial condition and results of operations will be materially adversely affected.

Our success will depend on our ability to obtain regulatory approval of our product candidates under our Lantibiotics Program and our Oral Mucositis Program and their successful commercialization.

Our product candidates under our Lantibiotics Program and Oral Mucositis Program have not received regulatory approval in any jurisdiction and they may never receive approval or, if approvals are obtained, may never be commercialized successfully. We have incurred and will continue to incur significant costs relating to the nonclinical and clinical development of our antibiotic product candidates (including MU1140 homologs we may develop) and oral mucositis product candidate, respectively. We have performed extensive nonclinical testing using native MU1140 and entered into an Exclusive Channel Collaboration Agreement with Precigen (which was assigned to ICH Holdings, Inc.). We began nonclinical activities on homologs of MU1140 in the second half of 2014. Those activities include toxicity results, physicochemical characterizations, and efficacy studies in animals. This work will be done solely by us through the use of outside contractors. If our nonclinical work is successful, we would expect the IND for a first-in-human clinical trial of OG716 to be filed with the FDA based on our ability to complete the requisite studies, contingent on sufficient funding.

We initiated a Phase 2 clinical trial on our AG013 product candidate in 2017. Even if we are able to conduct successful clinical trials or the required regulatory approvals are obtained, we may never be able to generate significant revenues from our product candidates. If our product candidates are unsuccessful, we may be unable to generate sufficient revenues to sustain and grow our business, and our business, financial condition and results of operations will be materially adversely affected.

Our exclusive channel collaboration agreements are based on early stage technologies in their fields.

Our exclusive channel collaboration agreements contemplate the use of ILH's advanced transgene and cell engineering platforms for the development and production of lantibiotics and AG013. Such technologies have a limited history of use in the design and development of active pharmaceutical ingredients and drug products involving direct administration and may therefore involve unanticipated risks or delays.

We will incur additional expenses in connection with our exclusive channel collaboration arrangements.

Pursuant to our exclusive channel collaborations, we are responsible for future research and development expenses of product candidates developed under such collaborations, including those incurred by our collaboration partners for research on our behalf as provided in the ECC Agreements. As a result, we expect the level of our overall research and development expenses going forward will increase. The timing and amount of expenses under our ECCs are difficult to predict. Although all manufacturing, nonclinical studies and human clinical trials are expensive and difficult to design and implement, costs associated with the manufacturing, research and development of biologic product candidates are generally greater in comparison to small molecule product candidates. We expect over time to add additional personnel to support our Lantibiotics Program and Oral Mucositis Program as we progress in our development efforts.

Because our collaborations pursuant to our ECCS are in the early stage, future development costs associated with this program may be difficult to anticipate and exceed our expectations. Our actual cash requirements may vary materially from our current expectations for a number of other factors that may include, but are not limited to, unanticipated technical challenges, changes in the focus and direction of our development activities or adjustments necessitated by changes in the competitive landscape in which we operate. If we are unable to continue to financially support such collaborations due to our own working capital constraints, we may be forced to delay our activities. If we are unable to obtain additional financing on terms acceptable to us or at all, we may be forced to seek licensing partners or discontinue development, which in turn could lead to the termination of our ECC Agreements.

We may not be able to retain the exclusive rights licensed to us under our ECCs to develop and commercialize lantibiotic products and AG013 related products.

Under our ECCs we are responsible for, among other things, funding the further anticipated development of lantibiotics and AG013 toward the goal of commercialization, conducting nonclinical and clinical development of product candidates, as well as for other aspects of manufacturing and the commercialization of the product(s). Our collaboration partners may terminate such agreements if we do not perform certain specified requirements, including developing therapies identified to us and considered superior by our collaboration partners. There can be no assurance that we will be able to successfully perform under the Oral Mucositis ECC or Lantibiotic ECC and if either ECC is terminated it would prevent us from achieving our business objectives.

Our Collaboration Partners, Precigen and ILH, may not devote sufficient time and resources to successfully carry out their contracted duties or meet expected deadlines, we may not be able to advance our product candidates in a timely manner or at all.

On January 31, 2020, our prior collaboration partner, Intrexon Corporation, pursuant to a restructuring which in part, resulted in a change of Intrexon's name to Precigen, Inc. In addition, pursuant to Precigen's restructuring plan, the Lantibiotic ECC and Lantibiotic Stock Issuance Agreement were assigned to and assumed by ILH Holdings, Inc. ("ILH"), a wholly owned subsidiary of Precigen, Precigen subsequently sold the majority of its bioengineering assets, inclusive of ILH, to TS Biotechnology, an entity managed by Third Security. Our success depends, in part, on the performance by our collaborators of their responsibilities under our collaboration arrangements. Our new collaborator may not perform their obligations in a timely fashion or in a manner satisfactory to us or consistent with how previously performed. Typically, we cannot control the amount of resources or time our collaborators may devote to our programs or potential products that may be developed in collaboration with us. We are currently involved in multiple research and development collaborations with academic and research institutions. These collaborators frequently depend on outside sources of funding to conduct or complete research and development, such as grants or other awards. As a result of these uncertainties, we are unable to control the precise timing and execution of any experiments that may be conducted.

Additionally, our current or future corporate collaborators will retain the ability to pursue other research, product development or commercial opportunities that may be directly competitive with our programs. If these collaborators elect to prioritize or pursue other programs in lieu of ours, we may not be able to advance product development programs in an efficient or effective manner, if at all. If a collaborator is pursuing a competitive program and encounters unexpected financial or capability limitations, they may be motivated to reduce the priority placed on our programs or delay certain activities related to our programs or be unwilling to properly fund their share of the development expenses for our programs. Any of these developments could harm our product and technology development efforts, which could seriously harm our business.

Our success will depend on our ability to partner or sub-license our product candidates and their subsequent successful commercialization.

Our MU1140 homologs and AG013 product candidate are in early stage development and are expected to require partners with substantial financial resources to continue the development of each of these products to commercialization. In addition, none of these product candidates have received regulatory approval in any jurisdiction and they may never receive approval or, if approvals are obtained, may never be commercialized successfully. In addition, we do not know whether any of our clinical trials will be successful or can be completed within our current expected budget. For our MU1140 homologs and other antibiotic product candidates, we have performed extensive nonclinical testing using native MU1140 and expect to continue to pursue the nonclinical testing of our MU1140 homologs and other antibiotic product candidates during 2019 we would expect the IND for a first-in-human clinical trial of OG716 to be filed with the FDA based on our ability to complete the requisite studies, contingent on sufficient funding. Even if we are able to partner and conduct successful clinical trials or the required regulatory approvals are obtained, we may never be able to generate significant revenues from our MU1140 homologs or other antibiotic product candidates or other product candidates. If our MU1140 homologs product candidate or our other product candidates under the Lantibiotics Program and Oral Mucositis Program or otherwise are unsuccessful, we may be unable to generate sufficient revenues to sustain and grow our business, and our business, financial condition and results of operations will be materially adversely affected.

Our financial results could vary significantly from quarter to quarter and are difficult to predict.

Our operating results could vary significantly from quarter to quarter due to a variety of factors, many of which are outside of our control. As a result, comparing our operating results on a period-to-period basis may not be meaningful. In addition, we may not be able to predict our future revenues or results of operations. We base our current and future expense levels on our internal operating plans and sales forecasts, and our operating costs vary to the extent of our research and development and the candidate of clinical trials. As a result, we may incur significant or unanticipated expenses associated with our research and development efforts of our product candidates under development. In addition to other risk factors discussed in this section, factors that may contribute to the variability of our quarterly results include:

- the timing of release of pre-clinical and clinical trial results and new products and services by our competitors, particularly those that may represent a significant portion of revenues in any given period;
- the popularity of new products, and products released in prior periods;
- changes in pricing policies by us or our competitors;
- our success in entering new geographic markets;
- decisions by us to incur additional expenses, such as commencing a clinical trial or increases in research and development;
- the level of expenses associated with our clinical trials; and
- the timing of compensation expense associated with equity compensation grants.

As a result of these and other factors, our quarterly and annual operating results could be materially adversely affected. Moreover, our operating results may not meet the expectations of research analysts or investors, in which case the price of our common stock could decrease significantly.

If our manufacturers in general fail to meet our requirements and the requirements of regulatory authorities, our research and development may be materially adversely affected.

We do not have the internal capability to manufacture MU1140 homologs, AG013, or any other product candidates under GMPs, as required by the FDA and other regulatory agencies. In order to continue to develop and commercialize our product candidates, apply for regulatory approvals for our product candidates, we will need to contract with third parties that have, or otherwise develop, the necessary manufacturing capabilities in full compliance with applicable regulatory requirements.

There are a limited number of manufacturers that operate under GMPs that are capable of manufacturing MU1140 homologs and our AG013 product candidate. Manufacturing on a commercial scale has not yet been undertaken and there are additional technical skills needed for the manufacture of MU1140 homologs that will further limit the number of potential manufacturers. As such, if we are unable to enter into supply and processing contracts with any of these manufacturers or processors for our MU1140 product candidates, or our AG013 product candidate for the conduct of clinical trials on such product candidate we may incur additional costs and delays in development and commercialization.

Problems with these manufacturing processes such as equipment malfunctions, facility contamination, labor problems, raw material shortages or contamination, natural disasters, power outages, terrorist activities, or disruptions in the operations of our suppliers and even minor deviations from normal procedures, could result in product defects or manufacturing failures that result in lot failures, product recalls, product liability claims and insufficient inventory or supply of product for the conduct of clinical trials.

If we are required to find an additional or alternative source of supply, there may be additional costs and delays in the development, clinical trial timing, or commercialization of our product candidates. Additionally, the FDA and other regulatory agencies routinely inspect manufacturing facilities before approving a New Drug Application, or NDA, or Biologic License Application, or BLA, for a drug or biologic manufactured at those sites. If any of our manufacturers or processors fails to satisfy regulatory requirements, the approval and eventual commercialization of our commercial products and product candidates may be delayed.

All of our contract manufacturers must comply with the applicable GMPs, which include quality control and quality assurance requirements as well as the corresponding maintenance of records and documentation. If our contract manufacturers do not comply with the applicable GMPs and other FDA regulatory requirements, we may be subject to product liability claims, the availability of marketed products for sale could be reduced, our product commercialization could be delayed or subject to restrictions, we may be unable to meet demand for our products and may lose potential revenues and we could suffer delays in the progress of nonclinical testing and clinical trials for products under development. We do not have control over our third-party manufacturers' compliance with these regulations and standards. Moreover, while we may choose to manufacture our products ourselves in the future, we have no experience in the manufacture of pharmaceutical or biological products for clinical trials or commercial purposes. If we decide to manufacture products, we would be subject to the regulatory requirements described above. In addition, we would require substantial additional capital and would be subject to delays or difficulties encountered in manufacturing pharmaceutical or biological products. Regardless of the manufacturer of our products, we will be subject to continuing obligations regarding the submission of safety reports and other post-market information.

We rely on the significant experience and specialized expertise of our senior management and scientific team and the loss of any of our key personnel or our inability to successfully hire their successors could harm our business.

Our performance is substantially dependent on the continued services and on the performance of our senior management and scientific team, who have extensive experience and specialized expertise in our business. Our performance also depends on our ability to retain and motivate our other key employees. In June 2016, we hired Dr. Alan Joslyn as President and Chief Executive Officer and in February 2012 we hired Mr. Michael Sullivan, Certified Public Accountant as our Chief Financial Officer. Mr. Sullivan also served as our Interim Principal Executive Officer from October of 2014 through June of 2016. The loss of the services of senior management or any key employees could harm our ability to develop and commercialize our product candidates. We have no key man life insurance policies.

We need to hire and retain additional qualified scientists and other highly skilled personnel to maintain and grow our business.

Our future success depends on our ability to identify, attract, hire, train, retain and motivate highly skilled technical, managerial and research personnel in all areas within our organization. We plan to continue to grow our business and will need to hire additional personnel to support this growth. We believe that there are only a limited number of individuals with the requisite skills to serve in many of our key positions, and we compete for key personnel with other biotechnology companies, as well as universities and research institutions. It is often difficult to hire and retain these persons, and we may be unable to replace key persons if they leave or be unable to fill new positions requiring key persons with appropriate experience. If we fail to attract, integrate and retain the necessary personnel, our ability to maintain and grow our business could suffer significantly.

If any of our product candidates are shown to be ineffective or harmful in humans, we will be unable to generate revenues from these product candidates.

Before obtaining regulatory approvals for the commercial sale of our product candidates, we must demonstrate through nonclinical testing and clinical trials that our products are safe and effective for use in humans. To date the testing of the antibiotic substance MU1140 homologs has been undertaken solely in the laboratory and in animals. We have not yet conducted human trials with any MU1140 homolog. To date, available clinical data for our AG013 product candidate has been limited to a Phase 1b clinical trial. It is possible that when future antibiotic trials are conducted in humans, they will show that our antibiotic candidates are ineffective or harmful in humans. If MU1140 homologs are shown to be ineffective or harmful in humans, we will be unable to commercialize and generate revenues from sales of this compound. It is possible that further clinical testing of our AG013 product candidates could reveal that it is ineffective. If we are unable to generate revenues from the first generation of MU1140 and homologs, or any other product candidates, our business, financial condition and results of operations will be materially adversely affected.

We intend to rely on third parties to cover a portion of the costs associated with obtaining regulatory approval for, and manufacturing and marketing of, our product candidates. If we are unable to obtain agreements with third parties to fund these costs, we will have to fund such costs ourselves or we may be unable to extract any value from these technologies.

As we continue our development of product candidates, we intend to either license these product candidates to, or partner with, one or more major pharmaceutical companies at the earliest possible time in their product development. If we do so, we intend for these licensees or partners to pay the costs associated with any remaining development work, regulatory submissions, clinical trials and the manufacturing and marketing of our product candidates. If we are unable to license our product candidates or otherwise partner with third parties, we will have to fund the costs of our clinical trials ourselves or we will be unable to extract any value from these technologies. We will also have to establish our own manufacturing facilities and find our own distribution channels. This would greatly increase our future capital requirements and we cannot assure you that we would be able to obtain the necessary financing to pay these costs. If we are unable to cover the associated costs or we cannot obtain financing on acceptable terms or at all, our business, financial condition and results of operations will be materially adversely affected.

Our dependence on collaborative arrangements with third parties subjects us to a number of risks. These collaborative arrangements may not be on terms favorable to us. Agreements with collaborative partners typically allow partners significant discretion in electing whether or not to pursue any of the planned activities. We cannot control the amount and timing of resources our collaborative partners may devote to products based on the collaboration, and our partners may choose to pursue alternative products. Our partners may not perform their obligations as expected. Business combinations or significant changes in a collaborative partner's business strategy may adversely affect a partner's willingness or ability to complete its obligations under the arrangement. Moreover, we could become involved in disputes with our partners, which could lead to delays or termination of the collaborations and time-consuming and expensive litigation or arbitration. Even if we fulfill our obligations under a collaborative agreement, our partner may be able to terminate the agreement under certain circumstances. If any collaborative partner were to terminate or breach our agreement with it, or otherwise fail to complete its obligations in a timely manner, our chances of successfully commercializing our product candidates would be materially and adversely affected.

If our intellectual property rights do not adequately protect our products or product candidates, or if third parties claim we are infringing their intellectual property rights, others could compete against us more directly or we could be subject to significant litigation. Such results could prevent us from marketing our products or product candidates and hurt our profitability.

Our product and product candidates are protected by patents and patent applications. Our success depends in part on our ability to obtain patents or rights to patents, protect trade secrets, operate without infringing upon the proprietary rights of others, and prevent others from infringing on our patents, trademarks and other intellectual property rights. We will be able to protect our intellectual property from unauthorized use by third parties only to the extent that it is covered by valid and enforceable patents, trademarks and licenses. Patent protection generally involves complex legal and factual questions and, therefore, enforceability of patent rights cannot be predicted with certainty. Patents, if issued, may be challenged, invalidated or circumvented. Thus, any patents that we own or license from others may not provide adequate protection against competitors. In addition, any future patent applications may fail to result in patents being issued. Also, those patents that are issued may not provide us with adequate proprietary protection or competitive advantages against competitors with similar product candidates. Moreover, the laws of certain foreign countries do not protect intellectual property rights to the same extent as do the laws of the United States.

In addition to patents and trademarks, we rely on trade secrets and proprietary know-how. We seek protection of these rights, in part, through confidentiality and proprietary information agreements. These agreements may not provide meaningful protection or adequate remedies for violation of our rights in the event of unauthorized use or disclosure of confidential and proprietary information. Failure to protect our proprietary rights could seriously impair our competitive position.

In the event of an infringement or violation, we may face litigation and may be prevented from pursuing product development or commercialization. We may receive in the future, notice of claims of infringement of other parties' proprietary rights. We may not have the financial resources to defend against claims of infringement by other parties or to prosecute third parties for infringement of our intellectual property. Infringement or other claims could be asserted or prosecuted against us in the future and it is possible that past or future assertions or prosecutions could harm our business.

Our product candidates are subject to substantial government regulation, including the regulation of nonclinical testing and clinical trials. If we are unable to obtain regulatory approval for our product candidates, we will be unable to generate revenues.

The production and marketing of products which may be developed from our MU1140 homologs, from our Lantibiotics Program and Oral Mucositis Program or otherwise and our research and development, nonclinical testing and clinical trial activities are subject to extensive regulation and review by numerous governmental authorities. Most of the product candidates we are developing must undergo rigorous nonclinical testing and clinical trials and an extensive regulatory approval process before they can be marketed in the United States or internationally.

If we fail to obtain regulatory approval for our product candidates, we may have to cease further development. Clinical trials on our product candidates are expected to take several years to fully complete. The commencement or completion of nonclinical studies or clinical trials can be delayed or prevented for a number of reasons, including:

- an inability to raise sufficient capital to commence, conduct, or complete clinical trials;
- difficulties in finding a partner with the resources to support large and expensive clinical development and commercialization costs;
- findings in nonclinical trials;
- difficulties obtaining regulatory approval to commence a clinical trial or complying with conditions imposed by a regulatory authority regarding the scope or term of a clinical trial;

- delays in reaching or failing to reach agreement on acceptable terms with prospective contract research organizations, or CROs, and trial sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and trial sites;
- insufficient or inadequate supply or quality of a product candidate or other materials necessary to conduct our clinical trials;
- difficulties obtaining institutional review board, or IRB, approval to conduct a clinical trial at a prospective site;
- challenges recruiting and enrolling patients to participate in clinical trials for a variety of reasons, including the size and nature of patient population, proximity of patients to clinical sites, eligibility criteria for the trial, nature of the trial protocol, the availability of approved effective treatments for the relevant condition and competition from other clinical trial programs for similar indications;
- severe or unexpected drug or biologic-related side effects experienced by patients in a clinical trial; and
- difficulties retaining patients who have enrolled in a clinical trial but may be prone to withdraw due to rigors of the trial, lack of efficacy, side effects, or personal issues, or who are lost to further follow up.

Clinical trials also may be delayed or terminated as a result of ambiguous or negative interim results. In addition, a clinical trial may be suspended or terminated by us, the FDA, the IRBs at the sites where the IRBs are overseeing a trial, or a data safety monitoring board, or DSMB, overseeing the clinical trial at issue, or other regulatory authorities due to a number of factors, including:

- failure to conduct the clinical trial in accordance with regulatory requirements or our clinical protocols;
- inspection of the clinical trial operations or trial sites by the FDA or other regulatory authorities;
- inspection of manufacturing and drug packaging operations by regulatory authorities;
- unforeseen safety issues or lack of effectiveness; and
- lack of adequate funding to continue the clinical trial.

We cannot assure you that clinical trials will demonstrate the safety or effectiveness of any of our product candidates, or will otherwise satisfy regulatory requirements. Our nonclinical studies or clinical trials may produce negative or inconclusive results, there may be inconsistencies between early clinical trial results and results obtained in later clinical trials, and we may decide, or regulators may require us, to conduct additional nonclinical studies or clinical trials. Moreover, nonclinical and clinical data are often susceptible to varying interpretations and analyses, and many companies that have believed their product candidates performed satisfactorily in nonclinical studies and clinical trials have nonetheless failed to obtain FDA approval for their products. If we are unable to resolve the FDA's concerns, we will not be able to obtain regulatory approval for these product candidates.

The pre-marketing approval process can be particularly expensive, uncertain and lengthy, and a number of products for which FDA or other governmental regulatory approval has been sought by other companies have never been approved for marketing. In addition to testing and approval procedures, extensive regulations also govern marketing, manufacturing, distribution, labeling, and record-keeping procedures. If we do not comply with applicable regulatory requirements, such violations could result in warning letters, non-approval, suspensions of regulatory approvals or ongoing clinical trials, civil penalties and criminal fines, product seizures and recalls, operating restrictions, injunctions, and criminal prosecution.

We may encounter such delays and rejection of our product candidates by the FDA or other regulatory authority may also adversely affect our business. Such delays or rejection may be encountered due to, among other reasons, government or regulatory delays, lack of efficacy during clinical trials, unforeseen safety issues, or changes in regulatory policy during the period of product development. More stringent regulatory approval processes in product clearance and enforcement activities could result in our experiencing longer approval cycles, more uncertainty, greater risk, and higher expenses. Even if regulatory approval of a product is granted, this approval may entail limitations on uses for which the product may be labeled and promoted. It is possible, for example, that we may not receive FDA approval to market products based on our licensed, patented product candidates for different indications or to market updated products that represent extensions of our basic product candidates. In addition, we may not receive FDA approval to export our products based on our licensed, patented product candidates in the future, and countries to which products are to be exported may not approve them for import.

From time to time, legislative or regulatory proposals are introduced that could alter the review and approval process relating to our product candidates. It is possible that the applicable regulatory authority will issue additional regulations further restricting the sale of our product candidates. Any change in legislation or regulations that govern the review and approval process relating to our future product candidates could make it more difficult and costlier to obtain approval for new products based on our product candidates, or to produce, market, and distribute such products if approved.

We may be unable to obtain regulatory approval for AG013 or other early-stage product candidates under applicable regulatory requirements. The FDA and foreign regulatory bodies have substantial discretion in the approval process, including the ability to delay, limit or deny approval of product candidates. The delay, limitation or denial of any regulatory approval would adversely impact commercialization, our potential to generate revenue, our business and our operating results.

We are not permitted to market any of our current product candidates in the United States until we receive approval of an NDA or BLA from the FDA. We are also not permitted to market any of our current product candidates in any foreign countries until we receive the requisite approval from the applicable regulatory authorities of such countries. Failure to obtain such regulatory approvals will delay or prevent us from commercializing any of our current or future product candidates.

To gain approval to market a new drug such as OG716, or a new biological product such as AG013, we must provide the FDA and/or foreign regulatory authorities with, among other things, extensive preclinical and clinical data that adequately demonstrates the safety and efficacy of the drug in its intended indication and information to demonstrate the adequacy of the manufacturing methods to assure the drug's identity, strength, quality and purity. The development and approval of new drug product candidates involves a long, expensive and uncertain process, and delay or failure can occur at any stage. A number of companies in the pharmaceutical and biopharmaceutical industries have suffered significant setbacks in clinical trials, including in Phase 3 clinical development, even after promising results in earlier preclinical studies or clinical trials. These setbacks have been caused by, among other things, observations during clinical trials regarding safety or efficacy, such as previously unreported adverse events. Success in preclinical testing and early clinical trials does not ensure success in later clinical trials, and the results of clinical trials by other parties may not be indicative of the results in trials we may conduct. Further, different results may be achieved depending upon whether the "per protocol", or PP, analysis is used to report data results or whether the "modified intent-to-treat," or MITT, approach is used. Accordingly, regardless of the outcome of any Phase 2 trials, our Phase 3 trials may not be successful.

In the case of our product candidate, AG013, because it is a biological product, in order to ensure product consistency, quality, and purity, we must ensure the manufacturing process remains substantially the same over time. The systems used to produce biological products can be sensitive to very minor changes in the manufacturing process. Small process differences can significantly affect the nature of the finished biological product, and more importantly, the way it functions in the body. We will have to tightly control the source and nature of starting materials, and consistently employ numerous process controls that assure predictable manufacturing outcomes. Our ability to ensure that the manufacturing process remains stable over time may be difficult to establish. In addition, for a novel biological product, there may be uncertainties regarding the size and design of our clinical trials to establish safety, efficacy, purity or potency, and there are no assurances that data generated in any clinical trials we might conduct will be acceptable to the FDA or foreign regulatory bodies to support marketing approval.

The FDA and foreign regulatory bodies have substantial discretion in the drug approval process, including the ability to delay, limit or deny approval of product candidates for many reasons. The FDA or the applicable foreign regulatory body may:

- disagree with the design or implementation of one or more clinical trials;
- decline to deem a product candidate safe and effective for its proposed indication, or deem a product candidate's safety or other perceived risks to outweigh its clinical or other benefits.
- find the data from preclinical studies and clinical trials does not sufficiently support approval, or the results of clinical trials may not meet the level of statistical or clinical significance required for approval;
- disagree with our interpretation of data from preclinical studies or clinical trials performed by us or third parties;
- determine the data collected from clinical trials are insufficient to support the submission or approval of an NDA or other applicable regulatory filing.
- require additional preclinical studies or clinical trials;
- identify deficiencies in the formulation, quality control, labeling or specifications of our current or future product candidates;
- grant approval contingent on the performance of costly additional post-approval clinical trials;
- approve our current or any future product candidates for a more limited indication or a narrower patient population than we originally requested or with strong warnings that may affect marketability;

- decline to approve the labeling that we believe is necessary or desirable for the successful commercialization of our product candidates;
- require a Risk Evaluation and Mitigation Strategy, or REMS, with monitoring requirements or distribution limitations. For example, it is possible that the FDA could require distribution controls in the approval, if any, of our product candidates to prevent inadvertent exposure to pregnant women;
- decline to approve of the manufacturing processes, controls or facilities of third-party manufacturers or testing labs with whom we contract; or
- change its approval policies or adopt new regulations in a manner rendering our clinical data or regulatory filings insufficient for approval.

Any delay, limitation or denial of any regulatory approval would adversely impact commercialization, our potential to generate revenue, our business and our operating results.

Delays or difficulties in the enrollment of patients in clinical trials may result in additional costs and delays in our ability to generate significant revenues, and may delay or prevent our receipt of any regulatory approvals necessary to commercialize our planned and future products.

We may not be able to initiate or continue, or complete in a timely fashion clinical trials for AG013 or other product candidates if we are unable to locate and enroll a sufficient number of eligible patients to participate in these trials as required by the FDA or similar regulatory authorities outside the United States. In addition, some of our competitors are currently conducting clinical trials for product candidates that treat the same indications as AG013, and patients who are otherwise eligible for our clinical trials may instead enroll in clinical trials of our competitors' product candidates.

Patient enrollment is affected by other factors including:

- the severity of the disease under investigation;
- the eligibility criteria for the study in question;
- the perceived risks and benefits of the product candidate under study;
- the efforts to facilitate timely enrollment in clinical trials;
- the patient referral practices of physicians;
- the ability to monitor patients adequately during and after treatment; and
- the proximity and availability of clinical trial sites for prospective patients.

Our inability to enroll a sufficient number of patients for our clinical trials would result in significant delays, could require us to abandon one or more clinical trials altogether and could delay or prevent our receipt of necessary regulatory approvals. Enrollment delays in our clinical trials may result in increased development costs for our product candidates, which would cause the value of our company to decline and impede our ability to obtain additional financing.

Use of Patient Reported Outcome ("PROs") in our AG013 clinical trials may delay the development of AG013 or increase our development costs.

Due to the difficulty of objectively measuring the efficacy of AG013, PROs may have an important role in the development and regulatory approval of our AG013 product candidate. PROs involve patients' subjective assessments of efficacy, and this subjectivity increases the uncertainty in determining clinical endpoints. Such assessments can be influenced by factors outside of our control, and can vary widely from day-to-day for a particular patient, and from patient-to-patient and site-to-site within a clinical trial. Furthermore, we intend to use PROs in our planned Phase 2 clinical program for AG013 and if the FDA does not accept or requires changes to the PRO, this could delay clinical development of AG013, increase our costs and necessitate additional clinical trials.

We have limited experience in the conduct of clinical trials and have never obtained approval of any product candidates, and may be unable to do so successfully.

As a company, we have limited experience in conducting clinical trials or progressing a product candidate through to regulatory approval. In part because of this lack of experience, our clinical trials may require more time and incur greater costs than we anticipate. We cannot be certain that planned clinical trials will begin or conclude on time, if at all. Large-scale trials would require significant additional financial and management resources, and reliance on third-party clinical investigators, CROs and/or consultants. Any performance failure on the part of such third parties could delay clinical development or delay or prevent us from obtaining regulatory approval or commercializing our current or future product candidates, depriving us of potential product revenue and resulting in additional losses.

Any product candidates that we commercialize will be subject to ongoing and continued regulatory review.

Even after we achieve U.S. regulatory approval for a product candidate, if any, we will be subject to continued regulatory review and compliance obligations. For example, the FDA may impose significant restrictions on the approved indicated uses for which our product candidates may be marketed or on the conditions of approval. A product candidate's approval may contain requirements for potentially costly post-approval studies and surveillance, including Phase 4 clinical trials or a REMS to monitor the safety and efficacy of the product. We will also be subject to ongoing FDA obligations and continued regulatory review with respect to, among other things, the manufacturing, processing, labeling, packaging, distribution, adverse event reporting, storage, advertising, promotion and recordkeeping for our product candidates. These requirements include submissions of safety and other post-marketing information and reports, registration, continued compliance with the FDA's good clinical practice, or GCP, requirements and good laboratory practice requirements, which are regulations and guidelines the FDA would apply to all of our product candidates in clinical and preclinical development, along with any clinical trials that we conduct post-approval, and continued compliance with the FDA's cGMP requirements pursuant to which manufacturing facilities are subject to continual review and periodic inspections by the FDA. To the extent that a product candidate is approved for sale in other countries, we may be subject to similar restrictions and requirements imposed by laws and government regulators in those countries.

If we, our product candidates or the manufacturing facilities for our product candidates fail to comply with applicable regulatory requirements, a regulatory agency may:

- impose restrictions on the marketing or manufacturing of the product, suspend or withdraw product approvals or revoke necessary licenses;
- issue warning letters, show cause notices or untitled letters describing alleged violations, which may be publicly available;
- mandate modifications to promotional materials or require us to provide corrective information to healthcare practitioners;
- require us to enter into a consent decree, which can include imposition of various fines, reimbursements for inspection costs, required due dates for specific actions and penalties for noncompliance; commence criminal investigations and prosecutions;
- impose injunctions;
- impose other civil or criminal penalties;
- suspend any ongoing clinical trials;
- delay or refuse to approve pending applications or supplements to approved applications filed by us;
- refuse to permit drugs or active ingredients to be imported or exported to or from the United States;
- suspend or impose restrictions on operations, including costly new manufacturing requirements; or
- seize or detain products or require us to initiate a product recall.

The regulations, policies or guidance of the FDA and other applicable government agencies may change and new or additional statutes or government regulations may prevent or delay regulatory approval of our product candidates or further restrict or regulate post-approval activities. We cannot predict the likelihood, nature or extent of adverse government regulation that may arise from future legislation or administrative action, either in the United States or abroad. If we are not able to achieve and maintain regulatory compliance, we may not be permitted to market our product candidates, which would materially and adversely affect our ability to generate revenue and achieve or maintain profitability.

Our product candidates may cause serious or undesirable side effects or possess other unexpected properties that could delay or prevent their regulatory approval, limit the commercial profile of approved labeling or result in post-approval regulatory action.

Unforeseen side effects from any of our product candidates could arise either during clinical development or, if approved, after marketing such product. Undesirable side effects caused by product candidates could cause us or regulatory authorities to interrupt, modify, delay or halt clinical trials and could result in a more restrictive label or the delay or denial of regulatory approval by the FDA or comparable foreign authorities. Results of clinical trials could reveal a high and unacceptable severity and prevalence of side effects. In such an event, trials could be suspended or terminated and the FDA or comparable foreign regulatory authorities could order us to cease further development of or deny approval of product candidates for any or all targeted indications. The drug-related side effects could affect patient recruitment or the ability of enrolled patients to complete the trial or result in product liability claims. Any of these occurrences may harm our business, financial condition, operating results and prospects.

Additionally, if we or others identify undesirable side effects, or other previously unknown problems, caused by our product candidates after obtaining U.S. or foreign regulatory approval or other products with the same or related active ingredients, a number of potentially negative consequences could result, including:

- regulatory authorities may withdraw their approval of the product;
- regulatory authorities may require a recall of the product or we may voluntarily recall a product;
- regulatory authorities may require the addition of warnings or contraindications in the product labeling, narrowing of the indication in the product label or issuance of field alerts to physicians and pharmacies;
- we may be required to create a medication guide outlining the risks of such side effects for distribution to patients or institute a REMS;
- we may be subject to limitations as to how we promote the product;
- we may be required to change the way the product is administered or modify the product in some other way;
- the FDA or applicable foreign regulatory authority may require additional clinical trials or costly post-marketing testing and surveillance to monitor the safety or efficacy of the product;
- sales of the product may decrease significantly;
- we could be sued and held liable for harm caused to patients; and
- our brand and reputation may suffer.

Any of the above events could prevent us from achieving or maintaining market acceptance of the affected product candidate and could substantially increase the costs of commercializing our product candidates.

If any of our product candidates are approved for marketing and we are found to have improperly promoted off-label uses, or if physicians misuse our products or use our products off-label, we may become subject to prohibitions on the sale or marketing of our products, product liability claims and significant fines, penalties and sanctions, and our brand and reputation could be harmed.

The FDA and other regulatory agencies strictly regulate the marketing and promotional claims that are made about drug products. In particular, a product may not be promoted for uses or indications that are not approved by the FDA or such other regulatory agencies as reflected in the product's approved labeling. If we are found to have promoted off-label uses of any of our product candidates, we may receive warning or untitled letters and become subject to significant liability, which would materially harm our business. Both federal and state governments have levied large civil and criminal fines against companies for alleged improper promotion and have enjoined several companies from engaging in off-label promotion. If we become the target of such an investigation or prosecution based on our marketing and promotional practices, we could face similar sanctions, which would materially harm our business. In addition, management's attention could be diverted from our business operations, significant legal expenses could be incurred and our brand and reputation could be damaged. The FDA has also requested that companies enter into consent decrees or permanent injunctions under which specified promotional conduct is changed or curtailed. If we are deemed by the FDA to have engaged in the promotion of our products for off-label use, we could be subject to FDA regulatory or enforcement actions, including the issuance of an untitled letter, a warning letter, injunction, seizure, civil fine or criminal penalties. It is also possible that other federal, state or foreign enforcement authorities might take action if they determine our business activities constitute promotion of an off-label use, which could result in significant penalties, including criminal, civil or administrative penalties, damages, fines, disgorgement, exclusion from participation in government healthcare programs and the curtailment or restructuring of our operations.

We cannot, however, prevent a physician from using our product candidates in ways that fall outside the scope of the approved indications, as he or she may deem appropriate in his or her medical judgment. Physicians may also misuse our product candidates or use improper techniques, which may lead to adverse results, side effects or injury and, potentially, subsequent product liability claims. Furthermore, the use of our product candidates for indications other than those cleared by the FDA and/or other regulatory agencies may not effectively treat such conditions, which could harm our brand and reputation among both physicians and patients.

We may also be subject to healthcare laws, regulation and enforcement and our failure to comply with those laws could adversely affect our business, operations and financial condition.

Certain federal and state healthcare laws and regulations pertaining to fraud and abuse and patients' rights are and will be applicable to our business. We are subject to regulation by both the federal government and the states in which we conduct our business. The laws and regulations that may affect our ability to operate include:

- the federal healthcare program anti-kickback statute, which prohibits, among other things, any person or entity from knowingly and willfully offering, soliciting, receiving or providing any remuneration (including any kickback, bribe or rebate), directly or indirectly, overtly or covertly, in cash or in kind, to induce either the referral of an individual or in return for the purchase, lease, or order of any good, facility item or service, for which payment may be made, in whole or in part, under federal healthcare programs such as the Medicare and Medicaid programs;
- federal civil and criminal false claims laws and civil monetary penalty laws, including, for example, the United States False Claims Act, which impose criminal and civil penalties, including civil whistleblower or qui tam actions, against individuals or entities for, among other things, knowingly presenting, or causing to be presented, to the federal government, including the Medicare and Medicaid programs, 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, as amended by the Health Information Technology for Economic and Clinical Health Act, or HIPAA, which prohibits knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program or obtain, by means of false or fraudulent pretenses, representations or promises, any of the money or property owned by, or under the custody or control of, any healthcare benefit program, regardless of the payor (i.e., public or private), knowingly and willfully embezzling or stealing from a health care benefit program, willfully obstructing a criminal investigation of a health care offense and knowingly and willfully falsifying, concealing or covering up by any trick or device a material fact or making any materially false statements in connection with the delivery of, or payment for, healthcare benefits, items or services relating to healthcare matters;
- HIPAA and related implementing regulations, which impose obligations on covered entities, including healthcare providers, health plans, and healthcare clearinghouses, as well as their respective business associates that create, receive, maintain or transmit individually identifiable health information for or on behalf of a covered entity, with respect to safeguarding the privacy, security and transmission of individually identifiable health information;
- the federal physician sunshine requirements under the Patient Protection and Affordable Care Act, or ACA, which require manufacturers of drugs, devices, biologics and medical supplies to report annually to the Centers for Medicare & Medicaid Services information related to payments and other transfers of value provided to physicians and teaching hospitals, and ownership and investment interests held by physicians and their immediate family members, with such information published on a searchable website on an annual basis; and
- state law equivalents of each of the above federal laws, such as anti-kickback and false claims laws, which may apply to items or services reimbursed by any third-party payor, including commercial insurers; state laws that require pharmaceutical companies to comply with the pharmaceutical industry's voluntary compliance guidelines and the applicable compliance guidance promulgated by the federal government, or otherwise restrict payments that may be provided 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 healthcare providers or marketing expenditures; and state laws governing the privacy and security of health information in certain 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 recently enacted ACA, among other things, amended the intent requirement of the federal anti-kickback statute and certain criminal healthcare fraud statutes. A person or entity no longer needs to have actual knowledge of the statute or specific intent to violate it. In addition, 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 federal civil False Claims Act.

Achieving and sustaining compliance with these laws may prove costly. In addition, any action against us for violation of these laws, even if we successfully defend against it, could cause us to incur significant legal expenses and divert our management's attention from the operation of our business. If our operations are found to be in violation of any of the laws described above or any other governmental laws or regulations that apply to us, we may be subject to penalties, including administrative, civil and criminal penalties, damages, fines, disgorgement, the exclusion from participation in federal and state healthcare programs, individual imprisonment or the curtailment or restructuring of our operations, any of which could materially and adversely affect our ability to operate our business and our financial results.

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

We are exposed to the risk that our employees, independent contractors, principal investigators, consultants, vendors and CROs may engage in fraudulent or other illegal activity. Misconduct by these persons could include intentional, reckless or negligent conduct or unauthorized activity that violates: laws or regulations, including those laws requiring the reporting of true, complete and accurate information to the FDA or foreign regulatory authorities; manufacturing standards; federal, state and foreign healthcare fraud and abuse laws and data privacy; or laws that require the true, complete and accurate reporting of financial information or data. In particular, sales, marketing and other business arrangements in the healthcare industry are subject to extensive laws intended to prevent fraud, kickbacks, self-dealing and other abusive practices. These laws may restrict or prohibit a wide range of business activities, including research, manufacturing, distribution, pricing, discounting, marketing and promotion, sales commission, customer incentive programs and other business arrangements. Activities subject to these laws also involve the improper use of information obtained in the course of clinical trials, or illegal misappropriation of drug product, which could result in regulatory sanctions or other actions or lawsuits stemming from a failure to comply with such laws or regulations, and serious harm to our reputation. In addition, federal procurement laws impose substantial penalties for misconduct in connection with government contracts and require certain contractors to maintain a code of business ethics and conduct. If any such actions are instituted against us, we may have to terminate employees or others involved and the impact of such termination can result in our experiencing delays and additional costs associated with replacing the services being provided. If we are not successful in defending ourselves or asserting our rights, those actions could have a significant impact on our business, including the imposition of civil, criminal and administrative penalties, damages, monetary fines, possible exclusion from participation in Medicare, Medicaid and other federal healthcare programs, FDA debarment, 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 operating results.

Even if our current product candidates or any future product candidates obtain regulatory approval, they may fail to achieve the broad degree of physician and patient adoption and use necessary for commercial success.

The commercial success of any of our current or future product candidates, if approved, will depend significantly on the broad adoption and use of the resulting product by physicians and patients for approved indications, and may not be commercially successful. The degree and rate of physician and patient adoption of our current or future product candidates, if approved, will depend on a number of factors, including:

- the clinical indications for which the product is approved and patient demand for approved products that treat those indications;
- the effectiveness of our product as compared to other available therapies;
- the availability of coverage and adequate reimbursement from managed care plans and other healthcare payors for any of our product candidates that may be approved;
- the cost of treatment with our product candidates in relation to alternative treatments and willingness to pay for the product, if approved, on the part of patients;
- acceptance by physicians, major operators of clinics and patients of the product as a safe and effective treatment;

- physician and patient willingness to adopt a new therapy over other available therapies to treat approved indications;
- in the case of oral mucositis, patients' perceptions of the condition as one for which medical treatment may be appropriate and a prescription therapy may be available;
- overcoming any biases physicians or patients may have toward particular therapies for the treatment of approved indications;
- proper training and administration of our product candidates by physicians and medical staff;
- patient satisfaction with the results and administration of our product candidates and overall treatment experience;
- the willingness of patients to pay for certain of our product candidates relative to other discretionary items, especially during economically challenging times;
- the revenue and profitability that our product candidate may offer a physician as compared to alternative therapies;
- the prevalence and severity of side effects;
- limitations or warnings contained in the FDA-approved labeling for our product candidates;
- any FDA requirement to undertake a REMS;
- the effectiveness of our sales, marketing and distribution efforts;
- adverse publicity about our product candidates or favorable publicity about competitive products; and
- potential product liability claims.

If any of our current or future product candidates are approved for use but fail to achieve the broad degree of physician and patient adoption necessary for commercial success, our operating results and financial condition will be adversely affected, which may delay, prevent or limit our ability to generate revenue and continue our operations.

If we are unable to achieve and maintain coverage and adequate levels of reimbursement for any of our product candidates for which we receive regulatory approval, or any future products we may seek to commercialize, their commercial success may be severely hindered.

As to any of our product candidates that become available by prescription only, our success will depend on the availability of coverage and adequate reimbursement for our product from third-party payors. Patients who are prescribed medicine for the treatment of their conditions generally rely on third-party payors to reimburse all or part of the costs associated with their prescription drugs. The availability of coverage and adequate reimbursement from governmental healthcare programs, such as Medicare and Medicaid, and private third-party payors is critical to new product acceptance. Coverage decisions may depend upon clinical and economic standards that disfavor new drug products when more established or lower cost therapeutic alternatives are already available or subsequently become available. If any of our product candidates fail to demonstrate attractive efficacy profiles, they may not qualify for coverage and reimbursement. Even if we obtain coverage for a given product, the resulting reimbursement payment rates might not be adequate or may require co-payments that patients find unacceptably high. Patients are unlikely to use our prescription-only products unless coverage is provided and reimbursement is adequate to cover a significant portion of the cost of our products.

In addition, the market for certain of our product candidates will depend significantly on access to third-party payors' drug formularies, or lists of medications for which third-party payors provide coverage and reimbursement. The industry competition to be included in such formularies often leads to downward pricing pressures on pharmaceutical companies. Also, third-party payors may refuse to include a particular branded drug in their formularies or otherwise restrict patient access to a branded drug when a less costly generic equivalent or another alternative is available.

Further, third-party payors, whether foreign or domestic, or governmental or commercial, are developing increasingly sophisticated methods of controlling healthcare costs. In addition, in the United States, although private third-party payors tend to follow Medicare, no uniform policy of coverage and reimbursement for drug products exists among third-party payors. Therefore, coverage and reimbursement for drug products can differ significantly from payor to payor. As a result, the coverage determination process is often a time-consuming and costly process that will require us to provide scientific and clinical support for the use of our product candidates to each payor separately, with no assurance that coverage and adequate reimbursement will be obtained.

Further, we believe that future coverage and reimbursement will likely be subject to increased restrictions in both the United States and in international markets. Third-party coverage and reimbursement for any of our product candidates for which we may receive regulatory approval may not be available or adequate in either the United States or international markets, which could harm our business, financial condition, operating results and prospects.

Our product candidates, if approved, will face significant competition and our failure to compete effectively may prevent us from achieving significant market penetration.

The pharmaceutical industry is characterized by rapidly advancing technologies, intense competition and a strong emphasis on developing proprietary therapeutics. Numerous companies are engaged in the development, patenting, manufacturing and marketing of healthcare products competitive with those that we are developing. We face competition from a number of sources, such as pharmaceutical companies, including generic drug companies, biotechnology companies and academic and research institutions, many of which have greater financial resources, marketing capabilities, sales forces, manufacturing capabilities, research and development capabilities, clinical trial expertise, intellectual property portfolios, experience in obtaining patents and regulatory approvals for product candidates and other resources than us. Some of the companies that offer competing products also have a broad range of other product offerings, large direct sales forces and long-term customer relationships with our target physicians, which could inhibit our market penetration efforts. In addition, certain of our product candidates, if approved, may compete with other products, for a share of some patients' discretionary budgets and for physicians' attention within their clinical practices.

We anticipate that, if we obtain regulatory approval of our product candidates, we will face significant competition from other approved therapies and may need to compete with unregulated, unapproved and off-label treatments. Certain of our product candidates, if approved, will present novel therapeutic approaches for the approved indications and will have to compete with existing therapies, some of which are widely known and accepted by physicians and patients. To compete successfully in this market, we will have to demonstrate that the relative cost, safety and efficacy of our approved products, if any, provide an attractive alternative to existing and other new therapies. Such competition could lead to reduced market share for our product candidates and contribute to downward pressure on the pricing of our product candidates, which could harm our business, financial condition, operating results and prospects.

Due to less stringent regulatory requirements in certain foreign countries, there are many more products and procedures available for use in those international markets than are approved for use in the United States. In certain international markets, there are also fewer limitations on the claims that our competitors can make about the effectiveness of their products and the manner in which they can market them. As a result, we expect to face more competition in these markets than in the United States.

We may face product liability exposure, and if successful claims are brought against us, we may incur substantial liability if our insurance coverage for those claims is inadequate.

We face an inherent risk of product liability as a result of the clinical testing of our product candidates and will face an even greater risk if we commercialize any products. This risk exists even if a product is approved for commercial sale by the FDA and manufactured in facilities regulated by the FDA or an applicable foreign regulatory authority. Our products and product candidates are designed to affect bodily functions and processes. Any side effects, manufacturing defects, misuse or abuse associated with our product candidates could result in injury and possibly death to a patient. An inability to obtain sufficient insurance coverage on commercially reasonable terms or otherwise to protect against potential product liability claims could inhibit our business.

In addition, a liability claim may be brought against us even if our product candidates merely appear to have caused an injury. Product liability claims may be brought against us by consumers, healthcare providers, pharmaceutical companies or others selling or otherwise coming into contact with our product candidates, among others. If we cannot successfully defend ourselves against product liability claims we will incur substantial liabilities and reputational harm. In addition, regardless of merit or eventual outcome, product liability claims may result in:

- withdrawal of clinical trial participants;
- termination of clinical trial sites or entire trial programs;
- the inability to commercialize our product candidates;
- decreased demand for our product candidates;
- impairment of our brand and/or reputation;

- product recall or withdrawal from the market or labeling, marketing or promotional restrictions;
- substantial costs of any related litigation or similar disputes;
- distraction of management’s attention and other resources from our primary business;
- substantial monetary awards to patients or other claimants against us that may not be covered by insurance; or
- loss of revenue.

Although we maintain product liability insurance coverage for clinical trials, our insurance coverage may not be sufficient to cover all of our product liability-related expenses or losses and may not cover us for any expenses or losses we suffer. Moreover, insurance coverage is becoming increasingly expensive, and, in the future, we may not be able to maintain insurance coverage at a reasonable cost, in sufficient amounts or upon adequate terms to protect us against losses due to product liability, particularly if any of our product candidates receive regulatory approval. Further, a successful product liability claim or series of claims brought against us could cause our stock price to decline and, if judgments exceed our insurance coverage, could decrease our cash and harm our business, financial condition, operating results and prospects.

We may choose not to continue developing or commercializing any of our product candidates at any time during development or after approval, which would reduce or eliminate our potential return on investment for those product candidates.

At any time, we may decide to discontinue the development or commercialization of any of our products or product candidates for a variety of reasons, including inadequate financial resources the appearance of new technologies that render our product obsolete, competition from a competing product or changes in or failure to comply with applicable regulatory requirements. If we terminate a program in which we have invested significant resources, we will not receive any return on our investment and we will have missed the opportunity to allocate those resources to potentially more productive uses.

Failure to obtain marketing approval in international jurisdictions would prevent our product candidates from being marketed abroad.

In order to market and sell our products in the European Union and many other jurisdictions, we or our third-party collaborators must obtain separate marketing approvals and comply with numerous and varying regulatory requirements. The approval procedure varies among countries and can involve additional testing. The time required to obtain approval may differ substantially from that required to obtain FDA approval. The regulatory approval process outside the United States generally includes all of the risks associated with obtaining FDA approval. In addition, in many countries outside the United States, it is required that the product be approved for reimbursement before the product can be approved for sale in that country. We or these third parties may not obtain approvals from regulatory authorities outside the United States on a timely basis, if at all. Approval by the FDA does not ensure approval by regulatory authorities in other countries or jurisdictions, and approval by one regulatory authority outside the United States does not ensure approval by regulatory authorities in other countries or jurisdictions or by the FDA. We may not be able to file for marketing approvals and may not receive necessary approvals to commercialize our products in any market.

We will need to further increase the size and complexity of our organization in the future, and we may experience difficulties in executing our growth strategy and managing our growth.

Our current management, personnel, systems and facilities are not adequate to support our future growth plans. We will need to further expand our scientific, sales and marketing, operational, financial and other resources to support our planned research, development, clinical trial work, and commercialization activities.

To manage our operations, growth and various projects effectively, we must:

- continue to improve our operational, financial, management and regulatory compliance controls and reporting systems and procedures;
- attract and retain sufficient numbers of talented employees;
- develop a marketing, sales, and distribution capability;
- manage our commercialization activities for our product candidates effectively;
- establish and maintain relationships with development and commercialization partners;

- manage our preclinical and clinical trials effectively;
- manage our third-party supply and manufacturing operations effectively and in a cost-effective manner, while increasing production capabilities for our current product candidates to commercial levels; and
- manage our development efforts effectively while carrying out our contractual obligations to partners and other third parties.

In addition, we have utilized and continue to utilize the services of part-time outside consultants to perform a number of tasks for us, including tasks related to preclinical and clinical testing. Our growth strategy may also entail expanding our use of consultants to implement these and other tasks going forward. We rely on consultants for certain functions of our business and will need to effectively manage these consultants to ensure that they successfully carry out their contractual obligations and meet expected deadlines. There can be no assurance that we will be able to manage our existing consultants or find other competent outside consultants, as needed, on economically reasonable terms, or at all. If we are not able to manage our growth effectively and expand our organization by hiring new employees and expanding our use of consultants, we might be unable to implement successfully the tasks necessary to execute effectively on our planned research, development and commercialization activities and, accordingly, might fail to achieve our research, development and commercialization goals.

We may be adversely affected by natural disasters and other catastrophic events, and by man-made problems such as terrorism, that could disrupt our business operations and our business continuity and disaster recovery plans may not adequately protect us from a serious disaster.

Our corporate headquarters are located in Tampa, Florida, a hurricane zone. If a disaster, power outage or other event occurred that prevented us from using all or a significant portion of our headquarters, that damaged critical infrastructure, such as enterprise financial systems, manufacturing resource planning or enterprise quality systems, or that otherwise disrupted operations, it may be difficult or, in certain cases, impossible for us to continue our business for a substantial period of time. Our contract manufacturers' and suppliers' facilities are located in multiple locations, where other natural disasters or similar events, such as blizzards, tornadoes, fires, explosions or large-scale accidents or power outages, could severely disrupt our operations and have a material adverse effect on our business, financial condition, operating results and prospects. In addition, acts of terrorism and other geo-political unrest could cause disruptions in our business or the businesses of our partners, manufacturers or the economy as a whole. All of the aforementioned risks may be further increased if we do not implement a disaster recovery plan or our partners' or manufacturers' disaster recovery plans prove to be inadequate. To the extent that any of the above should result in delays in the regulatory approval, manufacture, distribution or commercialization of our product candidates, our business, financial condition, operating results and prospects would suffer.

Our business and operations would suffer in the event of cybersecurity/information systems risk.

Despite the implementation of security measures, our internal computer systems, and those of our manufacturers and other third parties on which we rely, are vulnerable to damage from computer viruses, unauthorized access, natural disasters, fire, terrorism, successful breaches, employee malfeasance, or human or technological error, war and telecommunication and electrical failures. In addition, our systems safeguard important confidential personal data regarding our subjects. If a disruption event were to occur and cause interruptions in our operations, it could result in a material disruption of our drug development programs. For example, the loss of clinical trial data from completed, ongoing or planned clinical trials 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 results in a loss of or damage to our data or applications, or inappropriate disclosure of confidential or proprietary information, we could incur liability and the further development of our product candidates could be delayed.

We may incur costs of addressing a cybersecurity incident.

Cybersecurity incidents have increased in number and severity recently and it is expected that these trends will continue. Should we be affected by such an incident, we may incur substantial costs and suffer other negative consequences, which may include:

- investigation costs and costs to engage specialized consultants;
- remediation costs, such as liability for stolen assets or information, repairs of system damage, and incentives to customers or business partners in an effort to maintain relationships after an attack; and
- litigation and legal risks, including regulatory actions by state and federal regulators.

Changes in patent law or patent jurisprudence could diminish the value of patents in general, thereby impairing our ability to protect our product candidates.

The United States has recently enacted and is currently implementing wide-ranging patent reform legislation. Further, recent United States Supreme Court rulings have either narrowed the scope of patent protection available in certain circumstances or weakened the rights of patent owners in certain 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 scope and value of patents, once obtained.

For our U.S. patent applications containing a priority claim after March 16, 2013, there is a greater level of uncertainty in the patent law. In September 2011, the Leahy-Smith America Invents Act, also known as the America Invents Act, or AIA, was signed into law. The AIA includes a number of significant changes to U.S. patent law, including provisions that affect the way patent applications will be prosecuted and may also affect patent litigation. The USPTO is currently developing regulations and procedures to govern administration of the AIA, and many of the substantive changes to patent law associated with the AIA. It is not clear what other, if any, impact(s) the AIA will have on the operation of our business. Moreover, the AIA and its implementation could increase the uncertainties and costs surrounding the prosecution of our patent applications and the enforcement or defense of our issued patents, all of which could have an adverse effect on our business. One important change introduced by the AIA is that, as of March 16, 2013, the United States transitioned to a “first-to-file” system for deciding which party should be granted a patent when two or more patent applications are filed by different parties claiming the same invention. A third party who files a patent application with the USPTO after such date but prior to us may therefore be awarded a patent covering an invention of ours even if we were the first to invent. This “first-inventor-to-file” system will require us both to remain cognizant, going forward, of the timing between invention and filing of a patent application.

Among some of the other changes introduced by the AIA are those that (i) limit where a patentee may file a patent infringement suit and (ii) provide opportunities for third parties to challenge any issued patent in the USPTO. Such changes apply to all of our U.S. patents, even those issued prior to March 16, 2013. Because of a lower evidentiary standard in USPTO proceedings, as compared to the evidentiary standard applied in U.S. federal courts, necessary to invalidate a patent claim, a third party could potentially present evidence in a USPTO proceeding sufficient for the USPTO to find a claim invalid, notwithstanding that the same evidence would be insufficient to invalidate a claim first presented in a district court action. Accordingly, a third party may attempt opportunistically to use USPTO procedures to invalidate our patent claims.

Depending on decisions by the United States Congress, the U.S. federal courts, the USPTO or similar authorities in foreign jurisdictions, the laws and regulations governing patents could change in unpredictable ways that may weaken our and our licensors’ abilities to obtain new patents or to enforce existing patents we and our licensors or partners may obtain in the future.

If we are unable to protect our trademarks from infringement, our business prospects may be harmed.

We have applied for trademark protection for trademarks in the United States, the European Union and China. Although we take steps to monitor the possible infringement or misuse of our trademarks, it is possible that third parties may infringe, dilute or otherwise violate our trademark rights. Any unauthorized use of our trademarks could harm our reputation or commercial interests. In addition, our enforcement against third-party infringers or violators may be unduly expensive and time-consuming, and any remedy obtained may constitute insufficient redress relative to the damages we may suffer.

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

Filing, prosecuting and defending patents on our product candidates in all countries throughout the world would be prohibitively expensive. The requirements for patentability may differ in certain countries, particularly developing countries. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as laws in the United States. Consequently, we may not be able to prevent third parties from practicing our inventions in all countries outside the United States. 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 insufficient to guard against such infringement. 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.

The legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents and other intellectual property protection, particularly those relating to pharmaceuticals. In such instances, we may be unable to enjoin or otherwise prevent infringement of our patents or marketing of competing products in violation of our proprietary rights, generally. Proceedings to enforce our patent rights in foreign jurisdictions could (i) result in substantial costs and divert our efforts and attention from other aspects of our business, (ii) put our patents at risk of being invalidated or interpreted narrowly and our patent applications at risk of not issuing and (iii) provoke third parties to assert claims against us. We may not prevail in any lawsuits that we initiate and the damages or other remedies awarded, if any, may not be commercially meaningful. In addition, certain countries in Europe and certain developing countries have compulsory licensing laws under which a patent owner may be compelled to grant licenses to third parties. In those countries, we may be unable to seek adequate remedies to address infringement and/or material diminishment of the value of our patents, which could limit our potential revenue opportunities in such jurisdictions. Accordingly, our efforts to establish or enforce our intellectual property rights around the world may be inadequate to obtain a significant commercial advantage from our intellectual property. Finally, our ability to protect and enforce our intellectual property rights may be adversely affected by unforeseen changes in foreign intellectual property laws.

If we fail to comply with our obligations under our intellectual property license agreements, we could lose our license rights that are important to our business and development of our product candidates.

We are a party to two ECC agreements that impose various royalty and other obligations on us. If we fail to comply with these obligations, our collaboration partners may have the right to terminate the license, in which event we may not be able to develop or market the affected product candidate. Both ECC agreements may be terminated in the event of a breach. The loss of such rights could materially adversely affect our business, financial condition, operating results and prospects.

If we are sued for infringing intellectual property rights of third parties, it will be costly and time-consuming and an unfavorable outcome in that litigation could have a material adverse effect on our business.

Our commercial success depends upon our ability to develop, manufacture, market, and sell our product candidates and use our proprietary technologies without infringing the proprietary rights of third parties. We cannot guarantee that marketing and selling such candidates and using such technologies will not infringe existing or future patents. Numerous U.S. and foreign issued patents and pending patent applications owned by third parties exist in the fields relating to our product candidates. As the biotechnology and pharmaceutical industries expand and more patents issue, the risk increases that others may assert that our product candidates, technologies or methods of delivery or use infringe their patent rights. Moreover, it is not always clear to industry participants, including us, which patents cover various drugs, biologics, drug delivery systems or their methods of use, and which of these patents may be valid and enforceable. Thus, due to the large number of patents issued and patent applications filed in our fields, third parties may allege they have patent rights encompassing our product candidates, technologies or methods.

In addition, our product candidates or proprietary technologies may infringe patents owned and/or filed by third parties, or third parties may allege such infringement. Because (i) some patent applications in the United States may be maintained in secrecy until the patents are issued, (ii) patent applications in the United States and many foreign jurisdictions are typically not published until 18 months after filing and (iii) publications in the scientific literature often lag behind actual discoveries, we cannot be certain that others have not filed patent applications for technology covered by our own and in-licensed issued patents or our pending applications. Our competitors may have filed, and may in the future file, patent applications covering our product candidates or technology similar to ours. Any such patent application may have priority over our own and in-licensed patent applications or patents, which could further require us to obtain rights to issued patents covering such technologies. If another party has filed a U.S. patent application on inventions similar to those owned or in-licensed to us, we or, in the case of in-licensed technology, the licensor may have to participate, in the United States, in an interference proceeding to determine priority of invention.

We may be exposed to, or threatened with, future litigation by third parties having patent or other intellectual property rights alleging that our product candidates or proprietary technologies infringe such third parties' intellectual property rights, including litigation resulting from filing under Paragraph IV of the Hatch-Waxman Act. Such lawsuits can be costly and could adversely affect our operating results and divert the attention of managerial and technical personnel, even if we do not infringe such patents or the patents asserted against us are later invalidated. A court may, however, decide that we are infringing the third party's patents and order us to cease the activities covered by the patents. In addition, there is a risk that a court will order us to pay to such third-party damages for having violated the other party's patents.

As a result of patent infringement claims, or to avoid potential claims, we may choose or be required to seek licenses from third parties. These licenses may not be available on commercially acceptable terms, or at all. Even if we are able to obtain a license, the license would likely obligate us to pay license fees or royalties or both, and the rights granted to us might be nonexclusive, which could result in our competitors gaining access to the same intellectual property, or such rights might be restrictive and limit our present and future activities. Ultimately, we or a licensee could be prevented from commercializing a product, or forced to cease some aspect of our business operations, if, as a result of actual or threatened patent infringement claims, we are unable to enter into licenses on acceptable terms.

In addition to possible infringement claims against us, we may become a party to other patent litigation and other proceedings, including interference, derivation, re-examination or other post-grant proceedings declared or granted by the USPTO, and similar proceedings in foreign countries, regarding intellectual property rights with respect to our current or future products.

There is a substantial amount of litigation involving patent and other intellectual property rights in the biotechnology and pharmaceutical industries, generally. To date, no litigation asserting infringement claims has ever been brought against us. If a third-party claims that we infringe its intellectual property rights, we may face a number of issues, including:

- infringement and other intellectual property claims which, regardless of merit, may be expensive and time-consuming to litigate and may divert our management's attention from our core business;
- substantial damages for infringement, which we may have to pay if a court decides that the product or technology at issue infringes or violates the third party's rights, and if the court finds that the infringement was willful, we could be ordered to pay treble damages and the patent owner's attorneys' fees;
- a court prohibiting us from selling or licensing the product or using the technology unless the third party licenses its intellectual property rights to us, which it is not required to do;
- if a license is available from a third party, we may have to pay substantial royalties or upfront fees or grant cross-licenses to intellectual property rights for our products or technologies; and
- redesigning our products or processes so they do not infringe, which may not be possible or may require substantial monetary expenditures and time.

Some of our competitors may be able to sustain the costs of complex patent litigation more effectively than we can because they have substantially greater resources. In addition, any uncertainties resulting from the initiation and continuation of any litigation could harm our ability to raise additional funds or otherwise adversely affect our business, financial condition, operating results and prospects.

Because we rely on certain third-party licensors and partners, and will continue to do so in the future, if one of our licensors or partners is sued for infringing a third party's intellectual property rights, our business, financial condition, operating results and prospects could suffer in the same manner as if we were sued directly. In addition to facing litigation risks, we have agreed to indemnify certain third-party licensors and partners against claims of infringement caused by our proprietary technologies, and we have entered or may enter into cost-sharing agreements with some of our licensors and partners that could require us to pay some of the costs of patent litigation brought against those third parties whether or not the alleged infringement is caused by our proprietary technologies. In certain instances, these cost-sharing agreements could also require us to assume greater responsibility for infringement damages than our technology alone would otherwise suggest.

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

Competitors may infringe our intellectual property, including our patent applications or the patents of our licensors. As a result, we may be required to file infringement claims to stop third-party infringement or unauthorized use. Such proceedings and/or litigation can be expensive – particularly for a company of our size – and time-consuming. In addition, in an infringement proceeding, a court may decide that a patent of ours is not valid or is unenforceable, or may refuse to enjoin the other party from using the technology at issue on the grounds that our patent claims do not cover its technology or that the factors necessary to grant an injunction are not satisfied. An adverse determination in such case could put one or more of our patents at risk of being invalidated, interpreted narrowly or amended such that they fail to cover or otherwise protect our product candidates. Moreover, such adverse determinations could subject our patent applications to the risk that they will not issue, or issue with limited and potentially inadequate scope to cover our product candidates.

Interference, derivation or other proceedings brought at the USPTO may be necessary to determine the priority or patentability of inventions with respect to our patent applications or those of our licensors or potential partners. Litigation or USPTO proceedings brought by us may fail or may be invoked against us by third parties. Even if we are successful, domestic or foreign litigation, or USPTO or foreign patent office proceedings may result in substantial costs and distraction to our management. We may not be able, alone or with our licensors or potential partners, to prevent misappropriation of our proprietary rights, particularly in countries where the laws may not protect such rights as fully as in the United States.

Furthermore, because of the substantial amount of discovery required in connection with intellectual property litigation or other proceedings, there is a risk that we may, intentionally or incidentally, disclose some of our confidential results of hearings, motions or other interim proceedings or developments or public access to related documents. If investors perceive these results to be negative, the market price for our common stock could be significantly harmed.

Our business and operations would suffer in the event of failures in our internal computer systems or those of our collaborators.

Despite the implementation of security measures, our internal computer systems and those of our current and any future partners, contractors and consultants are vulnerable to damage from computer viruses, unauthorized access, natural disasters, terrorism, war and telecommunication and electrical failures. While we have not experienced any such material system failure, accident or security breach to date, if such an event were to occur and cause interruptions in our operations, it could result in a material disruption of our development programs and our business operations. For example, the loss of manufacturing records or clinical trial data from completed or future clinical trials 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 and the further development of our product candidates could be delayed.

We cannot assure you that the market and consumers will accept our products or product candidates. If they do not, we will be unable to generate significant revenues from our products or product candidates and our business, financial condition and results of operations will be materially adversely affected.

The commercial success of our MU1140 homologs antibiotic product candidates, and any of our other product candidates and technologies, will depend in part on market acceptance by consumers. Biopharmaceutical companies have received substantial support from the scientific community, regulatory agencies and many governmental officials in the United States and internationally. Future scientific developments, media coverage and political events may diminish such support. Public attitudes may be influenced by claims that health products are unsafe for consumption or pose unknown risks to the environment or to traditional social or economic practices. Securing governmental approvals for, and consumer confidence in, such products poses numerous challenges, particularly outside the United States. The market success of product candidates developed by biopharmaceutical companies could be delayed or impaired in certain geographical areas as a result. Products based on our product candidates may compete with a number of traditional dental therapies and drugs manufactured and marketed by major pharmaceutical companies and biotechnology companies. Market acceptance of products based on our product candidates will depend on a number of factors including potential advantage over alternative treatment methods. We can offer you no assurance that dentists, physicians, patients or the medical and dental communities in general will accept and utilize products developed from our product candidates. If they do not, we may be unable to generate significant revenues from our product candidates and our business, financial condition and results of operations will be materially adversely affected.

If our products do not receive favorable third-party reimbursement, or if new restrictive legislation is adopted, market acceptance of our products may be limited and we may not generate significant revenues.

Our ability to commercialize our products will depend in part on the extent to which appropriate reimbursement levels for the cost of our proposed formulations and products and related treatments are obtained by governmental authorities, private health insurers and other organizations, such as Health Maintenance Organizations, or HMOs. Reimbursement from third parties depends greatly on our ability to present data which demonstrate positive outcomes and reduced utilization of other products or services as well as cost data which show that treatment costs using the new product are equal to or less than what is currently covered for other products. If our products do not receive favorable third-party reimbursement and patients are unwilling or unable to pay for our products out-of-pocket, it could limit our revenues and harm our business.

The continuing efforts of government and insurance companies, health maintenance organizations and other payers of healthcare costs to contain or reduce costs of health care may affect our future revenues and profitability, and the future revenues and profitability of our potential customers, suppliers and collaborative partners and the availability of capital. For example, in certain foreign markets, pricing or profitability of prescription pharmaceuticals is subject to government control. In the United States, recent federal and state government initiatives have been directed at lowering the total cost of health care. In March 2010, President Obama signed into law the Patient Protection and Affordable Care Act, a sweeping law intended to broaden access to health insurance, reduce or constrain the growth of healthcare spending, enhance remedies against fraud and abuse, add new transparency requirements for healthcare and health insurance industries, impose new taxes and fees on the health industry and impose additional health policy reforms. Federal and state legislatures will likely continue to focus on health care reform, controlling the cost of prescription pharmaceuticals and on the reform of the Medicare and Medicaid systems. While we cannot predict whether any such legislative or regulatory proposals will be adopted, the announcement or adoption of such proposals could materially harm our business, financial condition and results of operations.

If we fail to maintain an effective system of internal controls, we may not be able to accurately report our financial results or prevent fraud which could subject us to regulatory sanctions, harm our business and operating results and cause the trading price of our stock to decline.

Effective internal controls required under Section 404 of the Sarbanes-Oxley Act of 2002, or Sarbanes-Oxley Act, are necessary for us to provide reliable financial reports and effectively prevent fraud. If we cannot provide reliable financial reports or prevent fraud, our business, reputation and operating results could be harmed. We have discovered, and may in the future discover, areas of our internal controls that need improvement. We cannot be certain that the measures we have taken or intend to take will ensure that we maintain adequate controls over our financial processes and reporting in the future. Any failure to implement required new or improved controls or difficulties encountered in their implementation could subject us to regulatory sanctions, harm our business and operating results or cause us to fail to meet our reporting obligations. Inferior internal controls could also harm our reputation and cause investors to lose confidence in our reported financial information, which could have a negative impact on the trading price of our stock.

The recently passed U.S. federal income tax reform could adversely affect us.

On December 22, 2017, U.S. federal tax legislation, commonly referred to as the Tax Cuts and Jobs Act (TCJA), was signed into law, significantly reforming the U.S. Internal Revenue Code. The TCJA, among other things, includes changes to U.S. federal tax rates, limitation of the deduction for net operating losses to 80% of current year taxable income and elimination of net operating loss carrybacks. We have evaluated the effect of the TCJA on our net operating losses for the quarter and the year ending December 31, 2019. The estimated impact of the TCJA is based on our management's current knowledge and assumptions and recognized impacts could be materially different from current estimates based on our actual results and our further analysis of the new law. The impact of the TCJA on holders of common shares is uncertain and could be adverse. This Annual Report on Form 10-K does not discuss any such tax legislation or the manner in which it might affect holders of our common stock. Investors should consult with their own tax advisors with respect to such legislation and the potential tax consequences of investing in our common stock.

Our ability to use our net operating loss carryforwards and certain other tax attributes may be limited, each of which could harm our business.

As of December 31, 2019, we had U.S. federal and state net operating loss carryforwards of approximately \$117,963,000. We also accumulated U.S. federal and state research tax credits of \$2,805,000 as of December 31, 2019. Under Sections 382 and 383 of the Internal Revenue Code (the "Code"), if a corporation undergoes an "ownership change," the corporation's ability to use its pre-ownership change net operating loss carryforwards and other pre-ownership change tax attributes, such as research tax credits, to offset its post-ownership change income and taxes may be limited. In general, an ownership change will occur when the percentage of the Corporation's ownership (by value) of one or more "5-percent shareholders" (as defined in the Code) has increased by more than 50 percent over the lowest percentage owned by such shareholders at any time during the prior three years (calculated on a rolling basis). Similar rules may apply under state tax laws. An entity that experiences an ownership change generally will be subject to an annual limitation on its pre-ownership change tax loss and credit carryforwards equal to the equity value of the corporation immediately before the ownership change, multiplied by the long-term, tax-exempt rate posted monthly by the IRS (subject to certain adjustments). The annual limitation would be increased each year to the extent that there is an unused limitation in a prior year. In the event that it is determined that we have in the past experienced an ownership change as a result of transactions in our stock, or if we experience one or more ownership changes as a result of future transactions in our stock, then we may be limited in our ability to use our net operating loss carryforwards and other tax assets to reduce taxes owed on the net taxable income that we earn. Any limitations on the ability to use our net operating loss carryforwards and other tax assets could harm our business.

Additionally, the Tax Act, which was enacted on December 22, 2017, significantly reforms the Code, including changes to the rules governing net operating loss carryforwards. For net operating loss carryforwards arising in tax years beginning after December 31, 2017, the Tax Act limits a taxpayer's ability to utilize such carryforwards to 80% of taxable income. In addition, net operating loss carryforwards arising in tax years ending after December 31, 2017 can be carried forward indefinitely, but carryback is generally prohibited. Net operating loss carryforwards generated by us before January 1, 2018 will not be subject to the taxable income limitation and will continue to have a twenty-year carryforward period. However, the changes in the carryforward and carryback periods as well as the new limitation on use of net operating losses may significantly impact our ability to use net operating loss carryforwards generated after December 31, 2017, as well as the timing of any such use, and could harm our business.

The United Kingdom's vote in favor of withdrawing from the European Union may have a negative effect on our ability to obtain marketing approval in foreign jurisdictions and could prevent our product candidates from being marketed abroad.

In order to market and sell our products in the European Union (the "EU") and many other foreign jurisdictions, we or our potential third-party collaborators must obtain separate marketing approvals and comply with numerous and varying regulatory requirements. The approval procedure varies among countries and can involve additional testing. The time required to obtain approval may differ substantially from that required to obtain FDA approval. The regulatory approval process outside of the United States generally includes all of the risks associated with obtaining FDA approval. In addition, in many countries outside of the United States, it is required that the product be approved for reimbursement before the product can be approved for sale in that country. We or our potential third-party collaborators may not obtain approvals from regulatory authorities outside of the United States on a timely basis, if at all. Approval by the FDA does not ensure approval by regulatory authorities in other countries or jurisdictions, and approval by one regulatory authority outside of the United States does not ensure approval by regulatory authorities in other countries or jurisdictions or by the FDA. However, a failure or delay in obtaining regulatory approval in one country may have a negative effect on the regulatory process in other countries. We may not be able to file for marketing approvals and may not receive necessary approvals to commercialize our products in any market.

On January 31, 2020 the UK formally withdrew from the EU. Since a significant proportion of the regulatory framework in the UK is derived from EU directives and regulations, the withdrawal could materially impact the regulatory regime with respect to the approval of our product candidate in the UK or the EU. Any delay in obtaining, or an inability to obtain, any marketing approvals, as a result of Brexit or otherwise, would prevent us from commercializing our product candidate in the UK and/or the EU and restrict our ability to generate revenue and achieve and sustain profitability. If any of these outcomes occur, we may be forced to restrict or delay efforts to seek regulatory approval in the UK and/or EU for our product candidate, which could significantly and materially harm our business.

Risks Related to Our Common Stock

We had previously received a non-compliance letter from the NYSE American and we cannot assure you that our shares will continue to be listed on the NYSE American.

The listing of our common stock on the NYSE American is contingent on our compliance with the NYSE American's continued listing standards. On May 10, 2015, we were notified by the NYSE American (formerly known as NYSE MKT) that we were no longer in compliance with the NYSE American continued listing standards because our last reported stockholders' equity was below continued listing standards. Specifically, we are not in compliance with Section 1003(a)(iii) (requiring stockholders' equity of \$6.0 million or more if it has reported losses from continuing operations and/or net losses in its five most recent fiscal years). As of December 31, 2015, we had stockholders' equity of \$4.7 million. We were required to submit a plan to the NYSE American by June 10, 2016 advising of actions we have taken or will take to regain compliance with the continued listing standards by November 10, 2017.

We submitted a plan by the June 10, 2016 deadline and were notified that NYSE Regulation has accepted the Company's plan to regain compliance with the NYSE American exchange's continued listing standards set forth in Sections 1003(a)(ii) and 1003(a)(iii) of the NYSE American Company Guide (the "Company Guide") by November 10, 2017, subject to periodic review by the NYSE American for compliance with the initiatives set forth in the plan. On November 9, 2017, the Company filed a Form 8-K report with the Securities and Exchange Commission announcing that its Stockholders' Equity was approximately \$6,929,555 on a pro-forma basis. With this information provided, the NYSE American determined the Company had resolved the continued listing deficiency with respect to Section 1003(a)(i), Section 1003(a)(ii) and Section 1003(a)(iii) of the Guide. In a letter dated November 10, 2017, the NYSE American notified the Company that it had successfully regained compliance with the NYSE American continued listing standards.

Going forward, the Company will be subject to the NYSE American's normal continued listing monitoring. In addition, in the event that the Company is again determined to be noncompliant with any of the NYSE American's continued listing standards within twelve (12) months of the notice, the NYSE American will consider the relationship between the Company's previous noncompliance and such new event of noncompliance and take appropriate action which may include implementing truncated compliance procedures or immediately initiating delisting proceedings.

A delisting of our common stock from the NYSE American could negatively affect the price and liquidity of our common stock and could impair our ability to raise capital in the future.

Our Series C preferred stock has a preference senior to all other classes of stock in distribution and liquidation and our Series A and Series B preferred stock, if not converted into common stock, will also have a distribution and liquidation preference senior to our common stock in liquidation either of which could negatively affect the value of our common stock and impair our ability to raise additional capital.

On November 8, 2017 we issued to Precigen Corporation ("Precigen") approximately \$3.4 million of equity in the form of 100 shares of Series C, Non-Voting, Non-Convertible Preferred Stock (the "Series C Preferred Stock"). The shares of Series C are entitled to (payment-in-kind ("PIK") dividends thereon at the annual rate of twelve percent (12%) (the "Initial Rate") of its Stated Value, payable by issuing additional shares of Series C Preferred Stock within thirty days after the end of each calendar year pro-rata for partial years. The Initial Rate is subject to increase to twenty percent (20%) automatically after May 10, 2019. In January of 2020, we paid a dividend on our Series C Preferred Stock to Precigen of 19,542 shares of additional Series C Preferred Stock with a stated value of approximately \$661,000. Upon Liquidation of the Company, whether voluntary or involuntary, each holder of shares of Series C Preferred Stock is entitled to receive, in preference to the holders of Common Stock, Series A Preferred Stock, Series B Preferred Stock and to all other equity securities issued by the Company from time to time (the "Junior Securities"), an amount of cash equal to the product of the number of shares of Series C Non-Convertible Preferred Stock then held by such holder, multiplied by the Stated Value per share of Series C Non-Convertible Preferred Stock plus any accrued but unpaid dividends (the "Series C Liquidation Amount") and no distributions or payments shall be made in respect of any Junior Securities unless all Series C Liquidation Amounts, if any, are first paid in full. The "Stated Value" shall mean \$33,847.9874 per share. In January of 2018 we paid a dividend on our Series C Preferred Stock to Precigen of 1,733 shares for the portion of the 2017 fiscal year that the Series C Preferred was outstanding and in January of 2019, we paid a dividend on our Series C Preferred Stock to Precigen of 12,208 shares. On January 27, 2020 we paid a dividend on our Series C Preferred Stock to Precigen of 19,542 shares of additional Series C Preferred Stock. As a result of the recent sale by Precigen of its equity interest in Oragenics to TS Biotechnology LLC, future dividend payments would be paid to TS Biotechnology.

On November 8, 2017, we issued \$3.3 million of Series B Non-Voting, Convertible Preferred Stock (the "Series B Preferred Stock") pursuant to which upon Liquidation each holder of shares of Series B Preferred Stock shall be entitled to receive, after payment to the Series C Preferred Stock, but on par with Series A Convertible Preferred Stock and in preference to the holders of Common Stock, an amount of cash equal to the greater of (i) the product of the number of shares of Series B Preferred Stock then held by such holder, multiplied by the Series B Original Issue Price; and (ii) the amount that would be payable to such holder in the Liquidation in respect of Common Stock issuable upon conversion of such shares of Series B Preferred Stock if all outstanding shares of Series B Preferred Stock were converted into Common Stock immediately prior to the Liquidation.

In May and July of 2017, we issued an aggregate of \$3.0 million of Series A Non-Voting, Convertible Preferred Stock (the “Series A Preferred Stock”) pursuant to which upon Liquidation each holder of shares of Series A Preferred Stock shall be entitled to receive, after payment to the Series C Preferred Stock, but on par with Series B Convertible Preferred Stock and in preference to the holders of Common Stock, an amount of cash equal to the greater of (i) the product of the number of shares of Series A Preferred Stock then held by such holder, multiplied by the Series B Original Issue Price; and (ii) the amount that would be payable to such holder in the Liquidation in respect of Common Stock issuable upon conversion of such shares of Series A Preferred Stock if all outstanding shares of Series A Preferred Stock were converted into Common Stock immediately prior to the Liquidation.

As such, our Series C preferred stock is senior to all other classes of stock in distribution and liquidation and our Series A and Series B preferred stock, if not converted into common stock, will also be senior to our common stock in distribution and liquidation if such shares are not converted into common stock, which could negatively affect the value of our common stock and impair our ability to raise additional capital.

The conversion of our Series A Preferred Stock, and Series B Preferred Stock and the exercise of currently outstanding warrants could result in significant dilution to the holders of our common stock.

The holders of our Series A Preferred Stock and Series B Preferred Stock may convert their shares of preferred stock into shares of common stock. As of December 31, 2019, we had outstanding: (i) 9,417,000 shares of Series A Preferred Stock outstanding, which are convertible into 941,701 shares of common stock and (ii) 6,600,000 shares of Series B Preferred Stock, which are convertible into 1,320,002 shares of common stock. In addition to our outstanding shares of preferred stock, as of December 31, 2019, there were currently outstanding warrants to purchase 26,538,593 shares of our common stock. The conversion of our Series A Preferred Stock and Series B Preferred Stock, as well as the exercise of our outstanding warrants could result in significant dilution to existing common shareholders, adversely affect the market price of our common stock and impair our ability to raise capital through the sale of additional equity securities.

The Holder of Our Series C Preferred Stock continues to receive dividends in additional shares of Series C Preferred Stock.

Each issued and outstanding share of Series C Preferred Stock entitled the holder of record to receive dividends at the annual rate of twelve percent (12%) (the “Initial Rate”) of its Stated Value of \$33,847 per share, payable by issuing additional shares of Series C Preferred Stock within thirty days after the end of each calendar year. Such Initial Rate was automatically increased to a rate of twenty percent (20%), effective May 10, 2019, for periods after such date. On January 25, 2018 we paid a dividend on our Series C Preferred Stock to Precigen of 1.733 shares of additional Series C Preferred Stock, on January 31, 2019 we paid a dividend on our Series C Preferred Stock to Precigen of 12.208 shares of additional Series C Preferred Stock and on January 27, 2020 we paid an additional annual dividend on our Series C Preferred Stock to the holder of 19,542 shares of additional Series C Preferred Stock. The accruing dividend is payable in additional shares of Series C Preferred Stock that we continue to be obligated to pay annually.

The issuance of additional equity securities by us in the future would result in dilution to our existing common shareholders.

Our board of directors has authority, without action or vote of our shareholders, to issue all or a part of our authorized but unissued shares, except where shareholder approval is required by law. Any issuance of additional equity securities by us in the future could result in dilution to our existing common shareholders. Such issuances could be made at a price that reflects a discount or a premium to the then-current trading price of our common stock. In addition, our business strategy may include expansion through internal growth by acquiring complementary businesses, acquiring or licensing additional products or brands, or establishing strategic relationships with targeted customers and suppliers. In order to do so, or to finance the cost of our other activities, we may issue additional equity securities that could result in further dilution to our existing common shareholders. These issuances would dilute the percentage ownership interest of our existing common shareholders, which would have the effect of reducing their influence on matters on which our shareholders vote, and might dilute the book value of our common stock. For example, we issued a total of 4,436,000 shares of common stock, 9,364,000 shares of Series D Preferred Stock convertible into 9,364,000 shares of common stock, and total warrants to purchase 13,800,000 shares of common stock in our recent underwritten public offering that closed on July 17, 2018. As of December 31, 2018, 9,364,000 shares of Series D Preferred Stock had been converted into shares of common stock and 9,505,500 warrants had been exercised. We also issued 16,666,668 shares of common stock, short-term warrants to purchase up to 9,583,334 shares of common stock, and long-term warrants to purchase up to 9,583,334 shares of common stock, as part of our March 25, 2019 underwritten public offering. As a result, our outstanding shares of common stock has increased significantly from 2,738,283 shares as of December 31, 2012 to 46,124,803 shares as of December 31, 2019.

In connection with the Oral Mucositis ECC we entered into on June 9, 2015 and which was amended in November of 2017, we will be required, at our option, to pay up to \$37.5 million cash to Precigen or issue up to \$37.5 million of additional shares of our common stock to Precigen upon meeting certain milestone events.

Certain provisions of our articles of incorporation, bylaws, executive employment agreements and stock option plan may prevent a change of control of our company that a shareholder may consider favorable.

Provisions of our articles of incorporation, bylaws, executive employment agreements and stock option plan may discourage, delay or prevent a change of control of our company that a shareholder may consider favorable. These provisions include:

- authorization of the issuance of “blank check” preferred stock that could be issued by our Board of Directors without shareholder approval and that may be substantially dilutive or contain preferences or rights objectionable to an acquirer;
- the ability of our Board of Directors to amend the bylaws without shareholder approval;
- vacancies on our Board may only be filled by the remaining directors and not our shareholders;
- requirements that only our Board, our President or holders of more than 10% of our shares can call a special meeting of shareholders;
- obligations to make certain payments under executive employment agreements in the event of a change of control and termination of employment; and
- immediate vesting of all outstanding stock options.

As a result, these provisions could discourage bids for our common stock at a premium and limit the price that investors are willing to pay in the future for shares of our common stock. However, in our articles of incorporation we expressly elected not to be governed by Sections 607.0901 and 607.0902 of the Florida Business Corporation Act, which are statutory anti-takeover provisions relating to affiliated transactions and control share acquisitions, respectively. As such, we do not have the protection of these statutes in connection with any unwanted takeover attempts which could have the effect of encouraging an attempted change of control without first negotiating with our Board of Directors.

We cannot assure you that we will continue to be listed on the NYSE American.

Our common stock commenced trading on the NYSE American (formerly the NYSE MKT) on April 10, 2013, and we are subject to certain NYSE American continued listing requirements and standards. We may also incur costs that we have not previously incurred for expenses for compliance with the rules and requirements of the NYSE American. We cannot provide any assurance that we will be able to continue to satisfy the requirements of the NYSE American’s continued listing standards. A delisting of our common stock could negatively affect the price and liquidity of our common stock and could impair our ability to raise capital in the future.

Our stock price has historically been volatile and the trading volume of our stock has been low.

The trading price of our common stock has historically been, and may in the future be, subject to wide fluctuations in response to a number of factors, many of which are beyond our control. These factors include:

- announcements of the results of our pending clinical trials;
- our level of, and expected future use of, working capital;
- quarter-to-quarter variations in our operating results;
- our perceived funding needs;
- the results of testing, technological innovations, or new commercial products by us or our competitors;
- governmental regulations, rules, and orders;
- general conditions in the healthcare, dentistry, or biopharmaceutical industries;
- comments, research reports and/or earnings estimates by securities analysts;
- developments concerning patents or other intellectual property rights;
- litigation or public concern about the safety of our products;
- announcements by us or our competitors of significant acquisitions, strategic partnerships, joint ventures or capital commitments;
- additions or departures of directors, officers and key personnel;
- release of transfer restrictions on our outstanding shares of common stock or sales of additional shares of common stock;

- potential litigation initiated against us; and
- the additional sale of common stock by us in capital raising transactions.

Historically, the daily trading volume of our common stock has been relatively low and on some days our stock does not trade at all. An order for the purchase or sale of a large number of our shares could significantly affect the price at which the order is executed. We cannot guarantee that an active public market for our common stock will be sustained or that the average trading volume will increase. In addition, the stock market in general has experienced significant price and volume fluctuations. Volatility in the market price for particular companies has often been unrelated or disproportionate to the operating performance of those companies. Broad market factors may seriously harm the market price of our common stock, regardless of our operating performance. In addition, securities class action litigation has often been initiated following periods of volatility in the market price of a company's securities. A securities class action suit against us could result in substantial costs, potential liabilities, and the diversion of management's attention and resources. To the extent our stock price fluctuates or remains low, it could impair our ability to raise capital through the offering of additional equity securities.

Future sales of our common stock may depress our stock price.

The market price of our common stock could decline as a result of sales of substantial amounts of our common stock in the public market, or the perception that these sales could occur. In addition, these factors could make it more difficult for us to raise funds through future offerings of common stock. We have recently issued a significant number of shares of common stock and the number of outstanding shares has increased from 2,738,283 shares as of December 31, 2012 to 46,124,803 as of December 31, 2019. In addition, there were 16,017,000 shares of our Preferred stock outstanding which are convertible into 2,261,703 shares of our common stock and, as of December 31, 2019, warrants to purchase an additional 26,538,593 shares of our common stock issuable upon exercise of warrants to investors. There were also 2,486,365 shares issuable upon exercise of options outstanding and an additional 5,522,885 shares available for option grants under our 2012 Equity Incentive Plan

The issuance of shares of our common stock under our 2012 Equity Incentive Plan is covered by Form S-8 registration statements we filed with the Securities and Exchange Commission, or SEC, and upon exercise of the options, such shares may be resold into the market. We have also issued shares of common stock and warrants in connection with previous private placements. Such shares are available for resale as well as certain of the shares of common stock issuable upon exercise of the warrants. We have also issued shares of our common stock in the private placement and financing transaction, which are deemed to be "restricted securities," as that term is defined in Rule 144 promulgated under the Securities Act of 1933, as amended, or Securities Act, and such shares may be resold pursuant to the provisions of Rule 144. For example, on June 30, 2016 we issued 904,568 restricted shares of our common stock to three accredited investors (Precigen, the KFLP and our Chairman Dr. Telling) in a private placement. The resale of shares acquired from us in private transactions could cause our stock price to decline significantly. In addition, the conversion of outstanding shares of Series A and Series B convertible preferred stock issued in 2017 private placements into common stock and the subsequent sale of shares of common stock could also cause our stock price to decline significantly.

In addition, from time to time, certain of our shareholders may be eligible to sell all or some of their restricted shares of common stock by means of ordinary brokerage transactions in the open market pursuant to Rule 144, subject to certain limitations. In general, pursuant to Rule 144, after satisfying a six-month holding period: (i) affiliated shareholders, or shareholders whose shares are aggregated, may, under certain circumstances, sell within any three-month period a number of securities which does not exceed the greater of 1% of the then-outstanding shares of common stock or the average weekly trading volume of the class during the four calendar weeks prior to such sale and (ii) non-affiliated shareholders may sell without such limitations, in each case provided we are current in our public reporting obligations. Rule 144 also permits the sale of securities by non-affiliates that have satisfied a one-year holding period without any limitation or restriction.

We are unable to estimate the number of shares that may be sold because this will depend on the market price for our common stock, the personal or business circumstances of sellers and other factors.

The requirements of being a public company may strain our resources, divert management's attention and affect our ability to attract and retain qualified members for our Board of Directors.

As a public company, we are already subject to the reporting requirements of the Securities Exchange Act of 1934, as amended, or the Exchange Act, and the Sarbanes-Oxley Act. The requirements of these rules and regulations may increase our legal, accounting and financial compliance costs; may make some activities more difficult, time-consuming and costly; and may also place undue strain on our personnel, systems and resources. Our management and other personnel need to devote a substantial amount of time to comply with these requirements. Moreover, these rules and regulations increase our legal and financial compliance costs and make some activities more time-consuming and costlier. These rules and regulations could also make it more difficult for us to attract and retain qualified persons to serve on our Board of Directors and Board committees or as executive officers.

As a public company we are also required to assess our internal control over financial reporting under Section 404 of the Sarbanes-Oxley Act and file periodic reports with the SEC. If we are unable to comply with these requirements in a timely manner, or if material weaknesses or significant deficiencies persist, the market price of our stock could decline and we could be subject to sanctions or regulatory investigations, which could harm our business. We must perform an assessment of our internal control over financial reporting to allow management to report on the effectiveness of our internal control over financial reporting, as required by Section 404 of the Sarbanes-Oxley Act. Our compliance with Section 404 of the Sarbanes-Oxley Act requires that we incur substantial accounting expense and expend significant management efforts. If we are unable to comply with the requirements of Section 404 of the Sarbanes-Oxley Act or the SEC reporting requirements in a timely manner, or if we note or identify deficiencies in our internal control over financial reporting that are deemed to be material weaknesses, the market price of our stock could decline and we could be subject to sanctions or investigations by the SEC or other regulatory authorities, which would require additional financial and management resources. As a smaller reporting company, we do not have to have our independent registered public accounting firm report on the effectiveness of our internal control over financial reporting. If in the future we no longer meet the requirements of a smaller reporting company, our independent registered public accounting firm will have to report on our internal controls over financial reporting. There can be no assurance that our independent registered public accounting firm will not identify material weaknesses which could have an adverse effect on our stock price.

We will continue to incur significant costs as a result of and devote substantial management time to operating as a public company listed on the NYSE American.

As a public company listed on the NYSE American, we incurred and will continue to incur significant legal, accounting and other expenses that we did not incur before when trading on the OTCQB Marketplace. For example, we are subject to the rules and regulations required by the NYSE American, including changes in corporate governance practices and minimum listing requirements. These requirements have increased our legal and financial compliance costs and have and will continue to render some activities more time-consuming and costlier. In addition, our management and other personnel have diverted and will continue to divert attention from operational and other business matters to devote substantial time to these listing requirements and failure to meet these requirements could lead to an adverse effect on the listing of our common stock on the NYSE American.

If securities or industry analysts 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 depends in part upon the research and reports that securities or industry analysts publish about us or our business from time to time. If one or more of the analysts who seek to cover us downgrades our stock or publishes inaccurate or unfavorable research about our business, our stock price would likely decline. If one or more of these analysts ceases coverage, once commenced, or fails to publish reports on us regularly, demand for our stock could decrease, which could cause our stock price and trading volume to decline.

We may issue debt or debt securities convertible into equity securities, any of which may be senior to our common stock as to distributions and in liquidation, which could negatively affect the value of our common stock.

In the future, we may attempt to increase our capital resources by entering into debt or debt-like financing that is unsecured or secured by up to all of our assets, or by issuing additional debt or equity securities, which could include issuances of secured or unsecured commercial paper, medium-term notes, senior notes, subordinated notes, guarantees, preferred stock, hybrid securities, or securities convertible into or exchangeable for equity securities. In the event of our liquidation, our lenders and holders of our debt and securities would receive distributions of our available assets before distributions to the holders of our common stock. Because our decision to incur debt and issue securities in future offerings may be influenced by market conditions and other factors beyond our control, we cannot predict or estimate the amount, timing or nature of our future offerings or debt financings. Further, market conditions could require us to accept less favorable terms for the issuance of our securities in the future.

We are a “smaller reporting company” and, as a result of the reduced disclosure and governance requirements applicable to smaller reporting companies, our common stock may be less attractive to investors.

We are a “smaller reporting company,” meaning that we are not an investment company, an asset-backed issuer, or a majority-owned subsidiary of a parent company that is not a “smaller reporting company;” have a public float of less than \$250 million and have annual revenues of less than \$100 million during the most recently completed fiscal year. As a “smaller reporting company,” we are subject to lesser disclosure obligations in our SEC filings compared to other issuers. Specifically, “smaller reporting companies” are able to provide simplified executive compensation disclosures in their filings, are exempt from the provisions of Section 404(b) of the Sarbanes-Oxley Act requiring that independent registered public accounting firms provide an attestation report on the effectiveness of internal control over financial reporting and have certain other decreased disclosure obligations in their SEC filings, including, among other things, only being required to provide two years of audited financial statements in annual reports. Decreased disclosures in our SEC filings due to our status a “smaller reporting company” may make it harder for investors to analyze our operating results and financial prospects.

We have never paid cash dividends on our capital stock, and we do not anticipate paying any cash dividends in the foreseeable future.

We have never paid cash dividends on our capital stock. We currently intend to retain any future earnings to finance the operation and expansion of our business, and we do not expect to declare or pay any cash dividends in the foreseeable future. Consequently, stockholders must rely on sales of their common stock after price appreciation, which may never occur, as the only way to realize any future gains on their investment.

ITEM 1B. UNRESOLVED STAFF COMMENTS.

Not applicable.

ITEM 2. PROPERTIES.

We lease approximately 2,207 square feet for our corporate offices located at 4902 Eisenhower Boulevard, Suite 125, Tampa, Florida 33634. Lease payments range from \$4,138 per month to \$4,392 per month inclusive of insurance, taxes and utilities. The lease costs for the year ended December 31, 2019 were approximately \$64,000 which includes insurance, taxes and utilities. In November of 2019, the Company entered into an amendment for the office space in Tampa to extend the term for an additional three years beginning in March of 2020. Under the amended lease agreement, the rental payments are expected to range from \$4,524 per month to \$4,800 per month.

In addition to our Tampa location we continue to lease our research facility located at 13700 Progress Boulevard, Alachua, Florida 32615. The facility is approximately 5,300 square feet of which approximately 60% is laboratory space and the remainder is office space and common areas. The lease costs for the year ended December 31, 2019 were approximately \$154,000 which includes insurance, taxes and utilities. Lease payments are capped during the term. In June of 2019, the Company entered into an amendment to our lease for the Alachua facility to provide for a term of five years beginning at the end of the existing lease term in December of 2019. Under the amended lease agreement, the rental payments range from \$12,870 per month to \$13,338 per month.

ITEM 3. LEGAL PROCEEDINGS.

We are not a party to any material legal proceedings.

ITEM 4. MINE SAFETY DISCLOSURES.

Not applicable.

PART II

ITEM 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED SHAREHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES.

Our common stock is quoted on the NYSE American under the ticker symbol "OGEN". The last price of our common stock as reported on the NYSE American on February 14, 2020 was \$0.53 per share. As of February 14, 2020, there were approximately 35 stockholders of record of our common stock. This number does not include beneficial owners from whom shares are held by nominees in street name such as banks and brokerage firms.

Dividends

To date, we have neither declared nor paid any dividends on our common stock nor do we anticipate that such dividends will be paid in the foreseeable future. Rather, we intend to retain any earnings to finance the growth and development of our business. Any payment of cash dividends on our common stock in the future will be dependent, among other things, upon our earnings, financial condition, capital requirements and other factors which the board of directors deems relevant. In addition, restrictive covenants contained in any financing agreements entered into in the future may preclude us from paying any dividends.

Our outstanding shares of Series C, Non-Voting, Non-Convertible, Redeemable Preferred Stock ("Series C Preferred Stock") with a stated value of \$33,847 per share has an accruing dividend payable in additional shares of Series C Preferred Stock that we are obligated to pay annually. The accruing dividend increased from 12% to 20% per year after May 10, 2019. In January of 2018, January of 2019, and January 2020, we paid dividends on our Series C Preferred Stock to Precigen (formerly known as Precigen) of 1.733 Series C Preferred shares, 12.208 Series C Preferred shares, and 19.542 Series C Preferred shares, respectively.

Unregistered Sale Of Equity Securities And Use Of Proceeds

None.

Stock Repurchases in the Fourth Quarter

There were no purchases of our common stock during the three months ended December 31, 2019. The Company has no publicly announced share repurchase programs.

ITEM 6. SELECTED FINANCIAL DATA.

Not applicable.

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS.

The following information should be read in conjunction with the Financial Statements, including the notes thereto, included elsewhere in this Form 10-K. This discussion contains certain forward-looking statements that involve risks and uncertainties. Our actual results and the timing of certain events could differ materially from those discussed in these forward-looking statements as a result of certain factors, including, but not limited to, those set forth herein and elsewhere in this Form 10-K.

Overview

We are focused on developing effective treatments for oral mucositis and becoming a leader in developing novel antibiotics against infectious disease.

Our Oral Mucositis Product Candidate-Clinical

In June of 2015, we entered into a worldwide Exclusive Channel Collaboration Agreement (“Oral Mucositis ECC”) with Precigen, Inc. (“Precigen”) (formerly known as Intrexon Corporation) and Intrexon Actobiotics NV, a wholly-owned subsidiary of Intrexon, pursuant to which we obtained certain exclusive rights to AG013 as a potential treatment of oral mucositis, or OM for cancer patients, which we intend to continue to develop. AG013, is an oral rinsing solution system designed to deliver human Trefoil Factor 1 (hTFF1) to protect and regenerate damaged mucosal lining of the oral cavity.

OM results in a painful inflammation and mucosal ulceration in the lining of the oral cavity, throat and esophagus and is one of the most commonly reported adverse events associated with cancer chemotherapy. Approximately 770,000 patients annually in the US are at an increased risk of developing OM according to cancer statistics provided by the Center for Disease Control (CDC) in 2017. OM has a negative effect on patient well-being and if severe, negatively affects adherence to a patient's cancer treatment regimen. At present, we are not aware of any drug that is approved to prevent the condition broadly and current therapies are primarily palliative in nature, only addressing symptom relief but not treating the underlying causes of the condition.

AG013 has been granted Orphan Drug status in the European Union. In November of 2016, the United States Food and Drug Administration (the “FDA”) granted Fast Track designation for AG013, and we believe it may be eligible for Biologic License Application (“BLA”) exclusivity as well. The FDA's fast track therapy designation program is intended to facilitate the development and expedite the review of drug candidates intended for the treatment of serious or life-threatening conditions and that demonstrate the potential to address unmet medical needs for those conditions. Under this program, FDA can, for example, review portions of a New Drug Application or BLA for a drug candidate before the entire application is complete, thus potentially beginning the review process at an earlier time.

In a Phase 1b clinical trial in 25 cancer patients with OM, AG013 was safe and well tolerated. Data published in the journal Cancer showed a 35% reduction of the duration of ulcerative OM in the AG013-treated patients versus the placebo-treated patients. Furthermore, close to 30% of the patients treated with AG013 were full responders while all placebo-treated patients developed ulcerative OM. Additionally, in a Phase 1 pharmacokinetic (PK) study in 10 healthy volunteers, AG013 bacteria adhered to the buccal mucosa and actively secrete protein locally, resulting in homogeneous exposure of the entire mucosal surface up to 24 hours after administration of the rinse system.

We developed a Phase 2 protocol for AG013 with the FDA under the fast track designation. In August of 2016, we received feedback from the FDA in response to our Type C meeting and the pursuit of a Phase 2 trial on AG013 for the treatment of oral mucositis in head and neck cancer patients. We filed an Investigational New Drug (“IND”) update in March 2017 and we initiated the Phase 2 study with AG013 in the United States in 2017 and in Europe in 2018. The Phase 2 trial was a double-blind, placebo-controlled, 2-arm, multi-center trial in which approximately 200 patients were randomized in a 1:1 ratio to receive either a placebo or AG013 following meals, beginning on the first day of chemoradiation therapy and continuing through the course of cancer treatment. The study enrolled patients receiving chemoradiation for treatment of head and neck cancer for 7 to 9 weeks. The clinical trial was conducted at clinical sites across the United States and Europe. The purpose of the Phase 2 study (NCT03234465) is to evaluate the efficacy (preventing the occurrence and shortening the duration of severe oral mucositis (“SOM”), safety and tolerability of topically administered AG013 rinse compared to the placebo for reducing the incidence and severity of OM in patients undergoing traditional chemoradiation for the treatment of head and neck cancer. Key efficacy measures include collection of data regarding the duration, time to development, and overall incidence of OM (World Health Organization scale used) during the active treatment phase, beginning from the start of chemoradiation therapy until 2 weeks following its completion.

On December 2, 2019 we announced completion of enrollment in our Phase 2 clinical trial. As of February 27, 2020, all 200 randomized patients, have completed the Phase 2 clinical trial. We expect to release top line results from the trial early in the second quarter of 2020.

An interim safety analysis was requested by the FDA on patients from our Phase 2 clinical trial of AG013 for the treatment of OM. We completed enrollment of the interim safety analysis cohort, which included 24 randomized patients in our Phase 2 clinical trial of AG013 for the treatment OM. Nineteen of those patients were included in the unblinded safety evaluation, of which 10 received AG013. We announced positive results from our interim safety analysis in May, 2018. The study provided information that, we believe, likely indicates that the overall incidence of severe OM is less than would be anticipated in the general head and neck cancer population.

Safety was evaluated on the basis of treatment-emergent adverse events, vital signs, weight, physical examinations, clinical laboratory assessments and the presence of AG013 in whole blood. Tolerability measures (taste, consistency and smell) were collected from the patient diaries. In addition, the reasons for study treatment discontinuation were also summarized. Following review of the data by an independent Data Safety Monitoring Board (DSMB), it was concluded that the clinical trial can proceed with no changes to the study. The data analysis indicated that the distribution of adverse events was similar between AG013 and placebo. The serious adverse events reported were consistent with those commonly reported in a head and neck cancer population receiving traditional chemoradiation therapy treatments and included fevers, neutropenia, anemia, nausea and vomiting, infections and oral (mouth and throat) pain and there were no reports of AG013 related bacteremia or sepsis. Of patients that discontinued participation in the clinical study, 4 patients experienced adverse events, including 3 patients who developed nausea and vomiting, 2 patients that were non-compliant with the study procedures and 3 patients developed severe OM.

The DSMB met again in December 2019 and reviewed safety data on the first 150 patients who completed the trial and determined that the clinical trial could continue with no adjustments or further review.

On September 30, 2019, we made a poster presentation at the European Society for Medical Oncology Congress where we announced initial blinded blended data from our Phase 2, placebo-controlled, clinical trial of AG013 in oral mucositis. The presentation described the methods and initial blinded results from the ongoing Phase 2 clinical trial for our lead oral mucositis product candidate, AG013. The initial blinded data, submitted in the abstract, reflected the results for 42 of the 71 enrolled and randomized patients across 48 study sites who had completed their treatment course and demonstrated that in the blinded, combined placebo and active treatment groups, there was sufficient evidence of efficacy and safety to continue the study. Additional data accumulated since poster submission, indicated the blinded efficacy evaluation, which included any patient with SOM after week one of treatment and those receiving a cumulative dose of 55 Gy (week 6 of treatment), demonstrated an overall SOM incidence of 47%, which we believe is lower than would be expected based on historical data in the head and neck cancer population receiving this chemoradiation regimen. The overall rate of SOM was reported in only 13.1 % (110 of 842) of evaluable visits. The overall safety profile continues to be consistent with those adverse events that normally occur in cancer patients receiving chemoradiation therapy. The study, however, remains blinded and individual treatment responses remain to be identified.

Our Antibiotic Product Candidate-Preclinical

Members of our scientific team discovered that a certain bacterial strain produces MU1140, a molecule belonging to the novel class of antibiotics known as lantibiotics. Lantibiotics, such as MU1140, are highly modified peptide antibiotics made by a small group of Gram-positive bacterial species. Over 700 lantibiotics have been characterized, to date. We believe lantibiotics are generally recognized by the scientific community to be potent antibiotic agents.

In nonclinical testing, MU1140 has shown activity against all Gram-positive bacteria against which it has been tested, including those responsible for a number of healthcare associated infections, or HAIs. A high percentage of hospital-acquired infections are caused by highly resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) or multidrug-resistant Gram-negative bacteria. We believe the need for novel antibiotics is increasing as a result of the growing resistance of target pathogens to existing FDA approved antibiotics on the market.

Lantibiotics have been difficult to investigate for their clinical usefulness as therapeutic agents in the treatment of infectious diseases due to a general inability to produce or synthesize sufficient quantities of pure amounts of these molecules. Traditional fermentation methods can only produce minute amounts of the lantibiotic.

In June 2012, we entered into the Lantibiotic Exclusive Channel Collaboration agreement (“Lantibiotic ECC”) with Precigen for the development and commercialization of the native strain of MU1140 and related homologs using Precigen’s advanced transgene and cell engineering platforms. Through our work with Precigen, we have been able to produce a significant increase in the fermentation titer of MU1140 compared to standard fermentation methods and have discovered a new purification process for MU1140. Our work with Precigen generated a substantial number of homologs of MU1140. In January 2020 Precigen consummated a reorganization of its ongoing API fermentation operations and assets into ILH Holdings, Inc. which at the time was an affiliate of Precigen. In connection with the reorganization, Precigen assigned the Lantibiotic ECC and related stock issuance agreements to ILH Holdings. Following such reorganization, Precigen divested certain of its assets to TS Biotechnology Holdings, LLC which included ILH Holdings and shares of Oragenics securities held by Precigen. As a result of such change by Precigen we expect to continue our research and development and collaboration efforts with ILH Holdings to develop potential derivatives of the MU1140 molecule using genetically modified bacteria.

In our pre-clinical studies to support a potential IND filing with the FDA, we tested a total of six homologs of MU1140 for certain compound characteristics, including but not limited to: drug activity (based on minimum inhibitory concentration or “MIC”) equal or better than “standard of care” drugs against certain drug-resistant bacteria, safety, toxicity, stability, and manufacturability. An animal study specifically evaluated homolog efficacy in relation to survival, measurable amounts of *Clostridium difficile* (“*C. diff*”) colony forming units, and toxin levels. Three homologs demonstrated promising results with one homolog, OG253, delivered rectally achieving a 100% survival rate throughout the entire study in contrast to an approximately 30% survival rate for the vancomycin positive control.

Based on these early results, we selected a lead candidate, OG253, for which we had a pre-IND meeting with the FDA in November of 2015 regarding the pursuit of an IND for OG253. Following additional research and development on second generation lantibiotics, in August of 2016, we opted to select a second generation lantibiotic, OG716, for treatment of *C. diff* as our new lead candidate. OG716 is a new, orally-active homolog, that has exhibited positive results in an animal model for potential treatment of *C. diff*. Generated from our MU1140 platform, this new lantibiotic showed promising efficacy in reducing clinically relevant *C. diff* infections as measured by increased animal survival and decreased relapse as well as reduced production of toxins A & B and *C. diff* spores.

The timing of the filing of an IND regarding OG716 is subject to our having sufficient available capital given all of our anticipated needs and expected requirements in connection with our ongoing research and development initiatives. We currently expect the IND for a first-in-human clinical trial of OG716 to be filed with the FDA based on our ability to complete the requisite studies, contingent on sufficient funding. Based upon the funding available we expect to conduct some of the requisite studies. While we commenced certain of these studies at the end of 2019, we expect to focus on efficient and cost-effective manufacturing of the product to support and be able to conduct further broad-based studies.

Other Product Candidates and Technologies.

In addition to our lantibiotics and oral mucositis product candidates, we also have other candidates and technologies in the oral care and weight loss areas. We do not intend to continue to develop these potential product candidates and technologies without partnering with a third party. We out-licensed the continued research and development of our weight loss product candidate in December 2013 to, LPThera LLC, and LPThera LLC continues to work to develop a product for commercial use. Our oral care product candidate SMART Replacement Therapy is positioned for out-licensing opportunities.

Recent Developments

Precigen Restructuring. In January 2020 Precigen (formerly known as Intrexon Corporation) consummated a reorganization of its ongoing API fermentation operations and assets into ILH Holdings, Inc. which at the time was an affiliate of Precigen. In connection with the reorganization, Precigen assigned the Lantibiotic ECC and related stock issuance agreements to ILH Holdings. Following such reorganization, Precigen divested certain of its assets to TS Biotechnology Holdings, LLC which included ILH Holdings and shares of Orogenics securities held by Precigen.

Financial Overview

Net Revenues

We did not generate any revenue for the years ended December 31, 2019 and 2018, respectively from the sales or licensing of our product candidates.

Research and Development Expenses

Research and development consist of expenses incurred in connection with the discovery and development of our product candidates. These expenses consist primarily of employee-related expenses, which include salaries and benefits and attending science conferences; expenses incurred under our ECC agreements with third parties and under other agreements with contract research organizations, investigative sites and consultants that conduct our clinical trials and a substantial portion of our nonclinical studies; the cost of acquiring and manufacturing clinical trial materials; facilities, depreciation and other allocated expenses, which include direct and allocated expenses for rent and maintenance of facilities and equipment, and depreciation of fixed assets; license fees, for and milestone payments related to, in-licensed products and technology; stock-based compensation expense; and costs associated with nonclinical activities and regulatory approvals. We expense research and development costs as incurred.

Our research and development expenses can be divided into (i) clinical research, and (ii) nonclinical research and development activities. Clinical research costs consist of clinical trials, manufacturing services, regulatory activities and related personnel costs, and other costs such as rent, utilities, depreciation and stock-based compensation. Nonclinical research and development costs consist of our research activities, nonclinical studies, related personnel costs and laboratory supplies, and other costs such as rent, utilities, depreciation and stock-based compensation and research expenses we incur associated with our ECC agreements with third parties. While we are currently focused on advancing our product development programs, our future research and development expenses will depend on the clinical success of our product candidates, as well as ongoing assessments of each product candidate's commercial potential. In addition, we cannot forecast with any degree of certainty which product candidates may be subject to future collaborations, when such arrangements will be secured, if at all, and to what degree such arrangements would affect our development plans, research expenses and capital requirements.

Our research and development expenses were \$12,120,318 and \$5,971,833 for the years ended December 31, 2019 and 2018, respectively.

Our current product development strategy contemplates an expected increase in our research and development expenses in the future as we continue the advancement of our clinical trial for our oral mucositis candidate and nonclinical product development programs for our lantibiotic product candidate. The lengthy process of completing clinical trials; seeking regulatory approval for our product candidates; and expanding the potential claims we are able to make, requires expenditure of substantial resources. Any failure or delay in completing clinical trials, or in obtaining regulatory approvals, could cause a delay in generating product revenues and cause our research and development expenses to increase and, in turn, have a material adverse effect on our operations. Our current product candidates are not expected to be commercially available until we are able to obtain regulatory approval from the FDA or European Medicines Agency.

Our plan is to budget and manage expenditures in research and development such that they are undertaken in a cost-effective manner yet still advance the research and development efforts. While we have some control under our Lantibiotic ECC and Oral Mucositis ECC as to the planning and timing of the research and development and therefore the timing of when expenditures may be incurred for various phases of agreed upon projects, actual expenditures can vary from period to period. Subject to available capital, we expect overall research and development expenses to increase as a result of clinical trial work related to our oral mucositis product candidate as our financial resources permit. Our research and development projects are currently expected to be taken to the point where they can be licensed or partnered with larger pharmaceutical companies.

General and Administrative Expenses

General and administrative expenses consist principally of salaries and related costs for personnel in executive, finance, business development, marketing, information technology, legal and human resources functions. Other general and administrative expenses include facility costs not otherwise included in research and development expenses, patent filing, and professional fees for legal, consulting, auditing and tax services.

We anticipate that our general and administrative expenses may remain flat, but be subject to variability for, among others, the following reasons:

- to support our research and development activities, which, subject to available capital, we expect to expand as we continue the development of our product candidates;
- the efforts we undertake from, time to time, to raise additional capital; and
- the increased payroll, and stock-based compensation, expanded infrastructure and consulting, legal, accounting and investor relations costs associated with being a public company.

Other Income (Expense)

Other income (expense) includes local business taxes, as well as interest income and expense. Interest income consists of interest earned on our cash and cash equivalents. The primary objective of our investment policy is capital preservation. Interest expense consists primarily of interest and costs associated with our indebtedness.

Income Taxes

As of December 31, 2019, and 2018, we have net operating loss carryforwards of approximately \$117,963,000 and \$102,984,000, respectively, to offset future federal and state income taxes. Federal and state tax net operating loss carryforwards generated prior to December 31, 2017 will expire through 2037. Federal tax net operating loss carryforwards generated subsequent to December 31, 2017, do not expire but are subject to a limitation of 80% of federal taxable income. We also have research and development tax credit carryforwards of approximately \$2,805,000 and \$2,301,000 as of December 31, 2019, and 2018, respectively, to offset future federal and state income taxes. Our net operating loss and research and development tax credit carryforwards will expire if not used by 2039 and 2029, respectively. Utilization of net operating loss carryforwards and research and development credit carryforwards may be subject to a substantial annual limitation due to ownership change limitations that may have occurred or, could occur in the future in accordance with Section 382 of the Internal Revenue Code of 1986 ("IRC Section 382") and with Section 383 of the Internal Revenue Code of 1986, as well as similar state provisions. These ownership changes may limit the amount of net operating loss carryforwards and research and development credit carryforwards that can be utilized annually to offset future taxable income and taxes, respectively. In general, an ownership change, as defined by IRC Section 382, results from transactions increasing the ownership of certain stockholders or public groups in the stock of a corporation by more than 50 percentage points over a three-year period. The Company has completed several financings since its inception which may result in a change in ownership as defined by IRC Section 382, or could result in a change in control in the future. In each period since our inception, we have recorded a 100% valuation allowance for the full amount of our deferred tax asset, as the realization of the deferred tax asset is uncertain. As a result, we have not recorded any federal tax benefit in our statements of operations.

On December 22, 2017, the Jobs Act was enacted, which reforms corporate tax legislation in the United States and related laws. Any change in the Company's reasonable estimates of the impact of the Jobs Act will be included in the reporting period in which the change is identified in accordance with SAB Topic 5 EE.

Critical Accounting Estimates and Policies

Our discussion and analysis of our financial condition and results of operations are based upon our financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States ("US GAAP"). The preparation of financial statements in accordance with US GAAP requires us to make estimates and assumptions that affect reported amounts and related disclosures. There are certain critical estimates that we believe require significant judgment in the preparation of our financial statements. We consider an accounting estimate to be critical if:

- It requires us to make an assumption because information was not available at the time or it included matters that were highly uncertain at the time, we were making the estimate; and
- Changes in the estimate or different estimates that we could have selected may have had a material impact on our financial condition or results of operations.

The principal areas of estimation reflected in the financial statements are stock-based compensation, valuation of warrants, and income tax valuation allowance.

Stock-Based Payment Arrangements

Generally, all forms of stock-based payments, including stock option grants, warrants, and restricted stock grants are measured at their fair value on the awards' grant date typically using a Black-Scholes pricing model. Stock-based compensation awards issued to non-employees for services rendered are recorded at the fair value of the stock-based payment. The expense resulting from stock-based payments are recorded in research and development expense or general and administrative expense in the statement of operations, depending on the nature of the services provided. Stock-based payment expense is recorded over the requisite service period in which the grantee provides services to us. To the extent the stock option grants, warrants, or restricted stock grants do not vest at the grant date they are subject to forfeiture.

Stock-Based Compensation

U.S. Generally Accepted Accounting Principles ("US GAAP") requires all share-based payments to employees, including grants of employee stock options, to be recognized in the financial statements based on their fair values as of the grant date. Stock-based compensation expense is recorded over the requisite service period in which the grantee provides services to us, to the extent the options do not vest at the grant date and are subject to forfeiture. For performance-based awards that do not include market-based conditions, we record share-based compensation expense only when the performance-based milestone is deemed probable of achievement. We utilize both quantitative and qualitative criteria to judge whether milestones are probable of achievement. For awards with market-based performance conditions, we recognize the grant-date fair value of the award over the derived service period regardless of whether the underlying performance condition is met. We account for forfeitures of stock-based awards as a component of compensation expense as the forfeitures occur.

Warrants

The Company used the Black Scholes Option Pricing Model in calculating the relative fair value of any warrants that have been issued.

Income Taxes

Income taxes are accounted for under the asset and liability method. Deferred tax assets and liabilities are recognized for future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases and operating loss and tax credit carryforwards.

Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect on deferred tax assets and liabilities of a change in tax rate is recognized in operations in the period that includes the enactment date. Deferred tax assets are reduced to estimated amounts expected to be realized by the use of a valuation allowance. Based on our historical operating losses, a valuation allowance has been recognized for all deferred tax assets.

Under US GAAP, the impact of an uncertain income tax position on the income tax return must be recognized at the largest amount that is more-likely-than-not to be sustained upon audit by the relevant taxing authority. An uncertain income tax position will not be recognized if it has less than a 50% likelihood of being sustained. Additionally, GAAP provides guidance on derecognition, classification, interest and penalties, accounting for interim periods, disclosure and transition.

New Accounting Pronouncements

In July 2018, the Financial Accounting Standards Board issued Accounting Standards Updates 2018-10 Codification Improvements to Topic 842, Leases and 2018-11 Leases (Topic 842).

Update 2018-10 Codification Improvements to Topic 842 represent changes to clarify the Codification, correct unintended application of guidance, or make minor improvements to the Codification that are not expected to have a significant effect on current accounting practice or create a significant administrative cost to most entities. Some of the amendments make the Codification easier to understand and easier to apply by eliminating inconsistencies, providing needed clarifications, and improving the presentation of guidance in the Codification.

Update 2018-11 Leases (Topic 842) provides entities with an additional (and optional) transition method to adopt the new lease requirements by allowing entities to initially apply the requirements by recognizing a cumulative-effect adjustment transition method, which applies the provisions of the standard at the effective date without adjusting comparative periods presented. Consequently, an entity's reporting for the comparative periods presented in the financial statements in which the entity adopts the new lease requirements would continue to be in accordance with current GAAP (Topic 840). An entity electing this additional (and optional) transition method must provide the required Topic 840 disclosures for all periods that continue to be in accordance with Topic 840. The amendments do not change the existing disclosure requirements in Topic 840. We implemented this standard on January 1, 2019 using the cumulative-effect adjustment transition method, which applies the provisions of the standard at the effective date without adjusting the comparative periods presented. The Company adopted the following practical expedients and elected the following accounting policies related to this standard:

- We did not reassess whether any expired or existing contracts are or contain leases.
- We did not reassess the lease classification for any expired or existing leases.
- We did not reassess initial direct costs for any existing leases.

The standard did not have a material impact on our balance sheets or on our statements of operations. The most significant impact was the recognition of right of use (ROU) assets and lease liabilities for operating leases. We implemented internal controls to enable the preparation of financial information on adoption of the standard. Adoption of the lease standard had no impact to cash provided by or used in operating, financing, or investing activities in the cash flow statements.

In June 2018, the Financial Accounting Standards Board issued Accounting Standards Update 2018-07 Compensation—Stock Compensation (Topic 718) Improvements to Nonemployee Share-Based Payment Accounting. The amendments in this Update expand the scope of Topic 718 to include share-based payment transactions for acquiring goods and services from nonemployees. The requirements of Topic 718 should be applied to nonemployee awards except for specific guidance on inputs to an option pricing model and the attribution of cost (that is, the period of time over which share-based payment awards vest and the pattern of cost recognition over that period). The amendments specify that Topic 718 applies to all share-based payment transactions in which a grantor acquires goods or services to be used or consumed in a grantor's own operations by issuing share-based payment awards. The amendments also clarify that Topic 718 does not apply to share-based payments used to effectively provide (1) financing to the issuer or (2) awards granted in conjunction with selling goods or services to customers as part of a contract accounted for under Topic 606, Revenue from Contracts with Customers.

The amendments in this Update are effective for public business entities for fiscal years beginning after December 15, 2018, including interim periods within that fiscal year. The adoption of this guidance did not have a material impact on the Company's results of operation, financial position or disclosures.

There are no additional accounting pronouncements issued or effective during the twelve months ended December 31, 2019 that have had or are expected to have an impact on our financial statements.

Results of Operations:

	Year Ended December 31,		Increase/Decrease	Percentage
	2019	2018		
Revenue, net	\$ —	\$ —	\$ —	\$ —
Operating expenses:				
Research, and development	12,120,318	5,971,833	6,148,485	102.96%
General and administrative	3,757,251	4,022,307	(265,056)	-6.59%
Total operating expenses	15,877,569	9,994,140	5,883,429	58.87%
Loss from continuing operations	(15,877,569)	(9,994,140)	(5,883,429)	58.87%
Other income (expense):				
Interest income	320,011	86,527	233,484	269.84%
Interest expense	(7,300)	(5,786)	(1,514)	26.17%
Local business tax	(1,601)	(1,188)	(413)	34.76%
Other income	456	446	10	2.24%
Total other income (expense), net	311,566	79,999	231,567	289.46%
Loss from continuing operations before income taxes	(15,566,003)	(9,914,141)	(5,651,862)	57.01%
Income tax benefit	—	—	—	0.00%
Net loss from continuing operations	(15,566,003)	(9,914,141)	(5,651,862)	57.01%
Deemed dividend of Series D preferred stock	—	(1,412,041)	1,412,041	0.00%
Net loss applicable to common shareholders	\$ (15,566,003)	\$ (11,326,182)	\$ (4,239,821)	37.43%

For the Years Ended December 31, 2019 and 2018

Research and Development. Research and development expenses were \$12,120,318 for the year ended December 31, 2019 compared to \$5,971,833 for the year ended December 31, 2018; an increase of \$6,148,485, or 103.0%. This increase was primarily due to increases in costs associated with clinical trial work under our Oral Mucositis ECC and other work under our Lantibiotic ECC, salaries, consulting, rent and utilities, and insurance of costs of \$6,137,330, \$147,647, \$33,125, \$25,553, and \$16,381, respectively. These increases were partially offset by decreases in stock-based compensation, patent, bonus, and royalty costs of \$130,198, \$45,766, \$30,746, and \$28,521, respectively.

General and Administrative. General and administrative expenses were \$3,757,251 for the year ended December 31, 2019 compared to \$4,022,307 for the year ended December 31, 2018; a decrease of \$265,056, or 6.6%. This decrease was primarily due to decreases in non-employee stock-based compensation, bonus, legal and stock-based compensation costs of \$264,352, \$212,733, \$98,604, and \$72,814, respectively. These decreases were partially offset by increases in consulting, insurance, salary, travel and entertainment employee benefits, conferences, depreciation, and outside accountant costs of \$126,713, \$74,819, \$58,711, \$29,270, \$24,714, \$24,623, \$19,413 and \$15,048, respectively.

Other Income (Expense). Other income (expense) was \$311,566 for the year ended December 31, 2019 compared to \$79,999 for the year ended December 31, 2018; an increase of \$231,567. The increase was primarily attributable to an increase in interest income of \$233,484.

Liquidity and Capital Resources

Since our inception, we have funded our operations primarily through the sale of equity securities in our initial public offering, the sale of equity securities and warrants in private and public offerings, debt financing, warrant exercises and grants. As of December 31, 2019, we had an accumulated deficit of \$(127,352,826) and we have yet to achieve profitability. We incurred net losses of \$(15,566,003) and \$(9,914,141) for the years ended December 31, 2019 and 2018, respectively. We expect to incur significant and increasing operating losses for the foreseeable future as we seek to advance our product candidates through nonclinical testing and clinical trials to ultimately obtain regulatory approval and eventual commercialization. We will need to raise additional capital to fund our operations. We anticipate that our cash resources as of December 31, 2019, will be sufficient to fund our operations as presently structured through the second quarter of 2021. There can be no assurance that additional capital will be available to us on acceptable terms, if at all. Adequate additional funding may not be available to us on acceptable terms, or at all. We expect that research and development expenses will increase along with general and administrative costs, as we grow and operate our business. The following table sets forth the primary sources and uses of cash for each of the periods indicated:

	Years ended December 31,	
	2019	2018
Net cash used in operating activities	\$ (13,012,843)	\$ (9,079,817)
Net cash used by investing activities	(25,214)	(124,727)
Net cash provided by financing activities	11,097,750	23,246,702
Net (decrease) increase in cash and cash equivalents	<u>\$ (1,940,307)</u>	<u>\$ 14,042,158</u>

During the years ended December 31, 2019 and 2018, our operating cash flows from operations used cash of \$(13,012,843) and \$(9,079,817), respectively. The use of cash in all periods primarily resulted from our net losses adjusted for non-cash items and changes in operating assets and liabilities. We had working capital surplus of \$16,987,690 and \$20,765,707 as of December 31, 2019 and 2018, respectively.

Additional details of our financing activities for the periods reflected in this report are provided below:

Financings

The May 2017 Series A Preferred Stock Financing

On May 10, 2017 we entered into a securities purchase agreement with three accredited investors, to purchase up to \$3,000,000 of Series A Convertible Preferred Stock (the "Series A Preferred Stock Financing"). The sale of the Preferred Stock took place in two separate closings and at the first closing which occurred on May 10, 2017, we received gross proceeds of approximately \$1,302,000. The second closing occurred on July 25, 2017 and we received gross proceeds of approximately \$1,698,000, which was the balance of the Preferred Stock Financing. The full \$3,000,000 of Preferred Stock, and after giving effect to the reverse stock split, is convertible into one million two hundred thousand shares of our Common Stock, based on a fixed conversion price of \$2.50 per share on an as-converted basis. In addition, and after giving effect to the reverse stock split, we issued warrants to purchase an aggregate of 462,106 shares of Common Stock at the first closing and we issued an aggregate of 602,414 shares of Common Stock at the second closing. The warrants have a term of seven years from the date of issuance are non-exercisable until 6 months after issuance, have an exercise price of \$3.10 per share. Proceeds from the Series A Preferred Stock Financing (including the exercise of any warrants for cash) will be used for general corporate purposes, including working capital.

On July 27, 2017, we entered into an agreement to amend the warrants issued in connection with the Series A Preferred Stock Financing to provide notification and objection requirements with respect to the change of control provisions. The change of control provisions in the warrants had previously caused the warrants to be treated as a derivative liability as opposed to being treated as equity on our balance sheet. The warrants have been replaced by amended and restated warrants containing such notification and objection requirements (the “Amended and Restated Common Stock Purchase Warrants”) so that the Amended and Restated Common Stock Purchase Warrants are now treated as equity on our balance sheet. All other terms of the original warrants remain unchanged by the Amended and Restated Common Stock Purchase Warrants.

In connection with the Series A Preferred Financing, we filed a Certificate of Designations of Preferences, Rights and Limitations of Series A Preferred Stock with the Secretary of State of the State of Florida, effective May 10, 2017. The number of shares of Preferred Stock designated as Series A Preferred Stock was 12,000,000.

In connection with the issuance and sale of the Series A Preferred Stock and common stock warrants that were issued commensurate with the issuance of the Series A Preferred Stock, we granted certain demand registration rights and piggyback registration rights with respect to the shares of our Common Stock issuable upon conversion of the Preferred Stock and exercise of the Warrants, pursuant to a Registration Rights Agreement.

Except as otherwise required by law, the Series A Preferred Stock shall have no voting rights. However, as long as any shares of Series A Preferred Stock are outstanding, we shall not, without the affirmative vote of the holders of a majority of the then outstanding shares of the Series A Preferred Stock, (a) alter or change adversely the powers, preferences or rights given to the Series A Preferred Stock or alter or amend the Certificate of Designation, (b) amend its articles of incorporation or other charter documents in any manner that adversely affects any rights of the holders of Series A Preferred Stock, (c) increase the number of authorized shares of Series A Preferred Stock, or (d) enter into any agreement with respect to any of the foregoing. Upon any liquidation, dissolution or winding-up by us, whether voluntary or involuntary that is not a Fundamental Transaction (as defined in the Certificate of Designation), the holders of Series A Preferred Stock shall be entitled to receive out of the assets, the greater of (i) the product of the number of shares of Series A Preferred Stock then held by such holder, multiplied by the Original Issue Price; and (ii) the amount that would be payable to such holder in the Liquidation in respect of Common Stock issuable upon conversion of such shares of Series A Preferred Stock if all outstanding shares of Series A Preferred Stock were converted into Common Stock immediately prior to the Liquidation. The Series A Preferred Stock is classified as permanent equity.

The May 2017 Precigen Debt Financing and ECC Amendment

On May 10, 2017, concurrently with the above referenced Series A Preferred Stock Financing, we entered into Note Purchase Agreement with Precigen pursuant to which the Company issued a \$2,400,000 unsecured non-convertible promissory note to Precigen (the “Precigen Note”) and amended the first milestone in our Oral Mucositis exclusive channel collaboration agreement (the “May Oral Mucositis ECC Amendment”) with Precigen. The Precigen Note matured in two (2) years and has a simple interest rate of 12% per annum. Proceeds from the Precigen Note were used to fund our AG013 research and clinical trials. In addition to, and as part of the Precigen Note, we amended the first milestone payment on the Oral Mucositis ECC from a \$2,000,000 payment upon first dosing of a patient to a \$3,000,000 payment upon the earlier of (a) dosing of the last patient, in a Phase 2 clinical trial, and (b) the twenty-four (24) month anniversary of the dosing of the first patient in the Phase 2 clinical trial. Simultaneously with the amendment to the Oral Mucositis ECC a similar amendment was put in place with respect to our Stock Issuance Agreement with Precigen reflecting the milestone amendment. The Precigen Note was subsequently repaid in November 2017 through the issuance of Series C Preferred Stock to Precigen (see below).

The November 2017 Series B Preferred Stock Financing

On November 8, 2017, we completed a private placement of \$3,300,000 of Series B Non-Voting, Convertible Preferred Stock (the “Series B Convertible Preferred Stock”) pursuant to a Securities Purchase Agreement with four existing shareholders who are accredited investors including an entity affiliated with a director of the Company (the “Series B Preferred Stock Financing”).

The full \$3,300,000 of Series B Convertible Preferred Stock is convertible, after giving effect to the reverse stock split into one million three hundred and twenty thousand shares of our Common Stock, based on a conversion of one share of Series B Preferred Stock into two shares of Common Stock. The purchase price per share of the Series B Preferred Stock is represented by \$2.50 per share of the Common Stock on an as converted basis. In addition, and after giving effect to the reverse stock split, we issued to the investors in the private placement accompanying common stock purchase warrants to purchase an aggregate of 1,064,518 shares of Common Stock. The warrants have a term of seven years from the date of issuance, and are non-exercisable until six (6) months after issuance, and after giving effect to the reverse stock split, have an exercise price of \$3.10 per share.

In connection with the Series B Preferred Financing, we filed a Certificate of Designation and Rights of Series B Convertible Preferred Stock with the Secretary of State of the State of Florida, effective November 8, 2017. The number of shares of Preferred Stock designated as Series B Preferred Stock was 6,600,000.

Except as otherwise required by law, the Series B Preferred Stock shall have no voting rights. However, as long as any shares of Series B Preferred Stock are outstanding, we shall not, without the affirmative vote of the holders of a majority of the then outstanding shares of the Series B Preferred Stock, (a) alter or change adversely the powers, preferences or rights given to the Series B Preferred Stock or alter or amend the Certificate of Designation, (b) amend its articles of incorporation or other charter documents in any manner that adversely affects any rights of the holders of Series B Preferred Stock, (c) increase the number of authorized shares of Series B Preferred Stock, or (d) enter into any agreement with respect to any of the foregoing.

The Series B Preferred Stock shall rank (i) on par with the Common Stock and Series A Preferred Stock and junior to Series C Preferred Stock as to dividend rights and (ii) junior to Series C Preferred Stock, on par with Series A Preferred Stock and senior to the Common Stock as to distribution of assets upon liquidation, dissolution or winding-up by us, whether voluntary or involuntary.

Upon any liquidation, dissolution or winding-up by us, whether voluntary or involuntary, the holders of Series B Preferred Stock shall be entitled to receive out of the assets, after payment to the holders of Series C Preferred Stock but on par with the holders of Series A Preferred Stock and in preference to the holders of the Common Stock, an amount of cash equal to the greater of (i) the product of the number of shares of Series B Preferred Stock then held by such holder, multiplied by the Original Issue Price; and (ii) the amount that would be payable to such holder in the Liquidation in respect of Common Stock issuable upon conversion of such shares of Series B Preferred Stock if all outstanding shares of Series B Preferred Stock were converted into Common Stock immediately prior to the Liquidation. The Series B Preferred Stock is classified as permanent equity.

The Series C Preferred Stock Issuance and Precigen Debt Conversion

Concurrently with the Series B Preferred Stock Financing, we also entered into a Debt Conversion Agreement (the "Precigen Debt Conversion Agreement") with Precigen Corporation ("Precigen") pursuant to which Precigen exchanged the \$2,400,000 unsecured non-convertible promissory note previously issued by us to Precigen (the "Precigen Note"), the accrued interest on the Precigen Note and trade payables owed by us (collectively the "Debt") in the aggregate amount of approximately \$3,400,000 for equity in the form of 100 shares of Series C, Non-Voting, Non-Convertible Preferred Stock (the "Series C Preferred Stock") issued by us to Precigen pursuant to the Debt Conversion Agreement which 100 shares have a stated value equal to the amount of the Debt.

In connection with the Precigen Debt Conversion Agreement, we filed a Certificate of Designation and Rights of Series C Non-Convertible Preferred Stock with the Secretary of State of the State of Florida, to be effective November 8, 2017. The number of shares of Preferred Stock designated as Series C Preferred Stock is 1,000.

Each issued and outstanding share of Series C Preferred Stock entitles the holder of record to receive dividends at the annual rate of twelve percent (12%) (the "Initial Rate") of its Stated Value, payable by issuing additional shares of Series C Preferred Stock within thirty days after the end of each calendar year pro-rata for partial years. The Initial Rate shall be subject to increase to twenty percent (20%) automatically after May 10, 2019.

The Series C Preferred Stock shall rank senior to the Common Stock, Series A Preferred Stock, Series B Preferred Stock and to any other equity securities issued by us (the "Junior Securities") as to rights upon liquidation, dissolution or winding-up by us, whether voluntary or involuntary.

Upon any liquidation, dissolution or winding-up by us, whether voluntary or involuntary, the holders of Series C Preferred Stock shall be entitled to receive, in preference to the Junior Securities, an amount of cash equal to the product of (i) sum of (a) the number of shares of Series C Preferred Stock then held by such holder plus, (b) the number of shares of Series C Preferred Stock issuable to such holder in connection with any accrued but unpaid dividends, multiplied by (ii) the Stated Value, of \$33,847.9874 per share, of Series C Preferred Stock ("the Series C Liquidation Amount") and no distribution or payments shall be made in respect of any Junior Securities unless all Series C Liquidation Amounts, if any, are first paid in full.

On January 25, 2018 we paid a dividend on our Series C Preferred Stock to Precigen of 1.733 shares of additional Series C Preferred Stock, on January 31, 2019 we paid a dividend on our Series C Preferred Stock to Precigen of 12.208 shares of additional Series C Preferred Stock and on January 27, 2020 we paid a dividend on our Series C Preferred Stock to Precigen of 19.542 shares of additional Series C Preferred Stock. As a result of the recent sale by Precigen of its equity interest in Oragenics to TS Biotechnology LLC, future dividend payments would be paid to TS Biotechnology.

The April 6, 2018 Registered Direct Offering and Private Placement

On April 6, 2018, we entered into a securities purchase agreement with certain investors pursuant to which issued an aggregate of 900,000 shares of our common stock, par value \$0.001 per share, at \$2.00 per share. In a concurrent private placement, we issued to the investors who participated in the registered offering, warrants exercisable for one share of common stock for each share purchased in the registered offering for an aggregate of warrants to acquire 900,000 shares of common stock at an exercise price of \$2.00 per share. Each warrant is exercisable beginning on the six-month anniversary of the date of its issuance and expires five years from the date of issuance.

The July 17, 2018 Underwritten Public Offering

On July 17, 2018, we closed an underwritten public offering of units for gross proceeds of approximately \$13.8 million, which includes the full exercise of the underwriter's over-allotment option to purchase additional shares and warrants, prior to deducting underwriting discounts and commissions and offering expenses payable by us.

The offering was comprised of Class A Units, priced at a public offering price of \$1.00 per unit, with each unit consisting of one share of common stock and a seven-year warrant to purchase one share of common stock with an exercise price of \$1.00 per share (each, a "Warrant" and collectively, the "Warrants"), and Class B Units, priced at a public offering price of \$1.00 per unit, with each unit comprised of one share of series D preferred stock (the "Series D Preferred Stock"), which is convertible into one share of common stock, and a Warrant. The conversion price of the Series D Preferred Stock issued in the transaction as well as the exercise price of the Warrants are fixed and do not contain any variable pricing features or any price based anti-dilutive features. The Series D Preferred Stock issued in this transaction included a beneficial ownership blocker but has no dividend rights (except to the extent that dividends are also paid on the common stock), liquidation preference or other preferences over common stock, and, with certain exceptions, has no voting rights. The securities comprising the units were immediately separable and have been issued separately.

At the closing of our underwritten public offering, a total of 4,436,000 shares of common stock, 9,364,000 shares of Series D Preferred Stock convertible into 9,364,000 shares of common stock, and warrants to acquire 13,800,000 shares of common stock were issued inclusive of the underwriter's exercise of their over-allotment option to purchase 1,800,000 shares of common stock and warrants to acquire 1,800,000 shares of common stock at \$1.00 per share.

Since the closing of our underwritten public offering all of the shares of Series D Preferred Stock that were issued have been converted into shares of our common stock in accordance with the terms for conversion and 9,505,500 warrants were exercised for cash generating approximately \$9.5 million in proceeds to us.

The March 25, 2019 Underwritten Public Offering.

On March 25, 2019, we announced the closing of an underwritten public offering for gross proceeds of approximately \$12.5 million, which included the partial exercise of the underwriter's over-allotment option to purchase additional shares and warrants, prior to deducting underwriting discounts and commissions and offering expenses. The offering is comprised of 16,666,668 shares of common stock, short-term warrants to purchase up to 8,333,334 shares of common stock, and long-term warrants to purchase up to 8,333,334 shares of common stock, at a price to the public of \$0.75 per share and accompanying warrants.

We granted the underwriter a 30-day option to purchase up to 2,500,000 additional shares of common stock and/or short-term warrants to purchase 1,250,000 shares of common stock and long-term warrants to purchase 1,250,000 shares of common stock the public offering price, less underwriting discounts and commissions.

The underwriter did not exercise its option to purchase additional shares of common stock, however the underwriter did exercise its option to purchase the short-term warrants to purchase 1,250,000 shares of common stock and long-term warrants to purchase 1,250,000 shares of common stock effective as of the closing. Each short-term warrant has an exercise price of \$0.75 per share of common stock, is immediately exercisable, and will expire on the earlier of (1) the eighteen-month anniversary of the date of issuance and (2) twenty-one trading days following our release of top-line data related to its Phase 2 double blind, placebo controlled clinical trial of AG013. Each long-term warrant has an exercise price of \$0.90 per share of common stock, is immediately exercisable and will expire five years following the date of issuance.

Other Financings

We enter into short term financing arrangements for the payment of our annual insurance premiums for our products liability insurance and directors and officers and employment practices insurance.

Products Liability Insurance

On March 10, 2019, we entered into a short-term note payable for \$17,688 bearing interest at 5.69% to finance the product liability insurance. Principal and interest payments on this note began April 10, 2019 and are made evenly based on a straight-line amortization over an 11-month period with the final payment being due on February 10, 2020.

On March 10, 2018, we entered into a short-term note payable for \$28,915 bearing interest at 5.09% to finance the product liability insurance. Principal and interest payments on this note began April 10, 2018 and are made evenly based on a straight-line amortization over an 11-month period with the final payment being made on February 12, 2019.

Directors' and Officers' Insurance

On August 7, 2019 we entered into a short-term note payable for \$254,889 bearing interest at 5.74% to finance a portion of the directors' and officers' liability insurance and employment practices liability insurance premiums. Principal and interest payments on this note began August 24, 2019 and are made evenly based on a straight-line amortization over an 11-month period with the final payment being due on June 24, 2020.

On July 24, 2018, we entered into a short-term note payable for \$215,575 bearing interest at 5.24% to finance a portion of the directors' and officers' liability insurance and employment practices liability insurance premiums. Principal and interest payments on this note began August 24, 2018 and are made evenly based on a straight-line amortization over an 11-month period with the final payment being made on June 27, 2019.

Future Capital Requirements

Our capital requirements for 2020 will depend on numerous factors, including the success of our commercialization efforts and of our research and development, the resources we devote to develop and support our technologies and our success in pursuing strategic licensing and funded product development relationships with external partners. Subject to our ability to raise additional capital including through possible joint ventures and/or partnerships, we expect to incur substantial expenditures to further commercialize or develop our technologies including continued increases in costs related to research, nonclinical testing and clinical trials, as well as costs associated with our capital raising efforts and being a public company. We will require substantial funds to conduct research and development and nonclinical and Phase 1 and Phase 2 clinical testing of our licensed, patented technologies and to develop sublicensing relationships for the Phase 2 and 3 clinical testing and manufacture and marketing of any products that are approved for commercial sale. Our plans include seeking both equity and debt financing, alliances or other partnership agreements with entities interested in our technologies, or other business transactions that would generate sufficient resources to ensure continuation of our operations and research and development programs.

Our current available cash and cash equivalents provide us with limited liquidity. We believe our existing cash and cash equivalents, inclusive of our net proceeds from our March 25, 2019 public offering, will allow us to fund our operating plan through the second quarter of 2021. We expect to continue to seek additional funding for our operations. Any such required additional capital may not be available on reasonable terms, if at all. If we were unable to obtain additional financing, we may be required to reduce the scope of, delay or eliminate some or all of our planned clinical testing, research and development and commercialization activities, which could harm our business. The sale of additional equity or debt securities may result in additional dilution to our shareholders. If we raise additional funds through the issuance of debt securities or preferred stock, these securities could have rights senior to those of our common stock and could contain covenants that would restrict our operations. We also will require additional capital beyond our currently forecasted amounts. For example, as we continue to work with Precigen under the Lantibiotic ECC for the development of MU1140 homologs and in our Oral Mucositis ECC, we will require additional capital.

Because of the numerous risks and uncertainties associated with research, development and commercialization of our product candidates, we are unable to estimate the exact amounts of our working capital requirements. Our future funding requirements will depend on many factors, including, but not limited to:

- the pace of patient enrollment in our clinical trial of AG013;
- identifying and securing clinical sites for the conduct of human trials for our product candidates;
- the determination to redeem all or any portion of our outstanding Series C Preferred Stock;

- the number and characteristics of the product candidates we pursue;
- the scope, progress, results and costs of researching and developing our product candidates, and conducting nonclinical and clinical trials including the research and development expenditures we expect to make in connection with our collaboration agreements with Precigen;
- the timing of, and the costs involved in, obtaining regulatory approvals for our product candidates;
- our ability to maintain current research and development licensing agreements and to establish new strategic partnerships, licensing or other arrangements and the financial terms of such agreements;
- our ability to achieve our milestones under our ECC agreements and licensing arrangements and the payment obligations we may have;
- the costs involved in preparing, filing, prosecuting, maintaining, defending and enforcing patent claims, including litigation costs and the outcome of such litigation; and
- the timing, receipt and amount of sales of, or royalties on, our products and future products, if any.

We have based our estimates on assumptions that may prove to be wrong. We may need to obtain additional funds sooner or in greater amounts than we currently anticipate. Potential sources of financing include strategic relationships, public or private sales of our shares or debt and other sources. We may seek to access the public or private equity markets when conditions are favorable due to our long-term capital requirements. We do not have any committed sources of financing at this time, and it is uncertain whether additional funding will be available when we need it on terms that will be acceptable to us, or at all. If we raise funds by selling additional shares of common stock or other securities convertible into common stock, the ownership interest of our existing stockholders will be diluted. If we are not able to obtain financing when needed, we may be unable to carry out our business plan. As a result, we may have to significantly limit our operations and our business, financial condition and results of operations would be materially harmed.

Off-Balance Sheet Arrangements

We have no off-balance sheet arrangements.

Tax Loss and Credit Carryforwards

As of December 31, 2019, and 2018, we have net operating loss carryforwards of approximately \$117,964,000 and \$102,984,000, respectively, to offset future federal and state income taxes. Federal and state tax net operating loss carryforwards generated prior to December 31, 2017 will expire through 2037. Federal tax net operating loss carryforwards generated subsequent to December 31, 2017, do not expire but are subject to a limitation of 80% of federal taxable income. The state tax loss carryforward generated subsequent to December 31, 2017, will expire through 2038, unless previously utilized. We also have research and development tax credit carryforwards of approximately \$2,805,000 and \$2,301,000 as of December 31, 2019 and 2018, respectively, to offset future federal and state income taxes. Our net operating loss and research and development tax credit carryforwards will expire if not used by 2038 and 2028, respectively. Utilization of net operating loss carryforwards and research and development credit carryforwards may be subject to a substantial annual limitation due to ownership change limitations that may have occurred or, could occur in the future in accordance with Section 382 of the Internal Revenue Code of 1986 ("IRC Section 382") and with Section 383 of the Internal Revenue Code of 1986, as well as similar state provisions. These ownership changes may limit the amount of net operating loss carryforwards and research and development credit carryforwards that can be utilized annually to offset future taxable income and taxes, respectively. In general, an ownership change, as defined by IRC Section 382, results from transactions increasing the ownership of certain stockholders or public groups in the stock of a corporation by more than 50 percentage points over a three-year period. The Company has completed several financings since its inception which may result in a change in ownership as defined by IRC Section 382, or could result in a change in control in the future.

On December 22, 2017, the Jobs Act was enacted, which reforms corporate tax legislation in the United States and related laws. Any change in the Company's reasonable estimates of the impact of the Jobs Act will be included in the reporting period in which the change is identified in accordance with SAB Topic 5 EE.

At December 31, 2019 and 2018, we recorded a 100% valuation allowance against our deferred tax assets of approximately \$30,098,000 and \$26,224,000, respectively, as our management believes it is uncertain that they will be fully realized. If we determine in the future that we will be able to realize all or a portion of our net operating loss carryforwards, an adjustment to our net operating loss carryforwards would increase net income in the period in which we make such a determination.

Inflation

Inflation affects the cost of raw materials, goods and services that we use. In recent years, inflation has been modest. However, high energy costs and fluctuations in commodity prices can affect the cost of all raw materials and components. The competitive environment somewhat limits our ability to recover higher costs resulting from inflation by raising prices. Although we cannot precisely determine the effects of inflation on our business, it is management's belief that the effects on revenues and operating results will not be significant. We do not believe that inflation has had a material impact on our results of operations for the periods presented, except with respect to payroll-related costs and other costs arising from or related to government-imposed regulations.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK.

Not applicable.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA.

The Financial Statements are incorporated herein by reference to pages F-1 to F-25 at the end of this report and the supplementary data is not applicable.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE.

Not Applicable.

ITEM 9A. CONTROLS AND PROCEDURES.

Disclosure Controls and Procedures

Management's evaluation of the effectiveness of the Company's disclosure controls and procedures as defined in Rules 13a-15(e) and 15d-15(e) of the Securities Exchange Act was performed under the supervision and participation of our senior management, including our Chief Executive Officer and Chief Financial Officer. The purpose of disclosure controls and procedures is to ensure that information required to be disclosed in the reports filed or submitted under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in the SEC's rules and forms, and that such information is accumulated and communicated to management, including our Chief Executive Officer and Chief Financial Officer, to allow timely decisions regarding required disclosures. Based upon that evaluation, our Chief Executive Officer and Chief Financial Officer concluded that, as of the end of such period, our disclosure controls and procedures were effective as of December 31, 2019 in ensuring that information required to be disclosed by us in reports that we file or submit under the Exchange Act is recorded, processed, summarized and reported with the time periods specified in the Securities and Exchange Commission's rules and forms. Management believes that, existing controls were effective and operating properly as designed. During 2019, management believes that the Company maintained a consistent and verifiable financial reporting organization and internal control procedures.

Changes in Internal Controls over Financial Reporting

Our management, with the participation of our Chief Executive Officer and Chief Financial Officer, has concluded there were no other significant changes in our internal controls over financial reporting that occurred during our last fiscal quarter that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Limitations on the Effectiveness of Controls

Our management, including our Chief Executive Officer and Chief Financial Officer, does not expect that our Disclosure Controls and internal controls will prevent all errors and all fraud. A control system, no matter how well conceived and operated, can provide only reasonable, not absolute, assurance that the objectives of the control system are met. Further, the design of a control system must reflect the fact that there are resource constraints, and the benefits of controls must be considered relative to their costs. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, within the Company have been detected. These inherent limitations include the realities that judgments in decision-making can be faulty, and that breakdowns can occur because of a simple error or mistake. Additionally, controls can be circumvented by the individual acts of some persons, by collusion of two or more people, or by management or board override of the control.

The design of any system of controls also is based in part upon certain assumptions about the likelihood of future events, and there can be no assurance that any design will succeed in achieving its stated goals under all potential future conditions; over time, controls may become inadequate because of changes in conditions, or the degree of compliance with the policies or procedures may deteriorate. Because of the inherent limitations in a cost-effective control system, misstatements due to error or fraud may occur and not be detected.

Chief Executive Officer and Chief Financial Officer Certification

Appearing after the Signatures section of this report there is a Certification of the Chief Executive Officer and the Chief Financial Officer. The Certification is required in accordance with Section 302 of the Sarbanes-Oxley Act of 2002 (the Section 302 Certifications). This Item of this report, which you are currently reading is the information concerning the evaluation referred to in the Section 302 Certification and this information should be read in conjunction with the Section 302 Certification for a more complete understanding of the topics presented.

Management's Report on Internal Control over Financial Reporting

The management of Oragenics, Inc. is responsible for establishing and maintaining adequate internal control over financial reporting, as such term is defined in the Securities Exchange Act Rule 13a-15(f). The Company's internal control over financial reporting is a process designed to provide reasonable assurance to the Company's management and board of directors regarding the reliability of financial reporting and the preparation of the financial statements for external purposes in accordance with accounting principles generally accepted in the United States of America.

The Company's internal control over financial reporting includes those policies and procedures that (i) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the Company; (ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with accounting principles generally accepted in the United States of America, and that receipts and expenditures of the Company are being made only in accordance with authorizations of management and directors of the Company; and (iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the Company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal controls over financial reporting may not prevent or detect misstatements. All internal control systems, no matter how well designed, have inherent limitations, including the possibility of human error and the circumvention of overriding controls. Accordingly, even effective internal control over financial reporting can provide only reasonable assurance with respect to financial statement preparation. Also, 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, under the supervision of the Chief Executive Officer and the Chief Financial Officer, assessed the effectiveness of the Company's internal control over financial reporting as of December 31, 2019. In making this assessment, it used the criteria set forth by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in *Internal Control-Integrated Framework (1992)* as updated in May of 2013, (the "2013 COSO Framework"). We integrated the changes prescribed by the 2013 COSO Framework into our internal controls over financial reporting during the year ending December 31, 2015. We also used SEC guidance on conducting such assessments. Based on our assessment, we believe that, as of December 31, 2019, the Company's internal control over financial reporting was effective.

This annual report does not include an attestation report of our registered public accounting firm regarding internal control over financial reporting. Management's report was not subject to attestation by our registered public accounting firm pursuant to temporary rules of the Securities and Exchange Commission that permit us to provide only management's report in this annual report.

ITEM 9B. OTHER INFORMATION.

None.

PART III

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE.

Directors and Executive Officers

The following table sets forth the names, ages and titles of the Company's Directors, executive officers, key employees and the position they each hold with the Company.

Name	Age	Position
Dr. Frederick W. Telling, Ph.D.	68	Chairman and Director
Alan Joslyn, Ph.D.	61	President, Chief Executive Officer and Director
Robert C. Koski	61	Director
Charles L. Pope	68	Director
Dr. Alan W. Dunton, M.D.	65	Director
Michael Sullivan	63	Chief Financial Officer, Secretary and Treasurer
Dr. Martin Handfield	49	Senior Vice President Discovery Research

Directors of the Company

Dr. Frederick W. Telling. Dr. Telling was elected Chairman of the Board of Directors on February 4, 2011. He has served as a Director since June 2010. Dr. Telling retired from Pfizer Inc. in June 2007 after 30 years of service. At Pfizer Dr. Telling served as its Corporate Vice President and Vice President of Corporate Strategic Planning and Policy. Dr. Telling also serves on the boards of various civic and non-profit organizations. Dr. Telling holds a B.A. degree in History and Economics from Hamilton College and a MA degree in Industrial and Labor Relations and a PhD in Economics and Public Policy from Cornell University.

Dr. Telling brings to our Board an extensive array of business and industry experience as well as experience as a director of public companies.

Alan F. Joslyn, Ph.D. Dr. Joslyn has served as a Director of our company since June 2016. Since 2009 he has served as Board member of Synergy Pharmaceuticals (NASDAQ: SGYP). Since 2014, Dr. Joslyn has been a partner in Lazarus Pharmaceuticals, LL. From March 2010 to April 2014, Dr. Joslyn served as CEO and a Director of Sentinella Pharmaceuticals and from August 2009 to October 2012 as CEO and Director of Edusa Pharmaceuticals, both privately held biotechnology companies. From March 2007 to March 2009, Dr. Joslyn served as President and Chief Executive Officer of Mt. Cook Pharma and as Senior Vice President of Research & Development at Penwest Pharmaceuticals from 2004 to 2007. From 1995 to 2004, Dr. Joslyn held a number of leadership positions within Johnson & Johnson focusing on development of gastroenterology products including Propulsid[®], Motilium[®], Aciphex[®] and prucalopride. Dr. Joslyn received his B.S. in medicinal chemistry, B.A. in biology and Ph.D. in biochemical pharmacology from the State University of New York at Buffalo.

Dr. Joslyn brings to our Board over two decades of experience in the pharmaceutical industry and extensive expertise in gastroenterology and infectious disease product development.

Charles L. Pope. Mr. Pope has served as a Director since June 2010. Mr. Pope served as the Chief Financial Officer of Palm Bancorp, Inc. from June 2009 to June 2012. From September 2007 through June 2009, Mr. Pope served as the Chief Financial Officer of Aerosonic Inc., a manufacturer of aviation products. Mr. Pope served as the Chief Financial Officer of Reptron Inc., a manufacturer of electronic products, from March 2005 through June 2007. From March 2002 to March 2005, Mr. Pope served as Chief Financial Officer of SRI/Surgical Express, Inc. From February 2001 to March 2002, Mr. Pope served as Chief Financial Officer of Innovaro, Inc. (formerly UTEK Corporation NYSE AMERICAN: INV) a public company. Mr. Pope served as a director of Innovaro, Inc. from March 2010 to August 2012. Mr. Pope also served as a director of Inuvo, Inc. from July 2008 through July 2018. Prior to this time, Mr. Pope served as a Partner in the Audit and Financial Advisory Consulting Divisions of PricewaterhouseCoopers LLP, and he was also a Partner in the Accounting and SEC Directorate in PricewaterhouseCoopers LLP's New York City office. Mr. Pope holds a B.S. degree in Economics and Accounting from Auburn University and is a Certified Public Accountant in Florida.

Mr. Pope brings to our Board over three decades of experience in the finance and accounting fields. In addition, Mr. Pope also has experience serving as a director of public companies.

Dr. Alan W. Dunton. Dr. Dunton has served as a Director of Oragenics, Inc. since April 2011. He is the principal owner of Danerius, LLC, a biotechnology consulting company which he founded in 2006. In addition to Oragenics, he is currently a Director of the public biotechnology company, Palatin, Inc. (AMEX: PTN), CorMedix (NASDAQ: CRMD) and Regeneus (ASX: RGS). Dr. Dunton is also a member of the Board of Members or Directors of Cytogel Pharma, a privately-held firm in Darien, Connecticut. He previously served as a Director of Sancilio and Company, MediciNova and Targacept, Inc. Dr. Dunton is also a member of the Board of Director of CorMedix, Inc. (CRMD), a publicly traded biotechnology company in Berkeley Heights, New Jersey since March 2019. Dr. Dunton has held significant senior positions in major pharmaceutical companies. Most recent was from November 2015 through March 2018 as the Senior Vice President of Research, Development and Regulatory Affairs of Purdue Pharma L.P., a private pharmaceutical company. From January 2007 until March 2009, Dr. Dunton served as President and Chief Executive Officer of Panacos Pharmaceuticals, Inc. He was the non-Executive Chairman and Director of EpiCept, Inc. (OTC MKTS: EPCT) a public biotechnology company developing products for cancer, pain and inflammatory conditions. In 2005, Dr. Dunton served as the Non-Executive Chairman of the Board of Directors of ActivBiotics, Inc., a private biopharmaceutical company. Previously, he was the President and Chief Executive Officer of Metaphore Pharmaceuticals, Inc. from 2003 until 2006, when it merged with ActivBiotics. From 2004 until 2005, Dr. Dunton served as a member of the board of directors of Vicuron Pharmaceuticals until it was acquired by Pfizer, Inc. In 2002, Dr. Dunton served as President, Chief Operating Officer and a director of Emisphere Technologies, Inc., a biopharmaceutical company. From 1994 to 2001, Dr. Dunton was a senior executive in various capacities in the Pharmaceuticals Group of Johnson & Johnson. From 1999 to 2001, Dr. Dunton was President and Managing Director of The Janssen Research Foundation, a Johnson & Johnson company. From 1998 to 1999, he served as Group Vice President of Global Clinical Research and Development of Janssen. Prior to joining Janssen, Dr. Dunton was Vice President of Global Clinical Research and Development at the R.W. Johnson Pharmaceutical Research Institute, also a Johnson & Johnson company. Prior to joining Johnson & Johnson, Dr. Dunton held positions in clinical research and development at Syntex Corporation, CIBA-GEIGY Corporation and Hoffmann La Roche Inc. Dr. Dunton holds a MD degree from New York University School of Medicine, where he completed his residency in internal medicine. He also was a Fellow in Clinical Pharmacology at the New York Hospital/Cornell University Medical Center.

Dr. Dunton brings to our Board a significant depth of experience in the pharmaceutical industry that will be invaluable to the Company as we continue to develop biotechnology assets.

Robert C. Koski. Mr. Koski has served as a Director since June 2009. Mr. Koski has practiced as an attorney with the Koski Firm, a sole proprietorship located in Atlanta, Georgia since 1992, where his practice includes litigation and tax law. Mr. Koski has also served as a partner in the Koski Family Limited Partnership, which beneficially owns an interest in the Company, and as a director of the Koski Family Foundation since December 1996. Mr. Koski holds a B.A. degree in Philosophy and English from Colgate University, a JD from Emory School of Law and an LLM degree in Taxation and Litigation from Emory University.

Mr. Koski brings to our Board over two decades of experience in the legal field as a practicing attorney. In addition to his legal experience, Mr. Koski's educational background provides a foundation for leadership and consensus-building.

Executive Management

Alan F. Joslyn, Ph.D. The biography of Dr. Joslyn is included above.

Michael Sullivan. Mr. Sullivan has served as our Interim Principal Executive Officer from October 30, 2014 until June 5, 2016 and served as our Chief Financial Officer, Secretary and Treasurer since February 6, 2012. Mr. Sullivan has held senior level financial positions for several publicly and privately held businesses including Utek Corporation, eANGLER, and HSN Direct International Limited. Most recently, he was the Group Financial Officer for the Investigative Services and Litigation Consulting Services segment of First Advantage Corporation a firm specializing in talent acquisition solutions where he streamlined the employee recruitment process. Mr. Sullivan is a Florida Certified Public Accountant. He graduated from the Florida State University with a Bachelor of Science in Accounting and a Master of Business Administration.

Key Employee

Dr. Martin Handfield. Dr. Handfield is, the Company's Senior Vice President of Discovery Research and previously has served as our Director of Research and Development. Dr. Handfield has served the Company since January 2009. Prior to joining our Company, Dr. Handfield held a position as Tenured Associate Professor at the Center for Molecular Microbiology and the Department of Oral Biology at the University of Florida College of Dentistry, where he co-invented IVIAT and co-founded *ivi* Gene Corp. and Epicure Corp. to commercialize this and related technologies. Dr. Handfield holds a B.S. degree in Biochemistry, and a MS degree and PhD in Microbiology and Immunology from the Université Laval College of Medicine in Canada, and did postdoctoral training at the University of Florida.

Our executive officers serve at the pleasure of our Board of Directors until their successors are elected or qualified and subject, in certain cases to employment agreements we have entered into with our officers. Our new chief Executive Officer and President Dr. Alan Joslyn and Mr. Sullivan, our Chief Financial Officer and Dr. Handfield, our Senior Vice President of Discovery Research, each have employment agreements with us. See "Executive Compensation—Employment Contracts and Change in Control Arrangements."

Board of Directors and Committees

Our property, affairs and business are under the general management of our Board of Directors as provided by the laws of the State of Florida and our Bylaws.

The Board of Directors conducts its business through meetings of the full Board and through committees of the Board. The Board of Directors has appointed standing Audit, Compensation and Nominating and Governance Committees of the Board of Directors.

The Board periodically reviews the size of the Board and recommends any changes it determines to be appropriate given our needs. Under our Bylaws, the number of members on the Board may be increased or decreased by resolution of the Board.

Independence of Directors

Our common stock is listed on a national securities exchange, the NYSE American. Accordingly, in determining whether our Directors are independent, we are required to comply with the rules of the NYSE American. We also expect to continue to comply with securities and other laws and regulations regarding the independence of directors, including those adopted under Section 301 of the Sarbanes-Oxley Act and Rule 10A-3 under the Securities and Exchange Act of 1934 with respect to the independence of Audit Committee members. The NYSE American listing standards define an "independent director" generally as a person, other than an officer of a company, who does not, in the view of the company's Board of Directors, have a relationship with the company that would interfere with the director's exercise of independent judgment. The Board has affirmatively determined that each of the following directors, constituting a majority of the Board, is independent within the meaning of the NYSE American listing standards:

Dr. Frederick W. Telling
Charles L. Pope
Dr. Alan Dunton
Robert Koski

Such independence definition includes a series of objective tests, including that the director is not an executive officer employee of the company and has not engaged in various types of business dealings with the company. In addition, as further required by the NYSE American listing standards, the Board has made a subjective determination as to each independent director that no relationships exist which, in the opinion of the Board, would interfere with the exercise of independent judgment in carrying out the responsibilities of a director.

Audit Committee Financial Expert

The Audit Committee members currently consist of Mr. Charles Pope, Dr. Frederick Telling and Dr. Alan Dunton with Mr. Pope serving as Chairman. The Board has affirmatively determined that each such person met the independence requirements for audit committee purposes based on the more stringent independence standards imposed by applicable NYSE American and SEC rules. In addition, the Board of Directors has determined that Mr. Pope is an “audit committee financial expert” as that term is defined in Item 407(d)(5) of Regulation S-K promulgated under the Securities and Exchange Act of 1934. In March 2004, the Audit Committee adopted a written charter which was modified on April 24, 2007 and on December 29, 2009. The Company believes that its Audit Committee Charter complies with the requirements related to Sarbanes-Oxley and a current copy of the Audit Committee Charter is available on our website <http://ir.oragenics.com/governance-docs>.

Code of Ethics

We have adopted a code of ethics known as the Company Operating Principles, which is applicable to all of our directors and employees, including our principal executive officer and our principal financial officer. A copy of the Company Operating Principles can be found on our website at www.oragenics.com. Any future amendments to, or waivers from, the Company Operating Principles will be posted on our website.

Section 16(a) Beneficial Ownership Reporting Compliance

Section 16(a) of the Securities Exchange Act of 1934 requires the Company’s officers and Directors and any persons who beneficially own more than ten percent of the Company’s Common Stock to file reports of ownership and changes in ownership of such securities with the Securities and Exchange Commission Officers, Directors and beneficial owners of more than ten percent of the Common Stock are required by applicable regulations to furnish the Company with copies of all Section 16(a) forms they file. Based solely on its review of copies of forms furnished to the Company and written representations from the executive officers and directors, the Company believes, all persons subject to the reporting requirements with regard to the Common Stock complied with the applicable filing requirements during 2019.

ITEM 11. EXECUTIVE COMPENSATION.

Compensation Discussion and Analysis

This section explains the objectives of our named executive officer compensation program, the compensation decisions we made with respect to compensation for our fiscal year ended December 31, 2019, and the factors we considered in making those decisions, and focuses on the compensation of officers who are listed below as our “named executive officers”:

- Alan Joslyn, our President and Chief Executive Officer,
- Michael Sullivan, our Chief Financial Officer, and
- Martin Handfield, our Senior Vice President of Discovery Research.

The Compensation Committee of our Board of Directors is responsible for establishing and evaluating our policies governing the compensation of our executive officers, including its named executive officers. The Compensation Committee reviews and proposes recommendations to the Board of Directors regarding the compensation to be paid to the Chief Executive Officer. In addition, the Compensation Committee reviews and approves the compensation to be paid to all other executive officers. The Compensation Committee ensures that the total compensation paid to our executive officers is fair, reasonable and competitive. The Compensation Committee has, in the past, at times included the other members of our Board of Directors in its deliberations regarding the salaries of our named executive officers.

At our 2019 Annual Meeting of Stockholders, on an advisory basis, a majority of the stockholders who voted on this matter approved the compensation of our named executive officers as disclosed in our 2019 Proxy Statement. The Compensation Committee believes the views of our stockholders are an important consideration when making decisions regarding our compensation program and will continue to take the views of our stockholders into consideration when assessing our compensation program and making decisions related to the structure and amount of pay.

Business Highlights

This past year was significant for the Company in the focus on completing enrollment in our Phase 2 clinical trial for our AG013 product candidate for the treatment of Oral Mucositis. Our compensation program in 2019 reflects the challenges associated with designing a compensation program at the beginning of the year in light of the efforts directed at the enrollment in a clinical trial. Despite such challenges, the Compensation Committee remains committed to a philosophy which strongly aligns pay with demonstrated performance, and is confident that the decisions made are reflective of this overarching philosophy.

Compensation Objective

Our named executive compensation programs are designed to achieve the following objectives:

- Attract, motivate and reward named executive officers whose knowledge, skills, performance and business relationships are critical to our success;
- Align the interests of our named executive officers and stockholders by motivating named executive officers to ultimately increase stockholder value as well as facilitate retention;
- Motivate our named executive officers to manage our business to meet our short term and long-range goals and reward accomplishment of these goals;
- Provide a competitive compensation package which includes some pay for performance factors.

Compensation Determination Process

We conduct an annual review of named executive officer compensation, generally in December or January. At the Compensation Committee’s direction, our Chief Executive Officer prepares an executive compensation review for each named executive officer, other than himself, which includes recommendations for:

- a proposed year-end bonus, if any, based on the achievement of individual and/or corporate objectives;
- a proposed increase, if any, in base salary and target annual incentive opportunity for the upcoming year; and
- an award, if any, of stock options or stock awards for the year under review.

As part of the compensation review, our Compensation Committee also considers changes to a named executive officer's employment agreement, compensation arrangements, responsibilities or severance arrangements.

In accordance with NYSE requirements, the Compensation Committee also meets in an executive session without the Chief Executive Officer to consider and make recommendations to our Board of Directors regarding the Chief Executive Officer's compensation, including base salary, cash bonus and year-end annual stock options. The Compensation Committee also grants year-end stock options to other named executive officers based on, among other factors, recommendations by our Chief Executive Officer.

In conjunction with the year-end annual compensation review, or as soon as practicable after the fiscal year-end, our Chief Executive Officer recommends to the Compensation Committee the corporate objectives and other criteria to be utilized for purposes of determining cash bonuses (i) for each named executive officer for the upcoming year (in accordance with that named executive officer's employment agreement), and (ii) for all other employees as a group. The Compensation Committee in its discretion may revise our Chief Executive Officer's recommendations or make its own recommendations to our Board of Directors, which may in turn suggest further revisions. At the end of the year, the Compensation Committee, in consultation with our Chief Executive Officer, reviews performance and determines the extent to which any established goals were achieved.

Setting Compensation for Named Executive Officers - Compensation Committee, Board of Directors and Chief Executive Officer

The Compensation Committee of our Board of Directors has the primary responsibility for determining compensation of our named executive officers. Our Compensation Committee recommends the compensation of our Chief Executive Officer and determines all compensation matters for our named executive officers, including base salary, bonuses, and equity compensation. Our Board of Directors, after considering the recommendations of the Compensation Committee, makes the final determination with respect to the compensation of our Chief Executive Officer. Utilizing input from our Chief Executive Officer, the Compensation Committee makes an independent decision on compensation for each other named executive officers, although our Compensation Committee has, on occasion, submitted its compensation determinations for named executive officers to our full Board of Directors for its approval.

Role of Compensation Consultant

Our Compensation Committee is authorized to engage a compensation consultant or other advisors to review our executive officers' compensation, including a benchmarking analysis against the compensation of executive officers at comparable companies, to ensure that our compensation is market competitive, with the goal of retaining and adequately motivating our senior management. In March 2019, our Compensation Committee retained Korn Ferry as a compensation consultant ("Korn Ferry") to assess our current compensation programs and provide recommendations for continued improved alignment of the programs with our compensation philosophy and goals and to review and make recommendations regarding our executive and director compensation for 2019.

Our Compensation Committee regularly evaluates the performance of its compensation consultant, considers alternative compensation consultants, and has the final authority to engage and terminate such services. The Compensation Committee has assessed the independence of Korn Ferry pursuant to SEC rules and the applicable listing standards of the NYSE and concluded that no conflict of interest exists that would prevent Korn Ferry from serving as an independent consultant to our Compensation Committee.

During 2019, Korn Ferry attended meetings of our Compensation Committee (both with and without management present) and provided the following services:

- consulting with the Compensation Committee chair and other members between committee meetings;
- establishing a compensation comparator peer group for use when making compensation decisions;
- providing competitive market data based on the compensation peer group for our executive officer positions and evaluating how the compensation we pay our executive officers compares both to our performance and to how the companies in our compensation peer group compensate their executives;

- reviewing and analyzing the base salary levels, annual cash bonus opportunities, and equity incentive compensation opportunities of our executive officers;
- assessing executive compensation trends within our industry, and updating on corporate governance and regulatory issues and developments;
- reviewing market equity compensation practices, including burn rate and overhang, and advising on the mix of equity award types; and
- providing competitive market data based on the compensation peer group for the non-employee members of our Board and evaluating the compensation we pay to our non-employee directors.

Benchmarking in the Context of Our Other Executive Compensation Principles

Our Compensation Committee reviews the compensation of similarly-situated executive officers at companies that we consider to be our peers, taking into consideration the experience, position and functional role, level of responsibility and uniqueness of applicable skills of both our executive officers and those of our peers, and the demand and competitiveness for attracting and retaining an individual with each executive officer's specific expertise and experience. While this analysis is helpful in determining market-competitive compensation for senior management, it is only one factor in determining our executive officers' compensation, and our Compensation Committee exercises its judgment in determining the nature and extent of its use.

For purposes of comparing our executive compensation against the competitive market, our Compensation Committee reviews and considers the compensation levels and practices of a group of comparable biotechnology companies. The companies in this compensation peer group for 2019 were selected by our Compensation Committee in March 2019, in consultation with Korn Ferry, on the basis of their similarity to us in terms of size, market capitalization, stage of development, research and development spend, industry sector, business strategy, and number of employees.

To analyze the compensation practices of the companies in our compensation peer group, Korn Ferry gathered data from public filings (primarily proxy statements) and from other sources. This market data was then used as a reference point for our Compensation Committee to assess our current compensation levels in the course of its deliberations on forms and amounts of compensation. Given our objective of attracting, retaining, motivating, and rewarding a highly-skilled team of executive officers and other employees, we aim to deliver a total compensation package that is within a competitive range around the median as compared to peers, with an emphasis on equity incentive compensation so as to more effectively tie our named executive officers and employees' interests to those of our shareholders. In light of this, when undertaking its competitive analysis, our Compensation Committee reviews data pertaining to the 25th, 50th and 75th percentiles for base salary, total cash compensation (base salary plus annual bonus) and equity compensation. This competitive analysis is one factor, among others, taken into account by our Compensation Committee in assessing current compensation levels and recommending changes to compensation or additional awards of equity. Our Compensation Committee expects to review our compensation peer group at least annually and make adjustments to its composition, taking into account changes in both our business and the businesses of the companies in the peer group.

Our Compensation Committee believes that, given the competitiveness of our industry and our Company culture, our base compensation, annual cash bonuses and equity programs are flexible enough to reward the achievement of clearly defined corporate goals and are sufficient to retain our existing executive officers and to hire new executive officers with the appropriate qualifications and experience.

Elements of Named Executive Compensation

For 2019, the principal components of compensation for our named executive officers consisted of:

- Annual base salary;
- Annual bonus incentives; and
- Equity Incentive Awards/Option Awards.

Annual Base Salary

We provide our named executive officers with base salary to compensate them for services rendered during the year. Generally, the base salaries reflect the experience, skills, knowledge and responsibilities required of each executive officer, and reflect our executive officers' overall performance and contributions to our business.

During its review of base salaries for executives, the Compensation Committee primarily considers:

- the negotiated terms of each named executive officer's employment agreement, if any;
- an internal review of the named executive officer's compensation, both individually and relative to other named executive officers; and
- base salaries paid by comparable companies in the biopharmaceutical industry that have a similar business and financial profile.

Salary levels are considered annually as part of the company's performance review process. Merit-based increases to salaries are based on management's assessment of the individual's performance, the recommendations made by the Chief Executive Officer to the Compensation Committee, and the comparative compensation at peer companies. The factors used in determining increases in base salary include individual performance, changes in role and/or responsibility and changes in the competitive market environment. The Compensation Committee periodically reviews the base salary for each executive officer.

Annual Incentive Bonuses

We provide an opportunity for each of our named executive officers to receive an annual incentive bonus based on the satisfaction of individual and company objectives established by our Board of Directors, or if no objectives are established at the discretion of the Committee. These incentives can be paid in cash or stock at the discretion of the Committee. For any given year, these objectives may include individualized goals or company-wide goals that relate to operational, strategic or financial factors such as progress in developing our product candidates, achieving certain manufacturing, intellectual property, clinical and regulatory objectives, and raising certain levels of capital.

2019 Bonus Plan

The Company established performance-based bonus targets for its named executive officers in 2019 (the "2019 Bonus Plan"). The percentages are weighted for purposes of determining bonuses, if any, for the Company's executive officers with respect to 2019 performance. Under such cash bonus program, Dr. Joslyn, Mr. Sullivan, and Dr. Handfield are eligible for cash bonuses of up to 50%, 35% and 25% of their respective base salaries or \$183,750, \$80,483, and \$51,345 respectively, (each a "Bonus Target").

The bonuses payable to Dr. Joslyn were based upon the achievement of the following objectives:

- Up to 55% of the Bonus Target for objectives related to AG013 clinical trials and development strategy;
- Up to 25% of the Bonus Target for financial performance objectives including the Company's raising capital, budgeting and regulatory compliance;
- Up to 10% of the Bonus Target for objectives related to lantibiotic program developments;
- Up to 5% of the Bonus Target for strategic initiatives regarding expansion of Company development opportunities; and
- Up to 5% of the Bonus Target for administrative and management matters.

The bonuses payable to Mr. Sullivan were based upon the achievement of the following objectives:

- Up to 60 % of the Bonus Target for financial performance objectives including the Company's raising capital, budgeting and regulatory compliance;

- (ii) Up to 25% of the Bonus Target for objectives related to cost management of the AG013 clinical trials;
- (iii) Up to 5% of the Bonus Target for strategic initiatives regarding expansion of Company development opportunities;
- (iv) Up to 5% of the Bonus Target for objectives related to lantibiotic program toxicology studies; and
- (v) Up to 5% of the Bonus Target for administrative and management matters.

The bonuses payable to Dr. Handfield were based upon the achievement of the following objectives:

- (i) Up to 85% of the Bonus Target for objectives related to lantibiotic program developments, including toxicology studies, grants and publishing of, and presenting research results, and initiating collaborations;
- (ii) Up to 10% of the Bonus Target for administrative and management matters; and
- (iii) Up to 5% of the Bonus Target for strategic initiatives regarding expansion of Company development opportunities.

The executive officers' actual bonuses for fiscal year 2019 were eligible to exceed 100% of their 2019 Bonus Target percentage in the event performance exceeded the predetermined goals and/or upon the achievement of other specified goals, including stretch goals. Payment of bonuses to the Company's executive officers under the 2019 Bonus Plan and the actual amount of such bonus, if any, were subject to the discretion of the Committee.

Equity Incentive Compensation

We believe that successful long-term corporate performance is more likely to be achieved with a corporate culture that encourages a long-term focus by our named executive officers and other employees through the use of equity awards, the value of which depends on our stock performance. We established our 2012 Equity Incentive Plan, as amended to provide all of our employees, including our named executive officers, with incentives to help align our employees' interests with the interests of our stockholders and to enable them to participate in the long-term appreciation of our stockholder value. Additionally, equity awards provide an important retention tool for all employees, as the awards generally are subject to vesting over an extended period of time based on continued service with us.

We typically grant equity awards in connection with hiring a new employee. In addition, equity awards may also be granted for performance annually at, or soon after, the end of each year, depending on position, performance and tenure at the Company.

The determination of whether to grant stock options, as well as the size of such grants, to our named executive officers involves assessments by the Compensation Committee and our Board of Directors and, with respect to named executive officers other than himself, our Chief Executive Officer. Generally, annual equity awards are driven by our desire to retain and motivate our named executive officers, and we consider individual performance and contributions during the preceding year to the extent the Compensation Committee and our Board of Directors believe such factors are relevant. As with base salary and cash bonuses, in evaluating and determining stock option grants to our named executive officers, the Compensation Committee and our Board of Directors also considers publicly available data prepared by Korn Ferry at the request of the Compensation Committee from other similar clinical stage companies identified by the Compensation Committee.

We currently grant stock options or stock awards to new employees when they join our Company based upon their position with us and their relevant prior experience. The range of options that can be granted to employees is prescribed in a schedule based on employee's title and position. The awards granted by the Compensation Committee generally vest over time during the ten-year option term (although some previously granted awards vest immediately), or upon the achievement of certain milestones. Unless otherwise agreed to by us with respect to a termination without "cause" or for "good reason," vesting and exercise rights generally cease upon termination of employment, except in the case of death (subject to a one-year limitation), disability or retirement. Prior to the exercise of an option, the holder has no rights as a stockholder with respect to the shares subject to such option, including voting rights or the right to receive dividends or dividend equivalents. In addition to the initial option grants, our Compensation Committee may grant additional options to retain our employees and reward, or provide incentive for, the achievement of corporate goals and strong individual performance. Our Board of Directors has not granted our Chief Executive Officer the discretion to grant options to non-executive employees upon joining our Company, or to make grants during each annual non-executive employee review cycle.

It is our policy to award stock options at an exercise price equal to the closing price on the NYSE American Market of our common stock on the date of the grant. For purposes of determining the exercise price of stock options, the grant date is deemed to be the later of the first day of employment for newly hired employees, or the date on which the Compensation Committee approves the stock option grant.

We have no program, practice or plan to grant stock options, in coordination with the release of material nonpublic information. We also have not timed the release of material nonpublic information for the purpose of affecting the value of stock options or other compensation, and we have no plan to do so. We do, however, have a policy regarding the adjustment or recovery of stock option awards in connection with the restatement of our financial statements, as our stock option awards have not been tied to the achievement of specific financial statement goals.

Other Compensation

Other aspects of compensation applicable to our named executive officers consist of the following:

Retirement Benefits. The Company maintains a Simple Individual Retirement Arrangement plan in which all full-time employees, including the Company's named executive officers, are eligible to participate. The Company provides this plan to help its employees save some amount of their cash compensation for retirement in a tax efficient manner. The Company does not provide an option for its employees to invest in the Company's stock under the 401k plan. The Company matches 100% of the employee's contribution up to a maximum of 3% of the employee's compensation.

Health and Welfare Benefits. All full-time employees, including our named executive officers, may participate in the Company's health and welfare benefit programs, including medical, dental and vision care coverage as may be provided and applicable to all employees.

Perquisites. We do not provide perquisites or other personal benefits to our named executive officers other than those that we provide to our employees.

Employment Agreements. During 2019, the Company had employment agreements in effect with Dr. Alan Joslyn, Mr. Michael Sullivan, and Dr. Martin Handfield. The Company entered into employment agreements with these officers to ensure that they would perform their respective roles with the Company for an extended period of time. In addition, the Company also considered the critical nature of each of their positions and the Company's need to retain them when the Company committed to these agreements. See "Employment Contracts and Change in Control Arrangements."

2019 Named Executive Officer Compensation Decisions

We believe that the total compensation paid to our named executive officers for the fiscal year ended December 31, 2019 achieved the overall objectives of our executive compensation program. In accordance with our overall objectives, we believe executive compensation for 2019 was competitive with other similarly-sized companies. The Compensation Committee took the following key compensation actions in 2019:

Base Salaries

During 2019, we made no changes in the annual base salaries of our named executive officers.

Determination of Cash Bonus-2019

We made performance-based cash bonus awards pursuant to the terms of the 2019 Bonus Plan to Dr. Joslyn, Mr. Sullivan, and Dr. Handfield of \$87,282, \$76,458, and \$33,374, respectively, based upon their performance during 2019. These performance-based cash bonus awards were made in December of 2019.

Determination of Equity Awards:

We made no equity awards to Dr. Joslyn, Mr. Sullivan, and Dr. Handfield during 2019.

Other Policies and Considerations - Employment Contracts and Change in Control Arrangements

Employment Agreement—Dr. Joslyn

We have entered into an Executive Employment Agreement dated as of June 6, 2016, with Dr. Alan Joslyn pursuant to which Dr. Joslyn serves as our President and Chief Executive. The employment term is a one-year term with an automatic 12-month extension thereafter unless either party provides the other 30 days' prior written notice of its intention not to renew the employment agreement.

Dr. Joslyn received a one-time signing bonus of \$25,000 upon execution of the employment agreement and is currently entitled to receive an annual base salary of \$350,000 which is subject to annual review and adjustment by the Company's Board of Directors. He is eligible to receive annual performance bonus from the Company of up to fifty percent (50%) of his annual base salary based upon appropriate Company-based and individual-based targets specified by the Compensation Committee of the Board, in its discretion, as approved by the full Board of Directors. Dr. Joslyn is also entitled to participate in our employee benefit plans on terms comparable to other full-time employees as well as four weeks paid vacation annually.

The employment agreement also provided for Dr. Joslyn to be granted equity awards under the Company's 2012 Incentive Plan consisting of (i) stock options to purchase 30,000 shares of the Company's common stock at an exercise price equal to \$5.50 per share which stock options shall vest in six installments of 5,000 shares each every six months after June 6, 2016, provided that he has continued his employment with the Company through such dates, and (ii) 3,000 shares of restricted stock of the Company, vesting in two installments on the six month and twelve month anniversaries of June 6, 2016. All of the performance bonuses, as well as any equity awards which are granted to Dr. Joslyn or which become vested as a result of the satisfaction of financial performance goals of the Company, are subject to the Company's policy on recoupment or clawback of executive incentive compensation.

Dr. Joslyn is subject to a covenant not to disclose our confidential information during his employment term and an assignment of intellectual property rights. Also, during his employment term and for a period of 12 months thereafter, Dr. Joslyn covenants not to compete with us and not to solicit any of our customers, vendors or employees. If Dr. Joslyn breaches any of these covenants, the Company will be entitled to injunctive relief.

If Dr. Joslyn's employment is terminated by us for Cause (as defined in his employment agreement) or by Dr. Joslyn during the term of the agreement, he will be entitled to receive his (i) his then-current annual base salary through the date of termination; (ii) any reimbursable expenses for which he has not yet been reimbursed as of the date of termination; and (iii) any other rights and vested benefits (if any) provided under employee benefit plans and programs of the Company, determined in accordance with the applicable terms and provisions of such plans and programs ("Accrued Compensation").

If Dr. Joslyn's employment is terminated by us without "Cause", subject to his execution of a release of claims against us, and in addition to the payment of the Accrued Compensation, the Company is obligated to make payments to Dr. Joslyn within 60 days after his termination date equal to six months of his annual base salary, as in effect at the termination date, plus any earned but unpaid bonus (the "Additional Severance Payments").

The employment agreement also contains change of control provisions providing that if Dr. Joslyn's employment with the Company is terminated by the Company without Cause during the period of ninety (90) days following a Change in Control (as that term is defined below) of the Company, in lieu of the Additional Severance Payments described above, Dr. Joslyn will be entitled to receive a severance payment equal to the sum of (i) six (6) months of his annual base salary, at the higher of the base salary rate in effect on the date of termination or the base salary rate in effect immediately before the effective date of the Change of Control, and (ii) his Performance Bonus for the year which includes the effective date of the Change in Control, payable at the target level of performance, which will be paid in a single lump sum after his execution and non-revocation of the Release. In addition, he will also receive in the same payment the amount of any performance bonus that, as of the date of termination, has been earned by Dr. Joslyn but has not yet been paid by the Company. If Dr. Joslyn holds any stock options or other stock awards granted under the Company's 2012 Incentive Plan which are not fully vested at the time his employment with the Company is terminated by the Company without Cause during the period of ninety (90) days following a Change in Control, such equity awards shall become fully vested as of the termination date. For purposes of the employment agreement, the term "Change in Control" means a transaction or series of transactions which constitutes a sale of control of the Company, a change in effective control of the Company, or a sale of all or substantially all of the assets of the Company, or a transaction which qualifies as a "change in ownership" or "change in effective control" of the Company or a "change in ownership of substantially all of the assets" of the Company under the standards set forth in Treasury Regulation section 1.409A-3(i)(5).

Dr. Joslyn's employment agreement also provides that each of the payments and benefits under the agreement are subject to compliance with Section 409A of the Code and it includes time of payment language intended to comply with Section 409A requirements.

Amendment to Dr. Joslyn's Employment Agreement

On June 8, 2018 we entered into an amendment to Dr. Joslyn's employment agreement which extended the term of his agreement to June 6, 2020. All other terms of his employment agreement remained in full force and effect.

Employment Agreements—Mr. Sullivan and Dr. Handfield

We have entered into employment agreements with our Chief Financial Officer, Mr. Michael Sullivan and Dr. Martin Handfield, our Senior Vice-President of Research and Development (the "Employment Agreements"). The annual base salaries provided in the Employment Agreements are payable in installments consistent with our normal payroll practices. Mr. Sullivan and Dr. Handfield are also eligible under the Employment Agreements to receive annual bonuses during the term at the discretion of the Compensation Committee and the Board of Directors with Mr. Sullivan's employment agreement providing for such a discretionary bonus of up to 35% of his base salary and with Dr. Handfield's employment agreement providing for a discretionary bonus component, which the Compensation Committee has set as up to 25% of his base salary.

The Employment Agreements are terminable at any time by either party and if the executive officer is involuntarily terminated by us, he shall receive his base salary and vacation pay each accrued through the date of termination, and any nonforfeitable benefits earned and payable to him under the terms of the employee handbook (which applies to all employees) and benefits available under any applicable incentive plan in which the executive participates. In addition, if the executive officer's separation from employment is not voluntary and without cause, we would be obligated to pay the executive officer six months of his annual base salary as severance and the executive shall be entitled to out placement services. If the executive officer is terminated for cause, he shall be entitled to receive his base salary and accrued vacation due through the date of termination and any nonforfeitable benefits already earned and payable to the executive under the terms of the employee handbook or other applicable incentive plans maintained by us. Cause is defined in the Employment Agreements as any action that is illegal, immoral, or improper that reflects on the Company, the employee, or the ability of either to function optimally. If the executive officer voluntarily resigns, he shall be entitled to this base salary and accrued vacation due through the date of termination (including any mutually agreed upon notice period) and any nonforfeitable benefits already earned and payable to the executive officer employee under the terms of the employee handbook or other incentive plans maintained by us.

If the executive officer dies during the term of employment with us, his estate shall be paid his salary as it would have accrued over a period of thirty days after the executive officer's death. We shall also extend the executive officer's right to exercise vested stock options for six months. In the event the executive officer becomes disabled (as defined in the then applicable short and long-term disability insurance policies) we shall pay to the executive officer his salary as it would have accrued over a period of 30 days after the executive became so disabled and we shall extend the executive officer's right to exercise vested stock options for six months.

The Employment Agreements also each include non-disclosure and Company ownership of invention provisions, as well as a provision providing for the Company to defend and indemnify the executive if the executive is named as a defendant in any lawsuit regarding any action taken within the scope of employment. In the event of a change in control, any stock options or other awards granted (other than performance awards) under our 2012 Incentive Plan shall become immediately vested in full and, in the case of stock options, exercisable in full. If the change in control results in an involuntary separation from employment of the executive officer within 180 days following a change in control, the executive officer would be entitled to (i) receive six months of salary and the extension of his benefits (excluding vacation time and paid time off) and (ii) exercise vested options for six months from the date of separation. Under the Employment Agreements, "involuntary separation of employment" means (i) termination without cause, (ii) any reduction in responsibilities of office altering the status of the executive officer as an employee, or (iii) the duplication of the executive officer's position by an equivalent executive in an acquiring entity; and "change in control" means the sale of the entire company, or substantially all of its assets, or the sale of the business unit employing an individual which results in the termination of employment or subsequent transfer of the employment relationship to another legal entity, or entity, or single party acquiring more shares than are owned by the Koski Family Limited Partnership, including its members and their immediate families, including spouses and their children.

On February 20, 2015, we entered into an amended and restated employment agreement, effective January 1, 2015, with Mr. Sullivan. The terms of Mr. Sullivan's amended and restated employment agreement were substantially similar to those of the previous agreement disclosed above except for:

1. The percentage of base salary eligible for bonus awards was set as previously disclosed for Mr. Sullivan at up to 35% of base salary.
2. A provision was added in Mr. Sullivan's agreement to provide for the clawback of bonuses pursuant to the Board's adoption of a clawback policy. In the A&R Employment Agreement Mr. Sullivan acknowledges and agrees that any incentive-based compensation paid to him will be subject to clawback or repayment to the extent such clawback or repayment is required by the terms of the Company's recoupment, clawback or similar policy as may be in effect from time to time, or as required by law.
3. A provision was added whereby Mr. Sullivan would be required to release the Company as a condition to receiving any severance benefit provided by his A&R Employment Agreement with the form of release added and attached as an exhibit to his A&R Employment Agreement.
4. The definition of a change of control in the prior agreement was revised to align it with the definition of a change in control set forth in the Company's 2012 Incentive Plan as follows:
 - (i) Any "person" (as such term is used in Sections 13(d) and 14(d) of the Securities Exchange Act of 1934, as amended (the "Exchange Act")) becomes the "beneficial owner" (as defined in Rule 13d 3 of the Exchange Act), directly or indirectly, of securities of the Company representing fifty percent (50%) or more of the total voting power represented by the Company's then outstanding voting securities;
 - (ii) The consummation of the sale or disposition by the Company of all or substantially all of the Company's assets;
 - (iii) A change in the composition of the Board occurring within a two-year period, as a result of which fewer than a majority of the directors are Incumbent Directors. "Incumbent Directors" means directors who either (A) are Directors as of the effective date of this Agreement, or (B) are elected, or nominated for election, to the Board with the affirmative votes of at least a majority of the Directors at the time of such election or nomination (but will not include an individual whose election or nomination is in connection with an actual or threatened proxy contest relating to the election of directors to the Company); or
 - (iv) The consummation of a merger or consolidation of the Company with any other corporation, other than a merger or consolidation which would result in the voting securities of the Company outstanding immediately prior thereto continuing to represent (either by remaining outstanding or by being converted into voting securities of the surviving entity or its parent) at least fifty percent (50%) of the total voting power represented by the voting securities of the Company or such surviving entity or its parent outstanding immediately after such merger or consolidation.

Tax and Accounting Implications

Deductibility of Executive Compensation

The Compensation Committee takes into consideration the tax consequences of compensation to the named executive officers, but tax considerations are not a significant part of our Company's compensation policy.

Accounting for Share-Based Compensation

We account for share-based compensation in accordance with the requirements of FASB ASC Topic 718. This accounting treatment has not significantly affected our executive compensation decisions.

Clawbacks

In order to further align management's interests with those of shareholders and to support the Company's governance practices, the Board of Directors adopted a recoupment policy applicable to annual bonuses and other short-term and long-term incentive compensation based on financial targets ("Incentive Compensation") received by current and former executive officers of the Company and such other senior executives/employees of the Company who may from time to time be deemed subject to the policy by the Board of Directors ("Covered Executive"). The policy provides that if, as a result of a restatement of the Company's financial statements due to the Company's material noncompliance with any financial reporting requirement under the securities laws, a Covered Executive received more Incentive Compensation than the Covered Executive would have received absent the incorrect financial statements, the Company shall recover said excess Incentive Compensation (defined as the excess of (i) the actual amount of Incentive Compensation paid to the Covered Executive over (ii) the Incentive Compensation that would have been paid based on the restated financial results during the three-year period preceding the date on which the Company is required to prepare such restatement). The policy also provides that if the Board of Directors makes a determination in its sole discretion that a Covered Executive engaged in Misconduct (as defined below), the Board of Directors may require reimbursement or forfeiture of all or part of the Incentive Compensation received by the Covered Executive. The Board of Directors may use its judgment in determining the amount to be recovered. Misconduct is defined as (i) conviction of a felony, (ii) material breach of any agreement with the Company, (iii) material breach of any Company policy or code, (iv) act of theft, embezzlement or fraud, (v) misrepresentation or misstatement of financial or performance results, and (vi) any other act or event that the Board of Directors has determined that recoupment is appropriate.

Consideration of Stockholder Advisory Vote on Executive Compensation

The Compensation Committee also expects to consider the results of our stockholder advisory vote on executive compensation. At the Company's previous annual meeting, the Company's shareholders voted in favor of the compensation of our named executive officers: approximately 91.7% of the shares represented in person or by proxy having voted in favor of the program. In light of these results, the Compensation Committee decided to substantially continue to continue the executive compensation program in 2019. The Board of Directors determined that stockholder advisory votes on executive compensation will be submitted to stockholders of the Company annually until the next required advisory vote on the frequency of conducting advisory votes on executive compensation.

Summary Compensation Table

The following table sets forth the aggregate compensation in 2019 and 2018 for services in all capacities paid or accrued by the Company to Dr. Alan Joslyn, Mr. Michael Sullivan, our Chief Financial Officer, and our next most highly compensated officers who earned more than \$100,000 in total salary and bonus during the fiscal year ended December 31, 2019 (the "Named Executive Officers").

Name and principal position	Year	Salary	Bonus(1)	Stock Awards (2)	Option Awards (2)	All Other Compensation (3)	Total
Dr. Alan Joslyn President and Chief Executive Officer	2019	\$367,500	\$ 87,282	\$ —	\$ —	\$ 33,612	\$488,394
	2018	\$350,000	\$ 140,000	\$ —	\$330,280	\$ 14,703	\$834,983
Michael O. Sullivan Chief Financial Officer	2019	\$229,950	\$ 76,458	\$ —	\$ —	\$ 6,899	\$313,307
	2018	\$219,000	\$ 72,818	\$ —	\$207,180	\$ 6,570	\$505,568
Dr. Martin Handfield Senior Vice President Discovery Research	2019	\$205,380	\$ 33,374	\$ —	\$ —	\$ 6,162	\$244,916
	2018	\$195,600	\$ 39,120	\$ —	\$182,560	\$ 5,868	\$423,148

(1) The amounts in this column for 2019 represent a performance-based cash bonus award made pursuant to the terms of the Bonus Plan 2019 which was earned and paid in 2019.

(2) No equity awards were made to our named executive officers in 2019.

(3) Amounts in this column for Dr. Joslyn, Mr. Sullivan and Dr. Handfield represent the Company's matching contributions to our Simple IRA retirement plan. The retirement plan requires us to match employee contributions up to the first 3% of compensation earned. For Dr. Joslyn, the amount reflected also includes \$22,587 which represents amounts reimbursed by the Company for Dr. Joslyn's expense in commuting to the Company's headquarters in Tampa, Florida. Such reimbursement amount is included in Dr. Joslyn's compensation.

The Compensation Committee believes that our future success depends, in large part, upon our ability to maintain a competitive position in attracting, retaining and motivating key personnel. The Compensation Committee utilizes the 2012 Equity Incentive Plan to provide incentives to employees. We do not have any separate long-term incentive plans that provide compensation intended to serve as incentives for performance other than awards contemplated under, or pursuant to, our 2012 Equity Incentive Plan.

Outstanding Equity Awards

The following table provides information concerning unexercised options outstanding as of December 31, 2019:

Name	Number of securities underlying unexercised options (#) exercisable	Number of securities underlying unexercised options (#) unexercisable		Option exercise price (\$)	Option expiration date
Dr. Alan Joslyn President and Chief Executive Officer	266,666	133,334	(1)	0.73	9/27/2028
	28,000			1.52	6/22/2028
	9,334	4,666	(2)	3.70	6/22/2027
	30,000			5.50	6/6/2026
Michael O. Sullivan Chief Financial Officer	166,666	83,334	(1)	0.73	9/27/2028
	18,000			1.52	6/22/2028
	11,666	5,834	(2)	3.70	6/22/2027
	20,000			13.20	3/16/2025
	4,000			8.80	12/8/2024
	2,500			8.60	10/30/2024
Dr. Martin Handfield Senior Vice President of Discovery Research	4,500			12.00	2/10/2022
	146,666	73,334	(1)	0.73	9/27/2028
	16,000			1.52	6/22/2028
	9,334	4,666	(2)	3.70	6/27/2027
	15,000			13.20	3/16/2025
	4,000		8.80	12/8/2024	
	1,680		15.00	9/27/2021	

(1) Represents awards that are time vested with each award vesting evenly on an annual basis over two years, subject to earlier vesting upon a change in control as defined in the award agreements.

(2) Represents awards that are time vested with each award vesting evenly on an annual basis over three years, subject to earlier vesting upon a change in control as defined in the award agreements.

The Company believes that the total compensation paid to its named executive officers for the fiscal year ended December 31, 2019 achieved the overall objectives of its executive compensation program. In accordance with its overall objectives, executive compensation for 2019 was competitive with other similarly-sized companies. The Compensation Committee and Board took the following key compensation actions in 2019:

- **Determination of Annual Base Salaries**

On December 19, 2018, the Compensation Committee and Board authorized increases in the annual salary for each of the Company's named executive officers effective January 1, 2019 in the amounts set forth below.

Name	Annual Salary For 2018	Increase	Annual Salary For 2019
Dr. Alan Joslyn	\$ 350,000	\$ 17,500	\$ 367,500
Michael Sullivan	\$ 219,000	\$ 10,950	\$ 229,950
Dr. Martin Handfield	\$ 195,600	\$ 9,780	\$ 205,380

Director Compensation

The Director Compensation program for 2019 consisted of the following:

Non-employee directors

Cash Compensation. The Director compensation program for 2019 provided that all non-employee Directors would receive an annual base fee for service on the Board of \$45,000. In addition, the Chairperson of the Board and of our Audit Committee, Compensation Committee and Nominating Committee would also receive annual fees of \$40,000, \$20,000, \$15,000 and \$10,000 respectively. All non-employee Directors serving on our Audit Committee, Compensation Committee and Nominating Committee (other than as the Chairperson) would receive an annual fee of \$10,000, \$7,500, and \$5,000, respectively, in connection with such committee service. In addition, from time to time, the Board may establish special committees and in connection therewith determine the cash compensation that would be paid to the directors serving on a special committee at the time of the establishment of such committee. All fees for Board service are generally paid on or before the last business day of each quarter.

The Board is expecting to meet in-person for a minimum of four meetings each year. To the extent, the Board meets in excess of six in-person meetings an additional per meeting fee would also be considered to be paid to each director by the Board for such additional in-person meeting. To the extent the Board determines to establish a special committee or a special committee was previously established and continues to function, the Board would determine the cash compensation payable to each director serving on any such special committee.

Our Compensation Committee and our Board of Directors use market data as one means of evaluating and establishing Board remuneration. In 2019, the Compensation Committee engaged Korn Ferry, as a compensation consultant (“Korn Ferry”), and has assessed Korn Ferry’s independence pursuant to SEC rules and concluded that no conflict of interest exists that would prevent Korn Ferry from independently advising the Compensation Committee. Korn Ferry advises the Compensation Committee on matters related to executive compensation, board remuneration and related governance matters.

Equity Compensation-New Director. Equity compensation is issued to Directors upon joining our Board. Non-employee Directors receive a stock option for the purchase of 500 shares of our common stock at an exercise price per share equal to the fair market value per share on date they became a Director, which will immediately vest and be exercisable for ten years, subject to early termination under the terms of the 2012 Incentive Plan.

Annual Equity Compensation Awards. As part of the Director Compensation Program each non-employee director receives equity awards under the 2012 Incentive Plan. In 2019 at the time of determining such annual equity award the Board considered the view of its compensation consultant Korn Ferry and revised its annual equity awards from 4,000 shares of restricted stock and an award of 8,000 stock options to an annual award of stock options which was based upon a value of \$75,000 and equated to 156,400 stock options which were awarded under the Company’s 2012 Incentive Plan at an exercise price of \$0.48 per share, the closing price on the June 20, 2019, the date of grant to each of our non-employee directors. The options are subject to time-based vesting over a one-year period on the quarterly anniversary of the date of the grant provided that the recipient remains a director of the Company through the vesting date. The stock option awards are subject to the standard terms and conditions of the Company’s form of stock option agreement which includes earlier vesting upon a change in control of the Company.

Discretionary Awards. As part of the Director Compensation Program, the Board may also make discretionary equity-based awards from time to time under our 2012 Incentive Plan. No such awards were made in 2019.

Minimum dollar value stock ownership requirements. Each non-employee director receiving the above equity-based awards will be subject to a minimum dollar value stock ownership holding requirement with respect to the awards received as well as all prior equity awards under the 2012 Incentive Plan which requirement is intended to align the ability to sell shares with the performance of the Company’s stock price. The non-employee Directors will each be subject to a minimum dollar value stock ownership requirement equal to six times the annual Board retainer (\$270,000) which dollar threshold they would be precluded from selling shares of Company stock acquired from the Company under its 2012 Incentive Plan.

Reimbursement of Expenses. Non-employee Directors are also reimbursed for expenses incurred in connection with their attendance at Board or committee meetings and reasonable out-of-pocket business expenses associated with their Board service.

Long-term Incentive Compensation. The Company did not have a Long-Term Incentive Compensation plan in place performance in 2019 for its Non-Employee Directors.

The following table sets forth the compensation of our non-employee Directors in 2019.

Director Compensation Table

Name	Fees earned or paid in cash (1)	Stock Awards	Option awards (2)	All other compensation (3)	Total
Dr. Frederick W. Telling	\$ 107,500	\$ —	\$ 75,072	\$ —	\$ 182,572
Robert C. Koski	\$ 45,000	\$ —	\$ 75,072	\$ —	\$ 120,072
Charles L. Pope	\$ 82,500	\$ —	\$ 75,072	\$ —	\$ 157,572
Dr. Alan W. Dunton	\$ 75,000	\$ —	\$ 75,072	\$ 7,500	\$ 157,572

- (1) Amounts represent cash compensation earned by our Non-employee Directors during 2019 in connection with their Board service.
- (2) The amounts in this column represent the aggregate grant date fair value computed in accordance with Financial Accounting Standards Board Accounting Standards Codification, Topic 718, Compensation—Stock Compensation (ASC 718). As part of the Company’s non-employee Director Compensation Program, each non-employee Director was awarded 156,400 stock options under the Company’s 2012 Incentive Plan at an exercise price of \$0.48 per share, the closing price on the June 20, 2019, the date of grant. The options are subject to time-based vesting over a one-year period on the quarterly anniversary of the date of the grant provided that the recipient remains a director of the Company through the vesting date. The stock option awards are subject to the standard terms and conditions of the Company’s form of stock option agreement which includes earlier vesting upon a change in control of the Company. As of the end of the year non-employee directors, Telling, Koski, Pope and Dunton have aggregate options to acquire, 326,040, 325,540, 326,040 and 326,040, respectively and there are no stock awards outstanding for any non-employee director.
- (3) No other compensation was paid to the non-employee Directors except for reimbursement for travel expenses to Board meetings and other Board related meetings and a \$7,500 payment to a company controlled by Dr. Dunton for consulting services.

Employee Directors

The Director Compensation Program provides that employee Directors receive no additional compensation in connection with their board service. There was one employee Director in 2019, Dr. Joslyn, our Chief Executive Officer, and no separate compensation is paid for his service as a director. For a summary of Dr. Joslyn’s compensation see the Summary Compensation Table.

ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS.

The following table sets forth information about beneficial ownership of our Common Stock as of February 25, 2020 (unless otherwise noted) by (i) each shareholder that has indicated in public filings that the shareholder beneficially owns more than five percent of the Common Stock, (ii) each of the Company’s directors and named officers and (iii) all directors and officers as a group. Except as otherwise noted, each person listed below, either alone or together with members of the person’s family sharing the same household, had, to our knowledge, sole voting and investment power with respect to the shares listed next to the person’s name.

Name and address(1)	Number of shares beneficially owned	Percentage of ownership (2)
Directors and officers		
Dr. Frederick W. Telling (3)	982,983	2.1%
Alan Joslyn (4)	870,334	1.9%
Robert C. Koski (5)	2,402,289	5.0%
Charles L. Pope (6)	471,553	1.0
Dr. Alan Dunton (7)	504,706	1.1
Michael Sullivan (8)	491,589	1.0
(All Directors and officers as a group 6 persons)	5,723,454	11.4%
5% shareholders		
Intracoastal Capital LLC (9)	3,333,334	6.7%

* Beneficial ownership percentage is less than 1%.

- (1) Except as indicated, the address of the person named in the table is c/o Oragenics, Inc., 4902 Eisenhower Blvd., Suite 125, Tampa, Florida 33634.
- (2) In computing the number of shares beneficially owned by a person and the percentage ownership of that person, shares of the Common Stock subject to options or warrants held by that person that are currently exercisable or will become exercisable within 60 days after February 25, 2020, are deemed outstanding, while the shares are not deemed outstanding for purposes of computing percentage ownership of any other person. Except as otherwise indicated, and subject to applicable community property laws, the persons named in the table have sole voting and investment power with respect to all shares of the Common Stock held by them. Applicable percentage ownership is based on 46,124,803 shares of the Common Stock outstanding as of February 25, 2020. The inclusion in the table above of any shares deemed beneficially owned does not constitute an admission of beneficial ownership of those shares.
- (3) Includes: (i) 443,445 shares able to be acquired pursuant to stock options, and (ii) 200,000 shares able to be acquired upon the exercise of warrants and excludes 195,675 shares subject to options that have not vested.
- (4) Includes (i) 734,001 shares able to be acquired pursuant to stock options; and (ii) 66,666 shares able to be acquired upon the exercise of warrants. Excludes 537,999 shares subject to options that have not vested.
- (5) The share amounts include: (i) 1,086,483 shares held by the Koski Family Limited Partnership (“KFLP”) of which Mr. Koski is a general partner; (ii) 300,000 shares able to be acquired by the KFLP upon conversion of Series B Convertible Preferred Stock; (iii) 241,936 shares able to be acquired by the KFLP upon exercise of warrants; (iv) 277,839 shares owned directly by Mr. Koski; (v) 53,086 shares owned directly by trusts for which Mr. Koski serves as sole trustee as follows: the Robert Clayton Koski Trust for the benefit of Anthony James Hunter (10,760 shares); The Robert Clayton Koski Trust for the benefit of Hunter Buchanan Koski (10,760 shares); The Robert Clayton Koski Trust for the benefit of Clayton Ward Bennett (10,000 shares); and The Robert Clayton Koski Trust for the benefit of Robert Edward Koski (10,760 shares) and the Robert Clayton Koski Trust for the benefit of Elyse Margaux Koski (10,806 shares); and (vi) 442,945 shares able to be acquired pursuant to stock options and excludes 195,675 shares subject to options that have not vested.
- (6) Includes: 443,445 shares able to be acquired pursuant to stock options and excludes 195,675 shares subject to options that have not vested.
- (7) Includes: (i) 482,580 shares able to be acquired pursuant to stock options and (ii) 20,000 shares able to be acquired upon the exercise of warrants and excludes 195,675 shares subject to options that have not vested.
- (8) Includes: 477,834 shares able to be acquired pursuant to stock options and excludes 339,166 shares subject to options that have not vested.
- (9) Based upon information provided by Intracoastal Capital LLC (“Intracoastal”) in its Schedule 13G filing with the SEC on February 11, 2020, Intracoastal is the beneficial owner of 3,333,334 shares of Common Stock, which consisted of (i) 1,666,667 shares of Common Stock issuable upon exercise of Series 1 Warrant and (ii) 1,666,667 shares of Common Stock issuable upon exercise of Series 2 Warrant. Mr. Mitchell P. Kopin is the manager of Intracoastal and the Schedule 13G is filed on behalf of Mr. Daniel Asher, Mr. Kopin and Intracoastal. The warrants are also subject to a 9.99% ownership blocker, pursuant to which shares of our common stock may not be issued to the extent such issuance would cause Intracoastal to beneficially own more than 9.99% of our outstanding common stock. The principal business office of Mr. Kopin and Intracoastal is 245 Palm Trail, Delray Beach, Florida 33483. The principal business office of Mr. Asher is 111 W. Jackson Boulevard, Suite 2000, Chicago, Illinois 60604.

Securities Authorized for Issuance under Equity Compensation Plans

Our 2012 Incentive Plan, which is currently our only equity compensation plan, has been approved by our stockholders. The following table sets forth certain information as of December 31, 2019 with respect to the 2012 Incentive Plan:

Plan Category	Number of Securities to be Issued Upon Exercise of Outstanding Options (A)	Weighted- Average Exercise Price of Outstanding Options (B)	Number of Securities Remaining Available for Future Issuance Under Equity Compensation Plans (Excluding Securities Reflected in Column (A)) (C)
Equity compensation plans approved by stockholders:			
2012 Equity Incentive Plan	2,486,365	\$ 1.47	5,522,885
Equity compensation plans not approved by stockholders: (1)			
None	—	\$ —	—
Total:	<u>2,486,365</u>	<u>\$ 1.47</u>	<u>5,522,885</u>

(1) The Company does not have any equity compensation plans that have not been approved by shareholders.

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE.

SEC rules require us to disclose any transaction or currently proposed transaction in which we are a participant and in which any related person has or will have a direct or indirect material interest involving an amount that exceeds the lesser of \$120,000 or one percent (1%) of the average of the Company's total assets as of the end of last two completed fiscal years. A related person is any executive officer, director, nominee for director, or holder of 5% or more of the Company's common stock, or an immediate family member of any of those persons.

The Audit Committee of the Board of Directors (or, to the extent applicable, our disinterested directors) is responsible for reviewing all transactions between the Company and any officer or Director of the Company or any entity in which an officer of Director has a material interest. Any such transactions must be on terms no less favorable than those that could be obtained on an arms-length basis from independent third parties.

The July 17, 2018 Underwritten Public Offering

On July 17, 2018, we closed an underwritten public offering of units for gross proceeds of approximately \$13.8 million, which includes the full exercise of the underwriter's over-allotment option to purchase additional shares and warrants, prior to deducting underwriting discounts and commissions and offering expenses payable by us. The Company's non-employee directors, Frederick Telling and Alan Dunton participated in the Public Offering through the purchase of 100,000 shares and 20,000 shares, respectively, of the Company's common stock and warrants to purchase 100,000 shares and 20,000 shares, respectively, of the Company's common stock. Dr. Telling and Dr. Dunton's participation was approved by our Audit Committee.

The offering was comprised of Class A Units, priced at a public offering price of \$1.00 per unit, with each unit consisting of one share of common stock and a seven-year warrant to purchase one share of common stock with an exercise price of \$1.00 per share (each, a "Warrant" and collectively, the "Warrants"), and Class B Units, priced at a public offering price of \$1.00 per unit, with each unit comprised of one share of series D preferred stock (the "Series D Preferred Stock"), which is convertible into one share of common stock, and a Warrant. The conversion price of the Series D Preferred Stock issued in the transaction as well as the exercise price of the Warrants are fixed and do not contain any variable pricing features or any price based anti-dilutive features. The Series D Preferred Stock issued in this transaction included a beneficial ownership blocker but has no dividend rights (except to the extent that dividends are also paid on the common stock), liquidation preference or other preferences over common stock, and, with certain exceptions, has no voting rights. The securities comprising the units were immediately separable and have been issued separately.

At the closing of our underwritten public offering, a total of 4,436,000 shares of common stock, 9,364,000 shares of Series D Preferred Stock convertible into 9,364,000 shares of common stock, and warrants to acquire 13,800,000 shares of common stock were issued inclusive of the underwriter's exercise of their over-allotment option to purchase 1,800,000 shares of common stock and warrants to acquire 1,800,000 shares of common stock at \$1.00 per share.

Since the closing of our underwritten public offering all of the shares of Series D Preferred Stock that were issued have been converted into shares of our common stock in accordance with the terms for conversion and 9,505,500 warrants were exercised for cash generating approximately \$9.5 million in proceeds to us.

The March 25, 2019 Underwritten Public Offering

On March 25, 2019 we closed on an underwritten public offering of 16,666,668 shares of our common stock, par value \$0.001 per share (the "Common Stock"), together with Series 1 Warrants to purchase up to an aggregate of 8,333,334 shares of our common stock (the "Series 1 Warrants") and Series 2 Warrants to purchase up to an aggregate of 8,333,334 shares of our common stock (the "Series 2 Warrants"), at a price to the public of \$0.75 per share and related warrants (the "Public Offering"). We also granted the Underwriter a 30-day option to purchase up to an additional 2,500,000 additional shares of common stock (the "Option Shares") and/or Series 1 Warrants to purchase up to 1,250,000 shares of common stock and Series 2 Warrants to purchase up to 1,250,000 shares of common stock (the "Option Warrants").

Each Series 1 Warrant has an exercise price of \$0.75 per share of common stock and will expire on the earlier of (1) the eighteen-month anniversary of the date of issuance and (2) twenty-one trading days following the Company's release of top-line data related to its Phase 2 double blind, placebo controlled clinical trial of AG013. Each Series 2 Warrant has an exercise price of \$0.90 per share of common stock and will expire five years following the date of issuance.

Dr. Frederick Telling, Dr. Alan Joslyn, participated in the Public Offering through the purchase of 100,000 shares and 66,667 shares, respectively, of the Company's common stock and Series 1 warrants to purchase 50,000 shares and 33,333 shares, and Series 2 warrants to purchase 50,000 shares and 33,333 shares respectively, of the Company's common stock. Dr. Telling and Dr. Joslyn's participation was approved by our Audit Committee.

ITEM 14. PRINCIPAL ACCOUNTANT FEES AND SERVICES.

The following table provides the aggregate fees billed for professional services rendered by the Company's principal accountants, Mayer Hoffman McCann P.C. ("MHM"), in the categories indicated during each of the past two fiscal years ended December 31:

Services Rendered	2019	2018
Audit Fees (1)	\$ 151,500	\$ 155,000
Audit-Related Fees (2)	—	—
Tax Fees (3)	12,200	9,250
All Other Fees (4)	—	—
	<u>\$ 163,700</u>	<u>\$ 164,250</u>

- (1) *Audit Fees.* This category includes fees for professional services provided in conjunction with the audit of the Company's financial statements and with the audit of management's assessment of internal control over financial reporting and the effectiveness of internal control over financial reporting, review of the Company's quarterly financial statements, assistance and review of documents filed with the Securities and Exchange Commission, consents, and comfort letters and attestation services provided in connection with statutory and other regulatory filings and engagements.
- (2) *Audit-Related Fees.* This category includes fees for assurance and related professional services associated with due diligence related to mergers and acquisitions, consultation on accounting standards or transactions, internal control reviews and assistance with internal control reporting requirements, services related to the audit of employee benefit plans, and other attestation services not required by statute or regulation.
- (3) *Tax Fees.* This category includes fees for professional services provided related to tax compliance, tax planning and tax advice.
- (4) *All Other Fees.* There were no other fees paid to Mayer Hoffman McCann P.C.

Substantially all MHM's personnel, who work under the control of MHM shareholders, are employees of wholly-owned subsidiaries of CBIZ, Inc., which provides personnel and various services to MHM in an alternative practice structure.

Pre-Approval Policy

The Audit Committee approves in advance all audit and non-audit services to be performed by the Company's independent registered public accounting firm. The Audit Committee considers whether the provision of any proposed non-audit services is consistent with the Securities and Exchange Commission rules on auditor independence and has pre-approved certain specified audit and non-audit services to be provided by MHM for up to twelve (12) months from the date of the pre-approval. If there are any additional services to be provided, a request for pre-approval must be submitted by management to the Audit Committee for its consideration.

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES.

(a) The documents filed as part of this report are as follows:

1. The financial statements and accompanying report of independent registered public accounting firm are set forth immediately following the signature page of this report on pages F-1 through F-27.
2. All financial statement schedules are omitted because they are inapplicable, not required or the information is included elsewhere in the financial statements or the notes thereto.
3. The exhibits required to be filed by this report or able to be incorporated by reference are listed in the "Exhibit Index" following the financial statements.

(b) Other Exhibits

Exhibits required by Item 601 of Regulation S-K are submitted (or incorporated by reference) and listed in a separate section herein immediately following the F pages under the heading "Exhibit Index" and are incorporated herein by reference by reference. No exhibits in addition to those previously filed or listed in item 15(a) (3) and filed herein.

(c) Not Applicable.

ITEM 16. FORM 10-K SUMMARY

None.

EXHIBIT INDEX

Exhibit number	Exhibit description	Incorporated by Reference				Filed herewith
		Form	File no.	Exhibit	Filing date	
3.1	Amended and Restated Articles of Incorporation as amended prior to December 29, 2017 (including certificates of designation of Series A, B and C Preferred Stock)	8-K	001-32188	3.1	12/29/17	
3.2	Articles of Amendment to Amended and Restated Articles of Incorporation dated effective December 29, 2017	8-K	001-32188	3.2	12/29/17	
3.3	Articles of Amendment to Amended and Restated Articles of Incorporation effective January 19, 2018	8-K	001-32188	3.1	1/19/18	
3.4	Articles of Amendment to Amended and Restated Articles of Incorporation.	8-K	001-32188	3.4	6/26/18	
3.5	Bylaws	SB-2	333-100568	3.2	10/16/02	
3.6	First Amendment to Bylaws	8-K	001-32188	3.1	6/9/10	
3.7	Second Amendment to Bylaws	8-K	001-32188	3.1	8/24/10	
4.1	Specimen Stock Certificate	10-K	001-32188	4.1	3/29/19	
4.2	Form of Investor Warrant.	8-K	001-32188	4.1	4/10/18	
4.3	Form of Warrant to purchase shares of Common Stock.	S-1/A	333-224950	4.2	7/9/18	
4.4	Form of Series 1 Warrant	8-K	001-32188	4.1	3/25/19	
4.5	Form of Series 2 Warrant	8-K	001-32188	4.2	3/25/19	
4.6	Description of the Registrant's Securities Registered Pursuant to Section 12 of the Securities Exchange Act Of 1934					X
10.1	Exclusive Channel Collaboration Agreement by and between Oragenics, Inc. and Intrexon Corporation (n/k/a Precigen, Inc.) dated as of June 5, 2012 ("Lantibiotic ECC").*	8-K	001-32188	10.1	6/11/12	
10.2	Amendment No. 1 to the Lantibiotic ECC dated July 21, 2016.	10Q	001-32188	10.10	8/15/16	
10.3	Amendment No. 2 to the Lantibiotic ECC dated November 8, 2017.	8-K	001-32188	10.6	11/9/17	
10.4	Stock Issuance Agreement by and between Oragenics, Inc. and Intrexon Corporation (n/k/a Precigen, Inc.) dated as of June 5, 2012 ("Lantibiotic SIA").	8-K	001-32188	10.2	6/11/12	

Exhibit number	Exhibit description	Incorporated by Reference				Filed herewith
		Form	File no.	Exhibit	Filing date	
10.5	Amendment to Lantibiotic SIA dated as of November 8, 2017.	8-K	001-32188	10.8	11/9/17	
10.6	Notice of Assignment of Lantibiotic ECC and Lantibiotic SIA by and between Oragenics, Inc. and Intrexon Corporation (n/k/a Precigen Inc.) to ILH Holdings Inc. effective January 1, 2020					X
10.7	Exclusive Channel Collaboration Agreement with Intrexon Corporation (n/k/a Precigen, Inc.) dated June 9, 2015, as amended and subsequently assigned to ActoBio Therapeutics, Inc., a wholly owned subsidiary of Precigen, Inc.	10-Q	001-32188	10.2	8/13/18	
10.8	Stock Purchase and Issuance Agreement by and between Oragenics, Inc. and Intrexon Corporation (n/k/a Precigen Inc. dated as of June 9, 2015 (“Oral Mucositis SIA”).*	8-K	001-32188	10.2	7/11/15	
10.9	Amendment No. 1 to Oral Mucositis SIA dated as of May 10, 2017.	8-K	001-32188	10.5	5/11/17	
10.10	Amendment No. 2 to Oral Mucositis SIA dated as of November 8, 2017.	8-K	001-32188	10.14	11/9/17	
10.11	Notice of Assignment of Oral Mucositis SIA by Intrexon Corporation (n/k/a Precigen Inc.), effective January 1, 2018.	10-K	001-32188	10.20	2/16/18	
10.12	Joinder to Assignment of Oral Mucositis SIA by and between Oragenics, Inc. and Intrexon Corporation (n/k/a Precigen Inc.) and ActoBio Therapeutics, Inc. (n/k/a Precigen ActoBio Inc.), effective January 1, 2018.	10-K	001-32188	10.21	2/16/18	
10.13	Lease Agreement between the Company and Hawley-Wiggins LLC dated October 28, 2011 (13700 Progress Blvd, Alachua, FL 32615).	10-K	001-32188	10.20	4/16/12	
10.14	Amendment to Lease Agreement between the Company and Hawley-Wiggins LLC dated July 13, 2014 (13700 Progress Blvd, Alachua, FL 32615).	10-Q	001-32188	10.2	8/7/14	
10.15	Second Amendment to Lease Agreement between the Company and Hawley-Wiggins LLC dated July 13, 2014 (13700 Progress Blvd, Alachua, FL 32615).					X
10.16	2012 Equity Incentive Plan. +	8-K	001-32188	4.1	10/25/12	
10.17	First Amendment to 2012 Equity Incentive Plan. +	8-K	001-32188	4.2	5/5/17	
10.18	Second Amendment to 2012 Equity Incentive Plan. +	8-K	001-32188	4.3	12/29/17	
10.19	Third Amendment to 2012 Equity Incentive Plan. +	8-K	001-32188	4.4	6/26/18	
10.20	Form of Employee Stock Option Agreement. +	10-K	001-32188	10.26	3/26/13	
10.21	Form of Consultant Stock Option Agreement. +	10-K	001-32188	10.27	3/26/13	
10.22	Form of Notice of Grant of Stock Options and Stock Option Award Agreement (Employee). +	8-K	001-32188	10.1	3/18/15	

Exhibit number	Exhibit description	Incorporated by Reference				Filed herewith
		Form	File no.	Exhibit	Filing date	
10.23	Form of Notice of Grant of Stock Options and Stock Option Award Agreement (Directors). +					X
10.24	Form of Director Restricted Stock Award Agreement. +	8-K	001-32188	10.3	3/18/15	
10.25	Amended and Restated Executive Employment Agreement between the Company and Michael Sullivan dated effective January 1, 2015. +	8-K	001-32188	10.1	2/25/15	
10.26	Executive Employment Agreement between the Company and Martin Handfield dated May 11, 2010. +	10-Q	001-32188	10.16	11/14/11	
10.27	Executive Employment Agreement between the Company and Alan Joslyn dated effective June 6, 2016. +	8-K	001-32188	10.1	6/6/16	
10.28	First Amendment to Employment Agreement between the Company and Alan Joslyn effective June 6, 2018. +	8-K	001-32188	10.1	6/11/18	
23.1	Consent of Mayer Hoffman McCann P.C., an independent public accounting firm.					X
24.1	Powers of Attorney (included on signature page).					X
31.1	Certification of Principal Executive Officer pursuant to Rule 13a-14 and Rule 15d-14(a), promulgated under the Securities and Exchange Act of 1934, as amended.					X
31.2	Certification of Principal Financial Officer pursuant to Rule 13a-14 and Rule 15d-14(a), promulgated under the Securities and Exchange Act of 1934, as amended.					X
32.1	Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 (Chief Executive Officer).					X
32.2	Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 (Chief Financial Officer).					X
101.INS	XBRL Instance Document					X
101.SCH	XBRL Taxonomy Extension Schema					X
101.CAL	XBRL Taxonomy Extension Calculation Linkbase					X
101.DEF	XBRL Taxonomy Extension Definition Linkbase					X
101.LAB	XBRL Taxonomy Extension Label Linkbase					X
101.PRE	XBRL Taxonomy Extension Presentation Linkbase					X

* Confidential treatment has been granted as to certain portions of this exhibit pursuant to Rule 406 of the Securities Act of 1933, as amended, or Rule 24b-2 of the Securities Exchange Act of 1934, as amended.

+ Executive management contract or compensatory plan or arrangement.

SIGNATURES

Pursuant to the requirements of Section 13 and 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this amended report to be signed on its behalf by the undersigned, thereunto duly authorized.

Dated: March 4, 2020

ORAGENICS, INC.

By: /s/ Alan Joslyn
Alan Joslyn
President and Chief Executive Officer

POWER OF ATTORNEY

Each of the undersigned officers and directors of Oragenics, Inc., hereby constitutes and appoints Alan Joslyn and Michael Sullivan, their true and lawful attorney-in-fact and agent, for them and in their name, place and stead, in any and all capacities, to sign their name to any and all amendments to this Report on Form 10-K, and other related documents, and to cause the same to be filed with the Securities and Exchange Commission, granting unto said attorneys, full power and authority to do and perform any act and thing necessary and proper to be done in the premises, as fully to all intents and purposes as the undersigned could do if personally present, and the undersigned for himself hereby ratifies and confirms all that said attorney shall lawfully do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

Signature	Title	Date
<u>/s/ Alan Joslyn</u> Alan Joslyn	President and Chief Executive Officer	March 4, 2020
<u>/s/ Michael O. Sullivan</u> Michael O. Sullivan	Chief Financial Officer (Principal Accounting and Financial Officer)	March 4, 2020
<u>/s/ Robert C. Koski</u> Robert C. Koski	Director	March 4, 2020
<u>/s/ Frederick W. Telling</u> Frederick W. Telling	Chairman and Director	March 4, 2020
<u>/s/ Charles L. Pope</u> Charles L. Pope	Director	March 4, 2020
<u>/s/ Alan W. Dunton</u> Alan W. Dunton	Director	March 4, 2020

Financial Statements

Oragenics, Inc.

Financial Statements
Years Ended December 31, 2019 and 2018

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Report of Independent Registered Public Accounting Firm

To the Board of Directors and
Shareholders of Oragenics, Inc.

Opinion on the Financial Statements

We have audited the accompanying balance sheets of Oragenics, Inc. ("Company") as of December 31, 2019 and 2018, and the related statements of operations, changes in shareholder's equity, and cash flows for each of the two years in the period ended December 31, 2019, and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the two years in the period ended December 31, 2019, in conformity with accounting principles generally accepted in the United States of America.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) ("PCAOB") and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and 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 financial statements are free of material misstatement, whether due to error or fraud. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion.

Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Mayer Hoffman McCann P.C.

We have served as the Company's auditor since 2005
March 4, 2020, Clearwater, Florida

Oragenics, Inc.
Balance Sheets
December 31, 2019 and 2018

Assets	December 31, 2019	December 31, 2018
Assets		
Current assets:		
Cash and cash equivalents	\$ 18,267,994	\$ 20,208,301
Prepaid expenses and other current assets	570,071	1,724,975
Total current assets	18,838,065	21,933,276
Property and equipment, net	91,968	116,276
Operating lease right-of-use assets	822,684	—
Total assets	<u>\$ 19,752,717</u>	<u>\$ 22,049,552</u>
Liabilities and Shareholders' Equity		
Current liabilities:		
Accounts payable and accrued expenses	\$ 1,541,415	\$ 1,043,356
Short-term notes payable	143,864	124,213
Operating lease liabilities	165,096	—
Total current liabilities	1,850,375	1,167,569
Long-term liabilities		
Operating lease liabilities	670,690	—
Total long-term liabilities	670,690	—
Shareholders' equity:		
Preferred stock, no par value; 50,000,000 shares authorized; 9,417,000 and 9,417,000 Series A shares, 6,600,000 and 6,600,000 Series B shares, 113.941 and 101.733 Series C shares issued and outstanding at December 31, 2019 and December 31, 2018, respectively	6,513,396	6,100,182
Common stock, \$0.001 par value; 200,000,000 shares authorized 46,124,803 and 29,433,135 shares issued and outstanding at December 31, 2019 and December 31, 2018, respectively	46,125	29,433
Additional paid-in capital	138,024,957	126,125,976
Accumulated deficit	(127,352,826)	(111,373,608)
Total shareholders' equity	<u>17,231,652</u>	<u>20,881,983</u>
Total liabilities and shareholders' equity	<u>\$ 19,752,717</u>	<u>\$ 22,049,552</u>

See accompanying Report of Independent Registered Public Accounting Firm and notes to the financial statements.

Oragenics, Inc.
Statements of Operations
For the Years Ended December 31, 2019 and 2018

	Year Ended December 31,	
	2019	2018
Operating expenses:		
Research and development	\$ 12,120,318	\$ 5,971,833
General and administrative	3,757,251	4,022,307
Total operating expenses	<u>15,877,569</u>	<u>9,994,140</u>
Loss from operations	(15,877,569)	(9,994,140)
Other income (expense):		
Interest income	320,011	86,527
Interest expense	(7,300)	(5,786)
Local business tax	(1,601)	(1,188)
Other income	456	446
Total other income (expense), net	<u>311,566</u>	<u>79,999</u>
Loss before income taxes	<u>(15,566,003)</u>	<u>(9,914,141)</u>
Income tax benefit	—	—
Net loss	<u>\$ (15,566,003)</u>	<u>\$ (9,914,141)</u>
Deemed dividend of Series D preferred stock	<u>—</u>	<u>(1,412,041)</u>
Net loss applicable to common shareholders	<u>(15,566,003)</u>	<u>(11,326,182)</u>
Basic and diluted net loss per share	<u>\$ (0.37)</u>	<u>\$ (0.87)</u>
Shares used to compute basic and diluted net loss per share	<u>42,283,947</u>	<u>13,039,123</u>

See accompanying Report of Independent Registered Public Accounting Firm and notes to the financial statements.

Orogenics, Inc.
Statements of Changes in Shareholders' Equity
For the Years Ended December 31, 2019 and 2018

	Common Stock		Preferred Stock		Additional Paid In Capital	Accumulated Deficit	Total Shareholders' Equity
	Shares	Amount	Shares	Amount			
Balances at December 31, 2017	<u>4,928,335</u>	<u>\$ 4,928</u>	<u>18,600,100</u>	<u>\$ 6,309,608</u>	<u>\$ 101,402,570</u>	<u>\$ (101,400,797)</u>	<u>\$ 6,316,309</u>
Compensation expense relating to option issuances	—	—	—	—	996,038	—	996,038
Issuance of common stock - shelf takedown, net of expenses	900,000	900	—	—	1,509,427	—	1,510,327
Conversion of Series A preferred stock to common stock	258,300	258	(2,583,000)	(268,096)	267,838	—	—
Issuance of common stock, Series D preferred stock and warrants, net of expenses	4,436,000	4,436	9,364,000	4,464,107	7,963,086	—	12,431,629
Conversion of Series D preferred stock to common stock	9,364,000	9,364	(9,364,000)	(4,464,107)	4,454,743	—	—
Warrant exercises	9,505,500	9,506	—	—	9,495,995	—	9,505,501
Series C dividend	—	—	2	58,670	—	(58,670)	—
Issuance of restricted common stock	16,000	16	—	—	24,304	—	24,320
Issuance of common stock in exchange for services	25,000	25	—	—	11,975	—	12,000
Net loss	—	—	—	—	—	(9,914,141)	(9,914,141)
Balances at December 31, 2018	<u>29,433,135</u>	<u>\$ 29,433</u>	<u>16,017,102</u>	<u>\$ 6,100,182</u>	<u>\$ 126,125,976</u>	<u>\$ (111,373,608)</u>	<u>\$ 20,881,983</u>
Compensation expense relating to option issuances	—	—	—	—	552,997	—	552,997
Issuance of common stock - shelf takedown, net of expenses	16,666,668	16,667	—	—	11,334,010	—	11,350,676
Series C dividend	—	—	12	413,214	—	(413,214)	—
Issuance of common stock in exchange for services	25,000	25	—	—	11,975	—	12,000
Net loss	—	—	—	—	—	(15,566,003)	(15,566,003)
Balances at December 31, 2019	<u>46,124,803</u>	<u>\$ 46,125</u>	<u>16,017,114</u>	<u>\$ 6,513,396</u>	<u>\$ 138,024,957</u>	<u>\$ (127,352,826)</u>	<u>\$ 17,231,652</u>

See accompanying Report of Independent Registered Public Accounting Firm and notes to the financial statements.

Oragenics, Inc.
Statements of Cash Flows
For the Years Ended December 31, 2019 and 2018

	Year Ended December 31,	
	2019	2018
Cash flows from operating activities:		
Net loss	\$ (15,566,003)	\$ (9,914,141)
Adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization	62,622	30,110
Stock issued as compensation to non-employee directors	—	24,320
Stock-based compensation expense	552,997	996,038
Stock issued in exchange for services	12,001	12,000
Changes in operating assets and liabilities:		
Prepaid expenses and other current assets	1,427,481	(453,456)
Accounts payable and accrued expenses	498,059	225,312
Net cash used in operating activities	<u>(13,012,843)</u>	<u>(9,079,817)</u>
Cash flows from investing activities:		
Purchase of property and equipment	(25,214)	(124,727)
Net cash used by investing activities	<u>(25,214)</u>	<u>(124,727)</u>
Cash flows from financing activities:		
Payments on short-term notes payable	(252,926)	(200,755)
Net proceeds from issuance of common stock, convertible preferred stock, and warrants	11,350,676	12,431,629
Proceeds from issuance of common stock for warrant exercise	—	9,505,501
Net proceeds from issuance of common stock and warrants	<u>—</u>	<u>1,510,327</u>
Net cash provided by financing activities	<u>11,097,750</u>	<u>23,246,702</u>
Net (decrease) increase in cash and cash equivalents	(1,940,307)	14,042,158
Cash and cash equivalents at beginning of period	20,208,301	6,166,143
Cash and cash equivalents at end of period	<u>\$ 18,267,994</u>	<u>\$ 20,208,301</u>
<i>Supplemental disclosure of cash flow information:</i>		
Interest paid	<u>\$ 7,300</u>	<u>\$ 5,786</u>
<i>Non-cash investing and financing activities:</i>		
Borrowings under short term notes payable for prepaid expense	<u>\$ 272,577</u>	<u>\$ 244,490</u>
Par value of restricted shares issued	<u>—</u>	<u>\$ 16</u>
Stock dividend on Series C preferred stock	<u>\$ 413,214</u>	<u>\$ 58,670</u>
Par value of common stock issued in connection with Series A Preferred Stock conversion	<u>—</u>	<u>\$ 259</u>
Value of Series A preferred stock converted into common stock	<u>—</u>	<u>\$ 268,096</u>
Par value of common stock issued in connection with Series D Preferred Stock conversion	<u>\$ —</u>	<u>\$ 9,364</u>
Deemed dividend on Series D preferred stock	<u>—</u>	<u>\$ 1,412,041</u>
Par value of common stock issued in exchange for services	<u>\$ 25</u>	<u>\$ 25</u>
Conversion of Series D preferred stock to common stock	<u>\$ —</u>	<u>\$ 4,464,107</u>

See accompanying Report of Independent Registered Public Accounting Firm and notes to the financial statements.

1. Basis of Presentation

The Company

Oragenics, Inc. (formerly known as Oragen, Inc.) (the “Company” or “we”) was incorporated in November, 1996; however, operating activity did not commence until 1999. We are focused on becoming a leader in developing novel antibiotics against infectious disease and on developing effective treatments for oral mucositis.

Basis of Presentation

The accompanying financial statements of the Company have been prepared in accordance with accounting principles generally accepted in the United States (“US GAAP”) including the assumption of a going concern basis which contemplates the realization of assets and the settlement of liabilities and commitments in the normal course of business.

The Company has incurred recurring losses and negative cash flows from operations since inception. To date the Company has not generated significant revenues from operations. The Company incurred a net loss of \$(15,566,003) and used cash of \$(13,012,843) in its operating activities during the year ended December 31, 2019. As of December 31, 2019, the Company had an accumulated deficit of \$(127,352,826) and cash flows from operations were negative throughout 2019.

During 2019, 2018, 2017, 2016, 2013 and 2012 the Company raised \$12,500,000, \$25,105,500, \$9,684,799, \$4,666,667, \$14,900,000 and \$13,000,000 in gross proceeds respectively through the sale of its preferred and common stock, the exercise of warrants, and with the conversion of a note payable to shareholder and accrued expenses to preferred stock. The Company expects to incur substantial expenditures to further develop each of its technologies. The Company believes the working capital at December 31, 2019 will be sufficient to meet the business objectives, as presently structured, through the second quarter of 2021, as such, there is substantial doubt that we can continue as a going concern beyond that date without additional interim funding.

The Company’s ability to continue operations after its current cash resources are exhausted depends on its ability to obtain additional financing or achieve profitable operations, as to which no assurances can be given. Cash requirements may vary materially from those now planned because of changes in the Company’s focus and direction of its research and development programs, competitive and technical advances, or other developments. Additional financing will be required to continue operations after the Company exhausts its current cash resources and to continue its long-term plans for clinical trials and new product development. There can be no assurance that any such financing can be realized by the Company, or if realized, what the terms thereof may be, or that any amount that the Company is able to raise will be adequate to support the Company’s working capital requirements until it achieves profitable operations.

The Company intends to seek additional funding through sublicensing arrangements, joint venturing or partnering, sales of rights to technology, government grants and public or private financings and may receive funding through the exercise of outstanding warrants. The Company’s future success depends on its ability to raise capital and ultimately generate revenue and attain profitability. The Company cannot be certain that additional capital, whether through selling additional debt or equity securities or obtaining a line of credit or other loan, will be available to it or, if available, will be on terms acceptable to the Company. If the Company issues additional securities to raise funds, these securities may have rights, preferences, or privileges senior to those of its common stock, and the Company’s current shareholders may experience dilution. If the Company is unable to obtain funds when needed or on acceptable terms, the Company may be required to curtail its current development programs, cut operating costs and forego future development and other opportunities.

2. Significant Accounting Policies

New Accounting Pronouncements

In July 2018, the Financial Accounting Standards Board issued Accounting Standards Updates 2018-10 Codification Improvements to Topic 842, Leases and 2018-11 Leases (Topic 842).

Update 2018-10 Codification Improvements to Topic 842 represent changes to clarify the Codification, correct unintended application of guidance, or make minor improvements to the Codification that are not expected to have a significant effect on current accounting practice or create a significant administrative cost to most entities. Some of the amendments make the Codification easier to understand and easier to apply by eliminating inconsistencies, providing needed clarifications, and improving the presentation of guidance in the Codification.

Update 2018-11 Leases (Topic 842) provides entities with an additional (and optional) transition method to adopt the new lease requirements by allowing entities to initially apply the requirements by recognizing a cumulative-effect adjustment transition method, which applies the provisions of the standard at the effective date without adjusting comparative periods presented. Consequently, an entity's reporting for the comparative periods presented in the financial statements in which the entity adopts the new lease requirements would continue to be in accordance with current GAAP (Topic 840). An entity electing this additional (and optional) transition method must provide the required Topic 840 disclosures for all periods that continue to be in accordance with Topic 840. The amendments do not change the existing disclosure requirements in Topic 840. We implemented this standard on January 1, 2019 using the cumulative-effect adjustment transition method, which applies the provisions of the standard at the effective date without adjusting the comparative periods presented. The Company adopted the following practical expedients and elected the following accounting policies related to this standard:

- We did not reassess whether any expired or existing contracts are or contain leases.
- We did not reassess the lease classification for any expired or existing leases.
- We did not reassess initial direct costs for any existing leases.

The standard did not have a material impact on our balance sheets or on our statements of operations. The most significant impact was the recognition of right of use (ROU) assets and lease liabilities for operating leases. We implemented internal controls to enable the preparation of financial information on adoption of the standard. Adoption of the lease standard had no impact to cash provided by or used in operating, financing, or investing activities in the cash flow statements.

In June 2018, the Financial Accounting Standards Board issued Accounting Standards Update 2018-07 Compensation—Stock Compensation (Topic 718) Improvements to Nonemployee Share-Based Payment Accounting. The amendments in this Update expand the scope of Topic 718 to include share-based payment transactions for acquiring goods and services from nonemployees. The requirements of Topic 718 should be applied to nonemployee awards except for specific guidance on inputs to an option pricing model and the attribution of cost (that is, the period of time over which share-based payment awards vest and the pattern of cost recognition over that period). The amendments specify that Topic 718 applies to all share-based payment transactions in which a grantor acquires goods or services to be used or consumed in a grantor's own operations by issuing share-based payment awards. The amendments also clarify that Topic 718 does not apply to share-based payments used to effectively provide (1) financing to the issuer or (2) awards granted in conjunction with selling goods or services to customers as part of a contract accounted for under Topic 606, Revenue from Contracts with Customers.

The amendments in this Update are effective for public business entities for fiscal years beginning after December 15, 2018, including interim periods within that fiscal year. The adoption of this guidance did not have a material impact on the Company's results of operation, financial position or disclosures.

There are no additional accounting pronouncements issued or effective during the twelve months ended December 31, 2019, that have had or are expected to have an impact on our financial statements.

Use of Estimates

The preparation of financial statements in conformity with US GAAP requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements, as well as the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates. The principal areas of estimation reflected in the financial statements are stock-based compensation, valuation of warrants and stock options, and income tax valuation allowance.

Cash and Cash Equivalents

Cash and cash equivalents consist of all cash balances and highly liquid investments with an original maturity of three months or less. The Company's cash and cash equivalents are deposited in a financial institution and consist of demand deposits and overnight repurchase agreements and at times deposits are in excess of federally insured limits.

Property and Equipment

Property and equipment is stated at cost less accumulated depreciation and amortization. Depreciation is provided on the straight-line method over the estimated useful lives of the assets (three to seven years). Leasehold improvements are amortized over the shorter of the estimated useful life or the lease term of the related asset (three years).

Business Segments

In accordance with US GAAP, the Company is required to report segment information. As the Company only operates principally in one business segment, no additional reporting is required.

Stock-Based Payment Arrangements

Generally, all forms of stock-based payments, including stock option grants, warrants, and restricted stock grants are measured at their fair value on the awards' grant date typically using a Black-Scholes pricing model. Stock-based compensation awards issued to non-employees for services rendered are recorded at the fair value of the stock-based payment. The expense resulting from stock-based payments are recorded in research and development expense or selling, general and administrative expense in the statement of operations, depending on the nature of the services provided. Stock-based payment expense is recorded over the requisite service period in which the grantee provides services to us. To the extent the stock option grants, warrants, or restricted stock grants do not vest at the grant date they are subject to forfeiture.

Stock-Based Compensation

US GAAP requires all stock-based payments to employees, including grants of employee stock options, to be recognized in the financial statements based on their fair values as of the grant date. Stock-based compensation expense is recorded over the requisite service period in which the grantee provides services to us, to the extent the options do not vest at the grant date and are subject to forfeiture. For performance-based awards that do not include market-based conditions, we record share-based compensation expense only when the performance-based milestone is deemed probable of achievement. We utilize both quantitative and qualitative criteria to judge whether milestones are probable of achievement. For awards with market-based performance conditions, we recognize the grant-date fair value of the award over the derived service period regardless of whether the underlying performance condition is met. We account for forfeitures of stock-based awards as a component of compensation expense as the forfeitures occur.

Warrants

The Company used the Black Scholes Option Pricing Model in calculating the relative fair value of any warrants that have been issued.

Impairment of Long-Lived Assets

The Company periodically reviews their long-lived assets for impairment and reduces the carrying value to fair value whenever events or changes in circumstances indicate that the carrying value may not be recoverable. There were no impairment losses recorded during the years ended December 31, 2019, and 2018.

Research and Development Expenses

Research and development consist of expenses incurred in connection with the discovery and development of product candidates. These expenses consist primarily of the following: employee-related expenses, which include salaries and benefits and attending science conferences; costs incurred in connection with Exclusive Channel Collaboration ("ECC") agreements with third parties, expenses incurred under agreements with contract research organizations, investigative sites and consultants that conduct our clinical trials and a substantial portion of nonclinical studies; the cost of acquiring and manufacturing clinical trial materials; facilities, depreciation and other allocated expenses, which include direct and allocated expenses for rent and maintenance of facilities and equipment, and depreciation of fixed assets; license fees for and milestone payments related to in-licensed products and technology; stock-based compensation expense; and costs associated with nonclinical activities and regulatory approvals. The Company expenses research and development costs as incurred.

Income Taxes

Income taxes are accounted for under the asset and liability method. Deferred tax assets and liabilities are recognized for future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases and operating loss and tax credit carryforwards.

Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect on deferred tax assets and liabilities of a change in tax rate is recognized in operations in the period that includes the enactment date. Deferred tax assets are reduced to estimated amounts expected to be realized by the use of a valuation allowance. Based on our historical operating losses, a valuation allowance has been recognized for all deferred tax assets.

Under US GAAP, the impact of an uncertain income tax position on the income tax return must be recognized at the largest amount that is more-likely-than-not to be sustained upon audit by the relevant taxing authority. An uncertain income tax position will not be recognized if it has less than a 50% likelihood of being sustained. Additionally, US GAAP provides guidance on derecognition, classification, interest and penalties, accounting for interim periods, disclosure and transition.

Concentrations

Financial instruments which potentially subject the Company to concentrations of credit risk consist principally of cash and cash equivalents. The Company maintains cash accounts in commercial banks, which may, at times, exceed federally insured limits. The Company has not experienced any losses in such accounts. The Company believes it is not exposed to any significant credit risk on cash and cash equivalents. As of December 31, 2019, the uninsured portion of this balance was \$18,017,994. As of December 31, 2018, the uninsured portion of this balance was \$19,958,301.

3. Property and Equipment, net

Property and equipment, net consists of the following as of December 31, 2019 and 2018:

	2019	2018
Furniture and fixtures	\$ 20,742	\$ 20,742
Laboratory equipment	944,657	936,041
Leasehold improvements	487,871	487,871
Office and computer equipment	302,825	286,227
	<u>1,756,095</u>	<u>1,730,881</u>
Accumulated depreciation and amortization	(1,664,127)	(1,614,605)
Property and equipment, net	<u>\$ 91,968</u>	<u>\$ 116,276</u>

Depreciation and amortization expense for the years ending December 31, 2019 and 2018 was \$62,622 and \$30,110 respectively.

4. Accounts Payable and Accrued Expenses

Accounts payable and accrued expenses consist of the following as of December 31, 2019 and 2018:

	2019	2018
Accounts payable trade	\$ 1,207,231	\$ 828,706
Precigen Collaboration Agreements	131,089	39,607
Professional fees	55,000	46,775
Vacation	143,095	123,268
Consulting fees	5,000	5,000
Total accounts payable and accrued expenses	<u>\$ 1,541,415</u>	<u>\$ 1,043,356</u>

5. Short-Term Notes Payable

The Company had the following short-term notes payable as of December 31, 2019 and 2018:

	<u>2019</u>	<u>2018</u>
Product liability insurance financing of \$17,688 and \$28,915, due in monthly installments of \$1,599 and \$2,696 including principal and interest at 5.69% and 5.09% through February 10, 2020 and February 12, 2019, respectively	\$ 3,177	\$ 5,295
Directors' and officers' liability insurance financing of \$254,889 and \$215,575 due in monthly installments of \$23,842 and \$20,115 including principal and interest at 5.74% and 5.24% through June 24, 2020 and June 24, 2019, respectively	140,687	118,918
Total short-term notes payable	<u>\$ 143,864</u>	<u>\$ 124,213</u>

6. Shareholders' Equity

Common Stock

2018 Public Offerings

On April 6, 2018, the Company entered into a securities purchase agreement with certain investors pursuant to which the Company agreed to issue and sell, in a registered offering by the Company directly to the investors, an aggregate of 900,000 shares of the Company's common stock, par value \$0.001 per share, at an offering price of \$2.00 per share. In a concurrent private placement, the Company agreed to issue to the investors who participated in the registered offering, warrants exercisable for one share of common stock for each share purchased in the registered offering for an aggregate of warrants to purchase 900,000 shares of common stock at an exercise price of \$2.00 per share. Each warrant is exercisable beginning on the six-month anniversary of the date of its issuance and will expire five years from the date of issuance.

On July 17, 2018, the Company announced the closing of an underwritten public offering (the "Public Offering") of Class A Units, priced at a public offering price of \$1.00 per unit, with each unit consisting of one share of common stock and a seven-year warrant to purchase one share of common stock with an exercise price of \$1.00 per share, and Class B Units, priced at a public offering price of \$1.00 per unit, with each unit comprised of one share of series D preferred stock (the "Series D Preferred Stock"), which is convertible into one share of common stock, and a warrant. The conversion price of the Series D Preferred Stock issued in the transaction as well as the exercise price of the Warrants are fixed and do not contain any variable pricing features or any price based anti-dilutive features. The securities comprising the units were immediately separable and have been issued separately.

The conversion price of the Series D Preferred Stock and exercise price of the warrants is subject to appropriate adjustment in the event of recapitalization events, stock dividends, dilutive issuances, stock splits, stock combinations, reclassifications, reorganizations or similar events affecting the Company's common stock.

A total of 4,436,000 shares of common stock, 9,364,000 shares of Series D Preferred Stock convertible into 9,364,000 shares of common stock, and total warrants to purchase 13,800,000 shares of common stock were issued in the Public Offering inclusive of the underwriters exercise of their over-allotment option to purchase 1,800,000 shares of common stock and warrants to purchase 1,800,000 shares of common stock at the Public Offering price per share less the underwriting discounts and commissions.

The Company's non-employee directors, Frederick Telling and Alan Dunton participated in the Public Offering through the purchase of 100,000 shares and 20,000 shares, respectively, of the Company's common stock and warrants to purchase 100,000 shares and 20,000 shares, respectively, of the Company's common stock.

The net proceeds to the Company from the Public Offering, after deducting Underwriter fees and expenses and the Company's Public Offering expenses, was approximately \$12.4 million. The Company anticipates using the net proceeds from this Public Offering to continue funding development of AG013, our ongoing Phase 2 clinical trial for the treatment of Oral Mucositis, our pre-clinical development of our lantibiotics program and for general corporate purposes, including research and development activities, capital expenditures and working capital.

The proceeds received in the Public Offering were allocated to each instrument on a relative fair value basis. Total proceeds of \$13.8 million were allocated to warrants issued, \$6.5 million, common stock, \$2.3 million and Series D Preferred Stock, \$5.0 million. The allocation resulted in an effective conversion price for the Series D Preferred Stock that was below the quoted market price of the Company's common stock on the closing date. As such, the Company recognized a beneficial conversion feature equal to the intrinsic value of the conversion feature on the closing date, resulting in a deemed dividend for the Series D Preferred Stock of approximately \$1.4 million recognized on the closing date.

2019 Public Offering

On March 25, 2019, the Company announced the closing of an underwritten public offering for gross proceeds of approximately \$12.5 million, which included the partial exercise of the underwriter's over-allotment option to purchase additional shares and warrants, prior to deducting underwriting discounts and commissions and offering expenses payable by the Company.

The offering was comprised of 16,666,668 shares of common stock, together with short-term warrants to purchase up to 8,333,334 shares of common stock, and long-term warrants to purchase up to 8,333,334 shares of common stock, at a price to the public of \$0.75. The Company granted the underwriter a 30-day option to purchase up to 2,500,000 additional shares of common stock and/or short-term warrants to purchase 1,250,000 shares of common stock and long-term warrants to purchase 1,250,000 shares of common stock of the Company at the public offering price, less underwriting discounts and commissions. The underwriter did not exercise its option to purchase additional shares of common stock, however the underwriter exercised its option to purchase the short-term warrants to purchase 1,250,000 shares of common stock and long-term warrants to purchase 1,250,000 shares of common stock effective as of the closing.

Each short-term warrant has an exercise price of \$0.75 per share of common stock, is immediately exercisable, and will expire on the earlier of (1) the eighteen-month anniversary of the date of issuance and (2) twenty-one trading days following the Company's release of top-line data related to its Phase 2 double blind, placebo controlled clinical trial of AG013. Each long-term warrant has an exercise price of \$0.90 per share of common stock, is immediately exercisable and will expire five years following the date of issuance.

The Company intends to use the net proceeds of the offering to fund its AG013 research, clinical trials, pre-clinical development of the lantibiotics program, and for working capital and general corporate purposes.

Dr. Frederick Telling and Dr. Alan Joslyn, who are Directors of the Company, participated in the offering through the purchase of 100,000 shares and 66,667 shares, respectively, of the Company's common stock and Series 1 warrants to purchase 50,000 shares and 33,333 shares, and Series 2 warrants to purchase 50,000 shares and 33,333 shares respectively, of the Company's common stock. Dr. Telling and Dr. Joslyn's participation was approved by our Audit Committee.

Award of Shares to Non-employee Directors

On June 22, 2018, and in connection with, and in furtherance of, the non-employee director compensation program, the Board approved the award of 4,000 restricted shares of the Company's common stock to each of the Company's non-employee directors, Frederick Telling, Charles Pope, Alan Dunton, and Robert Koski under the Company's 2012 Equity Incentive Plan. Pursuant to the terms of the award, the restricted shares were immediately vested. The Company recognized \$24,320 in compensation expense relating to these awards.

Other Share Issuances.

On February 1, 2019, the Company issued 12,500 shares of its common stock, and May 1, 2019, respectively, the Company issued 12,500 shares of its common stock as partial consideration for the acquisition of certain services. As of December 31, 2018, the Company had issued 25,000 shares of its common stock as partial consideration for the acquisition of certain services.

As of December 31, 2018, 9,364,000 constituting all outstanding shares of Series D Preferred Stock had been converted into shares of Common Stock.

As of December 31, 2018, 9,505,500 warrants issued in connection with the Public Offering had been exercised resulting in the issuance of 9,505,500 shares common stock.

On March 9, 2018, a holder of 2,583,000 shares of the Company's Series A Convertible Preferred Stock, converted the Series A Convertible Preferred Stock into 258,300 shares of the Company's common stock.

Preferred Stock

Issuance of Series A Convertible Preferred Stock Financing

On May 10, 2017 we entered into a securities purchase agreement with three accredited investors, to purchase up to \$3,000,000 of Series A Convertible Preferred Stock (the "Series A Preferred Stock Financing"). The sale of the Preferred Stock took place in two separate closings and at the first closing which occurred on May 10, 2017, we received gross proceeds of approximately \$1,302,000. The second closing occurred on July 25, 2017 and we received gross proceeds of approximately \$1,698,000, which was the balance of the Preferred Stock Financing. The full \$3,000,000 of Preferred Stock, and after giving effect to the reverse stock split and the previous conversion of 2,583,000 shares of Series A Preferred Stock into 258,300 shares of the Company's common stock, is convertible into nine hundred, forty one thousand, seven hundred and one shares of our common stock, based on a fixed conversion price of \$2.50 per share on an as-converted basis. In addition, and after giving effect to the reverse stock split, we issued warrants to purchase an aggregate of 462,106 shares of common stock at the first closing and we issued an aggregate of 602,414 shares of common stock at the second closing. The warrants have a term of seven years from the date of issuance are non-exercisable until 6 months after issuance, have an exercise price of \$3.10 per share. Proceeds from the Series A Preferred Stock Financing (including the exercise of any warrants for cash) will be used for general corporate purposes, including working capital.

On July 27, 2017, we entered into an agreement to amend the warrants issued in connection with the Series A Preferred Stock Financing to provide notification and objection requirements with respect to the change of control provisions. The change of control provisions in the warrants had previously caused the warrants to be treated as a derivative liability as opposed to being treated as equity on our balance sheet. The warrants have been replaced by amended and restated warrants containing such notification and objection requirements (the “Amended and Restated Common Stock Purchase Warrants”) so that the Amended and Restated Common Stock Purchase Warrants are now treated as equity on our balance sheet. All other terms of the original warrants remain unchanged by the Amended and Restated Common Stock Purchase Warrants.

In connection with the Series A Preferred Financing, we filed a Certificate of Designations of Preferences, Rights and Limitations of Series A Preferred Stock with the Secretary of State of the State of Florida, to be effective May 10, 2017. The number of shares of Preferred Stock designated as Series A Preferred Stock is 12,000,000.

In connection with the issuance and sale of the Series A Preferred Stock and warrants, we granted certain demand registration rights and piggyback registration rights with respect to the shares of our Common Stock issuable upon conversion of the Preferred Stock and exercise of the Warrants, pursuant to a Registration Rights Agreement.

Except as otherwise required by law, the Series A Preferred Stock shall have no voting rights. However, as long as any shares of Series A Preferred Stock are outstanding, we shall not, without the affirmative vote of the holders of a majority of the then outstanding shares of the Series A Preferred Stock, (a) alter or change adversely the powers, preferences or rights given to the Series A Preferred Stock or alter or amend the Certificate of Designation, (b) amend its articles of incorporation or other charter documents in any manner that adversely affects any rights of the holders of Series A Preferred Stock, (c) increase the number of authorized shares of Series A Preferred Stock, or (d) enter into any agreement with respect to any of the foregoing. Upon any liquidation, dissolution or winding-up by us, whether voluntary or involuntary that is not a Fundamental Transaction (as defined in the Certificate of Designation), the holders of Series A Preferred Stock shall be entitled to receive out of the assets, the greater of (i) the product of the number of shares of Series A Preferred Stock then held by such holder, multiplied by the Original Issue Price; and (ii) the amount that would be payable to such holder in the Liquidation in respect of Common Stock issuable upon conversion of such shares of Series A Preferred Stock if all outstanding shares of Series A Preferred Stock were converted into Common Stock immediately prior to the Liquidation. The Series A Preferred Stock is classified as permanent equity.

The Series B Non-Voting, Convertible Preferred Stock Financing

On November 8, 2017, we completed a private placement of \$3,300,000 of Series B Non-Voting, Convertible Preferred Stock (the “Series B Convertible Preferred Stock”) pursuant to a Securities Purchase Agreement with four existing shareholders who are accredited investors including an entity affiliated with a director of the Company (the “Series B Preferred Stock Financing”).

The full \$3,300,000 of Series B Convertible Preferred Stock is convertible, after giving effect to the reverse stock split into one million three hundred and twenty thousand and two shares of our Common Stock, based on a conversion of one share of Series B Preferred Stock into two shares of Common Stock. The purchase price per share of the Series B Preferred Stock is represented by \$2.50 per share of the Common Stock on an as converted basis. In addition, and after giving effect to the reverse stock split, we issued to the investors in the private placement accompanying common stock purchase warrants to purchase an aggregate of 1,064,518 shares of Common Stock. The warrants have a term of seven years from the date of issuance, and are non-exercisable until six (6) months after issuance, and after giving effect to the reverse stock split, have an exercise price of \$3.10 per share.

In connection with the Series B Preferred Financing, we filed a Certificate of Designation and Rights of Series B Convertible Preferred Stock with the Secretary of State of the State of Florida, to be effective November 8, 2017. The number of shares of Preferred Stock designated as Series B Preferred Stock is 6,600,000.

Except as otherwise required by law, the Series B Preferred Stock shall have no voting rights. However, as long as any shares of Series B Preferred Stock are outstanding, we shall not, without the affirmative vote of the holders of a majority of the then outstanding shares of the Series B Preferred Stock, (a) alter or change adversely the powers, preferences or rights given to the Series B Preferred Stock or alter or amend the Certificate of Designation, (b) amend its articles of incorporation or other charter documents in any manner that adversely affects any rights of the holders of Series B Preferred Stock, (c) increase the number of authorized shares of Series B Preferred Stock, or (d) enter into any agreement with respect to any of the foregoing.

The Series B Preferred Stock shall rank (i) on par with the Common Stock and Series A Preferred Stock and junior to Series C Preferred Stock as to dividend rights and (ii) junior to Series C Preferred Stock, on par with Series A Preferred Stock and senior to the Common Stock as to distribution of assets upon liquidation, dissolution or winding-up by us, whether voluntary or involuntary.

Upon any liquidation, dissolution or winding-up by us, whether voluntary or involuntary, the holders of Series B Preferred Stock shall be entitled to receive out of the assets, after payment to the holders of Series C Preferred Stock but on par with the holders of Series A Preferred Stock and in preference to the holders of the Common Stock, an amount of cash equal to the greater of (i) the product of the number of shares of Series B Preferred Stock then held by such holder, multiplied by the Original Issue Price; and (ii) the amount that would be payable to such holder in the Liquidation in respect of Common Stock issuable upon conversion of such shares of Series B Preferred Stock if all outstanding shares of Series B Preferred Stock were converted into Common Stock immediately prior to the Liquidation. The Series B Preferred Stock is classified as permanent equity.

The Series C Non-Voting, Non-Convertible Preferred Stock Financing Precigen Debt Conversion

Concurrently with the Series B Preferred Stock Financing, we also entered into a Debt Conversion Agreement (the "Precigen Debt Conversion Agreement") with Precigen, Inc. (formerly Intrexon Corporation ("Intrexon")) pursuant to which Precigen exchanged the \$2,400,000 unsecured non-convertible promissory note previously issued by us to Precigen (the "Precigen Note"), the accrued interest on the Precigen Note and trade payables owed by us (collectively the "Debt") in the aggregate amount of approximately \$3,400,000 for equity in the form of 100 shares of Series C, Non-Voting, Non-Convertible Preferred Stock (the "Series C Preferred Stock") issued by us to Precigen pursuant to the Debt Conversion Agreement which 100 shares have a stated value equal to the amount of the Debt.

In connection with the Precigen Debt Conversion Agreement, we filed a Certificate of Designation and Rights of Series C Non-Convertible Preferred Stock with the Secretary of State of the State of Florida, to be effective November 8, 2017. The number of shares of Preferred Stock designated as Series C Preferred Stock is 1,000.

Each issued and outstanding share of Series C Preferred Stock entitles the holder of record to receive dividends at the annual rate of twelve percent (12%) (the "Initial Rate") of its Stated Value, payable by issuing additional shares of Series C Preferred Stock within thirty days after the end of each calendar year pro-rata for partial years. The Initial Rate shall be subject to increase to twenty percent (20%) automatically after May 10, 2019.

The Series C Preferred Stock shall rank senior to the Common Stock, Series A Preferred Stock, Series B Preferred Stock and to any other equity securities issued by us (the "Junior Securities") as to rights upon liquidation, dissolution or winding-up by us, whether voluntary or involuntary.

Upon any liquidation, dissolution or winding-up by us, whether voluntary or involuntary, the holders of Series C Preferred Stock shall be entitled to receive, in preference to the Junior Securities, an amount of cash equal to the product of (i) sum of (a) the number of shares of Series C Preferred Stock then held by such holder plus, (b) the number of shares of Series C Preferred Stock issuable to such holder in connection with any accrued but unpaid dividends, multiplied by (ii) the Stated Value, of \$33,847.9874 per share, of Series C Preferred Stock ("the Series C Liquidation Amount") and no distribution or payments shall be made in respect of any Junior Securities unless all Series C Liquidation Amounts, if any, are first paid in full.

As a result of the recent sale by Precigen of its equity interest in Oragenics to TS Biotechnology LLC, future dividend payments would be paid to TS Biotechnology.

Series D Non-Voting, Convertible Preferred Stock Financing

On July 17, 2018, we announced the closing of an underwritten public offering (the "Public Offering") of units for gross proceeds of approximately \$13.8 million, which included the full exercise of the underwriter's over-allotment option to purchase additional shares and warrants, prior to deducting underwriting discounts and commissions and offering expenses.

The Public Offering was comprised of Class A Units, priced at a public offering price of \$1.00 per unit, with each unit consisting of one share of common stock and a seven-year warrant to purchase one share of common stock with an exercise price of \$1.00 per share, and Class B Units, priced at a public offering price of \$1.00 per unit, with each unit comprised of one share of series D preferred stock, with a par value of \$0.001 per share, (the "Series D Preferred Stock"), which is convertible into one share of common stock, and a warrant. The conversion price of the Series D Preferred Stock issued in the transaction as well as the exercise price of the warrants are fixed and do not contain any variable pricing features or any price based anti-dilutive features. The Series D Preferred Stock issued in this transaction included a beneficial ownership blocker but has no dividend rights (except to the extent that dividends are also paid on the common stock), liquidation preference or other preferences over common stock, and, with certain exceptions, has no voting rights. The securities comprising the units were immediately separable and were issued separately.

The conversion price of the Series D Preferred Stock and exercise price of the warrants is subject to appropriate adjustment in the event of recapitalization events, stock dividends, dilutive issuances, stock splits, stock combinations, reclassifications, reorganizations or similar events affecting the Company's common stock.

A total of 4,436,000 shares of common stock, 9,364,000 shares of Series D Preferred Stock convertible into 9,364,000 shares of common stock, and total warrants to purchase 13,800,000 shares of common stock were issued in the Public Offering inclusive of the underwriters exercise of their over-allotment option to purchase 1,800,000 shares of common stock and warrants to purchase 1,800,000 shares of common stock at the Public Offering price per share less the underwriting discounts and commissions.

The net proceeds to the Company from the Public Offering, after deducting Underwriter fees and expenses and the Company's estimated Public Offering expenses was approximately \$12.4 million. The Company anticipates using the net proceeds from this Public Offering to continue funding development of AG013, our ongoing Phase 2 clinical trial for the treatment of Oral Mucositis, our pre-clinical development of our antibiotics program and for general corporate purposes, including research and development activities, capital expenditures and working capital.

In connection with the Public Offering, the Company filed a Certificate of Designation of Preferences, Rights and Limitations of the Series D Preferred Stock on July 13, 2018, with the Secretary of State of the State of Florida which became effective upon filing. The Certificate of Designation provides for the issuance of the shares of Series D Preferred Stock. With certain exceptions, the shares of Series D Preferred Stock rank on par with the shares of the Common Stock, in each case, as to dividend rights and distributions of assets upon liquidation, dissolution or winding up of the Company.

With certain exceptions, as described in the Certificate of Designation, the shares of Series D Preferred Stock have no voting rights. However, as long as any shares of Series D Preferred Stock remain outstanding, the Certificate of Designation provides that the Company shall not, without the affirmative vote of holders of a majority of the then outstanding shares of Series D Preferred Stock, (a) alter or change adversely the powers, preferences or rights given to the Preferred Stock or alter or amend this Certificate of Designation, (b) amend its certificate of incorporation or other charter documents in any manner that adversely affects any rights of the Holders, (c) increase the number of authorized shares of Preferred Stock, or (d) enter into any agreement with respect to any of the foregoing.

Each share of Series D Preferred Stock is convertible at any time at the holder's option into a number of shares of Common Stock equal to one share divided by the Conversion Price. The "Conversion Price" is initially \$1.00, subject to adjustment for reverse and forward stock splits, stock dividends, stock combinations and other similar transactions as specified in the Certificate of Designation. Notwithstanding the foregoing, the Certificate of Designation further provides that the Company shall not effect any conversion of the shares of Series D Preferred Stock, with certain exceptions, to the extent that, after giving effect to an attempted conversion, the holder of shares of Series D Preferred (together with such holder's affiliates and any persons acting as a group together with such holder or any of such holder's affiliates) would beneficially own a number of shares of Common Stock in excess of 4.99% of the shares of Common Stock then outstanding (or, upon election by a Holder prior to the issuance of the Warrants, 9.99%). At the holder's option, upon notice to the Company, the holder may increase or decrease this beneficial ownership limitation not to exceed 9.99% of the shares of Common Stock then outstanding, with any such increase becoming effective upon 61 days' prior notice to the Company.

Additionally, subject to certain exceptions and limitations, at any time prior to the three year anniversary of the issuance of the Series D Preferred Stock, the Company will have the right to cause each holder of the Series D Preferred Stock to convert all or part of such holder's Series D Preferred Stock in the event that (i) the volume weighted average price of our common stock for each of 30 consecutive trading days exceeds \$3.00 (subject to adjustment for stock splits, recapitalizations, stock dividends and similar transactions), (ii) the average daily trading volume for such measurement period exceeds \$175,000 per trading day and (iii) the holder is not in possession of any information that constitutes or might constitute, material non-public information which was provided by the Company. The description of the Series D Preferred Stock is qualified by reference to the Certificate of Designation filed with our Form 8-K on July 17, 2018.

As of December 31, 2019, 9,364,000 consisting of all outstanding shares of Series D Preferred Stock had converted into shares of common stock in accordance with the terms for conversion.

As of December 31, 2019, there are 26,538,593 warrants, 2,486,365 stock options, 9,417,000 shares of Series A Preferred stock, and 6,600,000 shares of Series B Preferred stock outstanding. If all warrants, stock options, and Preferred shares were exercised (other than on a net issuance basis), the total number of outstanding common shares would be 77,411,464 as of December 31, 2019.

Warrants

The Company's outstanding and exercisable warrants as of December 31, 2019 are presented below:

Exercise Price	Total Warrants Outstanding	Exercisable Warrants Outstanding	Expiration Date
\$ 3.10	48,387	48,387	9/19/2022
\$ 3.10	462,106	462,106	5/10/2024
\$ 3.10	602,414	602,414	7/25/2024
\$ 3.10	1,064,518	1,064,518	11/8/2024
\$ 2.00	900,000	900,000	4/10/2023
\$ 1.00	4,294,500	4,294,500	7/17/2025
\$ 0.75	9,583,334	9,583,334	09/25/2020 *
\$ 0.90	9,583,334	9,583,334	3/25/2024
	<u>26,538,593</u>	<u>26,538,593</u>	

* Subject to termination prior to the indicated date following the Company's release of top-line data related to its Phase 2 double blind, placebo controlled clinical trial of AG013 plus twenty-one (21) trading days.

On March 25, 2019, the Company announced the closing of an underwritten public offering for gross proceeds of approximately \$12.5 million, which included the partial exercise of the underwriter's over-allotment option to purchase additional shares and warrants, prior to deducting underwriting discounts and commissions and offering expenses payable by the Company.

The offering was comprised of 16,666,668 shares of common stock, together with short-term warrants to purchase up to 8,333,334 shares of common stock, and long-term warrants to purchase up to 8,333,334 shares of common stock, at a price to the public of \$0.75. The Company granted the underwriter a 30-day option to purchase up to 2,500,000 additional shares of common stock and/or short-term warrants to purchase 1,250,000 shares of common stock and long-term warrants to purchase 1,250,000 shares of common stock of the Company at the public offering price, less underwriting discounts and commissions. The underwriter exercised its option to purchase the short-term warrants to purchase 1,250,000 shares of common stock and long-term warrants to purchase 1,250,000 shares of common stock effective as of the closing.

Each short-term warrant has an exercise price of \$0.75 per share of common stock, is immediately exercisable, and will expire on the earlier of (1) the eighteen-month anniversary of the date of issuance and (2) twenty-one trading days following the Company's release of top-line data related to its Phase 2 double blind, placebo controlled clinical trial of AG013. Each long-term warrant has an exercise price of \$0.90 per share of common stock, is immediately exercisable and will expire five years following the date of issuance.

On July 17, 2018, the Company announced the closing of an underwritten public offering (the "Public Offering") of Class A Units, priced at a public offering price of \$1.00 per unit, with each unit consisting of one share of common stock and a seven-year warrant to purchase one share of common stock with an exercise price of \$1.00 per share, and Class B Units, priced at a public offering price of \$1.00 per unit, with each unit comprised of one share of series D preferred stock (the "Series D Preferred Stock"), which is convertible into one share of common stock, and a seven-year warrant to purchase one share of common stock with an exercise price of \$1.00 per share. The exercise price of the warrants is fixed and do not contain any variable pricing features or any price based anti-dilutive features. The exercise price of the warrants is subject to appropriate adjustment in the event of recapitalization events, stock dividends, dilutive issuances, stock splits, stock combinations, reclassifications, reorganizations or similar events affecting the Company's common stock. A total of 13,800,000 warrants to purchase 13,800,000 shares of common stock were issued in the Public Offering. As of December 31, 2019, 9,505,500 warrants issued in connection with the Public Offering have been exercised.

On April 6, 2018 (the "Closing Date"), the Company entered into a securities purchase agreement with certain institutional investors for the purchase and sale of 900,000 shares of the Company's common stock in a registered direct offering at a purchase price of \$2.00 per share. The Company also issued unregistered warrants to the investors in a concurrent private placement to purchase up to an equivalent number of shares of the Company's common stock with an exercise price of \$2.00 per share. The warrants were not exercisable until six months following issuance and will expire five years from the date of issuance.

7. Stock Compensation Plan

The Company originally adopted the Oragenics, Inc. 2002 Stock Option and Incentive Plan (the “Stock Incentive Plan”) in September 2002 which was subsequently amended on several occasions until it was amended and restated as the Company’s 2012 Equity Incentive Plan, as amended (the “2012 Incentive Plan”). In May 2017, the 2012 Incentive Plan was amended to increase the available number of shares authorized for issuance under the 2012 Incentive Plan by 1,500,000 shares of common stock from 4,000,000 shares of common stock to 5,500,000 shares of common stock. In December 2017, the 2012 Incentive Plan was amended to increase the available number of shares authorized for issuance under the 2012 Incentive Plan by 2,000,000 shares of common stock from 5,500,000 shares of common stock to 7,500,000 shares of common stock.

On January 8, 2018, the Company announced a reverse split of its common stock, \$0.001 par value, at a ratio of 1 for 10, which became effective January 19, 2018. The reverse split also applied to common stock issuable upon the exercise of the Company’s outstanding stock options.

At the Company’s Annual Meeting of Shareholders held on June 22, 2018, the shareholders approved an amendment to the Company’s 2012 Incentive Plan solely to increase the shares available for awards thereunder by 1,500,000 shares. In addition, at the Company’s Annual Meeting of Shareholders, held on June 20, 2019, the shareholders approved an amendment to the Company’s 2012 Equity Incentive Plan (the “Plan”) solely to increase the common shares available for awards thereunder by an additional 6,000,000 shares and ratified an amendment approved by shareholders at the prior year’s annual meeting to increase the shares available under the Plan by 1,500,000 shares. The aggregate number of shares of the Company’s common stock currently authorized pursuant to its Plan, as amended, is 8,250,000 and the Company’s Plan, as amended continues to provide that the maximum number of shares that may be subject to stock options and stock appreciation rights granted to any individual in a calendar year is 1,000,000 shares. The Plan also provides that the maximum number of shares that may be subject to awards (other than stock options and stock appreciation rights) intended to qualify as “performance-based compensation” under Section 162(m) of the Internal Revenue Code that may be granted to any individual in one calendar year is 1,000,000 shares (however, the exception for “performance-based compensation” under Code Section 162(m) was repealed in the Tax Cuts and Jobs Act of 2017, unless the awards intended to qualify for such exception were granted before November 2, 2017). As of December 31, 2019, an aggregate of 2,486,365 shares of common stock are covered by outstanding option awards and 5,522,885 shares of common stock are available for future awards under the Plan.

The purpose of the 2012 Incentive Plan is to advance the interests of the Company by affording certain employees and directors of the Company and key consultants and advisors an opportunity to acquire or increase their proprietary interests in the Company. The 2012 Incentive Plan authorizes the grant of stock options (incentive and non-statutory), stock appreciation rights and restricted stock. Options are granted at the fair market value of the Company’s stock on the date of grant. Options can generally vest either immediately or over a period of up to three years from their respective grant dates and expire 10 years from the date of grant. As of December 31, 2019, and 2018, the Company had not awarded any stock appreciation rights under the 2012 Incentive Plan.

Recipients of stock awards under our 2012 Incentive Plan become the owner of record of the stock immediately upon grant, which may be subject to certain restrictions. The balance of unvested restricted stock will be forfeited and automatically transferred back to us at no cost upon the termination of the recipient’s employment. Upon vesting of restricted stock that is made to recipients who are employees, the recipient has the option to settle minimum withholding taxes by electing to have us withhold otherwise deliverable shares having a fair market value equal to the required tax obligations (“net-settlement”). The net-settlement shares are then immediately cancelled and retired and reduce the shares available for issuance under the Company’s 2012 Incentive Plan.

The Company uses the Black-Scholes option pricing model to estimate the fair value of stock-based awards on the date of grant. The assumptions employed in the calculation of the fair value of share-based compensation expense were calculated as follows for all years presented:

- Expected dividend yield — based on the Company’s historical dividend yield.
- Expected volatility — based on the Company’s historical market price at consistent points in a period equal to the expected life of the options.
- Risk-free interest rate — based on the US Treasury yield curve in effect at the time of grant.
- Expected life of options — based on the Company’s historical life of options exercised, giving consideration to the contractual terms of the grants, vesting schedules and expectations of future employee behavior.

The following table summarizes the assumptions used to estimate the fair value of stock options granted during the years ended December 31, 2019 and 2018:

	<u>2019</u>	<u>2018</u>
Expected dividend yield	0%	0%
Weighted-average expected volatility	154-158%	161-163%
Weighted-average risk-free interest rate	2.10 - 2.43%	2.90% - 3.06%
Expected life of options	10 years	10 Years

Total compensation cost related to stock options was \$552,996 and \$996,038 for the years ended December 31, 2019 and 2018, respectively. As of December 31, 2019, there was \$168,697 of unrecognized compensation costs related to stock options, which is expected to be recognized over a weighted average period of less than one year.

The following table represents stock option activity for the year ended December 31, 2019:

	<u>Number of Options</u>	<u>Weighted Average Exercise Price</u>	<u>Weighted Average Contractual Term (In Years)</u>	<u>Aggregate Intrinsic Value</u>
Outstanding at December 31, 2018	1,812,133	\$ 1.89	9.37	\$ 185,250
Forfeited	(1,928)	54.00		
Granted	<u>676,160</u>	0.49		
Outstanding at December 31, 2019	<u>2,486,365</u>	\$ 1.47	8.67	\$ 22,229
Exercisable at December 31, 2019	1,798,419	\$ 1.77	8.51	\$ 11,114

The following table summarizes the weighted average grant date fair value of stock options granted per share, the total intrinsic value of stock options exercised and the grant date fair value of stock options that vested during the years ended December 31, 2019 and 2018:

	<u>2019</u>	<u>2018</u>
Weighted average grant date fair value of stock options granted per share	\$ 0.49	\$ 0.79
Intrinsic value of stock options exercised	—	—
Grant date fair value of stock options that vested	\$ 522,361	\$ 1,290,860

8. Exclusive Channel Collaboration Agreements (“ECC”)

The Company has the following Exclusive Channel Collaboration agreements (“ECCs”):

The Lantibiotic ECC

On June 5, 2012, the Company entered into the Lantibiotic ECC with Precigen, Inc. (“Precigen”) (formerly known as Intrexon) that governs a “channel collaboration” arrangement in which the Company will use Precigen’s advanced transgene and cell engineering platforms for the development and production of lantibiotics, a class of peptide antibiotics that are naturally produced in Gram-positive bacteria and contain the characteristic polycyclic thioether amino acids lanthionine and methylanthionine (collectively, the “Lantibiotics Program”). The Lantibiotic ECC grants the Company an exclusive worldwide license to use patents and other intellectual property of Precigen in connection with the research, development, use, importing, exporting, manufacture, sale, and offer for sale of drug products involving the direct administration to humans or companion animals of a lantibiotic for the prevention or treatment of infectious disease (“Oragenics Products”). Such license is exclusive with respect to any clinical development, selling, offering for sale or other commercialization of Oragenics Products, and otherwise is non-exclusive. Subject to limited exceptions, the Company may not sublicense the rights described without Precigen’s written consent. The Lantibiotic ECC establishes committees comprised of Company and Precigen representatives that will govern activities related to the Lantibiotics Program in the areas of project establishment, chemistry, manufacturing and controls matters, clinical and regulatory matters, commercialization efforts and intellectual property matters. The Company has agreed to indemnify and hold Precigen harmless from any damages caused as a result of (i) our negligence or willful misconduct, (ii) the use, handling, storage, or transport of Precigen Materials (as defined in the Lantibiotic ECC), (iii) our breach of a material representation, warranty or covenant in the Lantibiotic ECC, or (iv) the design, development, manufacture, regulatory approval, handling, storage, transport, distribution, sale or other disposition of any Oragenics Product.

Precigen may terminate the Lantibiotic ECC if we fail to use diligent efforts to develop and commercialize Oragenics Products or if we elect not to pursue the development of a Lantibiotics Program identified by Precigen that is a “Superior Therapy” as defined in the Lantibiotic ECC. We may voluntarily terminate the Lantibiotic ECC at any time upon 90 days written notice to Precigen. Upon termination of the Lantibiotic ECC, the Company may continue to develop and commercialize any Oragenics Product that has been, at the time of termination:

- commercialized by the Company;
- approved by regulatory authorities;
- a subject of an application for regulatory approval that is pending before the applicable regulatory authority; or
- the subject of at least an ongoing Phase 1, Phase 2 or Phase 3 clinical trial in the Field (in the case of a termination by Precigen due to an uncured material breach by the Company or a voluntary termination by the Company).

The Company has ongoing obligations and commitments with respect to the Lantibiotic ECC. See Note 11 — Commitments and Contingencies and See Note 13 — Subsequent Events.

The Oral Mucositis ECC

On June 9, 2015, the Company entered into an the Oral Mucositis ECC with Precigen and Precigen Actobiotics NV (formerly known as “Intrexon Actobiotics NV”) (“Actobiotics”), a wholly-owned subsidiary of Precigen, through which the Company intends to research, develop and commercialize products, including the continued development and commercialization of AG013, for use in the treatment of oral mucositis in humans through the administration of an effector via genetically modified bacteria, but, in any case, excluding the delivery of anti-cancer effectors for the purpose of treatment or prophylaxis of cancer (collectively, the “Program”). Contemporaneously with the Oral Mucositis ECC, the Company and Precigen also entered into a Stock Issuance Agreement (the “SIA”) which authorized the issuance of the Technology Access Fee and the future stock issuance of our Common Stock to Precigen upon the achievement of designated milestones. The ECC governs the “channel collaboration” arrangement in which we will use Precigen’s proprietary technology relating to the identification, design and production of genetically modified bacteria (the “Technology”) for the purpose of developing the Program. The Oral Mucositis ECC provides for the establishment of committees comprised from us and Precigen representatives that will govern activities in the areas of project establishment, chemistry, manufacturing and controls, clinical and regulatory matters, commercialization efforts, and intellectual property. The Company has agreed to indemnify and hold Precigen harmless from any damages caused as a result of (i) our negligence or willful misconduct, (ii) the use, handling, storage, or transport of Precigen Materials (as defined in the Oral Mucositis ECC) or materials that are Actobiotics IP (as defined in the Oral Mucositis ECC), (iii) our breach of a material representation, warranty or covenant in the Oral Mucositis ECC, or (iv) the design, development, manufacture, regulatory approval, handling, storage, transport, distribution, sale or other disposition of any Oragenics Product.

The Oral Mucositis ECC grants the Company an exclusive worldwide license to utilize Precigen’s and Actobiotics’ intellectual property to develop and commercialize products, including the continued development and commercialization of AG013, for use in the treatment of oral mucositis in humans through the administration of an effector via genetically modified bacteria, but, in any case, excluding the delivery of anti-cancer effectors for the purpose of treatment or prophylaxis of cancer (the “Field”). It also grants us an exclusive license in the Field under all Information Controlled by Actobiotics (or otherwise by Precigen) and existing as of the Effective Date relating to the regulatory approval of AG013, including regulatory filings, data, clinical trial reports, and rights thereunder. Under the Oral Mucositis ECC, and subject to certain exceptions, we are responsible for, among other things, funding the further anticipated development of products toward the goal of commercialization, conducting preclinical and clinical development of candidate products, as well as for other aspects of manufacturing and the commercialization of the product(s).

The Company may voluntarily terminate the Oral Mucositis ECC upon 90 days written notice to Precigen. Precigen may also terminate the Oral Mucositis ECC if the Company breaches and fails to cure the breach within 60 days or the Company does not pursue development of the Superior Therapy identified by Precigen that is a “Superior Therapy” as defined in the Oral Mucositis ECC. Upon termination of the Oral Mucositis ECC, the Company may continue to develop and commercialize any Company Product that, at the time of termination that satisfies at least one of the following criteria:

- (i) the particular Orogenics Product is being sold by the Company triggering profit sharing payments under the Oral Mucositis ECC to Precigen;
- (ii) the particular Orogenics Product has received regulatory approval;
- (iii) the particular Orogenics Product is a subject of an application for regulatory approval in the Field covered by the Oral Mucositis ECC that is pending before the applicable regulatory authority;
- (iv) the particular Orogenics Product is AG013, and such Orogenics Product has been the subject of at least one completed Phase 2 clinical trial (as such is defined by relevant FDA guidelines) during the Term; or
- (v) the particular Orogenics Product other than AG013 and such Orogenics Product is the subject of at least an ongoing Phase 1, Phase 2 or Phase 3 clinical trial in the Field.

Among other things, Precigen is responsible for technology discovery efforts, cell-engineering development, and certain aspects of the manufacturing process. See Note 11 — Commitments and Contingencies.

9. Retirement Plan

The Company has a defined contribution Simple Individual Retirement Arrangement plan, which covers all employees and provides for a Company match of up to 3% of all employee compensation to the plan. Total matching contributions made by the Company for the years ended December 31, 2019 and 2018 were \$36,074 and \$29,946, respectively.

10. Income Taxes

The components of the provision for income taxes for the years ended December 31, 2019 and 2018 are as follows:

	<u>2019</u>	<u>2018</u>
Current	\$ —	\$ —
Deferred	3,873,976	2,492,392
Valuation Allowance	<u>(3,873,976)</u>	<u>(2,492,392)</u>
Total provision for income taxes	<u>\$ —</u>	<u>\$ —</u>

At December 31, 2019 and 2018, the Company had temporary differences between the carrying amounts of assets and liabilities for financial reporting purposes and their respective income tax bases, as measured by enacted state and federal tax rates, as follows:

	<u>2019</u>	<u>2018</u>
Deferred tax assets (liabilities):		
Net operating loss carryforward	\$ 29,424,801	\$ 25,628,753
Accrued vacation	35,933	30,051
Non-qualified stock compensation	638,413	566,367
Restricted stock	(808)	(808)
Total deferred tax assets, net	<u>30,098,339</u>	<u>26,224,363</u>
Less valuation allowance	<u>(30,098,339)</u>	<u>(26,224,363)</u>
Total net deferred taxes	<u>\$ —</u>	<u>\$ —</u>

The following is a reconciliation of tax computed at the statutory federal rate to the income tax benefit in the statements of operations for the years ended December 31, 2019 and 2018:

	<u>2019</u>	<u>2018</u>
Income tax benefit computed at statutory federal rate of 21% and 21%, respectively	\$ (3,268,861)	\$ (2,081,970)
State income tax benefits, net of federal expense (benefit)	(676,343)	(430,770)
Change in valuation allowance	3,873,976	2,492,392
Non-deductible expenses	3,065	121,487
Other	68,163	(101,139)
Total	<u>\$ —</u>	<u>\$ —</u>

In assessing the realizability of deferred tax assets, management considers whether it is more likely than not that some portion or all of the deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent upon the generation of future taxable income during the periods in which those temporary differences become deductible. Management considers the scheduled reversal of deferred tax liabilities, projected future taxable income, and tax planning strategies in making this assessment. Based upon the levels of historical taxable income and projections of future taxable income over which the deferred tax assets are deductible, the Company believes that it is more likely than not that it will not be able to realize the benefits of some of these deductible differences.

On December 22, 2017, the Jobs Act was enacted, which reforms corporate tax legislation in the United States and related laws. Any change in the Company's reasonable estimates of the impact of the Jobs Act will be included in the reporting period in which the change is identified in accordance with SAB Topic 5 EE.

Accordingly, a valuation allowance of \$30,098,339 and \$26,224,363 has been provided in the accompanying financial statements as of December 31, 2019 and 2018, respectively. The 2019 net change in valuation allowance related to deferred tax assets was an increase of \$3,796,048 primarily relating to net operating loss carryforwards. The 2018 net change in valuation allowance related to deferred tax assets was a decrease of \$10,055,163 primarily relating to net operating loss carryforwards and a change in the effective tax rate.

At December 31, 2019, the Company has federal and state tax net operating loss carryforwards of approximately \$117,964,000. Federal and state tax net operating loss carryforwards generated prior to December 31, 2017 will expire through 2037. Federal tax net operating loss carryforwards generated subsequent to December 31, 2017, do not expire but are subject to a limitation of 80% of federal taxable income. The state tax loss carryforward generated subsequent to December 31, 2017, will expire through 2039, unless previously utilized. The Company also has federal research and development tax credit carryforwards of approximately \$2,805,000. The federal tax credit carryforward will expire through 2039, unless previously utilized.

Utilization of net operating loss carryforwards and research and development credit carryforwards may be subject to a substantial annual limitation due to ownership change limitations that may have occurred or, could occur in the future in accordance with Section 382 of the Internal Revenue Code of 1986 (“IRC Section 382”) and with Section 383 of the Internal Revenue Code of 1986, as well as similar state provisions. These ownership changes may limit the amount of net operating loss carryforwards and research and development credit carryforwards that can be utilized annually to offset future taxable income and taxes, respectively. In general, an ownership change, as defined by IRC Section 382, results from transactions increasing the ownership of certain stockholders or public groups in the stock of a corporation by more than 50 percentage points over a three-year period. The Company has completed several financings since its inception which may result in a change in ownership as defined by IRC Section 382, or could result in a change in control in the future.

For the years ended December 31, 2019 and 2018, the Company incurred \$503,944 and \$285,127, respectively, of additional unrecognized tax benefits that related to research and development credits. The entire amount of this unrecognized tax benefit, if recognized, would result in an increase to the deferred tax asset valuation allowance, and would not have an impact on the effective tax rate.

The Company files its income tax returns in the U.S. federal jurisdiction and in Florida. With few exceptions, the Company is no longer subject to federal or state income tax examinations by tax authorities for years before 2014.

A reconciliation of the beginning and ending amount of unrecognized tax benefits is as follows:

Balance as of December 31, 2017	\$ 2,015,650
Additions based on tax positions related to the current year	233,944
Additions for the tax positions of prior years	—
Reductions for the tax positions of prior years	—
Balance as of December 31, 2018	\$ 2,249,594
Additions based on tax positions related to the current year	503,944
Additions for return-to-provision true-up	51,183
Reductions for the tax positions of prior years	—
Balance as of December 31, 2019	<u>\$ 2,804,721</u>

Included in the balance at December 31, 2019 and 2018, are \$2,804,721 and \$2,249,594, respectively, of tax positions for which there is uncertainty about the validity of certain credits. The disallowance of the credits would impact the amount of gross deferred tax assets reflected in the accompanying footnotes.

During the years 2019 and 2018 the Company did not recognize any interest and penalties. Due to the potential offset of the Company’s operating loss carryforward for any future activity, the amount attributed to interest and penalties would be immaterial.

11. Commitments and Contingencies

The Lantibiotic ECC

Under the Lantibiotic ECC, and subject to certain exceptions, the Company is responsible for, among other things, funding the further anticipated development of lantibiotics toward the goal of commercialization, conducting nonclinical and clinical development of candidate lantibiotics, as well as for other aspects of manufacturing and the commercialization of the product(s). Among other things, Precigen is responsible for technology discovery efforts, cell-engineering development, certain aspects of the manufacturing process, and costs of filing, prosecution and maintenance of Precigen’s patents.

In November of 2017 the Lantibiotic ECC was amended to: (i) consolidate the development milestone payments into one payment of \$25,000,000, being due six months after receiving FDA approval of a New Drug Application, (ii) reduce the sublicense revenue percentage we would have had to pay from 50% to 25% of sublicensing revenue, (iii) reduce the royalty rate from 25% of Product Profit to 10% of Net Sales, (iv) revise the form of milestone payments from being share based or cash at the Company’s election to only cash, and (v) commit that Diligent Efforts (as defined in the Lantibiotic ECC) in pursuing the Lantibiotic Program would be deemed satisfied in 2018 provided that at least \$1,200,000 was expended for the advancement of the Lantibiotic Program.

In November of 2017, the Stock Issuance Agreement was also amended. Under the terms of the amendment, the Company has agreed to make certain payments, in cash, to Precigen upon our achievement of designated milestones. The milestone events and amounts payable are as follows:

- (i) a one-time payment of twenty-five million United States dollars (\$25,000,000) within six (6) months of the achievement of the Regulatory Approval Milestone Event meaning receiving approval from the FDA of a New Product Application for an Oragenics Product (or equivalent regulatory action in a foreign jurisdiction);

- (ii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Indication Milestone Event meaning receiving approval from the FDA of a Supplemental FDA Application (or an equivalent filing with another equivalent regulatory agency) which Supplemental FDA Application sought approval of an indication for use of the Orogenics Product other than the current regulatory-approved indication; and
- (iii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Product Milestone Event meaning receiving approval from the FDA of a New Product Application that is deemed to be a different drug product that the first Orogenics Product that was clinically pursued under the Lantibiotics Program.

Pursuant to the terms of the amendment, we will also pay Precigen on a quarterly basis 10% of Net Sales derived in that quarter from the sale of products developed from the Lantibiotic ECC, calculated on an Orogenics Product-by-Orogenics Product basis and we will pay Precigen on a quarterly basis 25% of revenue obtained in that quarter from a sublicensor in the event of a sublicensing arrangement.

On July 21, 2016, the Lantibiotics ECC was amended to revise the definition of Field in view of a provisional patent application filing between Precigen and Orogenics and to further clarify Orogenics' rights under the Lantibiotic ECC to genetically modified *Streptococcus mutans* that express Lantibiotic(s).

During the year ended December 31, 2019, we paid cash of \$2,250, and during the year ended December 31, 2018, we paid cash of \$-0-, to Precigen under the Lantibiotic ECC.

None of the Lantibiotic ECC milestones had been achieved as of December 31, 2019.

The Oral Mucositis ECC

Under the Oral Mucositis ECC, and subject to certain exceptions, the Company is responsible for, among other things, funding the further anticipated development of products toward the goal of commercialization, conducting preclinical and clinical development of candidate products, as well as for other aspects of manufacturing and the commercialization of the product(s). Among other things, Precigen is responsible for technology discovery efforts, cell-engineering development, and certain aspects of the manufacturing process.

In November of 2017 the Company amended the Oral Mucositis ECC to: (i) consolidate the development milestone payments into one payment of \$27,500,000 being due within six months after receiving FDA approval of a New Product Application; (ii) reduce the sublicense revenue percentage from 50% to 25% of sublicensing revenue; and (iii) revise the field in which the Company has exclusive rights to its Oral Mucositis product candidate for the treatment of Oral Mucositis to clarify that the Company has an exclusive for the treatment of Oral Mucositis in humans regardless of etiology.

Pursuant to the terms of the Oral Mucositis ECC, as amended, we are obligated to pay Precigen on a quarterly basis 12% of the net sales derived from the sale of products developed from the exclusive channel collaboration. We are also obligated to pay Precigen on a quarterly basis, 25% of revenue obtained in that quarter from a sublicensor in the event of a sublicensing arrangement.

In November of 2017, the Stock Issuance Agreement and Oral Mucositis ECC were amended. Under the terms of the amendment, the Company has agreed to make certain payments to Precigen upon our achievement of designated milestones in the form of shares of our Common Stock (based upon the fair market value of the shares otherwise required to be issued) unless the issuance of such shares would reasonably likely cause Precigen to consolidate our financial statements with Precigen's financial statements, or at our option make a cash payment to Precigen. The milestone events and amounts payable are as follows:

- (i) a one-time payment of twenty-seven million five hundred thousand United States dollars (\$27,500,000) within six (6) months of the achievement of the Regulatory Approval Milestone Event meaning receiving approval from the FDA of a New Product Application for an Orogenics Product (or equivalent regulatory action in a foreign jurisdiction);
- (ii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Indication Milestone Event meaning receiving approval from the FDA of a Supplemental FDA Application (or an equivalent filing with another equivalent regulatory agency) which Supplemental FDA Application sought approval of an indication for use of the Orogenics Product other than the current regulatory-approved indication; and
- (iii) a one-time payment of five million United States dollars (\$5,000,000) within six (6) months of the achievement of the New Product Milestone Event meaning receiving approval from the FDA of a New Product Application that is deemed to be a different drug product that the first Orogenics Product that was clinically pursued under the Program.

During the year ended December 31, 2019, we paid cash of \$380,900, and during the year ended December 31, 2018, we paid cash of \$460,056, to Precigen under the Oral Mucositis ECC.

None of the Oral Mucositis ECC milestones had been achieved as of December 31, 2019.

The Oral Mucositis ECC provides that in the event (i) Oragenics is required to make a milestone payment in cash as an issuance of shares would cause Precigen to consolidate the Company's financial statements with Precigen's financial statements, and (ii) Oragenics reasonably concludes that a cash milestone payment would have an adverse effect on its working capital needs over the next twelve (12) months, then such cash payment shall be in the form of an interest bearing promissory note with a maturity date of less than twelve (12) months and include other conventional market terms that would not be expected to unreasonably have an adverse effect on Oragenics working capital needs over such twelve (12) month period.

Leases

Lab Facility-Alachua. The Company's Alachua facility is being leased from a real estate developer for a term of five years beginning in December 2014. Under the lease agreement, the rental payments range from \$9,641 per month to \$10,851 per month. In June of 2019, the Company entered into an amendment for the Alachua facility for a term of five years beginning in December of 2019. Under the amended lease agreement, the rental payments range from \$12,870 per month to \$13,338 per month. Total rental expense for the Alachua facility during the year ended December 31, 2019 was approximately \$154,000. The lease may be terminated prior to its stated expiration date upon the payment of nine-months rent.

Corporate Office-Tampa. In November of 2016, the Company entered into an amendment for the leased office space for corporate personnel located in Tampa, FL. The amended lease is for approximately 2,207 square feet. The lease period for the office space is for thirty-six months commencing on March 1, 2017. Lease payments range from \$4,138 per month to \$4,392 per month inclusive of insurance, taxes and utilities. The lease expires on February 29, 2020. In November of 2019, the Company entered into an amendment for the Tampa facility for a term of three years beginning in March of 2020. Under the amended lease agreement, the rental payments range from \$4,524 per month to \$4,800 per month. Total rent expense under this lease was approximately \$64,000 for the year ended December 31, 2019.

Supplemental balance sheet information related to leases is as follows:

	December 31, 2019
Operating lease right-of-use assets	\$ 822,684
Operating lease liabilities - Short term	\$ 165,096
Operating lease liabilities - Long term	670,690
Total operating lease liabilities	\$ 835,786
Weighted Average Remaining Lease Term In Years	
Operating leases	4.46
Weighted Average Discount Rate	
Operating leases	5.70%

Maturities of operating lease liabilities are as follows:

Year ended December 31:	
2020	208,467
2021	210,561
2022	217,379
2023	169,657
2024	146,718
Total	\$ 952,782
Less: Imputed interest	(116,996)
Present value of lease liabilities	\$ 835,786

The cost component of operating leases is as follows:

	For the Twelve Months Ended December 31, 2019	
Operating lease cost	\$	214,359
Short-term lease cost		3,989
Total lease cost	\$	<u>218,348</u>

Supplemental cash flow information related to operating leases is as follows:

	For the Twelve Months Ended December 31, 2019	
Cash paid for amounts included in the measurement of lease liabilities:		
Operating cash flows from operating leases	\$	(201,256)
Non-cash investing and financing activities:		
Additions to ROU assets obtained from:		
Right-of-use assets obtained in exchange for new operating lease liabilities	\$	176,027
Right-of-use assets and lease liabilities obtained from lease modifications	\$	815,937

12. Unaudited Quarterly Financial Information

The quarterly interim financial information shown below has been prepared by the Company's management and is unaudited. It should be read in conjunction with the audited financial statements appearing herein.

	2019			
	First	Second	Third	Fourth
Revenues	\$ —	\$ —	\$ —	\$ —
Total operating expenses	3,394,210	4,904,854	3,920,453	3,658,053
Net Loss	(3,325,717)	(4,806,460)	(3,836,549)	(3,597,278)
Net Loss applicable to common shareholders	(3,325,717)	(4,806,460)	(3,836,549)	(3,597,278)
Loss per share:				
Basic and diluted net loss per share from continuing operations	\$ (0.11)	\$ (0.10)	\$ (0.08)	\$ (0.08)
	2018			
	First	Second	Third	Fourth
Revenues	\$ —	\$ —	\$ —	\$ —
Total operating expenses	2,121,704	2,283,549	2,764,341	2,824,546
Net Loss	(2,119,397)	(2,281,289)	(2,757,835)	(2,755,620)
Net Loss applicable to common shareholders	(2,119,397)	(2,281,289)	(4,169,876)	(2,755,620)
Loss per share:				
Basic and diluted net loss per share from continuing operations	\$ (0.42)	\$ (0.38)	\$ (0.35)	\$ (0.09)

13. Subsequent Events

In January 2020, Precigen (formerly Intrexon Corporation) consummated a reorganization of its ongoing API fermentation operations and assets into ILH Holdings, Inc. which at the time was an affiliate of Precigen. In connection with the reorganization, Precigen assigned the Lantibiotic ECC and related stock issuance agreements to ILH Holdings. Following such reorganization, Precigen divested certain of its assets to TS Biotechnology Holdings, LLC which included ILH Holdings and shares of Oragenics securities held by Precigen. On January 27, 2020 we paid a dividend on our Series C Preferred Stock to Precigen of 19.542 shares of additional Series C Preferred Stock. As a result of the recent divestiture by Precigen of its equity interest in Oragenics to TS Biotechnology LLC, future dividend payments would be paid to TS Biotechnology.

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

Oragenics, Inc. ("Oragenics," "we," "our," or "us") has one class of securities registered under Section 12 of the Securities Exchange Act of 1934, as amended: our common stock.

DESCRIPTION OF CAPITAL STOCK

The following descriptions are summaries of the material terms that are included in our amended and restated articles of incorporation (as amended) and our bylaws (as amended) as well as the specific agreements such descriptions relate to. This summary is qualified in its entirety by the specific terms and provisions contained in our restated articles of incorporation, bylaws and the specific agreements described herein, copies of which we have filed as exhibits to our Annual Report on Form 10-K and are incorporated herein by reference.

Overview

Authorized Capital Stock

Our authorized capital stock consists of 200,000,000 shares of common stock, par value \$0.001, and 50,000,000 shares of preferred stock, without par value.

Listing

Our common stock is listed and principally traded on the NYSE American under the symbol "OGEN."

Common Stock

Voting

The holders of our common stock are entitled to one vote for each share held of record on all matters submitted to a vote of the shareholders. Approval of an amendment of our articles of incorporation, a merger, a share exchange, a sale of all our property or dissolution must be approved by a majority of all votes entitled to be cast. Such votes may be cast in person or by proxy as provided in Article I Section 8 of our bylaws.

Dividends

Subject to preferences that may be applicable to any outstanding preferred stock, the holders of our common stock are entitled to receive ratably all dividends, if any, as may be declared from time to time by our Board of Directors out of the funds legally available.

In the event of the liquidation, dissolution or winding up of the Company, the holders of our common stock are entitled to share ratably in all assets remaining after payment of liabilities, subject to prior distribution rights of preferred stock, if any, then outstanding. The common stock has no preemptive or conversion rights. There are no redemption or sinking fund provisions applicable to the common stock. All outstanding shares of common stock are fully paid and non-assessable.

Rights upon Liquidation

Upon our liquidation, dissolution or winding-up, after payment in full of our liabilities and the amounts required to be paid to holders of any outstanding shares of preferred stock, if any, all holders of our common stock, along with the holders of our Series A Convertible Preferred Stock and Series B Convertible Preferred Stock on an "as if" converted basis, will be entitled to receive a pro rata distribution of all of our assets and funds legally available for distribution.

Redemption and Pre-Emptive Rights

No shares of our common stock are subject to redemption or have preemptive rights to purchase additional shares of our common stock or any of our other securities except for the Equity Participation Right described below.

Fully Paid and Non-assessable

All of our outstanding shares of common stock are fully paid and non-assessable.

Preferred Stock

Our Board of Directors has the authority, without action by our shareholders, to designate and issue up to 50,000,000 shares of preferred stock in one or more series or classes and to designate the rights, preferences and privileges of each series or class, which may be greater than the rights of our common stock. These rights, preferences and privileges could include dividend rights, conversion rights, voting rights, redemption rights, liquidation preferences, the number of shares constituting any class or series and the designation of the class or series. Terms selected by our Board Of Directors in the future could decrease the amount of earnings and assets available for distribution to holders of shares of common stock or adversely affect the rights and powers, including voting rights, of the holders of shares of common stock without any further vote or action by the stockholders. As a result, the rights of holders of our common stock will be subject to, and may be adversely affected by, the rights of the holders of the Series A Convertible Preferred Stock, Series B Convertible Preferred Stock, and Series C Non-Convertible Preferred Stock or any other preferred stock that may be issued by us in the future, which could have the effect of decreasing the market price of our common stock.

Transfer Agent and Registrar

The transfer agent and registrar of our common stock is Continental Stock Transfer & Trust Company, 17 Battery Place, New York, New York 10004, telephone: (212) 509-4000.

Certain Anti-Takeover Provisions

Florida Law

We are not subject to the statutory anti-takeover provisions under Florida law because in our articles of incorporation we have specifically elected to opt out of both the “control-share acquisitions” (F.S. 607.0902) and the “affiliated transactions” (F.S. 607.0901) statutes. Since these anti-takeover statutes do not apply to a corporation that has specifically elected to opt out of such provisions, we would not be able to invoke the protection of such statutes in the event of a hostile takeover attempt.

Articles of Incorporation and Bylaw Provisions

Our articles of incorporation and bylaws contain provisions that could have an anti-takeover effect. These provisions include

- authorization of the issuance of “blank check” preferred stock that could be issued by our Board of Directors without shareholder approval and that may be substantially dilutive or contain preferences or rights objectionable to an acquiror;
 - the ability of the Board of Directors to amend the bylaws without shareholder approval;
 - vacancies on our Board may only be filled by the remaining Directors and not our shareholders; and
 - requirements that only our Board, our President or holders of more than 10% of our shares can call a special meeting of shareholders.
-

These provisions in our articles of incorporation and bylaws could delay or discourage transactions involving an actual or potential change in control of us, including transactions in which shareholders might otherwise receive a premium for their shares over their current prices. Such provisions could also limit the ability of shareholders to approve transactions that shareholders may deem to be in their best interests and could adversely affect the price of our common stock.

Equity Participation Right-ILH Holdings

Pursuant to the stock issuance agreement with ILH Holdings, Inc. (assignee of Precigen Inc. f/k/a Intrexon Corporation “ILH Holdings”) is entitled, at its election, to participate in future securities offerings by us that constitute “qualified financings” and purchase securities equal to 30% of the number of shares of common stock or other securities sold in such offering (exclusive of Intrexon’s purchase). For this purpose, a “qualified financing” means a sale of common stock or equity securities convertible into common stock in a public or private offering, raising gross proceeds of at least \$1,000,000, where the sale of shares is either registered under the Securities Act of 1933, as amended, at the time of issuance or we agree to register the resale of such shares. Such participation rights were waived with respect to the July 2012, June 2016, May 2017 and November 2017, April 2018 and July 2018 Private Placements and did not elect to participate in the March 2019 offering.

Registration Rights

ILH Holdings (assignee of Precigen Inc. f/k/a Intrexon Corporation). Pursuant to the Stock Issuance Agreement with Precigen dated June 5, 2012, assigned to ILH Holdings, we granted certain registration rights to ILH Holdings. The registration rights consisted of “piggyback registration” rights which permit Precigen to participate in any firm commitment underwritten offering of securities by us, subject to underwriter cutbacks and lockups. In addition, we are precluded from granting registration rights in connection with a private placement unless (i) all shares held by ILH Holdings are, at the time of such private placement, included on a registration statement, or (ii) we agree, in connection with such private placement, to grant ILH Holdings the right to include on the registration statement a number of ILH Holdings’ Company shares equal to one half of the number of shares to be registered on behalf of the other holders or prospective holders. Such rights were waived in connection with the Company’s July 2012, June 2016, May 2017 and November 2017 Private Placements and the March 2019 Public Offering.

Precigen ActoBio Inc. f/k/a ActoBio Therapeutics, Inc. (as assignee of Precigen, Inc. f/k/a Intrexon Corporation) Pursuant to the stock issuance agreement with Precigen dated June 9, 2015, assigned to ActoBio Therapeutics, Inc. k/n/a Precigen ActoBio, Inc., we granted certain registration rights to Precigen ActoBio. The registration rights consisted of “piggyback registration” rights which permit Precigen ActoBio to participate in any firm commitment underwritten offering of securities by us, subject to underwriter cutbacks and lockups. In addition, we are precluded from granting registration rights in connection with a private placement unless (i) all shares held by Precigen ActoBio are, at the time of such private placement, included on a registration statement, or (ii) we agree, in connection with such private placement, to grant Precigen ActoBio the right to include on the registration statement a number of Precigen ActoBio Company shares equal to one half of the number of shares to be registered on behalf of the other holders or prospective holders. Such rights were waived in connection with the Company’s July 2012, June 2016, May 2017 and November 2017 Private Placements and the March 2019 Public Offering.

Series A Preferred Stock Private Placement. Pursuant to the May 10, 2017 Registration Rights Agreement, we granted certain demand registration rights and piggyback registration rights with respect to the shares of our Common Stock issuable upon conversion of the Series A Preferred Stock and the exercise of the common stock warrants that were issued commensurate with the issuance of the Series A Preferred Stock.

Series B Preferred Stock Private Placement. Pursuant to the November 8, 2017 Amended and Restated Registration Right Agreement, we granted certain demand registration rights and piggyback registration rights with respect to the shares of our Common Stock issuable upon conversion of the Series B Preferred Stock and the exercise of the common stock warrants that were issued commensurate with the issuance of the Series B Preferred Stock.. The Amended and Restated Registration Rights Agreement amended the previous registration rights agreement entered into in connection with our Series A Preferred Stock Financing in May 2017.

Intrexon

20374 Seneca Meadows Pkwy
Germantown, MD 20376
(+1) 301 556 9900
dna.com

Better DNA

December 23, 2019

Oragenics, Inc.
4902 Eisenhower Blvd., Suite 125
Tampa, FL 33634
Attention: Chief Executive Officer

Re: Letter providing Notice of Assignment (“Notice”) regarding the Stock Issuance Agreement and the Exclusive Channel Collaboration Agreement (as amended), each dated 6/5/2012 (collectively, the “Agreement(s)”) by and between Oragenics, Inc. and Intrexon Corporation (“Intrexon”)

Dear Sir or Madam:

Intrexon has recently executed an agreement to sell several of its business units, including its API fermentation business, in a transaction expected to close in early 2020 (the “Transaction”). For details regarding the Transaction, see the press release located on Intrexon’s website at <https://investors.dna.com/press>. In preparation for the Transaction closing, Intrexon has reorganized the entirety of its ongoing API fermentation operations and assets into ILH Holdings, Inc., a Delaware company and affiliate of Intrexon. ILH Holdings, Inc. is assuming all of Intrexon’s business relating to the above referenced Agreement(s), and therefore this Notice is provided pursuant to the Agreement(s) to notify you of Intrexon’s intent to assign the entirety of the Agreement(s) to ILH Holdings, Inc. effective Jan. 1, 2020. This reorganization will not negatively impact the Agreement(s), and ILH Holdings, Inc. agrees to comply with all obligations under the assigned Agreement(s). The Notice address for ILH Holdings, Inc. under the Agreement(s) will be:

ILH Holdings, Inc.
c/o Intrexon Corporation
20374 Seneca Meadows Parkway
Germantown, MD 20876
Attn: Legal Department

If you have questions, please contact Vanessa Hon of Intrexon Corporation, care of the above Intrexon address or by email tovhon@dna.com.

Sincerely,

Intrexon Corporation

/s/ Donald P. Lehr

Donald P. Lehr
Chief Legal Officer

SECOND AMENDMENT TO LEASE

WHEREAS, Hawley-Wiggins, LLC, a Florida limited company as “Landlord” and Oragenics, Inc., a Florida corporation as “Tenant” have entered into that certain Lease dated the 28th day of October 2011, and a First Amendment to Lease dated July 13, 2014, for that certain real property located at 13700 Progress Boulevard, Alachua, Florida 32615 and consisting of approximately 5,616 square feet of gross rentable area.

and;

WHEREAS, Landlord and Tenant have requested an amendment to the Lease to extend the Lease term for five (5) additional years.

NOW, THEREFORE, the Landlord and Tenant agree as follows:

The Lease is modified to read as follows:

1. 1.(e) “Commencement Date” of the renewal term is hereby amended to read: December 1, 2019 and this Lease shall now expire on November 30, 2024 (“Renewal Term”).
2. 1.(f) “Term” is hereby amended to be not less than sixty (60) months commencing on the Commencement Date, this Lease to end on the last day of the sixtieth (60th) month after the Commencement Date of the Renewal Term.
3. 1.(g) “Rent” for the Renewal Term is hereby amended to be:

Lease Year:	Annual Net Rent/RSF:	Annual Net Rent:	Monthly Payment Rent:
1	27.50	154,440.00	12,870.00
2	27.50	154,440.00	12,870.00
3	28.50	160,056.00	13,338.00
4	28.50	160,056.00	13,338.00
5	28.50	160,056.00	13,338.00

4. 2. **PREMISES AND TERM:** is hereby amended to provide that Tenant may terminate this Lease prior to the expiration upon the payment to the Landlord of nine (9) month’s rent in advance.
5. 6. **TENANT’S REPAIRS:** is hereby amended to provide that Tenant, at it’s expense, shall replace the HEPA HVAC filters in the lab space, however any repairs to the HVAC system serving only the lab space of the leased premises shall be split 50/50 between Landlord and Tenant. Tenant agrees to provide Landlord notice of any required repairs to this system prior to commencing work. Tenant shall be responsible for all routine maintenance of this lab space HVAC system.

All provisions of the original Agreement not amended herein shall remain unchanged and in full force and effect.

IN WITNESS WHEREOF, the parties have set their hands and seals this 7th day of June, 2019.

In the presence of:

“LANDLORD”

Hawley-Wiggins, LLC, a
Florida limited liability company

/s/Michael Durre

Printed Name: Michael Durre

/s/Phillip L. Hawley

By: PHILLIP L. HAWLEY

Its: Manager

/s/Janice A. Hawley

Printed Name: JANICE A. HAWLEY

“TENANT”

Oragenics, Inc., a
Florida corporation

/s/Martina Whittlesey

Printed Name: Martina Whittlesey

/s/Michael O. Sullivan

By: Michael O. Sullivan

Its: CFO

/s/Edward Picillo

Printed Name: Edward Picillo

Director

<p>Orogenics, Inc. Notice of Grant of Stock Options and Stock Option Award Agreement</p>

Dear [insert name of Director]

Orogenics, Inc. hereby grants you Stock Options to purchase up to [] shares of our Common Stock (the "Stock Options"), subject to the terms and conditions set forth in this Notice of Grant, the Terms and Conditions attached hereto as Appendix A and terms of the Orogenics, Inc. 2012 Equity Incentive Plan, as amended. The key terms of the Stock Options granted to you are as follows.

Number of Shares: Under these Stock Options, you may purchase up to [] shares of Common Stock.

Exercise Price: The purchase price for your Stock Options shall be \$[] per share.

Date of Grant: The "Date of Grant" for your Stock Options is [].

Vesting Schedule: Your Stock Options will be exercisable only after they become "vested." Vesting is subject to your continued performance of services for Orogenics through the following vesting dates.

Vesting Date	Vested Percentage of Shares	Total Number of Purchasable Shares
--------------	-----------------------------	------------------------------------

Not ISOs: These Stock Options are not "incentive stock options" under the federal tax laws.

Expiration Date: If not previously exercised or forfeited, the Stock Options shall expire on [].

Your signature below acknowledges your agreement that these Stock Options granted to you are subject to all of the terms and conditions contained in Appendix A and the Plan. PLEASE BE SURE TO READ APPENDIX A, WHICH CONTAINS THE SPECIFIC TERMS AND CONDITIONS OF YOUR AWARD.

Please sign one copy of this Stock Option Agreement (the other copy is for your files) and return the signed copy to me no later than [], 20__.

ORAGENICS, INC.

Date

M

Director

Print name: _____

Date

APPENDIX A

TERMS AND CONDITIONS OF STOCK OPTIONS

1. Grant. Oragenics, Inc. (the "Company") has granted the Director of the Company named in the attached Notice of Grant (the "Director") stock options to purchase the number of shares of the Company's Common Stock, \$.001 par value per share ("Common Stock"), specified in the Notice of Grant attached hereto and incorporated into this Award Agreement by reference. Capitalized terms used and not defined in this Agreement will have the meaning set forth in the Plan.

The Stock Options granted under this Award Agreement are not intended to be Incentive Stock Options covered by Section 422 of the Code.

2. Incorporation of the 2012 Incentive Plan. The Stock Options have been granted pursuant to the provisions of the Company's 2012 Equity Incentive Plan, and the terms and definitions of the 2012 Equity Incentive Plan are incorporated into this Award Agreement by reference and made a part of this Award Agreement. The Director acknowledges receipt of a copy of the 2012 Equity Incentive Plan.

3. Purchase Price. The price per share to be paid by the Director for the shares purchased pursuant to these Stock Options (the "Exercise Price") shall be as specified in the Notice of Grant. This Exercise Price shall be an amount not less than the Fair Market Value of a share of Common Stock as of the Date of Grant (as defined in the Plan and specified in the Notice of Grant).

4. Exercise Terms. The Stock Options shall become vested and exercisable in the amounts and at the time(s) described in vesting schedule set forth in the Notice of Grant. The Stock Options shall become vested and exercisable only if the Director continues to regularly perform services for the Company as a Director through the vesting dates set forth in the vesting schedule in Notice of Grant.

The Director must exercise the Stock Options for at least 100 shares, or, if less, the full number of shares shown as Purchasable Shares in the vesting schedule in the Notice of Grant as to which the Stock Options remain unexercised.

If the Stock Options are not exercised with respect to all or any part of the shares subject to the Stock Options prior to the expiration date specified in the Notice of Grant (which shall be no later than ten (10) years from the date of grant), the Stock Options shall expire and any shares with respect to which the Stock Options were not exercised shall no longer be Purchasable Shares subject to the Stock Options.

5. Option Non-Transferable. No Stock Options shall be transferable by the Director other than by will or the laws of descent and distribution or, in the case of non-Incentive Stock Options, pursuant to a Qualified Domestic Relations Order or as otherwise permitted pursuant to Section 11.7 of the 2012 Equity Incentive Plan. During the lifetime of the Director, the Stock Options shall be exercisable only by such Director (or by such Director's guardian or legal representative, should one be appointed).

6. Notice of Exercise of Option. The Stock Options may be exercised by the Director or by the Director's administrators, executors or personal representatives, by a written notice signed by the Director, or by such administrators, executors or personal representatives, and delivered or mailed to the Company to the attention of the President, Chief Executive Officer or such other officer as the President or Chief Executive Officer may designate. Any such notice shall:

(a) specify the number of shares of Common Stock which the Director or the Director's administrators, executors or personal representatives, as the case may be, then elects to purchase hereunder,

(b) contain such information as may be reasonably required pursuant to Section 11 below, and

(c) be accompanied by (i) a certified or cashier's check or, if acceptable to the Committee, a recourse note payable to the Company, in payment of the total Exercise Price applicable to such shares as provided herein, (ii) shares of Common Stock owned by the Director and duly endorsed or accompanied by stock transfer powers having a Fair Market Value equal to the total Exercise Price applicable to such shares purchased under this Agreement, (iii) shares otherwise issuable upon exercise of the Stock Options having a Fair Market Value equal to the total Exercise Price applicable to such shares purchased under this Agreement or (iv) a certified or cashier's check or, if acceptable to the Committee, a recourse note payable to the Company, accompanied by the number of shares of Common Stock whose Fair Market Value when added to the amount of the check or note equals the total Exercise Price applicable to the shares being purchased under this Agreement.

Upon receipt of any such notice and accompanying payment, and subject to the terms hereof, the Company agrees to issue to the Director or the Director's administrators, executors or personal representatives, as the case may be, stock certificates for the number of shares specified in such notice registered in the name of the person exercising the Stock Options.

7. Issuance of Stock Certificates for Shares. The stock certificates for any shares of Common Stock issuable to the Director upon exercise of the Stock Options shall be delivered to the Director (or to the person to whom the rights of the Director shall have passed by will or the laws of descent and distribution) as promptly after the date of exercise as is feasible, but not before the Director has paid the option price for such shares.

8. Termination of Service on Board. Except as otherwise specified in the Notice of Grant for the Stock Options covered by this Agreement, in the event the Director ceases to serve as a member of the Board of Directors of the Company before the Stock Options are exercised or expire, the Director may exercise the vested portion of the Stock Options at any time within the period of thirty six (36) months after such termination of service on the Board, to the extent of the number of shares which were Purchasable Shares under the vesting schedule in the Notice of Grant at the date of such termination.

9. Death of Director. In the event of the Director's death while performing services as a member of the Board of Directors of the Company or within thirty (36) months after termination of such services, the appropriate persons described in Section 6 of this Agreement or persons to whom all or a portion of the Stock Option is transferred in accordance with Section 5 of this Agreement may exercise the Stock Options at any time within a period ending on the earlier of (a) the last day of the thirty six (36) month period following the Director's death or (b) the expiration date of the Stock Options specified in the Notice of Grant. If the Director was actively serving on the Board at the time of death, any unvested rights to acquire shares pursuant to the Stock Options shall immediately vest and the Stock Options may be so exercised to the extent of the number of shares that were Purchasable Shares under the vesting schedule in the Notice of Grant at the date of death. If the Director's services on the Board terminated prior to his or her death, the Stock Options may be exercised only to the extent of the number of shares covered by the Stock Options which were Purchasable Shares under the vesting schedule in the Notice of Grant at the date of such termination.

10. Compliance with Regulatory Matters. The Director acknowledges that the issuance of capital stock of the Company is subject to limitations imposed by federal and state law, and the Director hereby agrees that the Company shall not be obligated to issue any shares of Common Stock upon an attempted exercise of this Stock Options that would cause the Company to violate law or any rule, regulation, order or consent decree of any regulatory authority (including without limitation the SEC) having jurisdiction over the affairs of the Company. The Director agrees that he or she will provide the Company with such information as is reasonably requested by the Company or its counsel to determine whether the issuance of Common Stock complies with the provisions described by this Section 10.

11. Adjustment in Option. The number of Shares subject to these Stock Options, the Exercise Price and other matters are subject to adjustment during the term of the Stock Options in accordance with Section 4.3 of the 2012 Equity Incentive Plan.

12. Rights Prior to Issuance of Certificates. Neither the Director nor any person to whom the rights of the Director shall have passed by will or the laws of descent and distribution shall have any of the rights of a shareholder with respect to any shares of Common Stock until the date of the issuance to him of certificates for such Common Stock as provided in Section 7 above.

13. Miscellaneous.

(a) This Agreement shall be binding upon the parties hereto and their representatives, successors and assigns.

(b) This Agreement shall be governed by the laws of, the State of Florida.

(c) Any requests or notices to be given hereunder shall be deemed given, and any elections or exercises to be made or accomplished shall be deemed made or accomplished, upon actual delivery thereof to the designated recipient, or three days after deposit thereof in the United States mail, registered, return receipt requested and postage prepaid, addressed, if to the Director, at the most recent mailing address provided to the Company in writing, and, if to the Company, to the executive offices of the Company at, 4902 Eisenhower Blvd., Suite 125, Tampa, Florida 33634 or at such other addresses that the parties provide to each other in accordance with the foregoing notice requirements.

(d) This Agreement may not be modified except in writing executed by each of the parties to it.

(e) This Agreement is subject to all terms and provisions of the Plan. In the event of a conflict between one or more provisions of this Agreement and one or more provisions of the Plan, the provisions of the Plan will govern.

(f) Neither this Agreement nor the Stock Options confer upon the Director any right with respect to continuance of services for the Company.

14. Minimum Stock Ownership. The Director acknowledges and agrees that director shall be subject to a minimum dollar value stock ownership holding requirement of six times the then applicable annual board retainer for directors (the "Minimum Stock Ownership Amount") and that Director shall be precluded from the sale of any shares of Company common stock owned by Director through equity awards received from the Company having a then value that is equal to or less than the Minimum Stock Ownership Amount. By way of example, if the Director's annual board retainer is \$45,000, Director could not sell any shares of Company common stock held (including shares able to be acquired by way of exercise of stock options that have vested) if the sale would cause Director to fall below \$270,000 in value of the Company common stock owned (or eligible to be acquired by the exercise of stock options that have vested and that are in-the-money). If Director does not own in excess of \$270,000 in Company common stock at such time, then such Director would be required to hold the shares (either owned or eligible to be acquired by exercise of vested options) until such time as the value exceeded the \$270,000 amount and then Director would only be permitted to sell such amount of Company common stock having a value in excess of \$270,000. Director shall follow the Company's pre-clearance requirements prior to any contemplated sale of Company stock in furtherance of the compliance with this section and Director shall not sell any Company common stock owned by Director unless such sale has been first cleared in advance by the Company including as to the Minimum Stock Ownership Amount. For the avoidance of doubt, any shares acquired by the Director outside of awards under the Plan shall not be subject to the Minimum Stock Ownership Amount.

Consent of Independent Registered Public Accounting Firm

We consent to the inclusion in this Annual Report (Form 10-K) of Oragenics, Inc. of our report dated March 4, 2020, with respect to the 2019 and 2018 financial statements of Oragenics, Inc. We consent to the incorporation of our report by reference in the following Registration Statements:

- (i) Form S-8 Registration Statements (Nos. 333-110646, 333-150716, 333-163083, 333-177091, 333-184588, 333-223088, 333-225894 and 333-232301) of Oragenics, Inc. pertaining to the Oragenics, Inc. 2012 Equity Incentive Plan; and
- (ii) Registration Statements (Form S-1 Nos. 333-224498, 333-224950 and 333-226150) and (Form S-3 Nos. 333-183685, 333-190609, 333-213321, 333-230422 and 333-235763) and related Prospectus of Oragenics, Inc.

/s/ Mayer Hoffman McCann P.C.

Clearwater, Florida

March 4, 2020

CERTIFICATION

I, Alan Joslyn, certify that:

1. I have reviewed this annual report on Form 10-K of Oragenics, 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 officers 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 we 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 officers 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 registrant's board of directors (or persons performing the equivalent function):
 - 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 4, 2020

/s/ Alan Joslyn

Alan Joslyn, President and Chief Executive Officer

CERTIFICATION

I, Michael Sullivan, certify that:

1. I have reviewed this annual report on Form 10-K of Oragenics, 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 officers 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 we 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 officers 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 registrant's board of directors (or persons performing the equivalent function):
 - 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 4, 2020

/s/ Michael Sullivan

Michael Sullivan, Chief Financial 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 Oragenics, Inc. (the "Company") on Form 10-K for the period ended December 31, 2019 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Alan Joslyn, President and Chief Executive Officer of the Company, certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 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 this Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

A signed original of this written certification 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.

Dated this 4th day of March, 2020

/s/ Alan Joslyn

Alan Joslyn
President and Chief 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 Oragenics, Inc. (the "Company") on Form 10-K for the period ended December 31, 2019 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Michael Sullivan, Chief Financial Officer of the Company, certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 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 this Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

A signed original of this written certification 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.

Dated this 4th day of March 2020

/s/ Michael Sullivan

Michael Sullivan
Chief Financial Officer