Section 1: 10-K (10-K)

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION

Washington, D.C. 20549

FORM 10-K

(Mark One)

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

For the fiscal year ended December 31, 2017

or

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

For the transition period from to

Commission File No. 001-36483

MIRAGEN THERAPEUTICS, INC.

(Exact name of registrant as specified in its charter)

Delaware	**47-1187261**
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
6200 Lookout Road, Boulder, CO	**80301**
(Address of principal executive offices)	**(Zip Code)**

Registrant's telephone number, including area code: (720) 643-5200

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

Title of each class	**Name of each exchange on which registered**
Common Stock, $0.01 par value	**The Nasdaq Capital Market**

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

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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 and posted on its corporate Web site, if any, every

Interactive Data File required to be submitted and posted 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 and post 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, a smaller reporting company, or an emerging growth company. See the definitions of “large accelerated filer,” “accelerated filer,” “smaller reporting company,” and “emerging growth company” in Rule 12b-2 of the Exchange Act.

Large accelerated filer ☐	Accelerated filer ☐
Non-accelerated filer ☐ (do not check if a smaller reporting company)	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 shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐
No ☒

The aggregate market value of the voting stock held by non-affiliates of the registrant, based upon the closing sale price of the registrant’s Common Stock on June 30, 2017 as reported on The Nasdaq Capital Market, was $122.4 million. Shares of Common Stock held by each executive officer and director and by each person who owns 10% or more of the outstanding Common Stock have been excluded in that such persons may be deemed to be affiliates. This determination of affiliate status is not necessarily a conclusive determination for other purposes.

As of March 12, 2018, there were 30,172,086 shares of the registrant’s Common Stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

None.

MIRAGEN THERAPEUTICS, INC.
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FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K, or this Annual Report, contains forward-looking statements that involve substantial risks and uncertainties for purposes of the safe harbor provided by the Private Securities Litigation Reform Act of 1995. All statements contained in this Annual Report other than statements of historical fact, including statements regarding our strategy, future operations, future financial position, future revenue, projected expenses, prospects, plans and objectives of management are forward-looking statements. The words "believe," "may," "will," "estimate," "continue," "anticipate," "intend," "plan," "expect," "predict," "potential," "opportunity," "goals," or "should," and similar expressions are intended to identify forward-looking statements. Unless otherwise mentioned or unless the context requires otherwise, all references in this Annual Report to "Miragen," "company," "we," "us" and "our" or similar references refer to Miragen Therapeutics, Inc., and our consolidated subsidiaries.

Such statements are based on management's current expectations and involve risks and uncertainties. Actual results and performance could differ materially from those projected in the forward-looking statements as a result of many factors, including, without limitation:

- We have incurred losses since our inception, have a limited operating history on which to assess our business, and anticipate that we will continue to incur significant losses for the foreseeable future.
- Raising additional capital may cause dilution to our stockholders, restrict our operations, or require us to relinquish rights.
- We have never generated any revenue from product sales and may never be profitable.
- We are heavily dependent on the success of our product candidates, which are in the early stages of clinical development. Some of our product candidates have produced results only in early stage or pre-clinical settings, or for other indications than those for which we contemplate conducting development and seeking U.S. Food and Drug Administration, or FDA, approval for, and we cannot give any assurance that we will generate sufficient data for any of our product candidates to receive regulatory approval in our planned indications, which will be required before they can be commercialized
- Regardless of clinical trial results, the FDA and other regulatory agencies may fail to approve our product candidates for marketing.
- We may be unsuccessful in maintaining orphan-drug designation for our product candidates because even after an orphan drug is approved, the FDA can subsequently approve a different drug for the same indication if the FDA concludes that the later drug is clinically superior in that it is shown to be safer, more effective, or makes a major contribution to patient care.
- Clinical trials are costly, time consuming, and inherently risky, and we may fail to demonstrate safety and efficacy to the satisfaction of applicable regulatory authorities.
- The approach we are taking to discover and develop novel therapeutics that target microRNAs is unproven and may never lead to marketable products.
- Our microRNA-targeted therapeutic product candidates are based on a relatively novel technology, which makes it unusually difficult to predict the time and cost of development, and the time and cost, or likelihood, of obtaining regulatory approval. To date, no microRNA-targeted therapeutics have been approved for marketing in the United States.
- Our product candidates may cause undesirable side effects or have other properties that could delay or prevent regulatory approval, limit the commercial viability of an approved label, or result in significant negative consequences following marketing approval, if any.
- We may use our financial and human resources to pursue a particular research program or product candidate and fail to capitalize on programs or product candidates that may be more profitable or for which there is a greater likelihood of success.

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

- We may be unable to realize the potential benefits of any collaboration.

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

- We may not be able to develop or identify technology that can effectively deliver MRG-106, or cobomarsen, MRG-201, or any other of our microRNA-targeted product candidates to the intended diseased cells or tissues, and any failure in such delivery technology could adversely affect and delay the development of cobomarsen, MRG-201, and our other product candidates.

- If equity research analysts do not publish research or reports, or publish unfavorable research or reports, about us, our business, or our market, our stock price and trading volume could decline.

We have based these forward-looking statements largely on our current expectations and projections about future events and trends that we believe may affect our financial condition, results of operations, business strategy, short-term and long-term business operations and objectives, and financial needs. These forward-looking statements are subject to a number of risks, uncertainties, and assumptions, including those described in Part I, Item 1A, "Risk Factors" in this Annual Report. Moreover, we operate in a very competitive and rapidly changing environment. New risks emerge from time to time. It is not possible for our management to predict all risks, nor can we assess the impact of all factors on our business or the extent to which any factor, or combination of factors, may cause actual results to differ materially from those contained in any forward-looking statements we may make. In light of these risks, uncertainties and assumptions, the future events and trends discussed in this Annual Report may not occur and actual results could differ materially and adversely from those anticipated or implied in the forward-looking statements.

We undertake no obligation to revise or publicly release the results of any revision to these forward-looking statements, except as required by law. Given these risks and uncertainties, readers are cautioned not to place undue reliance on such forward-looking statements. All forward-looking statements are qualified in their entirety by this cautionary statement.

PART I

ITEM 1. BUSINESS

Merger of Signal Genetics, Inc. and Miragen Therapeutics, Inc.

On February 13, 2017, we, then known as Signal Genetics, Inc., or Signal, completed our merger with Miragen Therapeutics, Inc., a then privately-held Delaware corporation, or Private Miragen. Pursuant to the Agreement and Plan of Merger and Reorganization, or the Merger Agreement, by and among Signal, Private Miragen, and Signal Merger Sub, Inc., a wholly-owned subsidiary of Signal, or Merger Sub, Merger Sub merged with and into Private Miragen, with Private Miragen surviving as a wholly-owned subsidiary of Signal, or the Merger. Immediately, following the Merger, Private Miragen merged with and into us, with us as the surviving corporation, or the Short-Form Merger, and, together with the Merger, the Mergers. In connection with the Short-Form Merger, we changed our corporate name to "Miragen Therapeutics, Inc." Our common stock, par value $0.01 per share, or our common stock, began trading on The Nasdaq Capital Market under the ticker symbol "MGEN" on February 14, 2017.

Overview

We are a clinical-stage biopharmaceutical company discovering and developing proprietary RNA-targeted therapies with a specific focus on microRNAs and their role in diseases where there is a high unmet medical need. microRNAs are short RNA molecules, or oligonucleotides, that regulate gene expression and play vital roles in influencing the pathways responsible for many disease processes. A leader in microRNA therapeutics discovery and development, we have advanced two product candidates, cobomarsen, also known as MRG-106, and MRG-201, into clinical development. We are also developing MRG-110 under a license and collaboration agreement, or the Servier Collaboration Agreement, with Les Laboratoires Servier and Institut de Recherches Servier, or, collectively, Servier.

Cobomarsen is an inhibitor of microRNA-155, or miR-155, which is found at abnormally high levels in malignant cells of several blood cancers, as well as certain cells involved in inflammation. In our Phase 1 clinical trial of cobomarsen in cutaneous T-cell lymphoma, or CTCL, 90% of patients treated systemically demonstrated improvement in modified Severity Weighted Assessment Tool, or mSWAT, score, which is a measurement of the severity of skin disease over a patient's entire body.

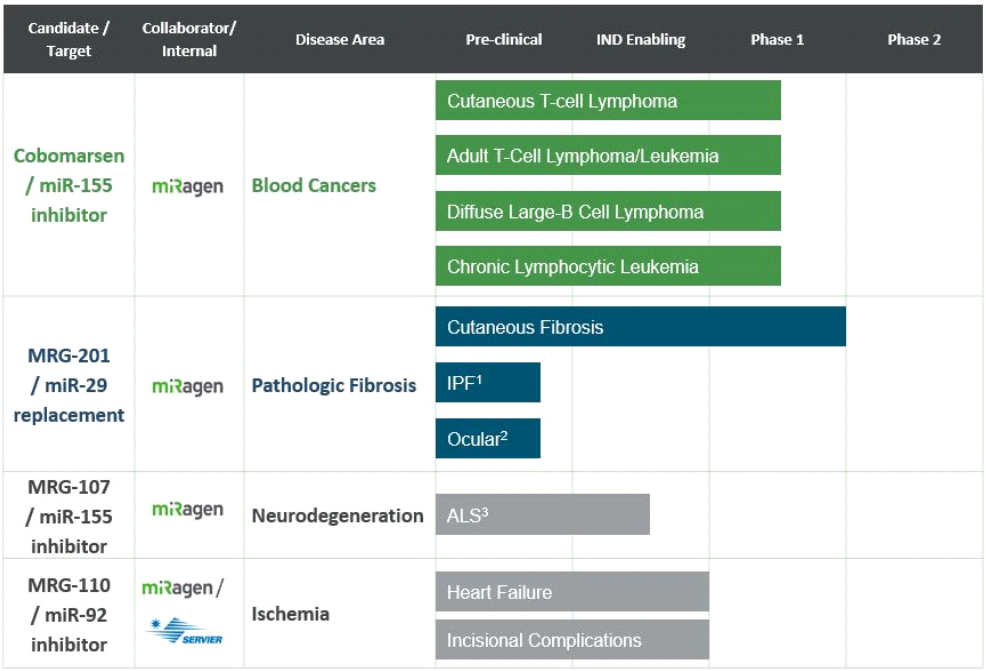
MRG-201 is a replacement for microRNA-29, or miR-29, which is found at abnormally low levels in a number of pathological fibrotic conditions, including cutaneous, cardiac, renal, hepatic, pulmonary, and ocular fibrosis, as well as in systemic sclerosis. In a Phase 1 clinical trial of MRG-201, we observed a statistically-significant reduction in fibroplasia, or scar tissue deposition, with no adverse effects on incisional wound healing when MRG-201 was given.

MRG-110 is an inhibitor of microRNA-92, or miR-92, a microRNA that is expressed in endothelial cells and has been shown to accelerate the formation of new blood vessels in preclinical models of heart failure, peripheral ischemia, and dermal wounding. MRG-110 is being developed for use in various indications in which enhanced vascular density is expected to provide clinical benefit. We retain all commercial rights to MRG-110 in the United States and Japan, and Servier has commercial rights in the rest of the world.

In addition to these programs, we continue to develop a pipeline of wholly-owned preclinical product candidates. We believe that our preclinical product candidates offer the potential to treat a number of indications including oncology, visual pathologies, neurodegeneration, and hearing loss. The goal of our translational medicine strategy is to progress rapidly to first-in-human trials once we have adequately established the pharmacokinetics (the movement of a drug into, through, and out of the body), pharmacodynamics (the effect and mechanism of action of a drug), safety, and manufacturability of the product candidate in preclinical studies.

We believe our experience in microRNA biology and chemistry, drug discovery, bioinformatics, and translational medicine allows us to identify and develop mircroRNA-targeted drugs that are designed to regulate gene pathways to return diseased tissues to a healthy state. We believe that our drug discovery and development strategy will enable us to progress our product candidates from preclinical discovery to confirmation of mechanism of action in humans quickly and efficiently. The elements of this strategy include identification of biomarkers that may predict clinical benefit and monitoring outcomes in early-stage clinical trials to help guide later clinical development.

The following table summarizes our most advanced programs:



1 Idiopathic Pulmonary Fibrosis
2 Ocular Fibrosis
3 Amyotrophic Lateral Sclerosis

Anticipated Milestones

Cobomarsen (blood cancers)

- Presentation of additional Phase 1 CTCL data, including response rates from longer-term duration of treatment (1H 2018)
- Phase 1 interim clinical data release in at least one potential expansion indication (2H 2018)
- Initiation of a Phase 2 clinical trial in CTCL (2H 2018)
- Presentation of Phase 2 CTCL clinical trial data (2H 2020)

MRG-201 (pathologic fibrosis)

- Initiation of a Phase 2 clinical trial in cutaneous fibrosis (1H 2018)
- Ocular fibrosis data release from preclinical models (1H 2018)
- Preclinical safety and efficacy lung fibrosis data release (2H 2018)
- Presentation of Phase 2 cutaneous fibrosis clinical trial data (2019)

MRG-110 (ischemic disease)

- Initiation of two Phase 1 clinical trials (1H 2018)

Our Strategy

We seek to use our expertise and understanding of microRNA biology, oligonucleotide chemistry, and product development to create novel products that have the potential to transform the treatment of patients with serious diseases. The key components of our strategy are as follows:

- **Continue to develop cobomarsen for blood cancers.** Cobomarsen is currently being developed in a Phase 1 clinical trial in multiple oncology indications. We intend to initiate a Phase 2 clinical trial for cobomarsen in patients with mycosis fungoides, or MF, the most common type of CTCL in the second half of 2018 using a 300 mg intravenous infusion, or IV infusion. This dosage and administration method demonstrated an 80% objective response rate in this cohort of five patients in the Phase 1 clinical trial. In addition to CTCL, we are also developing cobomarsen in three expansion indications where the disease process appears to correlate with an increase in miR-155 levels, the target of cobomarsen. These additional indications are adult T-cell leukemia/lymphoma, diffuse large B-cell lymphoma, and

chronic lymphocytic leukemia. We plan to release interim data during the second half of 2018 in at least one of these additional indications.

- **Continue to develop MRG-201 for pathological fibrosis.** We intend to initiate a double blinded, randomized Phase 2 clinical trial to evaluate MRG-201 in subjects with a predisposition for keloid formation in the first half of 2018. In 2017, we announced results from the double-blind, placebo-controlled, single and multiple dose-escalation Phase 1 clinical trial evaluating MRG-201 in induced cutaneous fibrosis. In the trial, treatment with MRG-201 appeared to result in a reduction in fibroplasia, a histopathological marker of scar tissue deposition, while not adversely affecting wound healing. Additional indications to be studied for a miR-29 mimic could include fibrotic diseases of the lung and eye.

- **Utilize rare disease development pathways at the FDA and comparable programs at foreign regulatory agencies to accelerate progression to late-stage development and early approval.** For our wholly-owned programs, we intend to focus on rare and genetic diseases where RNA modulation may produce clinical benefit, so that we can potentially take advantage of regulatory programs intended to expedite drug development. In March 2017, we announced that the FDA granted orphan-drug designation to cobomarsen, for the treatment of MF. Additionally, in May 2017, we announced that the European Commission granted orphan medicinal product designation to cobomarsen for the treatment of CTCL. We plan to apply for the regulatory programs for orphan drug designation, fast track, breakthrough therapy designation, and/or priority review when available to potentially reduce clinical trial expense and decrease time to commercialization.

- **Collaborate with other biotechnology and pharmaceutical companies to develop additional product candidates.** We intend to seek out collaborations for the development of compounds in our pipeline for certain disease areas where the costs would exceed our resources or in other areas where we believe that leveraging a partner's expertise or resources will allow us to accelerate development timelines. For example, we have a strategic collaboration with Servier to develop product candidates for the treatment of cardiovascular diseases.

- **Use our in-house research and translational expertise to further develop our product candidate pipeline.** Our in-house research team investigates microRNAs that have been identified as potential therapeutic targets through internal efforts and academic collaborations. We then seek to establish evidence that modulation of the microRNAs' activity may provide benefit in pathological conditions or diseases in which the microRNA is implicated. We believe that this internal research and expertise could provide a foundation to develop product candidates for the treatment of a variety of diseases.

- **Selectively build focused commercial capabilities and establish commercial collaborations to maximize the value of our pipeline.** To date, we have retained all U.S. and Japanese rights to our product candidates in the strategic collaboration with Servier and global rights in all of our other programs. While we have not yet defined our sales, marketing, or product distribution strategy for cobomarsen, MRG-201, MRG-110, or any of our other product candidates, if approved, our commercial strategy may include the use of strategic alliances, distributors, a contract sales force, or the establishment of our own commercial and specialty sales force to maximize the value of our pipeline.

Our Product Candidates

Cobomarsen

Cobomarsen is an inhibitor of miR-155. Data reported in the scientific literature identifies miR-155 as a cancer-causing microRNA, or oncomiR, with a role in the development of multiple blood cancers. Based on this literature, miR-155 is implicated in the expression of a number of validated cancer-related disease targets, including Bruton's tyrosine kinase, or BTK, and nuclear factor kappa-light-chain-enhancer of activated B-cells, or NFκB. In certain B-cell lymphomas, improvement of clinical outcomes has been associated with normalization of miR-155 levels, while poor prognosis, resistance to treatment, and recurrence of the disease are associated with elevated levels of miR-155. In addition to playing a role in B-cell malignancies, miR-155 is elevated in another group of malignant white blood cells, called T-cells, found in skin lesions of patients with MF. We screened a library of locked nucleic acid modified oligonucleotides and identified cobomarsen as having what we believed was the best potential efficacy and drug-like properties, including improved pharmacodynamics in human T-cell and B-cell lymphoma cell lines. We are conducting a Phase 1 clinical trial of cobomarsen in patients with MF, adult T-cell leukemia/lymphoma, diffuse large B-cell lymphoma, and chronic lymphocytic leukemia. In 26 of 29 evaluable patients with MF, or 90%, cobomarsen treatment demonstrated improvement in mSWAT score, which is a measurement of the severity of skin disease over a patient's entire body. Four of five MF patients, or 80%, who were treated with 300 mg IV infusion achieved

a 50% or greater mSWAT reduction, which we believe represents an important beneficial clinical response. Based on these results and our meeting with the FDA, we anticipate initiating the Phase 2 clinical trial of cobomarsen via 300 mg IV infusion in 2018. We retain worldwide rights for cobomarsen.

Mycosis Fungoides

MF is the most common form of a type of blood cancer called CTCL. CTCL occurs when certain types of T-cells become cancerous. These malignant T-cells then form specific types of skin lesions. Although the skin is involved, the skin cells themselves are not cancerous. According to the National Institutes of Health, or NIH, MF usually occurs in adults over age 50, although the disease may occur at any age.

We believe the total population of patients with CTCL in the United States and Canada is approximately 30,000. The Lymphoma Research Foundation estimated the prevalence of MF to be 16,000-20,000 cases in the United States. According to the Leukemia and Lymphoma Society in a 2014 publication, approximately 70% to 80% of patients are diagnosed with early-stage MF that impacts only the skin. In these patients, the disease typically has a slow progression, but is accompanied by serious quality of life detriments such as severe itchiness, pain, and disfiguration. The five-year survival rate for newly diagnosed patients with CTCL is approximately 90%. As CTCL progresses, the cancer may involve the lymph nodes, blood, and internal organs. The five-year survival rate in later stage patients with CTCL (stages IIB, III, IV) is approximately 20-60% depending on the stage.

There are currently no curative therapies for CTCL, and concurrent and consecutive treatments, many with significant adverse effects, tend to be given until loss of response. Most drugs for CTCL have response rates between 30% and 40%, and response durations tend to be less than a year. We believe there is a need for new and improved therapies in CTCL to treat the disease and reduce symptoms, such as itchiness and painful skin lesions, and to prolong survival in patients with aggressive disease.

There is no universally accepted standard of care for treatment of MF. Treatment is dependent on stage of disease and responsiveness to previous therapy and is divided into skin-directed therapy and whole-body treatments. For certain patients with advanced disease, allogeneic stem cell transplantation may offer prolonged survival, but the five-year survival rate is approximately 50%.

In addition to CTCL, elevation of miR-155 has been associated with several other blood cancers and certain solid tumors. We believe there is a potential opportunity to develop a companion diagnostic that could detect and quantify levels of miR-155 in circulating blood or malignant cells. We believe this approach may then allow for the selection of patients with elevated miR-155 levels who may be more likely to benefit from cobomarsen treatment and allow the drug to be used selectively in multiple cancers, if approved. There are several types of cancer in which high levels of miR-155 have been observed, including subsets of diffuse large B-cell lymphoma, acute myeloid leukemia, certain virally-induced lymphomas such as HTLV-1 associated lymphoma and Burkitt's lymphoma, Down Syndrome-associated acute lymphocytic leukemia, and other types of cancer. We are evaluating cobomarsen in additional types of lymphoma and leukemia in our Phase 1 clinical trial and intend to explore other potential applications for cobomarsen through additional clinical studies in other tumor types.

Cobomarsen Phase 1 Clinical Trial

Trial Design

We are conducting a multi-site, open-label, dose-ranging Phase 1 clinical trial of cobomarsen for the treatment of MF at 13 U.S.-based clinical sites. This clinical trial consists of two parts and is expected to enroll up to 50 patients with MF. Patients may be allowed to be on other medications or background therapies so long as they have had no change in treatment regimen for MF, including drug and dose, for more than four weeks prior to enrollment and, in the opinion of the investigator, the patient is currently clinically stable and is likely to remain clinically stable for a minimum of three months after screening.

The primary objectives of this clinical trial are safety and tolerability. Secondary objectives include pharmacokinetic assessments, including measurement of absorption and clearance of cobomarsen from the blood. Additionally, there are several exploratory measures to assess any changes in lesion severity before and after treatment, as well as pharmacodynamic and histology assessments. The clinical trial utilizes two validated measures of lesion severity: (i) Composite Assessment of Index Lesion Severity Score, or CAILS, which is a composite measure that assesses the severity of one or more lesions on a patient and (ii) mSWAT, which is an assessment tool that is used to analyze the disease severity over a patient's entire body.

Part A of the clinical trial tested the effect of direct intratumoral injections of 75 mg of cobomarsen and enrolled six patients, five of whom completed dosing. One patient discontinued the trial due to baseline disease that exceeded trial entry criteria,

which was discovered during the first week of the trial, and the decision was made to withdraw the patient. In four patients, saline placebo was injected into a separate skin lesion at the same time as cobomarsen treatment. After eight to 14 days of treatment, injections sites were biopsied in five patients and analyzed for drug concentration, molecular evidence of drug activity on target gene expression, and histological evidence of alterations in malignant cell numbers and other immune cell populations. Additionally, as an exploratory endpoint, CAILS scoring was used to assess clinical response.

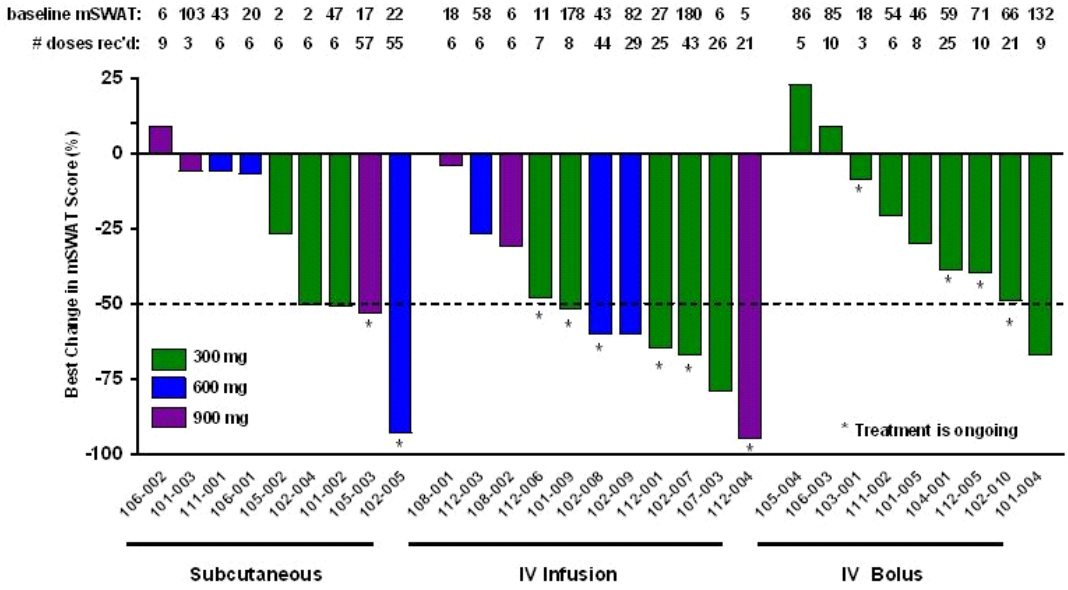
Part B of the clinical trial is enrolling patients and is designed to assess whole-body administration of cobomarsen. The first group, or cohort, of patients in Part B started receiving doses of cobomarsen in August 2016. Cohorts were dosed by multiple routes of administration, including subcutaneous injection, or SC injection or IV infusion, and intravenous bolus injection, or IV bolus. Efficacy and tolerability were assessed at doses of 300 mg, 600 mg, and 900 mg for SC injection and IV infusion and at 300 mg for IV bolus. Patients received six doses in the first 26 days of the study, followed by weekly or bi-weekly doses. In addition to safety, tolerability, and pharmacokinetics, exploratory pharmacodynamic endpoints are being assessed and clinical scoring using CAILS and mSWAT is being performed.

Efficacy

All patients who received cobomarsen in Part A of the clinical trial demonstrated a beneficial clinical response. Intratumoral injection was observed to result in significant absorption into the systemic circulation. Exploratory assessment of clinical response to therapy was performed for both cobomarsen-treated and saline-treated lesions based on the change from baseline in the CAILS scores. In Part A, four of the five patients who completed dosing had their scores evaluated in the cobomarsen-treated lesions. In the fifth patient, CAILS scores were monitored in two untreated lesions, instead of the treated lesions. The treated lesions in the four patients showed a 50% or greater reduction in the baseline CAILS score, which was maintained to the end of study visit (either 28 days or 35 days after the first dose). A greater than 50% reduction was observed in one saline-injected lesion.

In Part A, examination of pre-treatment and post-treatment tumor biopsies of the same lesion injected with cobomarsen was conducted in five patients. After treatment, histology revealed fewer cancerous cells or a reduction in cancer cell density or depth in most patients.

In Part B of the clinical trial, efficacy was assessed at doses of 300 mg, 600 mg, and 900 mg for SC injection and IV infusion and at 300 mg for IV bolus. Durable partial responses were observed at all dose levels tested. Based on the mSWAT score, 26 of 29 patients (90%) showed improvements in mSWAT scores. These improvements were observed as early as 17 days after a patient's first dose (the first post-treatment assessment), with the greatest improvement in mSWAT scores seen after one or more months of dosing. Additionally, all eight patients (100%) who achieved a 50% or greater reduction in mSWAT score and received more than two cycles of treatment maintained a durable response for greater than a four-month period. These patients were dosed either via SC injection or IV infusion at doses ranging from 300 mg to 900 mg. Cohorts that received 300 and 600 mg IV infusions had similar efficacy and tolerability profiles and provided the most consistent response rates based on skin mSWAT sores. Six of eight patients (75%) initially assigned to these cohorts achieved a 50% or greater mSWAT score reduction. The overall skin response in patients who received cobomarsen as monotherapy or cobomarsen with concurrent stable therapy were not significantly different. Reductions in the Skindex-29 total score that measures patients' quality of life correlated to reductions in mSWAT score, suggesting cobomarsen may be improving patients' quality of life as their skin disease improves.



Biomarker Analysis

Biomarkers were analyzed to assess the potential ability of cobomarsen to regulate the expression of gene pathways that are associated with elevated levels of miR-155 in MF. We identified a set of biomarkers based on cobomarsen activity in cell lines derived from MF patients. In Part A of the clinical trial, we assessed the expression of these biomarker genes in lesions before and after treatment with cobomarsen. Retrospective analysis of a subset of the genes from the cell line data indicated that cobomarsen treatment was correlated with the expression of some genes associated with cellular proliferation and potentially increased expression of some genes associated with cell death. The expression of these genes appears to correspond to the level of drug measured in the lesion biopsy. We also believe these data illustrate the potential of our approach to identify molecular biomarkers that translate from preclinical studies to predict product candidate activity in clinical trials.

Safety, Pharmacokinetics, and Pharmacodynamics

Cobomarsen has been generally well tolerated at all dose levels and routes of administration tested as of January 25, 2018, with multiple patients receiving more than a year of therapy (over 40 grams cumulative dose) and no serious adverse events, or AEs, attributed to cobomarsen. The maximally tolerated dose level has not been determined.

Six patients in Part A were administered cobomarsen intratumorally, with up to five 75 mg doses of cobomarsen administered to the same tumor over a period of up to two weeks. Four of these patients were simultaneously treated in a second lesion with a saline placebo solution. All patients who received cobomarsen generally tolerated the administrations well with only minimal redness of the skin at the site of injection noted in one patient. One patient was discontinued from the trial after receiving three doses of cobomarsen due to rapid progression of disease, which began shortly before the initiation of dosing and was considered unrelated to cobomarsen. The remaining five patients have completed the dosing and follow-up periods. AEs for these patients noted by the treating physician as possibly or definitely related to cobomarsen, included redness of the skin, pain, burning or tingling at the injection site, skin inflammation, and a hand sore. All possibly- or definitely-related AEs were judged as mild or moderate in severity. Abnormal lab values possibly related to use of cobomarsen were observed in two patients and included moderate neutropenia and prolonged partial thromboplastin time, both of which resolved while continuing cobomarsen.

In Part B of the clinical trial, as of January 25, 2018, 29 patients have been on study for up to approximately 16 months. Patients' disease stages ranged from Stage 1A to Stage IIIB. The median baseline mSWAT score was 45 (range 2 to 180). All dose levels were generally well tolerated. The most common related AEs observed in ≥ 15% of subjects were: fatigue, neutropenia, lymphopenia, and injection site pain. Most of the AEs were transient, of mild to moderate severity, and had resolved during the course of dosing. Subcutaneous administration of large volumes (≥ 600 mg dose levels) correlated with higher incidence of injection site reactions. Two AEs were deemed dose-limiting toxicities in two patients during their initial cycle: Grade 3 worsening itchiness (900 mg SC injection cohort), which recurred when the patient was dosed again at a lower dose level (300 mg IV infusion) and Grade 3 tumor flare (300 mg IV bolus cohort). These two patients experienced additional

Grade 3/4 AEs, including decreased lymphocytes, neutrophils and white blood cell counts, hyperuricaemia, rash, itchiness, and/or hypertension during the presumed disease flares. The only other Grade 3/4 AE reported in the trial that was possibly- or definitely-related to the administration of cobomarsen was neutropenia in a patient (300 mg IV infusion cohort) who was on concomitant bexarotene. This patient's neutropenia had resolved before the end of the dosing period.

In Part A of the clinical trial, high levels of cobomarsen (48-204 µg per gram of tissue) were detected in injected tumors 24 hours after the last dose. We also observed accumulation of cobomarsen in a lesion distant from the site of injection at low levels (4 µg per gram of tissue). Analysis of injected tumors also indicated an increased expression of several direct targets of miR-155, suggesting that the drug may be inhibiting its intended molecular target. A similar pattern of gene regulation was observed in a lesion not directly injected with drug that had 4 µg cobomarsen per gram of tissue, suggesting the minimum effective dose level in skin lesions may be near this level. Cobomarsen was measured in skin biopsies collected from systemically-treated patients in Part B. Levels measured showed a mean of 12 µg per gram of tissue. Similar patterns of cobomarsen target-gene expression changes were observed in patient biopsies after systemic dosing as were seen in the Part A lesions.

Data from clinical trial patients injected with cobomarsen indicate that the route of administration may affect the maximum plasma concentration, or C_{max}, and the time required to reach that concentration, or T_{max}, in the systemic circulation (approximately 10 minutes to one hour for intratumoral dosing, three to six hours for SC injection, two hours for IV infusion, and five minutes for IV bolus administration). However, dose-normalized systemic exposure (drug exposure/dose given) for all doses and routes of administration were similar, demonstrating good dose proportionality. The dose-normalized systemic exposure for the 300 mg IV bolus cohort indicated proportionally increased systemic exposure as compared to the other routes. Mean C_{max} values after the first 300 mg IV bolus injection were approximately six times the mean C_{max} observed for the 300 mg 2-hour IV infusion cohort. Plasma samples, evaluated for cobomarsen that were taken before weekly dosing, indicate that consistent plasma concentrations appear to be reached after approximately 12-16 weeks of weekly dosing, suggesting a half-life of approximately 2.5 to 3 weeks.

Expansion Indications

We are currently evaluating a 600 mg IV infusion of cobomarsen in our Phase 1 clinical trial in additional oncology indications in which the disease process appears to be related to abnormally high miR-155 levels, including chronic lymphocytic leukemia, diffuse large B-cell lymphoma, and adult T-cell leukemia/lymphoma. In the second half of 2018, we anticipate reporting interim safety and efficacy data for cobomarsen in at least one of these expansion indications.

Cobomarsen Phase 2 Clinical Trial

Based on the results of our Phase 1 clinical trial, we plan to initiate a Phase 2 clinical trial for cobomarsen in patients with MF. We met with the FDA in January 2018 to discuss our trial design, and we anticipate that our Phase 2 clinical trial, called SOLAR, will employ an open-label, parallel-group, randomized design to evaluate the safety and efficacy of 300 mg of cobomarsen given by IV infusion, versus an active control. The SOLAR clinical trial is intended to enroll patients with moderate to severe MF (stages Ib-III). The primary endpoint is planned to be a comparison of the numbers of responders in each treatment group with response defined as a 50% or greater improvement in the patient's mSWAT score maintained for at least four consecutive months, or ORR4, with no evidence of disease progression in the blood, lymph nodes, or viscera. Secondary endpoints are planned to include progression-free survival and patient-reported outcomes measuring improvements in quality of life and in symptoms, such as pain and itching. We anticipate enrollment to be approximately 65 patients per treatment group. Based on the discussions with the FDA, we believe that a successful outcome for the primary endpoint of this Phase 2 clinical trial may allow us to apply for accelerated approval of cobomarsen in the U.S.

MRG-201

MRG-201 is a replacement for, or mimic of, miR-29, which is found at abnormally low levels in a number of pathological fibrotic conditions, including cutaneous, cardiac, renal, hepatic, pulmonary, and ocular fibrosis, as well as in systemic sclerosis. MRG-201 is intended to increase miR-29-like activity in the setting of fibrotic conditions. miR-29 is believed to negatively regulate the expression of collagen and other proteins that are involved in fibrous scar formation and may be a regulator of extracellular matrix production. As such, we believe that increasing miR-29 to normal levels could be beneficial in the treatment of several pathological fibrotic conditions.

In 2017, we announced the data from a single-center, Phase 1, double-blind, placebo-controlled, single and multiple dose-escalation clinical trial for MRG-201 that enrolled 54 healthy volunteers. In the trial, we observed mechanistic proof-of-concept for MRG-201, based on a statistically-significant reduction in fibroplasia, or scar tissue deposition, with no adverse

effects on incisional wound healing when MRG-201 was given. We plan to initiate a double-blinded, randomized Phase 2 clinical trial to evaluate MRG-201 in subjects with a predisposition for keloid formation in the first half of 2018. Keloids are a common condition that is disfiguring and can be painful, itchy, and emotionally troubling to those that experience them. They are typically smooth, hard, benign growths that form when scar tissue grows excessively. We retain worldwide rights for MRG-201.

We believe that the miR-29 family of miRNAs is consistently present at abnormally low levels during fibrotic disease progression. We initially discovered the role of miR-29 in pathological cardiac fibrosis. Since this initial discovery, miR-29 has been implicated in pathological fibrosis in multiple organs including the skin, eye, lung, liver, tendon, and kidney. miR-29 is understood by the scientific community to play a role in the regulation of certain processes that contribute to fibrosis, including the initiation and maintenance of fibrosis through transforming growth factor beta, or TGF-ß, signaling and the deposition of the components that make up fibrotic tissue, including collagen and extracellular matrix, or ECM, proteins. Furthermore, both fibrotic ECM and TGF-ß are believed to down-regulate miR-29 levels, leading to continuously increased TGF-ß expression and uncontrolled ECM production. miR-29 levels are abnormally low in multiple fibrotic indications, and lower levels of miR-29 are correlated with increased severity of fibrosis. Although various fibrotic indications are potentially distinct, they share a number of features, including the activation of the cells that initiate the deposition of fibrotic tissue or fibroblast activation, excessive deposition of collagen and other fibrosis-associated pathways, and resulting organ dysfunction. We believe the functions and biomarkers regulated by miR-29 might be shared among multiple fibrotic indications and that increasing miR-29-like activity may provide potential benefit in any of these.

To demonstrate mechanistic proof-of-concept and as a potential initial indication, we initially focused on skin fibrosis. However, we believe data derived from skin fibrosis trials may facilitate development of a product candidate intended for the treatment of patients who suffer from Idiopathic Pulmonary Fibrosis, or IPF, ocular fibrosis, tendon fibrosis, and other major organ pathological fibrosis. We anticipate releasing preclinical in vivo data from studies in ocular and lung fibrosis this year and expect data from these studies to inform our future clinical development strategies in these expansion indications.

Pathological Fibrosis

Fibrosis describes the development of fibrous connective tissue as a response to injury or damage. Fibrosis may refer to the deposition of connective tissue that occurs as part of normal healing or to the excess tissue deposition that occurs as a disease process. When fibrosis occurs in response to injury, the term “scarring” is used. Pathological fibrosis can occur in many tissues of the body, either as a primary event or as a result of inflammation or damage. In every case, regardless of the trigger, collagen build up occurs, which can result in scarring of vital organs such as the skin, lung, liver, eye, kidney, tendon, and heart, leading to irreparable damage and eventual organ failure. In addition, fibrosis prevents the normal healing of the organs and further perpetuates the fibrotic process. We believe there is a significant need for additional clinical therapeutic approaches to treating pathological fibrosis.

Below is a description of several types of pathological fibrosis for which we may seek to develop a product candidate based on a replacement for miR-29:

Type of Pathological Fibrosis	Description
Skin Fibrosis	• Scarring is a result of an over production of collagen in a healing wound. Scarring may continue to thicken for up to six months or may overgrow the site of the wound, even after the wound has healed. • Hypertrophic scars and keloids are abnormal wound responses and represent an excessive connective tissue response to skin trauma, inflammation, surgery, or burns. • Hypertrophic scars and keloids are characterized by local fibroblast proliferation and overproduction of collagen. Both hypertrophic scars and keloids are diseases that tend to be painful and itchy, restrict mobility, and are resistant to treatment.
Pulmonary Fibrosis	• Pulmonary fibrosis, also known as lung fibrosis, is caused by accumulation of scar tissues surrounding the air sacs (interstitial space) in the lung. As a result, the lung tissue becomes stiff and loses the ability to expand. The scar tissue also prevents normal transport of oxygen. The result is a progressive respiratory failure, with symptoms that include persistent cough, chest pain, difficulty breathing and fatigue. Pulmonary fibrosis leads to cardiac failure and death. Pulmonary fibrosis may occur as a secondary condition in various other diseases, but in many cases the underlying cause is not clear and is referred to as IPF. • IPF is a chronic, progressive lung disease which ultimately leads to death in many of the patients. This condition causes scar tissue to build up in the lungs, which makes the lungs unable to transport oxygen into the bloodstream effectively.
Liver Fibrosis	• Liver fibrosis refers to the scar tissue and nodules that replace liver tissue and disrupt liver function. Major causes of liver fibrosis are alcohol, chronic hepatitis B virus, hepatitis C virus infection along with the metabolic disorders non-alcoholic fatty liver disease and non-alcoholic steatohepatitis. Liver fibrosis is a major global problem driven by increasing rates of obesity and diabetes.
Eye Fibrosis	• Infection or inflammation of the eye results in impairment of visual function. Chronic inflammation can ultimately lead to fibrosis. • Eye fibrosis diseases include retinal fibrosis such as diabetic retinopathy and proliferative vitreoretinopathy, corneal fibrosis, glaucoma trabeculectomy, age-related macular degeneration, and Fuch's endothelial corneal dystrophy.

MRG-201 Phase 1 Clinical Trial

Trial Design

We conducted a single-center Phase 1, double-blind, placebo-controlled, single and multiple dose-escalation clinical trial of MRG-201. In addition to safety, kinetics, and tolerability, MRG-201 was studied to determine if it can limit the formation of fibrous scar tissue. This four-part clinical trial enrolled 54 healthy volunteers in which:

- Part A studied the expression of biomarker genes in skin at different time points following an incision and was performed without MRG-201 administration;
- Part B studied a single ascending dose of 0.5 to 14 mg of MRG-201 in intact skin;
- Part C studied a single ascending dose of 4, 7, or 14 mg of MRG-201 administered around skin incisions; and
- Part D studied multiple ascending doses of MRG-201 ranging from 4 mg to 14 mg administered around skin incisions.

The primary objectives in this clinical trial were safety and tolerability of MRG-201 injected into the skin via intradermal injections. A secondary objective was to characterize local skin and systemic exposure to MRG-201 following intradermal injection. Exploratory endpoints included the pharmacodynamic effects of MRG-201 on the expression of miR-29 gene targets in skin wound biopsies and to evaluate changes in histology from skin wounds treated with MRG-201.

Safety and Pharmacokinetics

The clinical trial enrolled 54 volunteers, 47 of whom were administered MRG-201 and seven of whom were incised without receiving a dose of MRG-201.

Nineteen volunteers in Part B received a single dose of 0.5 mg, 1 mg, 2 mg, 4 mg, 7 mg, or 14 mg of MRG-201 in un-incised skin. In these volunteers, MRG-201 was generally well tolerated. Three incidents of injection site reactions were reported, which were generally moderate. Additional adverse events of mild severity were reported as possibly related to receiving MRG-201 and included redness of the skin, a tingling sensation and sensations of warmth at a patient's injection site, and sensations of warmth on a patient's limbs and back, all of which resolved within 24 hours, as well as fatigue, which resolved in less than a week.

Nine volunteers in Part C received a single dose of either 4 mg, 7 mg, or 14 mg of MRG-201 around an incision (three volunteers per dose level). In these volunteers, MRG-201 was generally well tolerated at all dose levels evaluated. One incident of injection site reaction was reported, which was moderate and resolved within approximately 48 hours.

Nine volunteers in the dose-escalation portion of Part D received six total doses each of 4 mg, 7 mg, or 14 mg of MRG-201 around an incision. In these volunteers, MRG-201 was generally well tolerated at all dose levels evaluated. There were two injection site reactions of moderate severity reported. Five adverse events of mild severity reported by the treating physician as possibly or definitely related to MRG-201 included itching or pain at the injection site, fatigue, headache, and microscopic hematuria (blood in the urine), which had all resolved by the end of the study.

An additional 10 volunteers were enrolled in Part D to understand drug diffusion. Volunteers received six total doses each of 14 mg of MRG-201 at one end of a 4 cm incision. The other end of the incision was untreated. Both ends of the incision were biopsied to measure the potential for diffusion and pharmacodynamic activity of MRG-201 away from the site of injection. In these volunteers, MRG-201 was generally well tolerated at all dose levels evaluated. One volunteer had an injection site reaction of mild severity and one had an injection site reaction of moderate severity. Three adverse events of mild severity reported by the treating physician as possibly related to MRG-201 included chills, weakness, and localized edema and itchiness around a patient's injection site.

Systemic exposure of MRG-201 was minimal and pharmacokinetic analysis was limited as the level of drug in the blood was often lower than the assay could detect. The high number of samples that were unmeasurable was due to the low dose concentrations used (maximum deliverable dose of 14 mg/dose) and the presumed metabolism/degradation of the parent drug into undetectable metabolites. Overall, T_{max} ranged from 0.25 to 6.2 hours with more variable data from cohorts dosed into incised skin, as compared to intact skin. There were no significant findings in any study part when assessing dose proportionality or when assessing accumulation of MRG-201 in multiple dose cohorts, although statistical assessments were confounded by the small number of observations and inter-subject variability of the bioanalytical data. Biodistribution testing of skin tissue biopsies showed low levels of full-length drug at 24 hours after dosing, with diffusion of drug into adjacent, un-injected skin at least one cm away from the site of injection.

Biomarker Analysis and Histopathology

In Part A of the clinical trial in which volunteers were incised without receiving any MRG-201 or placebo, molecular analysis confirmed that miR-29 expression decreased in incised skin compared to un-incised skin, as expected for fibrosis. In addition, gene expression of miR-29/MRG-201 biomarkers, including collagens and fibrosis-related genes, was increased approximately two-to-20-fold in incised skin and was correlated with the decrease in miR-29 expression. The magnitude of the change in the expression of miR-29 and the biomarker genes was approximately 30-85% greater 16 days after administration than it was nine days after administration, indicating a time-dependent effect on gene expression. We believe these data indicate the role of miR-29 in potentially regulating the biological pathways implicated in fibrosis in human skin.

In Part C of the clinical trial, biomarkers were analyzed to assess the ability of MRG-201 to regulate the expression of genes that are associated with reduced miR-29 expression in human skin. We identified a set of biomarkers based on MRG-201 activity in preclinical models of skin fibrosis, including mouse, rat, and rabbit skin in vivo, as well as human skin fibroblasts in vitro. The biomarker panel consists of direct targets for miR-29 and downstream genes we believe are indicative of an impact on miR-29 expression in wound healing and fibrosis, particularly collagens and other genes important in fibrosis. We assessed the expression of these biomarkers in healthy subject's biopsies taken from the site of the incision 24 hours after a single MRG-201 dose compared to saline-treated lesions. Analysis of the biomarker data indicated that MRG-201 decreased expression of collagens and fibrosis-associated genes, consistent with the role we believe miR-29 plays in regulating these fibrosis-related genes. The change in expression of collagens and fibrosis-related genes appeared to be correlated with the amount of MRG-201 administered. We believe these data demonstrate an effect of MRG-201 on fibrosis-associated genes and provide an indication that MRG-201 has the potential to reduce fibrosis and scar formation in human skin. We also believe these data highlight the potential of our approach to identify molecular biomarkers that translate from preclinical studies to assessing the activity of MRG-201 in human clinical trials.

In Part D of the clinical trial, three cohorts of three volunteers each received six total doses of 4 mg, 7 mg, or 14 mg of MRG-201 and have completed dosing and the follow-up process, and a final cohort of 10 volunteers was dosed at the 14 mg dose level. MRG-201 administration did not appear to adversely affect wound healing in any cohort evaluated. Based on biomarker analysis, the collagen and fibrosis-related genes were decreased in the majority of drug-treated incisions compared to the saline control. Additionally, histological analysis indicated that incisions treated with multiple administrations of MRG-201 showed a statistically significant reduction in the area and depth of fibroplasia, a marker of fibrosis or scar formation. Furthermore, we observed that the magnitude of fibroplasia prevention corresponded to the magnitude of biomarker regulation. Multiple administrations of MRG-201, administered either starting on Day 1 or on Day 4, appeared to result in pharmacodynamic biomarker regulation (e.g. repression of collagen expression) and repression of fibroplasia at both the site of dosing and in at least half of subjects, at a distal site at least 1 cm from the site of injection. We believe these data may suggest that MRG-201 has the potential to reduce fibrosis and scar formation in human skin. The collagens and extracellular matrix genes regulated by MRG-201 in human skin have also been implicated in pulmonary fibrosis, including IPF. We believe the molecular and histological data for MRG-201 in human skin support additional development of a miR-29 mimic for IPF and additional fibrotic indications.

MRG-201 Preclinical Activities

Correlation of Biological Pathways Between Skin Fibrosis and Other Major Organ Fibrosis

The biomarkers that we believe are regulated by MRG-201 in human skin represent biological pathways that are associated with skin fibrosis but are also fundamental processes involved in pathologic fibrosis in general. Increased expression of collagens and additional fibrosis-associated genes that we believe are down-regulated by MRG-201 have been associated with multiple fibrotic indications, including scleroderma, keloids, hypertrophic scarring, IPF, systemic sclerosis, pulmonary fibrosis, fibrosis of the eye (retinal and corneal fibrosis), kidney fibrosis, tendon fibrosis, and cardiac fibrosis. We believe that the documented ability of MRG-201 to reduce the expression of these fibrosis-associated biomarkers in human skin suggests that a miR-29 mimic could also provide anti-fibrotic activity in multiple fibrotic indications.

Work done by us, as well as published data, indicate that a set of biomarkers showing increased expression in response to incision-induced fibrosis in human skin also show increased expression in multiple fibrotic indications including pulmonary fibrosis.

Delivery of miR-29 Mimic to the Lung

Together with Yale University and Lovelace Respiratory Research Institute, we were awarded a Centers for Advanced Diagnostics and Experimental Therapeutics in Lung Disease Stage II Grant from the NIH in 2014. The objective of the grant is to develop miR-29 mimicry as an efficient and personalized anti-fibrotic therapy. The collaboration is currently in year four of the five-year grant. During the first three years of the grant, the group used preclinical models to compare intravenous and aerosolized delivery routes for the amount of miR-29 mimic that enters circulation, distribution, pharmacokinetics, pharmacodynamics, and efficacy. Recent studies have been focused on dose-schedule optimization of inhaled delivery, as well as good manufacturing practice, or GMP, manufacture of the product candidate. In one of its laboratories, Yale University also established a blood assay for miR-29 detection in IPF patients. During years four and five of the grant, we plan to perform potential IND-enabling activities including additional development of an aerosolized formulation, dose-range finding studies in multiple species, and initiation of good laboratory practice, or GLP, toxicology studies. In addition, the collaboration plans to further develop its blood miR-29 diagnostic and assess correlations to tissue and lung cells collected through a procedure called bronchoalveolar lavage.

Delivery of miR-29 Mimic to the Eye

We are exploring miR-29 replacement as a therapeutic for ocular indications including ocular fibrosis. RNA-based therapeutics can be administered to the eye via eye drops for diseases affecting the front of the eye (e.g., the cornea and anterior chamber), and via injection into the eye for diseases affecting the back of the eye. Both routes of administration have been established to be generally well-tolerated for oligonucleotide therapeutics. We believe that the direct application of our microRNA therapeutic candidate into the posterior compartment of the eye may have the advantage of a greater than one-week duration of effect, as the posterior chamber of the eye is a closed compartment and is devoid of the usual clearance mechanisms present in the rest of the body. Historically, this mode of drug delivery has allowed infrequent dosing and also provided the advantage of reduced systemic exposure. Preliminary preclinical studies investigated delivery of MRG-201 via topical drops for corneal administration or direct injection into the eye for retinal administration. Both routes of administration were observed to produce functional uptake of MRG-201 into the target cells as evidenced by decreased expression of collagens and extracellular matrix

genes. Topical administration of MRG-201 appeared to reduce fibrosis and enhanced healing in a preclinical model of corneal injury.

Delivery of miR-29 Mimic to the Liver

miR-29 family members are expressed at less than normal levels in preclinical models of liver fibrosis as well as in biopsies from human fibrotic livers. Delivery of miR-29 to liver cells using adeno-associated virus, or AAV, has been shown to reverse liver fibrosis induced by carbon tetrachloride in a rodent model. We are currently assessing liver delivery of several miR-29 replacements with varying conjugates. Initial data from such assessments have shown liver delivery in rodent models. We have studied multiple compounds in efficacy studies in rodents with the AAV-delivered miR-29 in a carbon tetrachloride model of liver fibrosis. These preclinical studies to date have guided potential future efforts to identify a lead compound intended for the treatment of liver fibrosis.

MRG-110

The primary product candidate under our amended Servier Collaboration Agreement is MRG-110 (or S95010 per Servier). MRG-110 is a locked nucleic acid modified oligonucleotide that appears to accelerate the formation of new blood vessels in preclinical models of heart failure, peripheral ischemia, and dermal wounding. MRG-110 is an inhibitor of miR-92a, a microRNA that is expressed in endothelial cells and has been shown to be integral in the direct control of new blood vessel growth in response to injury or tissue compromise as well as in the biology of tissue healing. The compound is being developed for potential use in various indications in which enhanced vascular density is expected to provide clinical benefit. Several preclinical studies indicated that tissue expression of miR-92a is increased in cardiovascular diseases. miR-92a was elevated in heart samples after myocardial infarction in multiple preclinical models, as well as in atherosclerotic lesions and neointima samples.

In preclinical testing, the inhibition of miR-92a by MRG-110 resulted in improved cardiac function following myocardial infarction in multiple species, with stimulatory effects on neovascularization. Improvements in neovascularization as well as accelerated healing rates were observed in models of acute excisional cutaneous wounds, as well as chronic non-healing cutaneous wounds. Initially, the collaboration intends to study MRG-110 for the treatment of chronic heart failure and in the healing of acute as well as chronic cutaneous wounds; however, other indications may be pursued later.

In the first half of 2018, Servier plans to initiate a Phase 1 clinical trial for MRG-110 evaluating the safety and tolerability of MRG-110 in a systemic dosing protocol intended to support further clinical studies for the potential treatment of heart failure. The Phase 1 clinical trial is planned to enroll 49 male subjects aged 18 to 45, and the trial results will be analyzed for biomarkers that may provide mechanistic proof-of-concept and support further potential clinical trials of MRG-110 in the treatment of cardiovascular disease and certain other conditions where vascular flow is compromised. We believe there is a significant need for medical advances in the treatment of heart failure, as over one third of the adult U.S. population suffers from at least one form of cardiovascular disease.

Also in the first half of 2018, we plan to initiate a separate Phase 1 clinical trial assessing the safety and tolerability of MRG-110 after intradermal administration in healthy volunteers. This clinical trial will include several exploratory endpoints that are intended to provide mechanistic proof-of-concept and biomarker validation to support potential use in patients at high risk for complications after surgical incisions or chronic wounds. The intradermal administration clinical trial is intended to support additional clinical studies in other diseases, including dermatologic applications, where increased vascularity may result in better healing and better outcomes. Under the Servier Collaboration Agreement, we granted Servier exclusive licenses to commercialize MRG-110 and one additional to be named product candidate in the field of cardiovascular disease in all countries except the United States and Japan. We retain all rights to these programs in the United States and Japan.

Chronic Heart Failure Physiopathology

The imbalance between oxygen demand and supply of cardiomyocytes plays an important role in the pathophysiology of heart failure. Chronic Heart Failure, or CHF, is associated with a decrease of myocardial blood flow that begins at the early stages of the heart failure. A preserved coronary microcirculation is able to increase blood flow in case of increased demand. In CHF, this Coronary Flow Reserve was shown to be reduced secondary to capillary dysfunction and rarefaction limiting oxygen supply to cardiomyocytes. Analysis of heart tissue from patients suffering CHF revealed a reduction of coronary microvascular density, or MVD. Sixty percent of cases of CHF patients with reduced ejection fraction, or HFrEF, have an ischemic origin. Progressive loss of cardiomyocytes and increase in fibrosis decrease capillary density. Compensatory elongation and hypertrophy of remaining cardiomyocytes further increase capillary length and inter-capillary distance reducing oxygenation.

CHF is one of the leading causes of mortality and morbidity in the world. The prognosis remains poor with 45-60% mortality five years after diagnosis. Quality of life in patients is impaired, from mild to severe limitations in daily life. To date, standard of care treatment slows down the progression of disease by inhibiting the neuro-hormonal activation and reducing vascular bed congestion. Coronary revascularization, with percutaneous coronary intervention, or PCI, or coronary arterial bypass grafting, or CABG, have been chosen to improve patient prognosis when the obstruction is located in the epicardial coronaries but is generally of no benefit in cases when the flow is limited downstream in the microcirculatory network. We believe that new reparative/regenerative solutions are needed for improving patient cardiac function that could consequently make a difference in daily quality of life with a further reduction in morbidity and mortality. The restoration of the microcirculation appears to be a potentially innovative therapeutic way to improve cardiac function.

In preclinical data, MRG-110 was observed to reduce infarct size in both rat and pig models of acute myocardial infarction, leading to an improved cardiac function. The cardioprotective effects were correlated with reduced cell death, reduced inflammation, and improved neovascularization of the affected myocardium. Similar effects were also observed in pig hibernating myocardium, a model of chronic ischemia, thought to be more representative of human cardiomyopathies.

Cutaneous wounds

In preclinical studies, we recently observed MRG-110 improving wound healing in normal, healthy farm pigs. In induced excisional wounds in healthy, normal farm pigs, MRG-110 appeared to result in increased perfusion, measured by laser Doppler imaging on Day 14, and more rapid wound closure compared to wounds in control animals treated similarly with vehicle control or standard of care, or SOC. Within the dermal portion of the wound bed, there was a dose dependent increase in granulation tissue and in vascularization on Day 49, 5 weeks after the last dose, in the wounds treated with MRG-110 compared with SOC-treated wounds. We believe the effects on wound healing in mice and pigs support further evaluation of MRG-110 for its potential to accelerate revascularization and granulation tissue formation, and ultimately wound closure in acute settings such as laparotomy or sternotomy incisions in patients with high risk of poor wound closure and incisional hernia.

Other Preclinical Programs

In 2016, we were awarded a milestone-driven grant by The ALS Association of up to $0.4 million to advance the development of MRG-107. MRG-107 is an inhibitor of miR-155 intended to be developed for the treatment of amyotrophic lateral sclerosis, or ALS. We are exploring miR-155 inhibition as a potential treatment to reduce neuronal degeneration in ALS and other neurodegenerative indications, including spinal cord injury. In preclinical studies of acute spinal cord injury, miR-155 inhibition appeared to: reduce tissue damage, reduce neuron degeneration, decrease fibrosis, increase axonal growth, and result in improved mobility and autonomic function.

We are also evaluating and developing additional microRNA-targeted, preclinical product candidates in a variety of disease indications where an abnormal level of one or more microRNAs has been implicated in disease pathology. Our inhibitor programs, including these product candidates, were created using the locked nucleic acid technology that we exclusively licensed from Santaris Pharma A/S, which subsequently changed its name to Roche Innovation Center Copenhagen A/S, or RICC, which was acquired by F. Hoffmann-La Roche Ltd, or Roche, in 2014 and subsequently changed its name to RICC, on a target-by-target basis. We believe combining this technology with our internal expertise may allow us to create unique product candidates that possess desirable drug-like properties capable of entering diseased cells without the need for additional delivery technologies. We have a broad patent portfolio intended to protect these product candidates.

Background on microRNAs

microRNAs are transcribed from the genome and unlike messenger RNA, or mRNA, they do not encode proteins. microRNAs function by preventing the translation of mRNAs into proteins and/or by triggering degradation of these mRNAs. Studies have shown that microRNA gene regulation is often not a decisive on and off switch but a subtle function that fine-tunes cellular phenotypes that becomes more pronounced during stress or disease conditions. microRNAs were first discovered in 1993 and have since been found in nearly every biological system examined since that time. They are highly conserved across species, demonstrating their importance to biological functions and cellular processes. According to the Sanger Institute, over 1,000 microRNAs have been identified in humans.

A body of evidence has shown that inappropriate levels of particular microRNAs are directly linked to a range of serious diseases, many of which are poorly served by existing therapies. microRNAs can affect the balance of protein expression and serve as “command and control” nodes that directly coordinate multiple critical systems simultaneously. This effect on systems biology is a naturally occurring homeostatic process that becomes disrupted in certain disease states. As a result, developing

microRNA-based therapeutics is fundamentally different from the single-protein, single-target approach that is the foundation of traditional small and large molecule drugs.

Our Approach to Drug Discovery and Development

Our research and development strategy is designed to accelerate timelines and reduce development risk. The goal of our translational medicine strategy is to progress rapidly to first-in-human trials once we have adequately established mechanistic proof-of-concept, consisting of pharmacokinetics, pharmacodynamics, safety, and manufacturability of the product candidate in preclinical studies. Programs that progress into human trials are designed to be accompanied by a validated set of pharmacodynamic biomarkers that allow us to verify the mechanism of drug action in humans and to potentially stratify and enrich the study population. Through this approach, we seek to reduce the risk of our programs by quantifying target engagement and identifying the likely efficacious dose prior to progression to Phase 2 clinical trials.

Discovery

Although there are over 1,000 identified human microRNAs, not all of them have been shown to be causal in disease. Our approach to drug discovery and development begins with the identification of potentially pathological microRNAs.

We apply three general approaches to the identification of potentially pathological, or disease-causing, microRNAs: (i) profiling of microRNA expression in diseased tissue versus normal tissue to identify microRNAs that are found at abnormally high or low levels; (ii) identification of microRNAs that are located within genes (typically in non-protein coding segments) of validated disease-relevant genes and thus simultaneously expressed with the disease associated gene; and (iii) evaluation of microRNAs that are predicted to directly modulate the expression of specific, disease-relevant genes.

We believe that the microRNA inhibitor candidates face lower delivery hurdles compared to microRNA mimics and have better drug-like properties in regard to affinity to their targets, stability, drug distribution, and pharmacodynamics. To improve their therapeutic potential, we chemically modify these compounds with changes such as locked nucleic acid (known as LNA) substitution of the ribose sugar in many of the nucleosides and deoxyribonucleoside (known as DNA).

In conditions where a deficit in microRNA expression has been identified as disease causing, microRNA replacements, which are modified, double-stranded RNA structures that are recognized by the RNA-induced silencing complex, or RISC, can serve as chemically-synthesized replacements for microRNAs.

Historically, the delivery of double stranded RNAs, such as microRNA replacements, has been a significant hurdle to overcome for drug development because these molecules are very rapidly degraded and because uptake into cells can be inefficient. Our delivery approach for double-stranded microRNA replacements is to append a conjugate to the molecule to enhance cellular uptake. The selection of the conjugate is dependent upon the intended therapeutic use. We have deployed hydrophobic conjugates, such as cholesterol, that are able to improve pharmacokinetics and allow for enhanced cellular uptake. We are also exploring a range of conjugates that help in targeting specific tissues and cells. Our strategy with microRNA replacements has centered on opportunities for efficient delivery of the molecules with an emphasis on local and topical applications, such as injections in the skin, eye, or lung. For organs where topical or local applications are not feasible, such as the liver, we have employed conjugates that have demonstrated successful delivery after systemic administration.

Development

Our approach to translational medicine is focused on rapidly testing the molecular hypothesis in human cell lines and animal models to demonstrate safety and measure pharmacokinetics and pharmacodynamics, and finally designing and conducting small, efficient, and targeted human Phase 1 clinical trials. We typically select an initial indication that is genetically defined or is a rare disease where abnormal levels of a microRNA have been implicated. These early-stage Phase 1 clinical trials are designed to test the mechanistic relevance and develop mechanistic proof-of-concept in humans in a setting that provides the opportunity to develop a biomarker toolkit for a mechanism of action that we believe has broader disease relevance.

The mechanistic proof-of-concept studies are designed to provide relevant information that helps to reduce development risks in humans. Our aim is to demonstrate that the expression levels of the microRNA could potentially serve as a diagnostic indicator that allows for better patient selection for later clinical trials and in additional indications. At the same time, we seek to confirm molecular activity of the drug.

By measuring the pharmacodynamics of target engagement, we are able to show that the product candidate effectively enters the appropriate cell and binds to its intended target. This process is particularly important for oligonucleotide drugs. We can

also measure the effects on a series of downstream genes that create a plausible link between target engagement and a mechanism of disease.

For some diseases, we believe that local administration allows us to achieve a variety of concentrations of drug at the site of action and facilitates the development of dose / response relationships. We believe understanding the dose necessary to show target engagement, while concomitant surrogate marker alterations provide the basis for which a systemic dose can be defined that will be necessary to potentially achieve a therapeutic effect.

Exploratory endpoints can provide us with verification of the pharmacodynamic effects of the drug based on biomarker readouts and morphological alterations. This translational strategy allows us to answer many questions about the drug target pair and provides improved confidence that the molecular basis of drug action is relevant in humans. Having built confidence in the drug mechanism and demonstrated an acceptable safety profile, later-stage clinical trials will be designed to establish appropriate dose and therapeutic efficacy.

Our Strategic Collaborations and License Agreements

Strategic Alliance and Collaboration with Servier

In October 2011, we entered into the Servier Collaboration Agreement with Servier for the research, development, and commercialization of RNA-targeting therapeutics in cardiovascular disease, or the Servier Collaboration Agreement. Under the Servier Collaboration Agreement, as amended, we granted Servier an exclusive license to research, develop, manufacture, and commercialize RNA-targeting therapeutics for certain microRNA targets in the cardiovascular field. In 2017, the Servier Collaboration Agreement was amended to remove all existing targets, add one new target (microRNA-92), and grant Servier with the right to add one additional target through September 2019. Under the terms of the amended agreement, the term of the research collaboration under the Servier Collaboration Agreement has been extended through September 2019.

Servier's rights to each of the targets are limited to therapeutics in the field of cardiovascular disease, as defined, and in Servier's territory, which is worldwide except for the United States and Japan. We retain all other rights including commercialization of therapeutics developed under the Servier Collaboration Agreement in the field of cardiovascular disease in the United States and Japan.

We are eligible to receive development milestone payments of €5.8 million to €13.8 million ($6.9 million to $16.5 million as of December 31, 2017) and regulatory milestone payments of €10.0 million to €40.0 million ($12.0 million to $47.9 million as of December 31, 2017) for each target. Additionally, we may receive up to €175.0 million ($209.6 million as of December 31, 2017) in commercialization milestones, as well as quarterly royalty payments expressed in percentages ranging from the low-double digits to the mid-teens (subject to reductions for patent expiration, generic competition, third-party royalty, and costs of goods) on the net sales of any licensed product commercialized by Servier. Servier is obligated to make royalty payments for a specified period under the Servier Collaboration Agreement.

As part of the Servier Collaboration Agreement, we established a multiple-year research collaboration, under which we jointly perform agreed upon research activities directed to the identification and characterization of named targets and oligonucleotides in the cardiovascular field, which we refer to as the Research Collaboration. The current term of the Research Collaboration extends through September 2019. Servier is responsible for funding all of the costs of the Research Collaboration, as defined under the Servier Collaboration Agreement. During the years ended December 31, 2017 and 2016, we recognized as revenue amounts reimbursable to us under the Servier Collaboration Agreement of $3.1 million and $2.3 million, respectively.

The development of each product candidate (commencing with registration enabling toxicology studies) under the Servier Collaboration Agreement is performed pursuant to a mutually agreed upon development plan to be conducted by the parties as necessary to generate data useful for both parties to obtain regulatory approval of such product candidates. Servier is responsible for a specified percentage of the cost of research and development activities under the development plan through the completion of one or more Phase 2 clinical trials and will reimburse us for a specified portion of such costs that we incur. The costs of Phase 3 clinical trials for each product candidate will be allocated between the parties at one of several specified percentages of costs. The applicable percentage for each product candidate will be based upon whether certain events under the Servier Collaboration Agreement occur, including if we enter into a third-party agreement for the development and/or commercialization of the product in the United States at least 180 days before the initiation of the first Phase 3 clinical trial, or if we subsequently enter into a U.S. partner agreement, or if we do not enter into a U.S. partner agreement but file for approval in the United States using data from the Phase 3 clinical trial. We are responsible, by ourselves or through a third-party manufacturer, for the manufacture and supply of all licensed oligonucleotides during the preclinical phase of development under the Servier Collaboration Agreement while Servier is primarily responsible for manufacture and supply of all licensed

oligonucleotides and product during the clinical phase of development under the Servier Collaboration Agreement. Each party is responsible for the commercial supply of any licensed product to be sold in its territory under the Servier Collaboration Agreement.

Under the Servier Collaboration Agreement, we also granted Servier a royalty-free, non-exclusive license to develop a companion diagnostic for any therapeutic product which may be developed by Servier under the Servier Collaboration Agreement. We also granted Servier an exclusive, royalty-free license to commercialize such a companion diagnostic in our territory for use in connection with the development and commercialization of such therapeutic product in Servier's territory.

The Servier Collaboration Agreement will expire as to each underlying product candidate when Servier's royalty obligations as to such product candidate have expired. Servier may also terminate the Servier Collaboration Agreement for: (i) convenience upon a specified number of days' prior notice to us or (ii) upon determination of a safety issue relating to development under the agreement upon a specified number of days' prior notice to us. Either party may terminate the Servier Collaboration Agreement upon a material breach by the other party which is not cured within a specified number of days. We may also terminate the agreement if Servier challenges any of the patents licensed by us to Servier.

License Agreements with the University of Texas

As of December 31, 2017, we had five exclusive patent license agreements, or the UT License Agreements, with the Board of Regents of The University of Texas System, or the University of Texas. Under each of the UT License Agreements, the University of Texas granted us exclusive and nonexclusive licenses to certain patent and technology rights. The University of Texas is one of our minority stockholders.

In consideration of rights granted by the University of Texas, we agreed to: (i) pay a nonrefundable upfront license documentation fee in the amount of $10 thousand per license; (ii) pay an annual license maintenance fee in the amount of $10 thousand per license starting one year from the date of each agreement; (iii) reimburse the University of Texas for actual costs incurred in conjunction with the filing, prosecution, enforcement, and maintenance of patent rights prior to the effective date; and (iv) bear all future costs of and manage the filing, prosecution, and maintenance of patent rights. During the years ended December 31, 2017 and 2016, we incurred immaterial upfront and maintenance fees, which were recorded as research and development expense. All costs related to the filing, prosecution, and maintenance of patent and technology rights are recorded as general and administrative expense when incurred.

Under the terms of the UT License Agreements, we may be obligated to make the following future milestone payments for each licensed product candidate: (i) up to approximately $0.6 million upon the initiation of defined clinical trials; (ii) $2.0 million upon regulatory approval in the United States; and (iii) $0.5 million per region upon regulatory approval in other specified regions. Additionally, if we or any of our sublicensees successfully commercialize any product candidate subject to the UT License Agreements, we are responsible for royalty payments in the low-single digits based upon net sales of such licensed products and payments at a percentage in the mid-teens of any sublicense income, subject to specified exceptions. The University of Texas's right to the royalty payments will expire as to each license agreement upon the expiration of the last patent claim subject to the applicable UT License Agreement.

The license term extends on a product-by-product and country-by-country basis until the expiration of the last to expire of the licensed patents that covers such product in such country. Upon expiration of the royalty payment obligation, we will have a fully paid license in such country. We may also terminate each UT License Agreement for convenience upon a specified number of days' prior notice to the University of Texas. The University of Texas also has the right to earlier terminate the UT License Agreements after a defined date under specified circumstances where we have effectively abandoned our research and development efforts or have no sales. The UT License Agreements will terminate under customary termination provisions including automatic termination upon our bankruptcy or insolvency, upon notice of an uncured material breach, and upon mutual written consent. We have expensed all charges incurred under the UT License Agreements to date, due to the uncertainty as to future economic benefit from the acquired rights.

License Agreement with RICC

In June 2010, we entered into a license agreement with RICC. The agreement was amended in October 2011 and amended and restated in December 2012, or the RICC License Agreement.

Under the RICC License Agreement, we received exclusive and nonexclusive licenses from RICC to use specified technology of RICC, or the RICC Technology, for specified uses including research, development, and commercialization of pharmaceutical products using this technology worldwide. Under the RICC License Agreement, we have the right to develop

and commercialize the RICC Technology directed to four specified targets and the option to obtain exclusive product licenses for up to six additional targets. The acquisition of Santaris Pharma A/S by Roche was considered a change-of-control under the RICC License Agreement, and as such, certain terms and conditions of the RICC License Agreement changed, as contemplated and in accordance with the RICC License Agreement. These changes primarily relate to milestone payments reflected in the disclosures below. As consideration for the grant of the license and option, we previously paid RICC $2.3 million and issued RICC 856,806 shares of our Series A convertible preferred stock, which were subsequently transferred to Roche Finance Ltd, an affiliate of Roche, and, in 2017, were converted into 602,420 shares of our common stock as a result of the Merger. If we exercise our option to obtain additional product licenses or to replace the target families, we will be required to make additional payments to RICC.

Under the terms of the RICC License Agreement, milestone payments were previously decreased by a specified percentage as a result of the change of control by RICC referenced above. We are obligated to make future milestone payments for each licensed product of up to $5.2 million, which is inclusive of a potential product license option fee. Certain of these milestones will be increased by a specified percentage if we undergo a change in control during the term of the RICC License Agreement. If we grant a third party a sublicense to the RICC Technology, we are required to remit to Roche a specified percentage of the upfront and milestone and other specified payments that we receive under its sublicense, and if such sublicense covers use of the RICC Technology in the United States or the entire European Union, we will not have any further obligation to pay the fixed milestone payments noted above.

If we or our sublicensee successfully commercializes any product candidate subject to the RICC License Agreements, then RICC is entitled to royalty payments in the mid-single digits on the net sales of such product, provided that if such net sales are made by a sublicensee under the RICC License Agreement, RICC is entitled to royalty payments equal to the lesser of a percentage in the mid-single digits on the net sales of such product or a specified percentage of the royalties paid to us by such sublicensee, subject to specified restrictions. We are obligated to make any such royalty payments until the later of: (i) a specified anniversary of the first commercial sale of the applicable product or (ii) the expiration of the last valid patent claim licensed by RICC under the RICC License Agreement underlying such product. Upon the occurrence of specified events, the royalty owed to RICC will be decreased by a specified percentage.

The RICC License Agreement will terminate upon the latest of the expiration of all of RICC's royalty rights, the termination of the last Miragen target or the expiration of its right to obtain a product license for a new target under the RICC License Agreement. We may also terminate the RICC License Agreement for convenience upon a specified number of days' prior notice to RICC, subject to specified terms and conditions. Either party may terminate the RICC License Agreement upon an uncured material breach by the other party and RICC may terminate the RICC License Agreement upon the occurrence of other specified events immediately or after such event is not cured within a specified number of days, as applicable.

License Agreements with the t2cure GmbH

In October 2010, we entered into a license and collaboration agreement, or the t2cure Agreement, with t2cure GmbH, or t2cure, which was subsequently amended. Under the t2cure Agreement, we received a worldwide, royalty bearing, and exclusive license to specified patent and technology rights to develop and commercialize product candidates targeted at miR-92.

In consideration of rights granted by t2cure, we paid a onetime upfront fee of $46 thousand and agreed to: (i) pay an annual license maintenance fee in the amount of €3 thousand ($3 thousand as of December 31, 2017) and (ii) reimburse t2cure for costs incurred in conjunction with the filing, prosecution, enforcement, and maintenance of patent rights. All costs related to the filing, prosecution, enforcement, and maintenance of patent and technology rights are recorded as general and administrative expense when incurred.

Under the terms of the t2cure Agreement, we are obligated to make the following future milestone payments for each licensed product: (i) up to approximately $0.7 million upon the initiation of certain defined clinical trials; (ii) $2.5 million upon regulatory approval in the United States; and (iii) up to $1.5 million per region upon regulatory approval in the European Union or Japan. Additionally, if we or any of our sublicensees successfully commercializes any product candidate subject to the t2cure Agreement, we are responsible for royalty payments in the low-single digits upon net sales of licensed products and sublicense fees equal to a percentage in the low-twenties of sublicense income received by us. We are obligated to make any such royalty payment until the later of: (i) the tenth anniversary of the first commercial sale of the applicable product or (ii) the expiration of the last valid claim to a patent licensed by t2cure under the t2cure Agreement covering such product. If such patent claims expire prior to the end of the ten-year term, then the royalty owed to t2cure will be decreased by a specified percentage. We also have the right to decrease our royalty payments by a specified percentage for royalties paid to third parties for licenses to certain third-party intellectual property.

The license term extends on a country-by-country basis until the later of: (i) the tenth anniversary of the first commercial sale of a licensed product in a country, and (ii) the expiration of the last to expire valid claim that claims such licensed product in such country. Upon expiration of the royalty payment obligation, we will have a fully paid license in such country. We have the right to terminate the t2cure Agreement at will, on a country-by-country basis, after 60 days' written notice. The t2cure Agreement will also automatically terminate upon our bankruptcy or insolvency or upon notice of an uncured material breach.

License Agreement with The Brigham and Women's Hospital

In May 2016, we entered into an exclusive patent license agreement, or the BWH License Agreement, with The Brigham and Women's Hospital, or BWH. Under the BWH License Agreement, we have an exclusive, worldwide license, including a right to sublicense, to specified patent rights and a nonexclusive, worldwide license, including a right to sublicense, to specified technology rights of BWH, each related to certain microRNAs believed to be involved in various neurodegenerative disorders. As consideration for these rights, we are obligated to pay a specified annual license fee. BWH is also entitled to milestone payments of up to approximately $2.6 million for each of our product candidates developed based on the patent rights subject to the BWH License Agreement plus a one-time sales milestone payment of $0.3 million for all product candidates developed based on the patent rights subject to the BWH License Agreement. If we successfully commercialize any product candidate subject to the BWH License Agreement, then BWH is entitled to royalty payments in the low-single digits on the net sales of such product. BWH's right to these royalty payments will expire on a product-by-product and country-by-country basis upon the expiration of the last patent claim in such country that is subject to BWH License Agreement and covers the product, and our license to such product in such country will become fully paid at such time. BWH is also entitled to a percentage in the low-double digits of any sublicense income from such product, subject to specified exceptions. We are also responsible for all costs associated with the preparation, filing, prosecution, and maintenance of the patent rights subject to the BWH License Agreement. Additionally, we are obligated to use commercially reasonable efforts to develop a product under the BWH License Agreement and to meet specified diligence milestones thereunder.

The BWH License Agreement will terminate upon the expiration of all issued patents and patent applications subject to the patent rights under the agreement. We may also terminate the BWH License Agreement for convenience upon a specified number of days' prior notice to BWH. BWH may terminate the BWH License Agreement upon a breach by us of our payment obligations and upon the occurrence of other specified events that are not cured within a specified number of days, provided that such termination is automatic upon our bankruptcy or insolvency.

Subcontract Agreement with Yale University

In October 2014, together with Yale University, or Yale, we entered into a subcontract agreement and into a subaward agreement in March 2015, or the Yale Agreements, which was subsequently amended. Under the Yale Agreements, we are providing specified services regarding the development of a proprietary compound that targets miR-29 in the indication of idiopathic pulmonary fibrosis. Yale entered into the Yale Agreements in connection with a grant that Yale received from the NIH for the development a miR-29 mimicry as a potential therapy for pulmonary fibrosis.

In consideration of our services under the Yale Agreements, Yale has agreed to pay us up to $1.1 million over five years, subject to the availably of funds under the grant and continued eligibility. Under the terms of the Yale Agreements, we retain all rights to any and all intellectual property developed solely by us in connection with the Yale Agreements. Yale has also agreed to provide us with an exclusive option to negotiate in good faith for an exclusive, royalty-bearing license from Yale for any intellectual property developed by Yale or jointly by the parties under the Yale Agreements. Yale is responsible for filing, prosecuting, and maintaining foreign and domestic patent applications and patents on all inventions jointly developed by the parties under the Yale Agreements.

The Yale Agreements terminates automatically on the date that Yale delivers its final research report to the NIH under the terms of the grant underlying the Yale Agreements. Each party may also terminate the Yale Agreements upon a specified number of days' notice if the NIH's grant funding is reduced or terminated or upon material breach by the other party.

Manufacturing

We do not own or operate manufacturing facilities for the production of cobomarsen, MRG-201, MRG-110, or other product candidates that we develop, nor do we have plans to develop our own manufacturing operations in the foreseeable future. We currently depend on third-party contract manufacturers for all of our required raw materials, active pharmaceutical ingredients, and finished product candidates for our clinical trials. We do not have any current contractual arrangements for the manufacture of commercial supplies of cobomarsen, MRG-201, MRG-110, or any other product candidates that we develop. We currently employ internal resources and third-party consultants to manage our manufacturing contractors.

Sales and Marketing

We have not yet defined our sales, marketing, or product distribution strategy for cobomarsen, MRG-201, MRG-110, or any of our other product candidates because our product candidates are still in preclinical or early-stage clinical development. Our commercial strategy may include the use of strategic partners, distributors, a contract sale force, or the establishment of our own commercial and specialty sales force. We plan to further evaluate these alternatives as we approach approval for one of our product candidates.

Intellectual Property

We are actively building an intellectual property portfolio around our clinical-stage product candidates and discovery programs. A key component of this portfolio strategy is to seek patent protection in the United States and in major market countries that we consider important to the development of our business worldwide. As of March 1, 2018, we have a portfolio of 295 patents and applications of which 172 are issued or allowed and 123 are pending applications. This portfolio includes methods of use and composition patents, and patent applications on our three lead product candidates, cobomarsen, MRG-201, and MRG-110. Our success depends in part on our ability to obtain and maintain proprietary protection for our product candidates and other discoveries, inventions, trade secrets and know-how that are critical to our business operations. Our success also depends in part on our ability to operate without infringing the proprietary rights of others, and in part, on our ability to prevent others from infringing our proprietary rights. A comprehensive discussion on risks relating to intellectual property is provided under "*Risk Factors*" under the subsection "*Risks Related to our Intellectual Property*".

We have filed patent applications directed to compositions of matter and methods of use covering cobomarsen in the United States and under the Patent Cooperation Treaty, or PCT, to access foreign countries. A U.S. patent application issued as U.S. 9,771,585 on September 26, 2017, which will expire in June of 2036 if we continue to pay the maintenance fees and annuities when due, with the possibility of Patent Term Extension that may be granted by the USPTO due to administrative delays in the FDA. Prior to the issue of this application, we filed a continuation application in August 2017 directed to methods of treatment, as U.S. 15/677,818, and this application is currently pending. We also filed an U.S. application directed to compositions of matter through the PCT, as U.S. 15/714,671, and this application is currently pending.

We expect these pending applications will issue as U.S. patents in the next two to three years, with a projected expiration year of 2036 if we continue to pay the maintenance fees and annuities when due, with the possibility of additional terms from the USPTO prosecution delays and from patent term extensions that may be granted due to administrative delays in the FDA. We also have pending applications that cover methods of use of cobomarsen and related compositions. Collectively, these applications, if they issue, would have patent expirations from 2036 if we continue to pay the maintenance fees and annuities when due, not including any possible additional terms for patent term adjustments or patent term extensions. We do not know if any patent will issue from any of these applications and, if any issue, we do not know whether the issued patents will provide significant proprietary protection or commercial advantage against our competitors or generics. Even if they are issued, our patents may be circumvented, challenged, opposed, and found to be invalid or unenforceable.

We have filed patent applications directed to compositions of matter and methods of use covering MRG-110 in the U.S. and under the PCT, to access foreign countries. A patent directed to compositions of matter and methods of use of MRG-110 issued as U.S. 9,803,202, on October 31, 2017, and will expire in June 2033 if we continue to pay the maintenance fees and annuities when due, with the possibility of Patent Term Extension that may be granted by the USPTO due to administrative delays in the FDA. We also have issued patents and pending applications that cover various therapeutic uses and generic compositions of matter comprising MRG-110. Collectively, these patents and patent applications, if they issue, would have patent expirations ranging from 2028 to 2036 if we continue to pay the maintenance fees and annuities when due, not including any possible additional terms for patent term adjustments or patent term extensions. We do not know if any patent will issue from any of the pending applications and, if any issue, we do not know whether the issued patents will provide significant proprietary protection or commercial advantage against our competitors or generics. Even if they are issued, our patents may be circumvented, challenged, opposed, and found to be invalid or unenforceable.

We have filed patent applications directed to compositions of matter and methods of use covering MRG-201 in the United States and under the PCT to access foreign countries. A U.S. patent application issued as U.S. 9,376,681 on June 28, 2016, which will expire in September of 2035 if we continue to pay the maintenance fees and annuities when due, with the possibility of Patent Term Extension that may be granted by the USPTO due to administrative delays in the FDA. Prior to the issue of this application, we filed a continuation application in June 2016 also directed to compositions of matter in the United States, as U.S. 15/175,636, and this application has been allowed, with a projected expiration date of September 2035, if we continue to pay the maintenance fees and annuities when due, not including any possible additional terms for patent term adjustments or

patent term extensions. We also have issued patents and pending applications that cover various therapeutic uses and generic compositions comprising MRG-201. Collectively, these patents and patent applications, if they issue, would have patent expirations ranging from 2028 to 2035 if we continue to pay the maintenance fees and annuities when due, not including any possible additional terms for patent term adjustments or patent term extensions. We do not know if any patent will issue from any of the pending applications and, if any issue, we do not know whether the issued patents will provide significant proprietary protection or commercial advantage against our competitors or generics. Even if they are issued, our patents may be circumvented, challenged, opposed, and found to be invalid or unenforceable.

For our earlier stage product candidates, we have filed compositions of matter and methods of use patent applications in the United States, and under the PCT to access foreign countries.

In addition to patent protection, we seek to rely on trade secret protection, trademark protection and know-how to expand our proprietary position around our chemistry, technology and other discoveries and inventions that we consider important to our business. We also seek to protect our intellectual property in part by entering into confidentiality agreements with our employees, consultants, scientific advisors, clinical investigators, and other contractors and also by requiring our employees, commercial contractors, and certain consultants and investigators, to enter into invention assignment agreements that grant us ownership of any discoveries or inventions made by them. Further, we seek trademark protection in the United States and internationally where available and when we deem appropriate. We have obtained registrations for the Miragen trademark, which we use in connection with our pharmaceutical research and development services as well as our clinical-stage product candidates. We currently have such registrations for Miragen in the United States, Canada, Japan, and the European Union.

Competition

The biotechnology and pharmaceutical industries are characterized by intense and rapidly changing competition to develop new technologies and proprietary products. Our clinical and preclinical product candidates may address multiple markets. Ultimately, the diseases our product candidates target for which we may receive marketing authorization will determine our competition. We believe that for most or all of our product development programs, there will be one or more competing programs under development by other companies. Any products that we may commercialize will have to compete with existing therapies and new therapies that may become available in the future. We face potential competition from many different sources, including larger and better-funded biotechnology and pharmaceutical companies. In many cases, the companies with competing programs will have access to greater resources and expertise than we do and may be more advanced in those programs.

We believe that our current and future competition for resources and eventually for customers can be grouped into three broad categories:

- companies working to develop microRNA targeted products, including Regulus Therapeutics Inc., Microlin Bio, Inc., and InteRNA Technologies B.V.;

- companies working to develop other types of oligonucleotide therapeutic products, including Ionis Pharmaceuticals, Inc., Alnylam Pharmaceuticals, Inc., Arrowhead Pharmaceuticals, Inc., Dicerna Pharmaceuticals, Inc., RaNa Therapeutics, Inc., RXi Pharmaceuticals Corporation, and Silence Therapeutics AG; and

- companies with marketed products and development programs for therapeutics that treat the same diseases for which we may also be developing potential treatments.

The following companies have therapeutics marketed or in development for CTCL: Actelion Ltd, Argenx, Bristol-Myers Squibb Company, Celgene Corporation, innate Pharma, Kyowa Hakko Kirin, Merck & Co., Inc., Mylan Pharmaceuticals Inc., Novartis International AG, Spectrum Pharmaceuticals, Inc., Seattle Genetics, Inc., Takeda Pharmaceutical Company Ltd, and Valeant Pharmaceuticals International, Inc.

The following companies have marketed therapeutics for pulmonary fibrosis: Boehringer Ingelheim GmbH, F. Hoffmann-La Roche Ltd.

We believe that the key competitive factors that will affect the success of any of our product candidates, if commercialized, are likely to be their efficacy, safety, convenience, price, and the availability of reimbursement from government and other third-party payors relative to such competing products. Our commercial opportunity could be reduced or eliminated if our competitors have products that are superior in one or more of these categories.

Government Regulation

FDA Drug Approval Process

In the United States, pharmaceutical products are subject to extensive regulation by the FDA. The Federal Food, Drug, and Cosmetic 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 at any time during the product development process may subject a company to a variety of administrative or judicial sanctions, such as imposition of clinical hold, FDA refusal to approve pending new drug applications, or NDAs, warning or untitled letters, withdrawal of approval, product recalls, product seizures, total or partial suspension of production or distribution, injunctions, fines, civil penalties, and criminal prosecution.

We cannot market a drug product candidate in the United States until the drug has received FDA approval. The steps required before a drug may be marketed in the United States generally include the following:

- completion of extensive preclinical laboratory tests, animal studies, and formulation studies in accordance with the FDA's good laboratory practices, or GLP, regulations;
- approval by an independent institutional review board, or IRB, at each clinical site before each trial may be initiated at that site;
- submission to the FDA of an investigational new drug application, or IND, for human clinical testing, which must become effective before human clinical trials may begin;
- performance of adequate and well-controlled human clinical trials in accordance with good clinical practice, or GCP, requirements to establish the safety and efficacy of the drug for each proposed indication;
- submission to the FDA of an NDA after completion of all pivotal clinical trials;
- satisfactory completion of an FDA advisory committee review, if applicable
- satisfactory completion of an FDA pre-approval inspection of the manufacturing facility or facilities at which the active pharmaceutical ingredient, or API, and finished drug product are produced and tested to assess compliance with current good manufacturing practices, or cGMPs; and
- FDA review and approval of the NDA prior to any commercial marketing or sale of the drug in the United States.

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 GLP. An IND sponsor must submit the results of preclinical testing 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 if all other requirements, including IRB review and approval, have been met. If the FDA raises concerns or questions about the conduct of the trial, such as whether human research subjects will be exposed to an unreasonable health risk, the IND sponsor and the FDA must resolve any outstanding FDA concerns or questions before clinical trials can proceed.

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 in compliance with federal regulations, including GCP requirements, which include the requirement that all research subjects provide their informed consent in writing for their participation in any clinical trial. Clinical trials are conducted 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 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 either is not being conducted in accordance with FDA requirements or presents an unacceptable risk to the clinical trial patients. The study protocol and informed consent information for patients in clinical trials must also be submitted to an IRB for approval at each site at which the clinical trial will be conducted. 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. Information about certain clinical trials must be submitted within specific timeframes to the NIH for public dissemination on their *www.clinicaltrials.gov* website.

Clinical trials to support NDAs 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 pharmacological actions, side effects associated with increasing doses and, if possible, early evidence of effectiveness. Phase 2 usually involves trials in a limited patient population to study metabolism of the drug, pharmacokinetics, 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 clinical trials, also called pivotal 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 study 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.

After completion of the required clinical testing, an NDA is prepared and submitted to the FDA. FDA approval of the NDA is required before marketing of the product may begin in the United States. The NDA 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 is additionally subject to a substantial application user fee, and the manufacturer and/or sponsor under an approved NDA are also subject to annual program fees. These fees are typically increased annually. Under the Prescription Drug User Fee Act, or PDUFA, guidelines that are currently in effect, the FDA has a goal of ten months from the date of "filing" of a standard NDA for a new molecular entity to review and act on the submission. This review typically takes twelve months from the date the NDA is submitted to FDA because the FDA has 60 days from its receipt of an NDA to determine whether the application will be accepted for filing based on the agency's threshold determination that it is sufficiently complete to permit substantive review. Once the submission is accepted for filing, the FDA begins an in-depth review. The FDA may request additional information rather than accept an NDA for filing. In this event, the application must be resubmitted with the additional information. The resubmitted application is also subject to review before the FDA accepts it for filing. The FDA reviews an NDA to determine, among other things, whether the drug is safe and effective and whether the facility in which it is manufactured, processed, packaged, or held meets standards designed to assure the product's continued safety, quality, and purity.

The FDA may also refer applications for novel drug products, or drug products that present difficult questions of safety or efficacy, to an advisory committee, which is 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, the FDA will typically inspect one or more clinical sites to assure compliance with GCPs. 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 contains data that provide substantial evidence that the drug is safe and effective in the indication studied.

After the FDA evaluates the NDA 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, 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. Even if the FDA approves a product, it may limit the approved indications for use of the product, require that contraindications, warnings, or precautions be included in the product labeling, require that post-approval studies, including Phase 4 clinical trials,

be conducted to further assess a drug's safety after approval, require testing and surveillance programs to monitor the product after commercialization, or impose other conditions, including distribution and use restrictions or other risk management mechanisms under a Risk Evaluation and Mitigation Strategy, or REMS, to ensure that the benefits of the drug outweigh the potential risks.

A REMS can include a medication guide, a communication plan for healthcare professionals and elements to assure safe use, such as special training and certification requirements for individuals who prescribe or dispense the drug, requirements that patients enroll in a registry, and other measures that the FDA deems necessary to assure the safe use of the drug. The requirement for a REMS can materially affect the potential market and profitability of the drug. The FDA may prevent or limit further marketing of a product based on the results of post-marketing studies or surveillance programs. 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 NDA supplement before the change can be implemented. An NDA 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 supplements as it does in reviewing NDAs. Such supplements are typically reviewed within 10 months of receipt by the FDA.

Expedited Development and Review Programs

The FDA has a Fast Track program that is intended to expedite or facilitate the process for development and review of new drug products that meet certain criteria. Specifically, new drug products are eligible for Fast Track designation if they are intended to treat a serious or life-threatening disease or condition and demonstrate the potential to address unmet medical needs for the disease or condition. Fast Track designation applies to the combination of the product and the specific indication for which it is being studied. The sponsor of a new drug may request that the FDA designate the drug as a Fast Track product at any time during the clinical development of the product. For a Fast Track-designated product, the FDA may consider for review sections of the marketing application on a rolling basis before the complete application is submitted. If the sponsor provides a schedule for the submission of the sections of the application, the FDA agrees to accept sections of the application and determines that the schedule is acceptable, and the sponsor pays any required user fees upon submission of the first section of the application.

Any product submitted to the FDA for marketing, including under a Fast Track program, may be eligible for other types of FDA programs intended to expedite development and review, such as priority review and accelerated approval. Any product is eligible for priority review if it has the potential to provide safe and effective therapy where no satisfactory alternative therapy exists or a significant improvement in the treatment, diagnosis, or prevention of a disease compared to marketed products. The FDA will attempt to direct additional resources to the evaluation of an application for a new drug product designated for priority review in an effort to facilitate the review. Additionally, a product may be eligible for accelerated approval. Drug products studied for their safety and effectiveness in treating serious or life-threatening illnesses and that provide meaningful therapeutic benefit over existing treatments may be eligible for accelerated approval, which means that they may be approved on the basis of adequate and well-controlled clinical trials establishing that the product has an effect on a surrogate endpoint that is reasonably likely to predict a clinical benefit, or on the basis of an effect on a clinical endpoint other than survival or irreversible morbidity or mortality or other clinical benefit, taking into account the severity, rarity, or prevalence of the condition and the availability or lack of alternative treatments. As a condition of approval, the FDA may require that a sponsor of a drug product subject to accelerated approval perform adequate and well-controlled post-marketing clinical trials. In addition, the FDA currently requires as a condition for accelerated approval pre-approval of promotional materials, which could adversely impact the timing of the commercial launch of the product.

In addition, the Breakthrough Therapy Designation is intended to expedite the development and review of products that treat serious or life-threatening diseases or conditions. A breakthrough therapy is defined as a drug that is intended, alone or in combination with one or more other drugs, to treat a serious or life-threatening disease or condition, where preliminary clinical evidence indicates that the drug may demonstrate substantial improvement over existing therapies on one or more clinically significant endpoints, such as substantial treatment effects observed early in clinical development. The designation includes all of the features of Fast Track designation, as well as more intensive FDA interaction and guidance. The Breakthrough Therapy Designation is distinct from both accelerated approval and priority review, but these can also be granted to the same product candidate if the relevant criteria are met. The FDA must take certain actions, such as holding timely meetings and providing advice, intended to expedite the development and review of an application for approval of a breakthrough therapy. Requests for breakthrough therapy designation will be reviewed within 60 days of receipt, and the FDA will either grant or deny the request.

Fast Track designation, priority review, accelerated approval, and breakthrough therapy designation do not change the standards for approval but may expedite the development or approval process by allowing for approval based on a surrogate endpoint likely to predict clinical benefit of the underlying drug, rather than through a direct measure of clinical benefit. Even if we receive one of these designations for our product candidates, the FDA may later decide that our product candidates no longer meet the conditions for qualification. In addition, these designations may not provide us with a material commercial advantage.

Post-Approval Requirements

Once an NDA is approved, a product may 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 and social media. 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 is required following FDA approval of an NDA. The FDA also may require post-approval testing, known as Phase 4 testing, REMS, surveillance to monitor the effects of an approved product, or restrictions on 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. Later discovery of previously unknown problems with a product, including adverse events of unanticipated severity or frequency, or failure to comply with regulatory requirements may result in mandatory revisions to the approved labeling to add new safety information, imposition of post-market studies or clinical trials to assess new safety risks, or imposition of distribution or other restrictions under a REMS program. Other potential consequences include, among other things:

- restrictions on the marketing or manufacturing of the product, complete withdrawal of the product from the market, or product recalls;
- fines, warning letters, or holds on post-approval clinical trials;
- refusal of the FDA to approve pending applications or supplements to approved applications or suspension or revocation of product approvals;
- product seizure or detention, or refusal to permit the import or export of products, or injunctions or the imposition of civil or criminal penalties.

The FDA strictly regulates marketing, labeling, advertising, and promotion of products that are placed on the market. Drugs may be promoted only for the approved indications and in accordance with the provisions of the approved label. The FDA and other agencies actively enforce the laws and regulations prohibiting the promotion of off-label uses, and a company that is found to have improperly promoted off-label uses may be subject to significant liability.

Foreign Regulation

In order to market any product outside of the United States, we would need to 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 our products. Whether or not we obtain FDA approval for a product, we would need to obtain the necessary approvals by the comparable foreign regulatory authorities before we can commence clinical trials or marketing of the product in foreign countries and jurisdictions.

Some countries outside of the United States have a similar process that requires the submission of a clinical trial application, or CTA, much like the IND prior to the commencement of human clinical trials. In Europe, for example, a CTA must be submitted to each country’s national health authority and an independent ethics committee, much like the FDA and IRB, respectively. Once the CTA is approved in accordance with a country’s requirements, a clinical trial may proceed in that country. To obtain regulatory approval to commercialize a new drug under European Union regulatory systems, we must submit a marketing authorization application, or MAA. The MAA is similar to the NDA, with the exception of, among other things, country-specific document requirements.

In Canada, biopharmaceutical product candidates are regulated by the Food and Drugs Act and the rules and regulations promulgated thereunder, which are enforced by the Therapeutic Products Directorate of Health Canada, or TPD. Before commencing clinical trials in Canada, an applicant must complete preclinical studies and file a CTA with the TPD. After filing a CTA, the applicant must receive different clearance authorizations to proceed with Phase 1 clinical trials, which can then lead to Phase 2 and Phase 3 clinical trials. To obtain regulatory approval to commercialize a new drug in Canada, a new drug submission, or NDS, must be filed with the TPD. If the NDS demonstrates that the product was developed in accordance with the regulatory authorities' rules, regulations, and guidelines and demonstrates favorable safety and efficacy and receives a favorable risk/benefit analysis, the TPD issues a notice of compliance which allows the applicant to market the product.

Other Healthcare Laws

Although we currently do not have any products on the market, our current and future business operations may be subject to additional healthcare regulation and enforcement by the federal government and by authorities in the states and foreign jurisdictions in which we conduct our business. Such laws include, without limitation, state and federal anti-kickback, fraud and abuse, false claims, privacy and security, price reporting, and physician sunshine laws. Some of our pre-commercial activities are subject to some of these laws.

The federal Anti-Kickback Statute makes it illegal for any person or entity, including a prescription drug manufacturer or a party acting on its behalf, to knowingly and willfully, directly or indirectly, solicit, receive, offer, or pay any remuneration that is intended to induce the referral of business, including the purchase, order, lease of any good, facility, item or service for which payment may be made under a federal healthcare program, such as Medicare or Medicaid. The term "remuneration" has been broadly interpreted to include anything of value. The Anti-Kickback Statute has been interpreted to apply to arrangements between pharmaceutical manufacturers on one hand and prescribers, purchasers, formulary managers, and beneficiaries on the other. Although there are a number of statutory exceptions and regulatory safe harbors protecting some common activities from prosecution, the exceptions and safe harbors are drawn narrowly. Practices that involve remuneration that may be alleged to be intended to induce prescribing, purchases, or recommendations may be subject to scrutiny if they do not qualify for an exception or safe harbor. Failure to meet all of the requirements of a particular applicable statutory exception or regulatory safe harbor does not make the conduct per se illegal under the Anti-Kickback Statute. Instead, the legality of the arrangement will be evaluated on a case-by-case basis based on a cumulative review of all its facts and circumstances. Several courts have interpreted the statute's intent requirement to mean that if any one purpose of an arrangement involving remuneration is to induce referrals of federal healthcare covered business, the Anti-Kickback Statute has been violated. In addition, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation. Violations of this law are punishable by up to five years in prison, and can also result in criminal fines, civil money penalties, and exclusion from participation in federal healthcare programs.

Moreover, 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.

The federal civil False Claims Act prohibits, among other things, any person or entity from knowingly presenting, or causing to be presented, for payment to, or approval by, federal programs, including Medicare and Medicaid, claims for items or services, including drugs, that are false or fraudulent or not provided as claimed. Persons and entities can be held liable under these laws if they are deemed to "cause" the submission of false or fraudulent claims by, for example, providing inaccurate billing or coding information to customers or promoting a product off-label. In addition, our future activities relating to the reporting of wholesaler or estimated retail prices for our products, the reporting of prices used to calculate Medicaid rebate information and other information affecting federal, state, and third-party reimbursement for our products, and the sale and marketing of our products are subject to scrutiny under this law. Penalties for federal civil False Claims Act violations may include up to three times the actual damages sustained by the government, plus mandatory civil penalties for each separate false claim, the potential for exclusion from participation in federal healthcare programs, and, although the federal False Claims Act is a civil statute, False Claims Act violations may also implicate various federal criminal statutes.

The Health Insurance Portability and Accountability Act of 1996, or HIPAA, created additional federal criminal statutes that prohibit, among other actions, knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program, including private third-party payors, knowingly and willfully embezzling or stealing from a healthcare benefit program, willfully obstructing a criminal investigation of a healthcare offense, and knowingly and willfully falsifying, concealing, or covering up a material fact or making any materially false, fictitious or fraudulent statement in connection with the delivery of or payment for healthcare benefits, items, or services. Like the federal Anti-Kickback Statute, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation.

The civil monetary penalties statute imposes penalties against any person or entity that, among other things, is determined to have presented or caused to be presented a claim to a federal health program that the person knows or should know is for an item or service that was not provided as claimed or is false or fraudulent.

Also, many states have similar fraud and abuse statutes or regulations that may be broader in scope and may apply regardless of payor, in addition to items and services reimbursed under Medicaid and other state programs. Additionally, to the extent that any of our products are sold in a foreign country, we may be subject to similar foreign laws.

HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act, or HITECH, and their implementing regulations, mandates, among other things, the adoption of uniform standards for the electronic exchange of information in common healthcare transactions, as well as standards relating to the privacy and security of individually identifiable health information, which require the adoption of administrative, physical, and technical safeguards to protect such information. Among other things, HITECH makes HIPAA's security standards directly applicable to business associates, defined as independent contractors or agents of covered entities that create, receive, or obtain protected health information in connection with providing a service for or on behalf of a covered entity. HITECH also increased the civil and criminal penalties that may be imposed against covered entities and business associates and gave state attorneys general new authority to file civil actions for damages or injunctions in federal courts to enforce the federal HIPAA laws and seek attorney's fees and costs associated with pursuing federal civil actions. In addition, certain state laws govern the privacy and security of health information in certain circumstances, some of which are more stringent than HIPAA, and many of which differ from each other in significant ways and may not have the same effect, thus complicating compliance efforts. Failure to comply with these laws, where applicable, can result in the imposition of significant civil and/or criminal penalties.

The Physician Payments Sunshine Act imposes, among other things, annual reporting requirements for covered manufacturers for certain payments and other transfers of value provided to physicians and teaching hospitals, as well as certain ownership and investment interests held by physicians and their immediate family members. Failure to submit timely, accurately, and completely the required information for all payments and transfers of value and ownership or investment interests may result in civil monetary penalties. Certain states also mandate implementation of compliance programs, impose restrictions on drug manufacturer marketing practices, and/or require the tracking and reporting of gifts, compensation, and other remuneration to physicians.

Because we intend to commercialize products that could be reimbursed under a federal healthcare program and other governmental healthcare programs, we intend to develop a comprehensive compliance program that establishes internal control to facilitate adherence to the rules and program requirements to which we will or may become subject. Although the development and implementation of compliance programs designed to establish internal control and facilitate compliance can mitigate the risk of investigation, prosecution, and penalties assessed for violations of these laws, the risks cannot be entirely eliminated.

If our operations are found to be in violation of any of such laws or any other governmental regulations that apply to us, we may be subject to penalties, including, without limitation, administrative, civil and criminal penalties, damages, fines, disgorgement, contractual damages, reputational harm, diminished profits and future earnings, individual imprisonment, additional reporting requirements and/or oversight if we become subject to a corporate integrity agreement or similar agreement to resolve allegations of non-compliance with these laws, the curtailment or restructuring of our operations, and exclusion from participation in federal and state healthcare programs, any of which could adversely affect our ability to operate our business and our financial results.

Health Reform

In the United States and foreign jurisdictions, there have been a number of legislative and regulatory changes to healthcare systems that could affect our future results of operations. There have been and continue to be a number of initiatives at the U.S. federal and state levels that seek to reduce healthcare costs.

In particular, the Affordable Care Act has had a significant impact on the healthcare industry. The Affordable Care Act was designed to expand coverage for the uninsured while at the same time containing overall healthcare costs. With regard to pharmaceutical products, among other things, the Affordable Care Act revised the definition of "average manufacturer price" for calculating and reporting Medicaid drug rebates on outpatient prescription drug prices and imposed a significant annual fee on companies that manufacture or import certain branded prescription drug products.

Since its enactment, certain aspects of the Affordable Care Act have faced Congressional and judicial challenges. In January 2017, Congress voted to adopt a budget resolution for fiscal year 2017, or the Budget Resolution, that authorizes the

implementation of legislation that would repeal portions of the Affordable Care Act. The Budget Resolution is not a law; however, it is widely viewed as the first step toward the passage of repeal legislation. Further, on January 20, 2017, an Executive Order was signed, directing federal agencies with authorities and responsibilities under the Affordable Care Act to waive, defer, grant exemptions from, or delay the implementation of any provision of the Affordable Care Act that would impose a fiscal or regulatory burden on states, individuals, healthcare providers, health insurers, or manufacturers of pharmaceuticals or medical devices. Congress also has considered subsequent legislation to repeal or replace elements of the Affordable Care Act. In the coming years, additional legislative and regulatory changes could be made to governmental health programs that could significantly impact pharmaceutical companies and the success of its product candidates.

In addition, other legislative changes have been proposed and adopted since the Affordable Care Act was enacted. In August 2011, the President signed into law the Budget Control Act of 2011, which, among other things, created the Joint Select Committee on Deficit Reduction to recommend to Congress proposals in spending reductions. The Joint Select Committee did not achieve a targeted deficit reduction of at least $1.2 trillion for the years 2013 through 2021, triggering the legislation's automatic reduction to several government programs. These included reductions to Medicare payments to providers of 2% per fiscal year, which went into effect on April 1, 2013, and, due to subsequent legislative amendments to the statute, will stay in effect through 2025 unless additional Congressional action is taken. Additionally, in January 2013, the American Taxpayer Relief Act of 2012 was signed into law, which, among other things, further reduced Medicare payments to several providers and increased the statute of limitations period for the government to recover overpayments to providers from three to five years.

Moreover, the Drug Supply Chain Security Act imposes obligations on manufacturers of pharmaceutical products, among others, related to product tracking and tracing. Among its requirements, manufacturers need to provide certain information regarding the drug product to individuals and entities to which product ownership is transferred, label drug product with a product identifier, and keep certain records regarding the drug product. The transfer of information to subsequent product owners by manufacturers will eventually be required to be done electronically. Manufacturers will also be required to verify that purchasers of the manufacturers' products are appropriately licensed. Further, manufacturers will have drug product investigation, quarantine, disposition, and notification responsibilities related to counterfeit, diverted, stolen, and intentionally adulterated products, as well as products that are the subject of fraudulent transactions or which are otherwise unfit for distribution such that they would be reasonably likely to result in serious health consequences or death.

Further, there has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices. Specifically, there have been recent U.S. Congressional inquiries and proposed bills designed to, among other things, bring more transparency to drug pricing, reduce the cost of prescription drugs under Medicare, review the relationship between pricing and manufacturer patient programs, and reform government program reimbursement methodologies for drugs.

Coverage and Reimbursement

Sales of our product candidates, once approved, will depend, in part, on the extent to which the costs of our products will be covered by third-party payors, such as government health programs, private health insurers and managed care organizations. Third-party payors generally decide which drugs they will cover and establish certain reimbursement levels for such drugs. In particular, in the United States, private health insurers and other third-party payors often provide reimbursement for products and services based on the level at which the government (through the Medicare or Medicaid programs) provides reimbursement for such treatments. Patients who are prescribed treatments for their conditions and providers performing the prescribed services generally rely on third-party payors to reimburse all or part of the associated healthcare costs. Patients are unlikely to use products unless coverage is provided and reimbursement is adequate to cover a significant portion of the cost of such products. Sales of our product candidates, and any future product candidates, will therefore depend substantially on the extent to which the costs of our product candidates, and any future product candidates, will be paid by third-party payors. Additionally, the market for our product candidates, and any future product candidates, will depend significantly on access to third-party payors' formularies without prior authorization, step therapy, or other limitations such as approved lists of treatments for which third-party payors provide coverage and reimbursement. Additionally, coverage and reimbursement for therapeutic products can differ significantly from payor to payor. One third-party payor's decision to cover a particular medical product or service does not ensure that other payors will also provide coverage for the medical product or service, or will provide coverage at an adequate reimbursement rate. As a result, the coverage determination process will require us to provide scientific and clinical support for the use of our products to each payor separately and will be a costly and time-consuming process.

Third-party payors are developing increasingly sophisticated methods of controlling healthcare costs and increasingly challenging the prices charged for medical products and services. Additionally, the containment of healthcare costs has become a priority of federal and state governments and the prices of drugs have been a focus in this effort. The U.S. government, state

legislatures and foreign governments have shown significant interest in implementing cost-containment programs, including price controls and transparency requirements, restrictions on reimbursement and requirements for substitution of generic products. Adoption of price controls and cost-containment measures, and adoption of more restrictive policies in jurisdictions with existing controls and measures, could limit our net revenue and results. If these third-party payors do not consider our products to be cost-effective compared to other therapies, they may not cover our products once approved as a benefit under their plans or, if they do, the level of reimbursement may not be sufficient to allow us to sell our products on a profitable basis. Decreases in third-party reimbursement for our products once approved or a decision by a third-party payor to not cover our products could reduce or eliminate utilization of our products and have an adverse effect on our sales, results of operations and financial condition. In addition, state and federal healthcare reform measures have been and will be adopted in the future, any of which could limit the amounts that federal and state governments will pay for healthcare products and services, which could result in reduced demand for our products once approved or additional pricing pressures.

Employees

As of December 31, 2017, we employed 65 employees, of which 63 were full-time employees. We have never had a work stoppage, and none of our employees is represented by a labor organization or under any collective bargaining arrangements. We consider our employee relations to be good.

Corporate Information

In February 2017, Signal merged with and into Private Miragen and changed its name to Miragen Therapeutics, Inc. Our principal executive offices are located at 6200 Lookout Road, Boulder, CO 80301, and our telephone number is (720) 643-5200. Our corporate website address is *http://www.miragen.com*. Our Annual Reports on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, and amendments to reports filed pursuant to Sections 13(a) and 15(d) of the Securities Exchange Act of 1934, as amended, or the Exchange Act, will be made available free of charge on our website as soon as reasonably practicable after we electronically file such material with, or furnish it to, the U.S. Securities and Exchange Commission, or the SEC. The contents of our website are not incorporated into this Annual Report and our reference to the URL for our website is intended to be an inactive textual reference only.

This Annual Report contains references to our trademarks and to trademarks belonging to other entities. Solely for convenience, trademarks and trade names referred to in this Annual Report, including logos, artwork, and other visual displays, may appear without the ® or TM symbols, but such references are not intended to indicate, in any way, that we will not assert, to the fullest extent under applicable law, our rights or the rights of the applicable licensor to these trademarks and trade names. We do not intend our use or display of other companies' trade names or trademarks to imply a relationship with, or endorsement or sponsorship of us by, any other company.

We are an "emerging growth company," as defined in the Jumpstart Our Business Startups Act of 2012. We will remain an emerging growth company until the earlier of (1) the last day of the fiscal year (a) following the fifth anniversary of the completion of our initial public offering in June 2014, (b) in which we have total annual gross revenue of at least $1.07 billion, or (c) in which we are deemed to be a large accelerated filer, which means the market value of our common stock that is held by non-affiliates exceeded $700.0 million as of the prior June 30th, and (2) the date on which we have issued more than $1.0 billion in non-convertible debt during the prior three-year period. We refer to the Jumpstart Our Business Startups Act of 2012 in this Annual Report as the "JOBS Act," and references to "emerging growth company" have the meaning associated with it in the JOBS Act.

ITEM 1A. RISK FACTORS

Our business, financial condition, and operating results may be affected by a number of factors, whether currently known or unknown, including but not limited to those described below. Any one or more of such factors could directly or indirectly cause our actual results of operations and financial condition to vary materially from past or anticipated future results of operations and financial condition. Any of these factors, in whole or in part, could materially and adversely affect our business, financial condition, results of operations, and stock price. The following information should be read in conjunction with Part II, Item 7, "Management's Discussion and Analysis of Financial Condition and Results of Operations" and the consolidated financial statements and related notes in Part II, Item 8, "Financial Statements and Supplementary Data" of this Annual Report.

Risks Related to Our Financial Condition and Capital Requirements

We have incurred losses since our inception, have a limited operating history on which to assess our business, and anticipate that we will continue to incur significant losses for the foreseeable future.

We are a clinical-stage biopharmaceutical company with a limited operating history. We have incurred net losses in each year since Private Miragen's inception in 2006. During the years ended December 31, 2017 and 2016, net loss was $26.5 million and $17.3 million, respectively. As of December 31, 2017, we had an accumulated deficit of $93.6 million.

As of December 31, 2017, we had cash and cash equivalents of $47.4 million. In February 2017, we received $40.7 million in financing through a common stock private placement. In March 2017, we entered into a Common Stock Sales Agreement, or the ATM Agreement, with Cowen and Company, LLC, or Cowen, under which we may offer and sell, from time to time, at our sole discretion, shares of our common stock having an aggregate offering price of up to $50.0 million through Cowen as our sales agent. As of December 31, 2017, we had sold, pursuant to the terms of the ATM Agreement, 840,534 shares of our common stock, at a weighted average price of $9.35 per share, for aggregate gross proceeds of approximately $7.9 million. Net proceeds at December 31, 2017 were approximately $7.5 million, including initial expenses for executing the "at the market offering" and commissions to Cowen as sales agent. In February 2018, we entered into an underwriting agreement, or the Underwriting Agreement, with Jefferies LLC, Evercore Group L.L.C., and Deutsche Bank Securities Inc., as representatives, or the Representatives, of the several underwriters, or collectively with the Representatives, the Underwriters, relating to the public offering of our common stock, or the Public Offering. Pursuant to the Underwriting Agreement, in February 2018 we sold 7,414,996 shares of our common stock at a price of $5.50 per share, which resulted in net proceeds of approximately $37.9 million after deducting underwriting commissions and discounts and other offering expenses payable by us. We believe that we have sufficient capital to fund our operations in the normal course of business and to meet our liquidity needs into early 2020.

We will continue to require substantial additional capital to continue our clinical development and potential commercialization activities. Accordingly, we will need to raise substantial additional capital to continue to fund our operations. The amount and timing of our future funding requirements will depend on many factors, including the pace and results of our clinical development efforts. Failure to raise capital as and when needed, on favorable terms or at all, would have a negative impact on our financial condition and our ability to develop our product candidates. Changing circumstances may cause us to consume capital significantly faster or slower than we currently anticipate. If we are unable to acquire additional capital or resources, we will be required to modify our operational plans to complete future milestones. We have based these estimates on assumptions that may prove to be wrong, and we could exhaust our available financial resources sooner than we currently anticipate. We may be forced to reduce our operating expenses and raise additional funds to meet our working capital needs, principally through the additional sales of our securities or debt financings or entering into strategic collaborations.

We have devoted substantially all of our financial resources to identify, acquire, and develop our product candidates, including conducting clinical trials and providing general and administrative support for our operations. To date, we have financed our operations primarily through the sale of equity securities and convertible promissory notes. The amount of our future net losses will depend, in part, on the rate of our future expenditures and our ability to obtain funding through equity or debt financings, strategic collaborations, or grants. Biopharmaceutical product development is a highly speculative undertaking and involves a substantial degree of risk. We expect our losses to increase as we complete Phase 1 development and advance into Phase 2 development of our lead product candidates. We have not yet commenced pivotal clinical trials for any product candidate and it may be several years, if ever, before we complete pivotal clinical trials or have a product candidate approved for commercialization. We expect to invest significant funds into the research and development of our current product candidates to determine the potential to advance these product candidates to regulatory approval.

If we obtain regulatory approval to market a product candidate, our future revenue will depend upon the size of any markets in which our product candidates may receive approval, and our ability to achieve sufficient market acceptance, pricing, reimbursement from third-party payors, and adequate market share for our product candidates in those markets. Even if we obtain adequate market share for our product candidates, because the potential markets in which our product candidates may ultimately receive regulatory approval could be very small, we may never become profitable despite obtaining such market share and acceptance of our products.

We expect to continue to incur significant expenses and increasing operating losses for the foreseeable future and our expenses will increase substantially if and as we:

- continue the clinical development of our product candidates;

- continue efforts to discover and develop new product candidates;
- undertake the manufacturing of our product candidates or increase volumes manufactured by third parties;
- advance our programs into larger, more expensive clinical trials;
- initiate additional preclinical, clinical, or other trials or studies for our product candidates;
- seek regulatory and marketing approvals and reimbursement for our product candidates;
- establish a sales, marketing, and distribution infrastructure to commercialize any products for which we may obtain marketing approval and market for ourselves;
- seek to identify, assess, acquire, and/or develop other product candidates;
- make milestone, royalty, or other payments under third-party license agreements;
- seek to maintain, protect, and expand our intellectual property portfolio;
- seek to attract and retain skilled personnel; and
- experience any delays or encounter issues with the development and potential for regulatory approval of our clinical candidates such as safety issues, manufacturing delays, clinical trial accrual delays, longer follow-up for planned studies, additional major studies, or supportive studies necessary to support marketing approval.

Further, the net losses we incur may fluctuate significantly from quarter to quarter and year to year, such that a period-to-period comparison of our results of operations may not be a good indication of our future performance.

We have never generated any revenue from product sales and may never be profitable.

We have no products approved for commercialization and have never generated any revenue from product sales. Our ability to generate revenue and achieve profitability depends on our ability, alone or with strategic collaborators, to successfully complete the development of, and obtain the regulatory and marketing approvals necessary to commercialize one or more of our product candidates. We do not anticipate generating revenue from product sales for the foreseeable future. Our ability to generate future revenue from product sales depends heavily on our success in many areas, including but not limited to:

- completing research and development of our product candidates;
- obtaining regulatory and marketing approvals for our product candidates;
- manufacturing product candidates and establishing and maintaining supply and manufacturing relationships with third parties that are commercially feasible, meet regulatory requirements and our supply needs in sufficient quantities to meet market demand for our product candidates, if approved;
- marketing, launching, and commercializing product candidates for which we obtain regulatory and marketing approval, either directly or with a collaborator or distributor;
- gaining market acceptance of our product candidates as treatment options;
- addressing any competing products;
- protecting and enforcing our intellectual property rights, including patents, trade secrets, and know-how;
- negotiating favorable terms in any collaboration, licensing, or other arrangements into which we may enter;
- obtaining reimbursement or pricing for our product candidates that supports profitability; and
- attracting, hiring, and retaining qualified personnel.

Even if one or more of the product candidates that we develop is approved for commercial sale, we anticipate incurring significant costs associated with commercializing any approved product candidate. Portions of our current pipeline of product candidates have been in-licensed from third parties, which make the commercial sale of such in-licensed products potentially subject to additional royalty and milestone payments to such third parties. We will also have to develop or acquire manufacturing capabilities or continue to contract with contract manufacturers in order to continue development and potential commercialization of our product candidates. For instance, our current costs of manufacturing our drug product are not commercially feasible and we will need to develop or procure our drug product in a commercially feasible manner in order to successfully commercialize any future approved product, if any. Additionally, if we are not able to generate revenue from the sale of any approved products, we may never become profitable.

Raising additional capital may cause dilution to our stockholders, restrict our operations, or require us to relinquish rights.

To the extent that we raise additional capital through the sale of equity, including pursuant to any sales under the ATM Agreement, convertible debt or other securities convertible into equity, the ownership interest of our stockholders will be diluted, and the terms of these new securities may include liquidation or other preferences that adversely affect rights of our stockholders. For instance, as of December 31, 2017, we have sold, pursuant to the terms of the ATM Agreement, 840,534 shares of our common stock, at a weighted average price of $9.35 per share, for aggregate gross proceeds of approximately $7.9 million. We anticipate that we will continue to make sales of our common stock under the ATM Agreement from time to time into the foreseeable future, and we may sell shares of our common stock of up to $50.0 million in aggregate value under the ATM Agreement. Sales under the ATM Agreement dilute the ownership interest of our stockholders and may cause the price per share of our common stock to decrease. Debt financing, if available, would likely involve agreements that include covenants limiting or restricting our ability to take specific actions, such as incurring additional debt, making capital expenditures, making additional product acquisitions, or declaring dividends. For instance, our loan and security agreement with Silicon Valley Bank limits our ability to enter into an asset sale, enter into any change of control, incur additional indebtedness, pay any dividends, or enter into specified transactions with our affiliates. If we raise additional funds through strategic collaborations or licensing arrangements with third parties, we may have to relinquish valuable rights to our product candidates or future revenue streams or grant licenses on terms that are not favorable to us. We cannot be assured that we will be able to obtain additional funding if and when necessary to fund our entire portfolio of product candidates to meet our projected plans. If we are unable to obtain funding on a timely basis, we may be required to delay or discontinue one or more of our development programs or the commercialization of any product candidates or be unable to expand our operations or otherwise capitalize on potential business opportunities, which could materially harm our business, financial condition, and results of operations.

We have also historically received funds from state and federal government grants for research and development. The grants have been, and any future government grants and contracts we may receive may be, subject to the risks and contingencies set forth below under the risk factor titled “Reliance on government funding for our programs may add uncertainty to our research and commercialization efforts with respect to those programs that are tied to such funding and may impose requirements that limit our ability to take specified actions, increase the costs of commercialization and production of product candidates developed under those programs and subject us to potential financial penalties, which could materially and adversely affect our business, financial condition, and results of operations.” Although we might apply for government contracts and grants in the future, we cannot be certain that we will be successful in obtaining additional grants for any product candidates or programs.

Risks Related to the Development of Our Product Candidates

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

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

- inability to generate satisfactory preclinical, toxicology, or other in vivo or in vitro data or diagnostics to support the initiation or continuation of clinical trials;

- delays in reaching agreement on acceptable terms with contract research organizations, or CROs, and clinical trial sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs

and clinical trial sites;

- delays in obtaining required institutional review board approval at each clinical trial site;
- failure to permit the conduct of a clinical trial by regulatory authorities, after review of an investigational new drug or equivalent foreign application or amendment;
- delays in recruiting qualified patients in our clinical trials;
- failure by clinical sites or CROs or other third parties to adhere to clinical trial requirements;
- failure by our clinical sites, CROs or other third parties to perform in accordance with the good clinical practices requirements of the FDA or applicable foreign regulatory guidelines;
- patients dropping out of our clinical trials;
- adverse events or tolerability or animal toxicology issues significant enough for the FDA or other regulatory agencies to put any or all clinical trials on hold;
- occurrence of adverse events associated with our product candidates;
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols;
- the cost of clinical trials of our product candidates;
- negative or inconclusive results from our clinical trials, which may result in our deciding, or regulators requiring us, to conduct additional clinical trials or abandon development programs in other ongoing or planned indications for a product candidate; and
- delays in reaching agreement on acceptable terms with third-party manufacturers and the time for manufacture of sufficient quantities of our product candidates for use in clinical trials.

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

The approach we are taking to discover and develop novel therapeutics that target microRNAs is unproven and may never lead to marketable products.

The scientific discoveries that form the basis for our efforts to discover and develop our product candidates are relatively recent. To date, neither we nor any other company has received regulatory approval to market therapeutics utilizing microRNA-targeted molecules. The scientific evidence to support the feasibility of developing drugs based on these discoveries is both preliminary and limited. Successful development of microRNA-targeted therapeutic products by us will require solving a number of issues, including providing suitable methods of stabilizing the therapeutic product and delivering it into target cells in the human body. In addition, any product candidates that we develop may not demonstrate in patients the chemical and pharmacological properties ascribed to them in laboratory and preclinical trials, and they may interact with human biological systems in unforeseen, ineffective, or even harmful ways. For instance, our clinical and preclinical data to date has not been fully validated and we have no way of knowing if, after validation, our clinical trial data will be complete and consistent. If we do not successfully develop and commercialize product candidates based upon this technological approach, we may not become profitable and the value of our capital stock may decline.

Further, our focus on microRNA technology for developing product candidates as opposed to multiple, more proven technologies for drug development, increases the risk associated with our business. If we are not successful in developing an approved product using microRNA technology, we may not be able to identify and successfully implement an alternative product development strategy. In addition, work by other companies pursuing similar technologies may encounter setbacks

and difficulties that regulators and investors may attribute to our product candidates, whether appropriately or not.

Our microRNA-targeted therapeutic product candidates are based on a relatively novel technology, which makes it unusually difficult to predict the time and cost of development and the time and cost, or likelihood, of subsequently obtaining regulatory approval. To date, no microRNA-targeted therapeutics have been approved for marketing in the United States.

We have concentrated our research and development efforts to date on a limited number of product candidates based on our microRNA-targeted therapeutic platform and identifying our initial targeted disease indications. Our future success depends on our successful development of viable product candidates. Only two of our product candidates, cobomarsen and MRG-201 are in clinical development, and the remainder of our product candidates are in preclinical development. There can be no assurance that we will not experience problems or delays in developing our product candidates and that such problems or delays will not cause unanticipated costs, or that any such development problems can be solved.

Additionally, the FDA, the European Medicines Agency, and other regulatory authorities, have relatively limited experience with microRNA-targeted therapeutics. No regulatory authority has granted approval to any person or entity, including us, to market or commercialize microRNA-targeted therapeutics, which may increase the complexity, uncertainty, and length of the regulatory approval process for our product candidates. If our product candidates fail to prove to be safe, effective, or commercially viable, our product candidate pipeline would have little, if any, value, which would have a material adverse effect on our business, financial condition, or results of operations.

The clinical trial and manufacturing requirements of the FDA, the European Medicines Agency, and other regulatory authorities, and the criteria these regulators use to determine the safety and efficacy of a product candidate, vary substantially according to the type, complexity, novelty, intended use, and market of the product candidate. The regulatory approval process for novel product candidates such as microRNA-targeted therapeutics can be more expensive and take longer than for other, better known or more extensively studied product candidates. It is difficult to determine how long it will take or how much it will cost to obtain regulatory approvals for our product candidates in either the United States or the European Union or from other agencies, or how long it will take to commercialize our product candidates, even if approved for marketing. Approvals by one regulatory agency may not be indicative of the approval requirements of other regulatory bodies. Delay or failure to obtain, or unexpected costs in obtaining, the regulatory approval necessary to bring a potential product candidate to market could decrease our ability to generate sufficient product revenue, and our business, financial condition, results of operations, and prospects may be harmed.

We may not be able to develop or identify a technology that can effectively deliver cobomarsen, MRG-201, MRG-110, or any other of our microRNA-targeted product candidates to the intended diseased cells or tissues, and any failure in such delivery technology could adversely affect and delay the development of cobomarsen, MRG-201, MRG-110, and our other product candidates.

In connection with our Phase 1 clinical trials of cobomarsen and MRG-201, we have used intravenous, intralesional, subcutaneous, and intradermal injections as the route of administration. We cannot be certain that these routes of administration will be capable of delivering adequate levels of cobomarsen, MRG-201, MRG-110, or our other product candidates to produce a therapeutic response for all indications. While we are continuing to evaluate the use of subcutaneous, intravenous, and intradermal injections in different indications, and additional delivery technologies and routes of administration that might enable us to target specific cells with our product candidates, we cannot be certain whether we will be successful in developing effective delivery mechanisms. Our failure to effectively deliver any of our product candidates to the intended diseased cells or tissues could adversely affect and delay the development of our product candidates.

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

Undesirable side effects caused by our product candidates could cause us or regulatory authorities to interrupt, delay, or terminate clinical trials. They additionally may result in a delay of regulatory approval by the FDA or comparable foreign authorities, or, even in the instance that an affected product candidate is approved, may result in a restrictive drug label.

Our cobomarsen and MRG-201 product candidates have been studied in only a limited number of patients with a confirmed diagnosis of MF and healthy volunteers, respectively, and the most common adverse events of any grade were injection site reactions, including pain, itchiness, redness, and swelling when compounds were delivered intradermally or subcutaneously. We may experience a higher rate or severity of adverse events and comparable or higher rates of discontinuation of trial

participants in our future clinical trials. There is no guarantee that additional or more severe side effects will not be identified during ongoing or future clinical trials of our product candidates for current and other indications. Undesirable side effects and negative results for other indications may negatively impact the development and potential for approval of our product candidates for their proposed indications.

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

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

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

Our product development program may not uncover all possible adverse events that patients who take cobomarsen, MRG-201, MRG-110, or our other product candidates may experience. The number of subjects exposed to cobomarsen, MRG-201, MRG-110, or our other product candidates and the average exposure time in the clinical development program may be inadequate to detect rare adverse events that may only be detected once the product is administered to more patients and for greater periods of time.

Clinical trials by their nature utilize a sample of the potential patient population. However, with a limited number of subjects and limited duration of exposure, we cannot be fully assured that rare and severe side effects of cobomarsen, MRG-201, MRG-110, or our other product candidates will be uncovered. Such rare and severe side effects may only be uncovered with a significantly larger number of patients exposed to the drug. If such safety problems occur or are identified after cobomarsen, MRG-201, MRG-110, or another product candidate reaches the market, the FDA may require that we amend the labeling of the product or recall the product or may even withdraw approval for the product.

Our microRNA-targeted therapeutic approach is novel. Negative public opinion and increased regulatory scrutiny of microRNA or other nucleic acid-based therapies may damage public perception of the safety of our product candidates and adversely affect our ability to conduct our business or obtain regulatory approvals for our product candidates.

MicroRNA therapy remains a novel technology, with no microRNA-targeted therapeutic product approved to date in the United States. Public perception may be influenced by claims that microRNA therapy is unsafe, and microRNA therapy may not gain the acceptance of the public or the medical community. In particular, our success will depend upon physicians who specialize in the treatment of the diseases targeted by our product candidates, prescribing treatments that involve the use of our product candidates in lieu of, or in addition to, existing treatments with which they are familiar and for which greater clinical data may be available. More restrictive government regulations or negative public opinion regarding microRNA or other nucleic acid-based therapeutics could have an adverse effect on our business, financial condition, or results of operations and may delay or impair the development and commercialization of our product candidates or demand for any products we may develop. Serious adverse events in microRNA clinical trials for our competitors' products, even if not ultimately attributable to the relevant product candidates, and the resulting publicity, could result in increased government regulation, unfavorable public perception, potential regulatory delays in the testing or approval of our product candidates, stricter labeling requirements for those product candidates that are approved, and a decrease in demand for any such product candidates. For instance, in June 2016, the FDA placed a regulatory hold on the clinical trial of a microRNA- or nucleic acid-focused biopharmaceutical company with a microRNA-targeted product candidate for the treatment of hepatitis C virus due to serious adverse events in that trial. Another microRNA-focused biopharmaceutical company also voluntarily halted an ongoing Phase 1 clinical trial for a microRNA-targeted therapy for multiple cancers in September 2016 due to multiple immune-related severe adverse events. We cannot predict what effect, if any, these clinical holds will have on the government and public perception of our product candidates.

We are heavily dependent on the success of our product candidates, which are in the early stages of clinical development. Some of our product candidates have produced results only in preclinical settings, or for other indications than those for which we contemplate conducting development and seeking FDA approval, and we cannot give any assurance that we will generate data for any of our product candidates sufficiently supportive to receive regulatory approval in our planned indications, which will be required before they can be commercialized.

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

We currently have three product candidates in Phase 1 clinical trials. Of these product candidates, cobomarsen has been predominantly administered in patients with MF. This is only one of the multiple indications for which we plan to develop this product candidate. Additionally, our clinical and preclinical data to date is not validated, and we have no way of knowing if after validation our clinical trial data will be complete and consistent. There can be no assurance that the data that we develop for our product candidates in our planned indications will be sufficiently supportive to obtain regulatory approval.

Based on the outcome of an FDA meeting on January 24, 2018, we anticipate that we will start a Phase 2 clinical trial of cobomarsen in patients with CTCL in the near future. After these discussions with the FDA, we believe that a successful outcome for the primary endpoint of this Phase 2 clinical trial could allow us to apply for accelerated approval. We cannot guarantee that the outcome of this Phase 2 clinical trial will be sufficient to support, or if the FDA will allow us to apply for, accelerated approval of cobomarsen. If our data is not supportive of, or the FDA will not allow us to apply for, accelerated approval of cobomarsen, we cannot predict when, if ever, we will be able to seek approval of cobomarsen.

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

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

Clinical testing is expensive and generally takes many years to complete, and the outcome is inherently uncertain. Failure can occur at any time during the clinical trial process. Additionally, microRNAs are a new class of drug target and as such may have some potentially unknown risks from both an efficacy and safety perspective. The results of preclinical trials and early clinical trials of our product candidates may not be predictive of the results of larger, later-stage controlled clinical trials. Product candidates that have shown promising results in early-stage clinical trials may still suffer significant setbacks in subsequent clinical trials. Our clinical trials to date have been conducted on a small number of patients or healthy volunteers in limited numbers of clinical sites for a limited number of indications. We will have to conduct larger, well-controlled trials in our proposed indications to verify the results obtained to date and to support any regulatory submissions for further clinical development. A number of companies in the biopharmaceutical industry have suffered significant setbacks in advanced clinical trials due to lack of efficacy or adverse safety profiles despite promising results in earlier, smaller clinical trials. For instance, in June 2016, the FDA placed a regulatory hold on the clinical trial of a microRNA-focused biopharmaceutical company with a microRNA product candidate for the treatment of hepatitis C virus due to serious adverse events in that trial. Another microRNA-focused biopharmaceutical company also voluntarily halted an ongoing Phase 1 clinical trial for a microRNA therapy for multiple cancers in September 2016 due to multiple immune-related severe adverse events. Moreover, clinical data are often susceptible to varying interpretations and analyses. We do not know whether any Phase 2, Phase 3, or other clinical trials we may conduct will demonstrate consistent or adequate efficacy and safety with respect to the proposed indication for use sufficient to receive regulatory approval or market our drug candidates.

We may use our financial and human resources to pursue a particular research program or product candidate and fail to capitalize on programs or product candidates that may be more profitable or for which there is a greater likelihood of success.

Because we have limited financial and human resources, we may forego or delay pursuit of opportunities with some programs

or product candidates or for other indications that later prove to have greater commercial potential. Our resource allocation decisions may cause us to fail to capitalize on viable commercial products or more profitable market opportunities. Our spending on current and future research and development programs and future product candidates for specific indications may not yield any commercially viable products. We may also enter into additional strategic collaboration agreements to develop and commercialize some of our programs and potential product candidates in indications with potentially large commercial markets. If we do not accurately evaluate the commercial potential or target market for a particular product candidate, we may relinquish valuable rights to that product candidate through strategic collaborations, licensing, or other royalty arrangements in cases in which it would have been more advantageous for us to retain sole development and commercialization rights to such product candidate, or we may allocate internal resources to a product candidate in a therapeutic area in which it would have been more advantageous to enter into a partnering arrangement.

We may find it difficult to enroll patients in our clinical trials given the limited number of patients who have the diseases for which our product candidates are being studied. Difficulty in enrolling patients could delay or prevent clinical trials of our product candidates.

Identifying and qualifying patients to participate in clinical trials of our product candidates is essential to our success. The timing of our clinical trials depends in part on the rate at which we can recruit patients to participate in clinical trials of our product candidates, and we may experience delays in our clinical trials if we encounter difficulties in enrollment.

The eligibility criteria of our planned clinical trials may further limit the available eligible trial participants as we expect to require that patients have specific characteristics that we can measure or meet the criteria to assure their conditions are appropriate for inclusion in our clinical trials. For instance, our Phase 1 clinical trial of cobomarsen includes patients with MF. The estimated prevalence of MF is 16,000 to 20,000 cases in the United States and only a subset of this group satisfies the enrollment criteria for our cobomarsen clinical trial. We may not be able to identify, recruit, and enroll a sufficient number of patients to complete our clinical trials in a timely manner because of the perceived risks and benefits of the product candidate under study, the availability and efficacy of competing therapies and clinical trials, and the willingness of physicians to participate in our planned clinical trials. If patients are unwilling to participate in our clinical trials for any reason, the timeline for conducting trials and obtaining regulatory approval of our product candidates may be delayed.

If we experience delays in the completion of, or termination of, any clinical trials of our product candidates, the commercial prospects of our product candidates could be harmed, and our ability to generate product revenue from any of these product candidates could be delayed or prevented. In addition, any delays in completing our clinical trials would likely increase our overall costs, impair product candidate development, and jeopardize our ability to obtain regulatory approval relative to our current plans. Any of these occurrences may harm our business, financial condition, and prospects significantly.

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

The use or misuse of our product candidates in clinical trials and the sale of any products for which we may obtain marketing approval exposes us to the risk of potential product liability claims. Product liability claims might be brought against us by consumers, healthcare providers, pharmaceutical companies, or others selling or otherwise coming into contact with our product candidates and approved products, if any. There is a risk that our product candidates may induce adverse events. If we cannot successfully defend against product liability claims, we could incur substantial liability and costs. Some of our microRNA-targeted therapeutics have shown adverse events in clinical trials, including injection site reactions and pain at the injection site, erythema, nausea, diarrhea, decreased white blood cell and platelet counts, neutropenia, elevated aspartate aminotransferase, alanine aminotransferase, uric acid, and creatine kinase levels, prolonged partial thromboplastin time, blurred vision, itchiness, fatigue, headache, and microscopic hematuria, among others. In almost all cases, these events were mild to moderate and self-limited. There is a risk that our future product candidates may induce similar or more severe adverse events. Patients with the diseases targeted by our product candidates may already be in severe and advanced stages of disease and have both known and unknown significant preexisting and potentially life-threatening health risks. During the course of treatment, patients may suffer adverse events, including death, for reasons that may be related to our product candidates. Such events could subject us to costly litigation, require us to pay substantial amounts of money to injured patients, delay, negatively impact, or end our opportunity to receive or maintain regulatory approval to market our products, or require us to suspend or abandon our commercialization efforts. Even in a circumstance in which an adverse event is

unrelated to our product candidates, the investigation into the circumstance may be time-consuming or inconclusive. These investigations may delay our regulatory approval process or impact and limit the type of regulatory approvals our product candidates receive or maintain.

As a result of these factors, a product liability claim, even if successfully defended, could have a material adverse effect on our business, financial condition, or results of operations.

Although we have product liability insurance, which covers our clinical trials in the United States, for up to $5.0 million per occurrence, up to an aggregate limit of $5.0 million, our insurance may be insufficient to reimburse us for any expenses or losses we may suffer. We will also likely be required to increase our product liability insurance coverage for the advanced clinical trials that we plan to initiate. If we obtain marketing approval for any of our product candidates, we will need to expand our insurance coverage to include the sale of commercial products. There is no way to know if we will be able to continue to obtain product liability coverage and obtain expanded coverage, if we require it, in sufficient amounts to protect us against losses due to liability, on acceptable terms, or at all. We may not have sufficient resources to pay for any liabilities resulting from a claim excluded from, or beyond the limits of, our insurance coverage. Where we have provided indemnities in favor of third parties under our agreements with them, there is also a risk that these third parties could incur liability and bring a claim under such indemnities. An individual may bring a product liability claim against us alleging that one of our product candidates causes, or is claimed to have caused, an injury or is found to be unsuitable for consumer use. Any such product liability claims may include allegations of defects in manufacturing, defects in design, failure to warn of dangers inherent in the product, negligence, strict liability, and a breach of warranties. Claims could also be asserted under state consumer protection acts. Any product liability claim brought against us, with or without merit, could result in:

- withdrawal of clinical trial volunteers, investigators, patients or trial sites, or limitations on approved indications;
- the inability to commercialize, or if commercialized, decreased demand for, our product candidates;
- if commercialized, product recalls, labeling, marketing or promotional restrictions, or the need for product modification;
- initiation of investigations by regulators;
- loss of revenues;
- substantial costs of litigation, including monetary awards to patients or other claimants;
- liabilities that substantially exceed our product liability insurance, which we would then be required to pay ourselves;
- an increase in our product liability insurance rates or the inability to maintain insurance coverage in the future on acceptable terms, if at all;
- the diversion of management's attention from our business; and
- damage to our reputation and the reputation of our products and our technology.

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

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

A potential breakthrough therapy designation by the FDA for our product candidates may not lead to a faster development or regulatory review or approval process, and it does not increase the likelihood that our product candidates will receive marketing approval.

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

to identify the most efficient path for clinical development while minimizing the number of patients placed in ineffective control regimens. Drugs designated as breakthrough therapies by the FDA could also be eligible for accelerated approval.

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

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

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

We may attempt to secure approval through the use of accelerated registration pathways. If unable to obtain approval under an accelerated pathway, we may be required to conduct additional preclinical studies or clinical trials beyond those that we contemplate, which could increase the expense of obtaining, reduce the likelihood of obtaining and/or delay the timing of obtaining, necessary marketing approvals. Even if we receive accelerated approval from the FDA, if our confirmatory trials do not verify clinical benefit, or if we do not comply with rigorous post-approval requirements, the FDA may seek to withdraw accelerated approval.

We may seek an accelerated approval development pathway for our product candidates, including cobomarsen. Under the accelerated approval provisions of the Federal Food, Drug, and Cosmetic Act and the FDA's implementing regulations, the FDA may grant accelerated approval to a product designed to treat a serious or life-threatening condition that provides meaningful therapeutic advantage over available therapies and demonstrates an effect on a surrogate endpoint or intermediate clinical endpoint that is reasonably likely to predict clinical benefit. The FDA considers a clinical benefit to be a positive therapeutic effect that is clinically meaningful in the context of a given disease. If granted, accelerated approval is contingent on the sponsor's agreement to conduct, in a diligent manner, additional post-approval confirmatory studies to verify and describe the drug's clinical profile or risks and benefits for accelerated approval. The FDA may require that any such confirmatory study be initiated or substantially underway prior to the submission of an application for accelerated approval. If such post-approval studies fail to confirm the drug's clinical profile or risks and benefits, the FDA may withdraw its approval of the drug. If we choose to pursue accelerated approval, there can be no assurance that the FDA will agree that our proposed primary endpoint is an appropriate surrogate endpoint. Similarly, there can be no assurance that after subsequent FDA feedback that we will continue to pursue or apply for accelerated approval or any other form of expedited development, review, or approval, even if we initially decide to do so. Furthermore, if we submit an application for accelerated approval, there can be no assurance that such application will be accepted or that approval will be granted on a timely basis, or at all. The FDA also could require us to conduct further studies or trials prior to considering our application or granting approval of any type. We might not be able to fulfill the FDA's requirements in a timely manner, which would cause delays, or approval might not be granted because our submission is deemed incomplete by the FDA. A failure to obtain accelerated approval or any other form of expedited development, review or approval for a product candidate would result in a longer time period to commercialize such product candidate, could increase the cost of development of such product candidate, and could harm our competitive position in the marketplace.

Even if we receive accelerated approval from the FDA, we will be subject to rigorous post-approval requirements, including the completion of confirmatory post-approval clinical trial(s) to verify the clinical benefit of the product, and submission to the FDA of all promotional materials prior to their dissemination. The FDA could seek to withdraw accelerated approval for multiple reasons, including if we fail to conduct any required post-approval study with due diligence, such study does not confirm the predicted clinical benefit, other evidence shows that the product is not safe or effective under the conditions of use, or we disseminate promotional materials that are found by the FDA to be false and misleading.

A failure to obtain accelerated approval or any other form of expedited development, review, or approval for a product candidate that we may choose to develop would result in a longer time period prior to commercializing such product candidate, could increase the cost of development of such product candidate and could harm our competitive position in the marketplace.

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

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

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

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

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

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

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

In addition, if we were able to obtain accelerated approval of any of our drug candidates, the FDA would require us to conduct a confirmatory study to verify the predicted clinical benefit and additional safety studies. Other regulatory authorities outside of the United States, may have similar requirements. The results from the confirmatory study may not support the clinical benefit, which would result in the approval being withdrawn. While operating under accelerated approval, we will be subject to certain restrictions that we would not be subject to upon receiving regular approval.

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

In the United States, there have been and continue to be a number of legislative initiatives to contain healthcare costs. For example, in March 2010, the Affordable Care Act was passed, which substantially changes the way healthcare is financed by both governmental and private insurers, and significantly impacts the U.S. pharmaceutical industry. The Affordable Care Act, among other things, addresses a new methodology by which rebates owed by manufacturers under the Medicaid Drug Rebate Program are calculated for drugs that are inhaled, infused, instilled, implanted, or injected, increases the minimum Medicaid rebates owed by manufacturers under the Medicaid Drug Rebate Program and extends the rebate program to individuals enrolled in Medicaid managed care organizations, establishes annual fees and taxes on manufacturers of specified branded prescription drugs, and promotes a new Medicare Part D coverage gap discount program.

Since its enactment, certain aspects of the Affordable Care Act have faced Congressional and Judicial challenges. On January 20, 2017, an Executive Order was signed directing federal agencies with authorities and responsibilities under the Affordable Care Act to waive, defer, grant exemptions from, or delay the implementation of any provision of the Affordable Care Act that would impose a fiscal or regulatory burden on states, individuals, healthcare providers, health insurers, or manufacturers of pharmaceuticals or medical devices. Congress has considered legislation to repeal or replace the Affordable Care Act or elements thereof. We cannot predict how the Affordable Care Act, its possible repeal, or any legislation Congress passes to replace the Affordable Care Act will affect our business.

In addition, other legislative changes have been proposed and adopted in the United States since the Affordable Care Act was enacted, and we expect that additional state and federal healthcare reform measures will be adopted in the future, any of which could limit the amounts that federal and state governments will pay for healthcare products and services, which could result in reduced demand or lower pricing for our product candidates or additional pricing pressures.

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

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

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

- federal civil and criminal false claims laws and civil monetary penalties law, which prohibit, among other things, individuals or entities from knowingly presenting, or causing to be presented, claims for payment from Medicare, Medicaid, or other third-party payors that are false or fraudulent;

- the Health Insurance Portability and Accountability Act of 1996, or HIPAA, which created new federal criminal statutes that prohibit, among other things, executing a scheme to defraud any healthcare benefit program and making false statements relating to healthcare matters;

- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act, and their implementing regulations, which imposes specified obligations, including mandatory contractual terms, with respect to safeguarding the privacy, security, and transmission of individually identifiable health information without the appropriate authorization, on entities subject to the law, such as healthcare providers, health plans, and healthcare clearinghouses and their respective business associates that perform services for them that involve the creation, use, maintenance, or disclosure of individually identifiable health information;

- the federal Physician Payment Sunshine Act under the Affordable Care Act requires manufacturers of drugs, devices, biologics, and medical supplies to report annually to the U.S. Department of Health and Human Services

information related to payments and other transfers of value to physicians, other healthcare providers, and teaching hospitals, and ownership and investment interests held by physicians and other healthcare providers, as well as their immediate family members and applicable group purchasing organizations; and

- state law equivalents of each of the above federal laws, such as anti-kickback and false claims laws that may apply to items or services reimbursed by any third-party payor, including governmental and private payors, to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant compliance guidance promulgated by the federal government, or otherwise restrict payments that may be made to healthcare providers and other potential referral sources; state laws that require drug manufacturers to report information related to payments and other transfers of value to physicians and other healthcare providers or marketing expenditures, and state laws governing the privacy and security of health information in specified circumstances, many of which differ from each other in significant ways and may not have the same effect, thus complicating compliance efforts.

Because of the breadth of these laws and the narrowness of the statutory exceptions and safe harbors available, it is possible that some of our business activities could be subject to challenge under one or more of such laws. In addition, recent healthcare reform legislation has strengthened these laws. For example, the Affordable Care Act, among other things, amends the intent requirement of the federal Anti-Kickback Statute and criminal healthcare fraud statutes, such that a person or entity no longer needs to have actual knowledge of the statute or specific intent to violate the law. Moreover, the Affordable Care Act provides that the government may assert that a claim including items or services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the False Claims Act.

If our operations are found to be in violation of any of the laws described above or any other governmental regulations that apply to us, we may be subject to penalties, including civil and criminal penalties, disgorgement, damages, fines, contractual damages, reputational harm, diminished profits and future earnings, exclusion from participation in government healthcare programs, such as Medicare and Medicaid, including imprisonment, additional reporting requirements and/or oversight if we become subject to a corporate integrity agreement or similar agreement to resolve allegations of non-compliance with these laws, and the curtailment or restructuring of our operations, any of which could adversely affect our ability to operate our business and our results of operations.

Reliance on government funding for our programs may add uncertainty to our research and commercialization efforts with respect to those programs that are tied to such funding and may impose requirements that limit our ability to take specified actions, increase the costs of commercialization and production of product candidates developed under those programs and subject us to potential financial penalties, which could materially and adversely affect our business, financial condition, and results of operations.

During the course of our development of our product candidates, we have been funded in part through federal and state grants, including but not limited to the funding we received from Yale pursuant to a subcontract agreement with Yale. In addition to the funding we have received to date, we have applied and intend to continue to apply for federal and state grants to receive additional funding in the future. Contracts and grants funded by the U.S. government, state governments and their related agencies include provisions that reflect the government's substantial rights and remedies, many of which are not typically found in commercial contracts, including powers of the government to:

- require repayment of all or a portion of the grant proceeds, in specified cases with interest, in the event we violate specified covenants pertaining to various matters that include a failure to achieve;
- specify milestones or terms relating to use of grant proceeds, or to comply with specified laws;
- terminate agreements, in whole or in part, for any reason or no reason;
- reduce or modify the government's obligations under such agreements without the consent of the other party;
- claim rights, including intellectual property rights, in products and data developed under such agreements;
- audit contract related costs and fees, including allocated indirect costs;
- suspend the contractor or grantee from receiving new contracts pending resolution of alleged violations of procurement laws or regulations;
- impose U.S. manufacturing requirements for products that embody inventions conceived or first reduced to practice

under such agreements;

- impose qualifications for the engagement of manufacturers, suppliers, and other contractors as well as other criteria for reimbursements;
- suspend or debar the contractor or grantee from doing future business with the government;
- control and potentially prohibit the export of products;
- pursue criminal or civil remedies under the False Claims Act, False Statements Act, and similar remedy provisions specific to government agreements; and
- limit the government's financial liability to amounts appropriated by the U.S. Congress on a fiscal year basis, thereby leaving some uncertainty about the future availability of funding for a program even after we have been funded for an initial period.

In addition to those powers set forth above, the government funding we may receive could also impose requirements to make payments based upon sales of our products, if any, in the future.

We may not have the right to prohibit the U.S. government from using specified technologies developed by it, and we may not be able 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 generally takes the position that we have the right to royalty-free use of technologies that are developed under U.S. government contracts. These and other provisions of government grants may also apply to intellectual property we license now or in the future.

In addition, government contracts and grants normally contain additional requirements that may increase our costs of doing business, reduce our profits, and expose us to liability for failure to comply with these terms and conditions. These requirements include, for example:

- specialized accounting systems unique to government contracts and grants;
- mandatory financial audits and potential liability for price adjustments or recoupment of government funds after such funds have been spent;
- public disclosures of some contract and grant information, which may enable competitors to gain insights into our research program; and
- mandatory socioeconomic compliance requirements, including labor standards, non-discrimination and affirmative action programs, and environmental compliance requirements.

If we fail to maintain compliance with any such requirements that may apply to us now or in the future, we may be subject to potential liability and to termination of our contracts.

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

Our research and development activities and our third-party manufacturers' and suppliers' activities involve the controlled storage, use, and disposal of hazardous materials, including the components of our product candidates and other hazardous compounds. We and our manufacturers and suppliers are subject to laws and regulations governing the use, manufacture, storage, handling, and disposal of these hazardous materials. In some cases, these hazardous materials and various wastes resulting from their use are stored at our and our manufacturers' facilities pending their use and disposal. We cannot eliminate the risk of contamination, which could cause an interruption of our commercialization efforts, research and development efforts, and business operations, and cause environmental damage resulting in costly clean-up and liabilities under applicable laws and regulations governing the use, storage, handling, and disposal of these materials and specified waste products. Although we believe that the safety procedures utilized by us and our third-party manufacturers for handling and disposing of these materials generally comply with the standards prescribed by these laws and regulations, we cannot guarantee that this is the case or eliminate the risk of accidental contamination or injury from these materials. In such an event, we may be held liable for any resulting damages and such liability could exceed our resources, and state or federal or other applicable

authorities may curtail our use of specified materials and/or interrupt our business operations. Furthermore, environmental laws and regulations are complex, change frequently, and have tended to become more stringent. We cannot predict the impact of such changes and cannot be certain of our future compliance. We do not currently carry biological or hazardous waste insurance coverage.

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

We and our partners may be subject to federal, state, and foreign data protection laws and regulations (i.e., laws and regulations that address privacy and data security). In the United States, numerous federal and state laws and regulations, including state data breach notification laws, state health information privacy laws, and federal and state consumer protection laws (e.g., Section 5 of the Federal Trade Commission Act), that govern the collection, use, disclosure, and protection of health-related and other personal information could apply to our operations or the operations of our partners. In addition, we may obtain health information from third parties (including research institutions from which we obtain clinical trial data) that are subject to privacy and security requirements under HIPAA, as amended. Depending on the facts and circumstances, we could be subject to criminal penalties if we knowingly obtain, use, or disclose individually identifiable health information maintained by a HIPAA-covered entity in a manner that is not authorized or permitted by HIPAA.

International data protection laws, including the European Union Directive 95/46/EC, or the EU Data Protection Directive, and member state implementing legislation, may also apply to health-related and other personal information obtained outside of the United States. The EU Data Protection Directive and the national implementing legislation of the individual European Union Member States impose strict obligations on the ability to process health-related and other personal information of EU data subjects, including in relation to collection, analysis, and transfer. These include several requirements relating to the consent of the individuals to whom the personal data relates, the information provided to the individuals, notification of data processing obligations to the competent national data protection authorities, and the security and confidentiality of the personal data. The EU Data Protection Directive prohibits the transfer of personal data to countries outside of the European Economic Area, or EEA, such as the United States, which are not considered by the European Commission to provide an adequate level of data protection. Switzerland has adopted similar restrictions.

Although there are legal mechanisms to allow for the transfer of personal data from the EEA and Switzerland to the United States, uncertainty about compliance with EU data protection laws remains. Data protection authorities from the different EU Member States may interpret the EU Data Protection Directive and national laws differently, and guidance on implementation and compliance practices are often updated or otherwise revised, which adds to the complexity of processing personal data in the EU.

In December 2015, a proposal for an EU General Data Protection Regulation, intended to replace the current EU Data Protection Directive, was agreed between the European Parliament, the Council of the European Union, and the European Commission. The EU General Data Protection Regulation, which was officially adopted in April 2016 and will be applicable in May 2018, will introduce new data protection requirements in the EU, as well as substantial fines for breaches of the data protection rules. The EU General Data Protection Regulation will increase our responsibility and liability in relation to personal data that we process, and we may be required to put in place additional mechanisms to ensure compliance with the new EU data protection rules.

Failure to comply with U.S. and international data protection laws and regulations could result in government enforcement actions (which could include civil or criminal penalties), private litigation, and/or adverse publicity and could negatively affect our operating results and business. Moreover, patients about whom we or our partners obtain information, as well as the providers who share this information with us, may contractually limit our ability to use and disclose the information. Claims that we have violated individuals' privacy rights, failed to comply with data protection laws, or breached our contractual obligations, even if we are not found liable, could be expensive and time-consuming to defend and could result in adverse publicity that could harm our business.

Risks Related to Our Intellectual Property

We may not be successful in obtaining or maintaining necessary rights to microRNA targets, product compounds and processes for our development pipeline through acquisitions and in-licenses.

Presently, we have rights to the intellectual property, through licenses from third parties and under patents and patent applications that we own, to modulate only a subset of the known microRNA targets. Because our programs may involve a

range of microRNA targets, including targets that require the use of proprietary rights held by third parties, the growth of our business will likely depend in part on our ability to acquire, in-license, or use these proprietary rights. In addition, our product candidates may require specific formulations to work effectively and efficiently and these rights may be held by others. We may be unable to acquire or in-license any compositions, methods of use, processes, or other third-party intellectual property rights from third parties that we identify. The licensing and acquisition of third-party intellectual property rights is a competitive area, and a number of more established companies are also pursuing strategies to license or acquire third-party intellectual property rights that we may consider attractive. These established companies may have a competitive advantage over us due to their size, cash resources, and greater clinical development and commercialization capabilities.

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

In addition, companies that perceive us to be a competitor may be unwilling to assign or license rights to us. We also may be unable to license or acquire third-party intellectual property rights on terms that would allow us to make an appropriate return on our investment. If we are unable to successfully obtain rights to third-party intellectual property rights, our business, financial condition, and prospects for growth could suffer.

We intend to rely on patent rights for our product candidates and any future product candidates. If we are unable to obtain or maintain exclusivity from the combination of these approaches, we may not be able to compete effectively in our markets.

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

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

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

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

If we cannot obtain and maintain effective protection of exclusivity from our regulatory efforts and intellectual property rights, including patent protection or data exclusivity, for our product candidates, we may not be able to compete effectively and our business and results of operations would be harmed.

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

Patents have a limited term. In the United States, the statutory expiration of a patent is generally 20 years after it is filed. Additional patent terms may be available through a patent term adjustment process, resulting from the United States Patent and Trademark Office, or USPTO, delays during prosecution. Although various extensions may be available, the life of a patent, and the protection it affords, is limited. Even if patents covering our product candidates are obtained, once the patent life has expired for a product candidate, we may be open to competition from generic medications.

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

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

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

The USPTO has issued subject matter eligibility guidance to patent examiners instructing USPTO examiners on the ramifications of the Supreme Court rulings in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.* and *Association for Molecular Pathology v. Myriad Genetics, Inc.*, and applied the Myriad ruling to natural products and principles including all naturally occurring nucleic acids. In addition, the USPTO continues to provide updates to its guidance and this is a developing area. The USPTO guidance may make it impossible for us to pursue similar patent claims in patent applications we may prosecute in the future.

Our patent portfolio contains claims of various types and scope, including chemically modified mimics, inhibitors, as well as methods of medical treatment. The presence of varying claims in our patent portfolio significantly reduces, but may not eliminate, our exposure to potential validity challenges.

For our U.S. patent applications containing a claim not entitled to priority before March 16, 2013, there is a greater level of uncertainty in the patent law. On September 16, 2011, the Leahy-Smith America Invents Act, or the Leahy-Smith Act, was signed into law. The Leahy-Smith Act includes a number of significant changes to U.S. patent law. These include provisions that affect the way patent applications will be prosecuted and may also affect patent litigation. The USPTO has promulgated regulations and developed procedures to govern administration of the Leahy-Smith Act, and many of the substantive changes to patent law associated with the Leahy-Smith Act, and in particular, the first to file provisions, did not come into effect until March 16, 2013. Accordingly, it is not yet clear what, if any, impact the Leahy-Smith Act will have on the operation of our business. However, the Leahy-Smith Act 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 a material adverse effect on our business, financial condition, or results of operations.

An important change introduced by the Leahy-Smith Act 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. This will require us to be cognizant going forward of the time from invention to filing of a patent application. Furthermore, our ability to obtain and maintain valid and enforceable patents depends on whether the differences between our technology and the prior art allow our technology to be patentable over the prior art. Since patent applications in the United States and most other countries are confidential for a period of time after filing, we cannot be certain that we were the first to either: (i) file any patent application related to our product candidates or (ii) invent

any of the inventions claimed in our patents or patent applications.

Among some of the other changes introduced by the Leahy-Smith Act are changes that limit where a patentee may file a patent infringement suit and new procedures providing opportunities for third parties to challenge any issued patent in the USPTO. Included in these new procedures is a process known as Inter Partes Review, or IPR, which has been generally used by many third parties over the past four years to invalidate patents. The IPR process is not limited to patents filed after the Leahy-Smith Act was enacted, and would therefore be available to a third party seeking to invalidate any of our U.S. patents, even those filed before March 16, 2013. Because of a lower evidentiary standard in USPTO proceedings compared to the evidentiary standard in U.S. federal court necessary to invalidate a patent claim, a third party could potentially provide evidence in a USPTO proceeding sufficient for the USPTO to hold a claim invalid even though the same evidence would be insufficient to invalidate the claim if first presented in a district court action. Accordingly, a third party may attempt to use the USPTO procedures to invalidate our patent claims that would not have been invalidated if first challenged by the third party as a defendant in a district court action. Additionally, the rights of review and appeal for IPR decisions is an area of law that is still developing.

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

In addition to the protection afforded by patents, we rely on trade secret protection and confidentiality agreements to protect proprietary know-how that is not patentable or that we elect not to patent, processes for which patents are difficult to enforce and any other elements of our product candidate discovery and development processes that involve proprietary know-how, information, or technology that is not covered by patents. However, trade secrets can be difficult to protect. We seek to protect our proprietary technology and processes, in part, by entering into confidentiality agreements with our employees, consultants, scientific advisors, and contractors. We also seek to preserve the integrity and confidentiality of our data and trade secrets by maintaining physical security of our premises and physical and electronic security of our information technology systems. While we have confidence in these individuals, organizations, and systems, agreements or security measures may be breached, and we may not have adequate remedies for any breach. In addition, our trade secrets may otherwise become known or be independently discovered by competitors.

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

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

Our commercial success depends in part on our ability to develop, manufacture, market, and sell our product candidates and use our proprietary technology without infringing the patent rights of third parties. Numerous third-party U.S. and non-U.S. issued patents and pending applications exist in the area of microRNA. We are aware of U.S. and foreign patents and pending patent applications owned by third parties that cover therapeutic uses of microRNA replacements and inhibitors. From time to time, we may also monitor these patents and patent applications. We may in the future pursue available proceedings in the U.S. and foreign patent offices to challenge the validity of these patents and patent applications. In addition, or alternatively, we may consider whether to seek to negotiate a license of rights to technology covered by one or more of such patents and patent applications. If any patents or patent applications cover our product candidates or technologies, we may not be free to manufacture or market our product candidates, including cobomarsen, MRG-201, or MRG-110, as planned, absent such a license, which may not be available to us on commercially reasonable terms, or at all.

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

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

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

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

We may not be successful in meeting our obligations under our existing license agreements necessary to maintain our product candidate licenses in effect. In addition, if required in order to commercialize our product candidates, we may be unsuccessful in obtaining or maintaining necessary rights to our product candidates through acquisitions and in-licenses.

We currently have rights to the intellectual property, through licenses from third parties and under patents that we do not own, to develop and commercialize our product candidates. Because our programs may require the use of proprietary rights held by third parties, the growth of our business will likely depend in part on our ability to maintain in effect these proprietary rights. Any termination of license agreements with third parties with respect to our product candidates would be expected to negatively impact our business prospects.

We may be unable to acquire or in-license any compositions, methods of use, processes, or other third-party intellectual property rights from third parties that we identify as necessary for our product candidates. The licensing and acquisition of third-party intellectual property rights is a competitive area, and a number of more established companies are also pursuing strategies to license or acquire third-party intellectual property rights that we may consider attractive. These established companies may have a competitive advantage over us due to their size, cash resources, and greater clinical development and commercialization capabilities. In addition, companies that perceive us to be a competitor may be unwilling to assign or license rights to us. Even if we are able to license or acquire third-party intellectual property rights that are necessary for our product candidates, there can be no assurance that they will be available on favorable terms.

We collaborate with U.S. and foreign academic institutions to identify product candidates, accelerate our research, and conduct development. Typically, these institutions have provided us with an option to negotiate an exclusive license to any of the institution's rights in the patents or other intellectual property resulting from the collaboration. Regardless of such option, we may be unable to negotiate a license within the specified timeframe or under terms that are acceptable to us. If we are unable to do so, the institution may offer the intellectual property rights to other parties, potentially blocking our ability to pursue a program of interest to us.

If we are unable to successfully obtain and maintain rights to required third-party intellectual property, we may have to abandon development of that product candidate or pay additional amounts to the third party, and our business and financial condition could suffer.

The patent protection and patent prosecution for some of our product candidates is dependent on third parties.

While we normally seek and gain the right to fully prosecute the patents relating to our product candidates, there may be times when patents relating to our product candidates are controlled by our licensors. For instance, this is the case with our agreement with RICC, who is primarily responsible for the prosecution of patents and patent applications licensed to us under the applicable agreement. If RICC or any of our future licensors fail to appropriately and broadly prosecute and maintain

patent protection for patents covering any of our product candidates, our ability to develop and commercialize those product candidates may be adversely affected, and we may not be able to prevent competitors from making, using, importing, and selling competing products. In addition, even where we now have the right to control patent prosecution of patents and patent applications we have licensed from third parties, we may still be adversely affected or prejudiced by actions or inactions of our licensors in effect from actions prior to us assuming control over patent prosecution.

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

We are a party to a number of intellectual property license and supply agreements that are important to our business and expect to enter into additional license agreements in the future. Our existing agreements impose, and we expect that future license agreements will impose, various diligence, milestone payments, royalties, purchasing, and other obligations on us. If we fail to comply with our obligations under these agreements, or we are subject to a bankruptcy, our agreements may be subject to termination by the licensor, in which event we would not be able to develop, manufacture, or market products covered by the license or subject to supply commitments.

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

Competitors may infringe our patents or the patents of our licensors. If we or one of our licensing partners were to initiate legal proceedings against a third party to enforce a patent covering one of our product candidates, the defendant could counterclaim that the patent covering our product candidate is invalid and/or unenforceable. In patent litigation in the United States, defendant counterclaims alleging invalidity and/or unenforceability are commonplace. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, including lack of novelty, obviousness, written description, clarity, or non-enablement. Grounds for an unenforceability assertion could be an allegation that someone connected with prosecution of the patent withheld relevant information from the USPTO, or made a misleading statement, during prosecution. The outcome following legal assertions of invalidity and unenforceability is unpredictable.

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

Furthermore, because of the substantial amount of discovery required in connection with intellectual property litigation, there is a risk that some of our confidential information could be compromised by disclosure during this type of litigation. There could also be public announcements of the results of hearings, motions, or other interim proceedings or developments. If securities analysts or investors perceive these results to be negative, it could have a material adverse effect on the price of our common stock.

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

We employ individuals who were previously employed at universities or other biotechnology or pharmaceutical companies, including our competitors or potential competitors. Although we have written agreements and make every effort to ensure that our employees, consultants, and independent contractors do not use the proprietary information or intellectual property rights of others in their work for us, we may in the future be subject to any claims that our employees, consultants, or independent contractors have wrongfully used or disclosed confidential information of third parties. Litigation may be necessary to defend against these claims. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights or personnel, which could adversely impact our business. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management and other employees.

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

Filing, prosecuting, and defending patents on product candidates in all countries throughout the world would be prohibitively expensive, and our intellectual property rights in some countries outside the United States can be less extensive than those in the United States. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as federal and state laws in the United States. Competitors may use our technologies in jurisdictions where we have not obtained patent protection to develop our own products and may also export infringing products to territories where we have patent protection, but enforcement is not as strong as that in the United States.

These products may compete with our products and our patents or other intellectual property rights may not be effective or sufficient to prevent them from competing.

Many companies have encountered significant problems in protecting and defending intellectual property rights in foreign jurisdictions. The legal systems of some countries, particularly some developing countries, do not favor the enforcement of patents, trade secrets, and other intellectual property protection, particularly those relating to biotechnology products, which could make it difficult for us to stop the infringement of our patents or marketing of competing products in violation of our proprietary rights generally.

Proceedings to enforce our patent rights in foreign jurisdictions, whether or not successful, could result in substantial costs and divert our efforts and attention from other aspects of our business, could put our patents at risk of being invalidated or interpreted narrowly and our patent applications at risk of not issuing, and could provoke third parties to assert claims against us. We may not prevail in any lawsuits that we initiate, and the damages or other remedies awarded, if any, may not be commercially meaningful. Accordingly, our efforts to enforce our intellectual property rights around the world may be inadequate to obtain a significant commercial advantage from the intellectual property that we develop or license.

Risks Related to Our Reliance on Third Parties

We rely on third parties to conduct our clinical trials, manufacture our product candidates, and perform other services. If these third parties do not successfully perform and comply with regulatory requirements, we may not be able to successfully complete clinical development, obtain regulatory approval, or commercialize our product candidates and our business could be substantially harmed.

We have relied upon and plan to continue to rely upon third-party CROs to conduct, monitor, and manage our ongoing clinical programs. We rely on these parties for execution of clinical trials, and we manage and control only some aspects of their activities. We remain responsible for ensuring that each of our trials is conducted in accordance with the applicable protocol, legal, regulatory, and scientific standards, and our reliance on the CROs does not relieve us of our regulatory responsibilities. We and our CROs and other vendors are required to comply with all applicable laws, regulations, and guidelines, including those required by the FDA and comparable foreign regulatory authorities for all of our product candidates in clinical development. If we or any of our CROs or vendors fail to comply with applicable laws, regulations, and guidelines, the results generated in our clinical trials may be deemed unreliable, and the FDA or comparable foreign regulatory authorities may require us to perform additional clinical trials before approving our marketing applications. We cannot be assured that our CROs and other vendors will meet these requirements, or that upon inspection by any regulatory authority, such regulatory authority will determine that efforts, including any of our clinical trials, comply with applicable requirements. Our failure to comply with these laws, regulations, and guidelines may require us to repeat clinical trials, which would be costly and delay the regulatory approval process.

If any of our relationships with these third-party CROs terminate, we may not be able to enter into arrangements with alternative CROs in a timely manner or do so on commercially reasonable terms. In addition, our CROs may not prioritize our clinical trials relative to those of other customers, and any turnover in personnel or delays in the allocation of CRO employees by the CRO may negatively affect our clinical trials. If CROs do not successfully carry out their contractual duties or obligations or meet expected deadlines, our clinical trials may be delayed or terminated, and we may not be able to meet our current plans with respect to our product candidates. CROs may also involve higher costs than anticipated, which could negatively affect our financial condition and operations.

In addition, we do not currently have, nor do we currently plan to establish, the capability to manufacture product candidates for use in the conduct of our clinical trials, and we lack the resources and the capability to manufacture any of our product candidates on a clinical or commercial scale without the use of third-party manufacturers. We plan to rely on third-party manufacturers and their responsibilities will include purchasing from third-party suppliers the materials necessary to produce our product candidates for our clinical trials and regulatory approval. There are expected to be a limited number of suppliers

for the active ingredients and other materials that we expect to use to manufacture our product candidates, and we may not be able to identify alternative suppliers to prevent a possible disruption of the manufacture of our product candidates for our clinical trials, and, if approved, ultimately for commercial sale. Although we generally do not expect to begin a clinical trial unless we believe we have a sufficient supply of a product candidate to complete the trial, any significant delay or discontinuity in the supply of a product candidate, or the active ingredient or other material components in the manufacture of the product candidate, could delay completion of our clinical trials and potential timing for regulatory approval of our product candidates, which would harm our business and results of operations.

We rely and expect to continue to rely on third parties to manufacture our clinical product supplies, and we intend to rely on third parties to produce and process our product candidates, if approved, and our commercialization of any of our product candidates could be stopped, delayed, or made less profitable if those third parties fail to obtain approval of government regulators, fail to provide us with sufficient quantities of drug product, or fail to do so at acceptable quality levels or prices.

We do not currently have nor do we currently plan to develop the infrastructure or capability internally to manufacture our clinical supplies for use in the conduct of our clinical trials, and we lack the resources and the capability to manufacture any of our product candidates on a clinical or commercial scale. We currently rely on outside vendors to manufacture our clinical supplies of our product candidates and plan to continue relying on third parties to manufacture our product candidates on a commercial scale, if approved.

We do not yet have sufficient information to reliably estimate the cost of the commercial manufacturing of our product candidates and our current cost to manufacture our drug products is not commercially feasible. Additionally, the actual cost to manufacture our product candidates could materially and adversely affect the commercial viability of our product candidates. As a result, we may never be able to develop a commercially viable product.

In addition, our reliance on third-party manufacturers exposes us to the following additional risks:

- We may be unable to identify manufacturers on acceptable terms or at all.
- Our third-party manufacturers might be unable to timely formulate and manufacture our product or produce the quantity and quality required to meet our clinical and commercial needs, if any.
- Contract manufacturers may not be able to execute our manufacturing procedures appropriately.
- Our future third-party manufacturers may not perform as agreed or may not remain in the contract manufacturing business for the time required to supply our clinical trials or to successfully produce, store, and distribute our products.
- Manufacturers are subject to ongoing periodic unannounced inspection by the FDA and corresponding state agencies to ensure strict compliance with cGMPs and other government regulations and corresponding foreign standards. We do not have control over third-party manufacturers' compliance with these regulations and standards.
- We may not own, or may have to share, the intellectual property rights to any improvements made by our third-party manufacturers in the manufacturing process for our product candidates.
- Our third-party manufacturers could breach or terminate their agreement with us.

Each of these risks could delay our clinical trials, as well as the approval, if any, of our product candidates by the FDA, or the commercialization of our product candidates, or could result in higher costs, or could deprive us of potential product revenue. In addition, we rely on third parties to perform release testing on our product candidates prior to delivery to patients. If these tests are not appropriately conducted and test data are not reliable, patients could be put at risk of serious harm and could result in product liability suits.

The manufacture of medical products is complex and requires significant expertise and capital investment, including the development of advanced manufacturing techniques and process controls. Manufacturers of medical products often encounter difficulties in production, particularly in scaling up and validating initial production and absence of contamination. These problems include difficulties with production costs and yields, quality control, including stability of the product, quality assurance testing, operator error, shortages of qualified personnel, as well as compliance with strictly enforced federal, state, and foreign regulations. Furthermore, if contaminants are discovered in our supply of our product candidates or in the

manufacturing facilities, such manufacturing facilities may need to be closed for an extended period of time to investigate and remedy the contamination. We cannot be assured that any stability or other issues relating to the manufacture of our product candidates will not occur in the future. Additionally, our manufacturers may experience manufacturing difficulties due to resource constraints or as a result of labor disputes or unstable political environments. If our manufacturers were to encounter any of these difficulties, or otherwise fail to comply with their contractual obligations, our ability to provide our product candidates to patients in clinical trials would be jeopardized. Any delay or interruption in the supply of clinical trial supplies could delay the completion of clinical trials, increase the costs associated with maintaining clinical trial programs and, depending upon the period of delay, require us to commence new clinical trials at additional expense or terminate clinical trials completely.

We may be unable to realize the potential benefits of any collaboration.

Even if we are successful in entering into a collaboration with respect to the development and/or commercialization of one or more product candidates, there is no guarantee that the collaboration will be successful. Collaborations may pose a number of risks, including:

- collaborators often have significant discretion in determining the efforts and resources that they will apply to the collaboration and may not commit sufficient resources to the development, marketing, or commercialization of the product or products that are subject to the collaboration;
- collaborators may not perform their obligations as expected;
- any such collaboration may significantly limit our share of potential future profits from the associated program and may require us to relinquish potentially valuable rights to our current product candidates, potential products, proprietary technologies, or grant licenses on terms that are not favorable to us;
- collaborators may cease to devote resources to the development or commercialization of our product candidates if the collaborators view our product candidates as competitive with their own products or product candidates;
- disagreements with collaborators, including disagreements over proprietary rights, contract interpretation, or the course of development, might cause delays or termination of the development or commercialization of product candidates, and might result in legal proceedings, which would be time consuming, distracting, and expensive;
- collaborators may be impacted by changes in their strategic focus or available funding, or business combinations involving them, which could cause them to divert resources away from the collaboration;
- collaborators may infringe the intellectual property rights of third parties, which may expose us to litigation and potential liability;
- the collaborations may not result in us achieving revenues to justify such transactions; and
- collaborations may be terminated and, if terminated, may result in a need for us to raise additional capital to pursue further development or commercialization of the applicable product candidate.

As a result, a collaboration may not result in the successful development or commercialization of our product candidates.

For instance, in October 2011, we entered into the Servier Collaboration Agreement with Servier for the research, development, and commercialization of RNA-targeting therapeutics in cardiovascular disease, which was subsequently amended. Under the Servier Collaboration Agreement, we have granted Servier an exclusive license to research, develop, and commercialize RNA-targeting therapeutics for one target in the cardiovascular field and the right to obtain such an exclusive license for one additional target through September 2019. Servier's rights to this target are limited to therapeutics in the cardiovascular field in their territory, which is worldwide except for the United States and Japan. We retain all rights for the named target in the United States and Japan and for any products or product candidates outside of the cardiovascular field. We cannot guarantee that any product candidate will ever be successfully commercialized under the Servier Collaboration Agreement. If no product candidate subject to the Servier Collaboration Agreement is successfully commercialized, we may never receive additional milestone or any royalty payments under the Servier Collaboration Agreement. Also, due to restrictions contained in the Servier Collaboration Agreement, we may not be able to effectively develop, market, or commercialize any such product candidate in the United States and Japan.

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

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

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

Risks Related to Commercialization of Our Product Candidates

We currently have limited marketing and sales experience. If we are unable to establish sales and marketing capabilities or enter into agreements with third parties to market and sell our product candidates, we may be unable to generate any revenue.

Although some of our employees may have launched other pharmaceutical products in the past while employed at other companies, we have no experience selling and marketing our product candidates and we currently have no marketing or sales organization. To successfully commercialize any products that may result from our development programs, we will need to find one or more collaborators to commercialize our products or invest in and develop these capabilities, either on our own or with others, which would be expensive, difficult, and time consuming. Any failure or delay in the timely development of our internal commercialization capabilities could adversely impact the potential for success of our products.

If commercialization collaborators do not commit sufficient resources to commercialize our future products and we are unable to develop the necessary marketing and sales capabilities on our own, we will be unable to generate sufficient product revenue to sustain or grow our business. We may be competing with companies that currently have extensive and well-funded marketing and sales operations, particularly in the markets our product candidates are intended to address. Without appropriate capabilities, whether directly or through third-party collaborators, we may be unable to compete successfully against these more established companies.

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

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

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

market and our business may be materially and adversely affected.

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

Given the small number of patients who have the diseases that we are targeting, our eligible patient population and pricing estimates may differ significantly from the actual market addressable by our product candidates. For instance, one of our Phase 1 clinical trials in cobomarsen is focused on MF. The estimated prevalence of MF is 16,000 to 20,000 cases in the United States, only a subset of which may benefit from treatment with cobomarsen. Our projections of both the number of people who have this disease, as well as the subset of people with this disease who have the potential to benefit from treatment with our product candidates, are based on our beliefs and estimates. These estimates have been derived from a variety of sources, including the scientific literature, patient foundations, or market research, and may prove to be incorrect. Further, new studies may change the estimated incidence or prevalence of these diseases. The number of patients may turn out to be lower than expected. Additionally, while we believe that the data in our Phase 1 clinical trials for cobomarsen and MRG-201 are supportive of application to other indications, there can be no assurance that our clinical trials will successfully address any additional indications. Likewise, the potentially addressable patient population for each of our product candidates may be limited or may not be amenable to treatment with our product candidates, and new patients may become increasingly difficult to identify or gain access to, which would adversely affect our business, financial condition, results of operations and prospects.

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

The development and commercialization of new drug products is highly competitive. We face competition from major pharmaceutical companies, specialty pharmaceutical companies, biotechnology companies, universities, and other research institutions worldwide with respect to cobomarsen, MRG-201, MRG-110, and the other product candidates that we may seek to develop or commercialize in the future. We are aware that the following companies have therapeutics marketed or in development for CTCL: Actelion Ltd, Argenx, Bristol-Myers Squibb Company, Celgene Corporation, innate Pharma, Kyowa Hakko Kirin, Merck & Co., Inc., Mylan Pharmaceuticals Inc., Novartis International AG, Spectrum Pharmaceuticals, Inc., Seattle Genetics, Inc., Takeda Pharmaceutical Company Ltd, and Valeant Pharmaceuticals International, Inc. We are also aware that the several companies have marketed therapeutics for pulmonary fibrosis, including Boehringer Ingelheim GmbH and F. Hoffmann-La Roche Ltd. Our competitors may succeed in developing, acquiring, or licensing technologies and drug products that are more effective or less costly than cobomarsen, MRG-201, or any other product candidates that we are currently developing or that we may develop, which could render our product candidates obsolete and noncompetitive.

In addition to the competition we face from alternative therapies for the diseases we intend to target with our product candidates, we are also aware of several companies that are also working specifically to develop microRNA-targeted therapeutics, including Regulus Therapeutics, Inc., Microlin Bio, Inc., and InteRNA Technologies, B.V. Further, there are several companies working to develop other types of oligonucleotide therapeutic products, including Ionis Pharmaceuticals, Inc., Alnylam Pharmaceuticals, Inc., Arrowhead Pharmaceuticals, Inc., Dicerna Pharmaceuticals, Inc., RaNa Therapeutics, Inc., RXi Pharmaceuticals Corporation, and Silence Therapeutics AG. Many of our competitors have substantially greater financial, technical, and other resources, such as larger research and development staff and experienced marketing and manufacturing organizations. Third-party payors, including governmental and private insurers, may also encourage the use of generic products. For example, if cobomarsen or MRG-201 is approved, it may be priced at a significant premium over other competitive products. This may make it difficult for cobomarsen, MRG-201, or any other future products to compete with these products.

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

Many of our competitors have materially greater name recognition and financial, manufacturing, marketing, research, and drug development resources than we do. Additional mergers and acquisitions in the biotechnology and pharmaceutical industries may result in even more resources being concentrated in our competitors. Large pharmaceutical companies in particular have extensive expertise in preclinical and clinical testing and in obtaining regulatory approvals for drugs. In addition, academic institutions, government agencies, and other public and private organizations conducting research may seek patent protection with respect to potentially competitive products or technologies. These organizations may also

establish exclusive collaborative or licensing relationships with our competitors. Failure of cobomarsen, MRG-201, or other product candidates to effectively compete against established treatment options or in the future with new products currently in development would harm our business, financial condition, results of operations, and prospects.

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

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

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

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

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

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

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

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

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

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

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

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

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

Moreover, increasing efforts by governmental and private payors in the United States and abroad to limit or reduce healthcare costs may result in restrictions on coverage and the level of reimbursement for new products and, as a result, they may not cover or provide adequate payment for our products. Further, there has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices. Specifically, there have been several recent U.S. Congressional inquiries and proposed bills designed to, among other things, bring more transparency to drug pricing, review the relationship between pricing and manufacturer patient programs, reduce the cost of drugs under Medicare, and reform government program reimbursement methodologies for drugs. We expect to experience pricing pressures in connection with products due to the increasing trend toward managed healthcare, including the increasing influence of health maintenance organizations and additional legislative changes. The downward pressure on healthcare costs in general, particularly prescription drugs, has increased and is expected to continue to increase in the future. As a result, profitability of our products, if any, may be more difficult to achieve even if they receive regulatory approval.

Risks Related to Our Business Operations

Our future success depends in part on our ability to retain our president and chief executive officer and to attract, retain, and motivate other qualified personnel.

We are highly dependent on William S. Marshall, Ph.D., our president and chief executive officer, the loss of whose services may adversely impact the achievement of our objectives. Dr. Marshall could leave our employment at any time, as he is an "at will" employee. Recruiting and retaining other qualified employees, consultants, and advisors for our business, including scientific and technical personnel, will also be critical to our success. There is currently a shortage of highly qualified personnel in our industry, which is likely to continue. Additionally, this shortage of highly qualified personnel is particularly acute in the area where we are located. As a result, competition for personnel is intense and the turnover rate can be high. We may not be able to attract and retain personnel on acceptable terms given the competition among numerous pharmaceutical and biotechnology companies for individuals with similar skill sets. In addition, failure to succeed in development and commercialization of our product candidates may make it more challenging to recruit and retain qualified personnel. The inability to recruit and retain qualified personnel, or the loss of the services of Dr. Marshall, may impede the progress of our research, development, and commercialization objectives and would negatively impact our ability to succeed in our product development strategy.

We will need to expand our organization and we may experience difficulties in managing this growth, which could disrupt our operations.

As of December 31, 2017, we had 63 full-time employees. As our development and commercialization plans and strategies develop, we expect to need additional managerial, operational, sales, marketing, financial, legal, and other resources. Our management may need to divert a disproportionate amount of our attention away from our day-to-day activities and devote a substantial amount of time to managing these growth activities. We may not be able to effectively manage the expansion of our operations, which may result in weaknesses in our infrastructure, operational mistakes, loss of business opportunities, loss of employees, and reduced productivity among remaining employees. Our expected growth could require significant capital expenditures and may divert financial resources from other projects, such as the development of additional product candidates. If our management is unable to effectively manage our growth, our expenses may increase more than expected, our ability to generate and/or grow revenue could be reduced and we may not be able to implement our business strategy. Our future financial performance and our ability to commercialize product candidates and compete effectively will depend, in part, on our ability to effectively manage any future growth.

Failure in our information technology and storage systems could significantly disrupt the operation of our business.

Our ability to execute our business plan and maintain operations depends on the continued and uninterrupted performance of our information technology, or IT, systems. IT systems are vulnerable to risks and damages from a variety of sources, including telecommunications or network failures, malicious human acts, and natural disasters. Moreover, despite network security and back-up measures, some of our and our vendors' servers are potentially vulnerable to physical or electronic break-ins, including cyber-attacks, computer viruses, and similar disruptive problems. These events could lead to the unauthorized access, disclosure, and use of non-public information. The techniques used by criminal elements to attack computer systems are sophisticated, change frequently, and may originate from less regulated and remote areas of the world. As a result, we may not be able to address these techniques proactively or implement adequate preventative measures. If our computer systems are compromised, we could be subject to fines, damages, litigation, and enforcement actions, and we could lose trade secrets, the occurrence of which could harm our business. Despite precautionary measures to prevent unanticipated problems that could affect our IT systems, sustained or repeated system failures that interrupt our ability to generate and maintain data could adversely affect our ability to operate our business.

Our ability to use net operating losses to offset future taxable income may be subject to limitation.

Our net operating loss carryforwards could expire unused and be unavailable to offset future income tax liabilities. Under the newly enacted federal income tax law, federal net operating losses incurred in 2018 and in future years may be carried forward indefinitely, but the deductibility of such federal net operating losses is limited. It is uncertain if and to what extent various states will conform to the newly enacted federal tax law. In addition, under Section 382 of the Internal Revenue Code of 1986, as amended, and corresponding provisions of state law, if a corporation undergoes an "ownership change," which is generally defined as a greater than 50% change, by value, in its equity ownership over a three-year period, the corporation's ability to use its pre-change net operating loss carryforwards and other pre-change tax attributes to offset its post-change income or taxes may be limited. Our most recent analysis of possible ownership changes was completed for certain tax periods ending through the date of the Merger. The Merger resulted in an ownership change for us and, accordingly, our net

operating loss carryforwards and certain other tax attributes are subject to limitation. Additional ownership changes in the future could result in additional limitations on our net operating loss carryforwards and certain other tax attributes. Consequently, even if we achieve profitability, we may not be able to utilize a material portion of our net operating loss carryforwards and certain other tax attributes, which could have a material adverse effect on cash flow and results of operations.

The recently passed comprehensive tax reform bill could adversely affect our business and financial condition.

On December 22, 2017, new legislation was signed into law that significantly revises the Internal Revenue Code of 1986, as amended. The newly enacted federal income tax law, among other things, contains significant changes to corporate taxation, including reduction of the corporate tax rate from a top marginal rate of 35% to a flat rate of 21%, limitation of the tax deduction for interest expense to 30% of adjusted earnings (except for certain small businesses), limitation of the deduction for net operating losses to 80% of current year taxable income and elimination of net operating loss carrybacks, one time taxation of offshore earnings at reduced rates regardless of whether they are repatriated, elimination of U.S. tax on foreign earnings (subject to certain important exceptions), immediate deductions for certain new investments instead of deductions for depreciation expense over time, and modifying or repealing many business deductions and credits. Notwithstanding the reduction in the corporate income tax rate, the overall impact of the new federal tax law is uncertain and our business and financial condition could be adversely affected. In addition, it is uncertain if and to what extent various states will conform to the newly enacted federal tax law. The impact of this tax reform or any future tax laws on holders of our common stock is also uncertain and could be adverse. We urge our stockholders to consult with their legal and tax advisors with respect to this legislation and the potential tax consequences of investing in or holding our common stock.

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

Our directors, officers, 5% stockholders, and their affiliates currently beneficially own a substantial portion of our outstanding voting stock. Therefore, these stockholders have the ability and may continue to have the ability to influence us through this ownership position. These stockholders may be able to determine some or all matters requiring stockholder approval. For example, these stockholders, acting together, may be able to control elections of directors, amendments of organizational documents, or approval of any merger, sale of assets, or other major corporate transaction. This may prevent or discourage unsolicited acquisition proposals or offers for our common stock that you may believe are in your best interest as one of our stockholders.

Our effective tax rate may fluctuate, and we may incur obligations in tax jurisdictions in excess of accrued amounts.

We are subject to taxation in numerous U.S. states and territories and non-U.S. jurisdictions. As a result, our effective tax rate is derived from a combination of applicable tax rates in the various places that we operate. In preparing our financial statements, we estimate the amount of tax that will become payable in each of such places. Nevertheless, our effective tax rate may be different than experienced in the past due to numerous factors including passage of the newly enacted federal income tax law, the results of examinations and audits of our tax filings, our inability to secure or sustain acceptable agreements with tax authorities, changes in accounting for income taxes, and changes in tax laws. Any of these factors could cause us to experience an effective tax rate significantly different from previous periods or our current expectations and may result in tax obligations in excess of amounts accrued in our financial statements.

Risks Related to Ownership of our Common Stock

The market price of our common stock is expected to be volatile, and the market price of our common stock may drop in the future.

The market price of our common stock following the Merger could be subject to significant fluctuations. Market prices for securities of early-stage pharmaceutical, biotechnology, and other life sciences companies have historically been particularly volatile. Some of the factors that may cause the market price of our common stock to fluctuate include:

- our ability to obtain regulatory approvals for cobomarsen, MRG-201, MRG-110, or other product candidates, and delays or failures to obtain such approvals;
- failure of any of our product candidates, if approved, to achieve commercial success;
- failure to maintain our existing third-party license and supply agreements;

- changes in laws or regulations applicable to our product candidates;
- any inability to obtain adequate supply of our product candidates or the inability to do so at acceptable prices;
- adverse regulatory authority decisions;
- introduction of new products, services, or technologies by our competitors;
- failure to meet or exceed financial and development projections we may provide to the public;
- failure to meet or exceed the financial and development projections of the investment community;
- the perception of the pharmaceutical industry by the public, legislatures, regulators, and the investment community;
- announcements of significant acquisitions, strategic collaborations, joint ventures, or capital commitments by us or our competitors;
- disputes or other developments relating to proprietary rights, including patents, litigation matters, and our ability to obtain patent protection for our technologies;
- additions or departures of key personnel;
- significant lawsuits, including patent or stockholder litigation;
- if securities or industry analysts do not publish research or reports about our business, or if they issue an adverse or misleading opinion regarding our business and stock;
- changes in the market valuations of similar companies;
- general market or macroeconomic conditions;
- sales of our common stock by us our stockholders in the future;
- trading volume of our common stock;
- announcements by commercial partners or competitors of new commercial products, clinical progress or the lack thereof, significant contracts, commercial relationships, or capital commitments;
- adverse publicity relating to microRNA-targeted therapeutics generally, including with respect to other products and potential products in such markets;
- the introduction of technological innovations or new therapies that compete with our potential products;
- changes in the structure of health care payment systems; and
- period-to-period fluctuations in our financial results.

Moreover, the capital markets in general have experienced substantial volatility that has often been unrelated to the operating performance of individual companies. These broad market fluctuations may also adversely affect the trading price of our common stock.

In the past, following periods of volatility in the market price of a company’s securities, stockholders have often instituted class action securities litigation against those companies. Such litigation, if instituted, could result in substantial costs and diversion of management attention and resources, which could significantly harm our profitability and reputation.

Additionally, a decrease in our stock price may cause our common stock to no longer satisfy the continued listing standards of The Nasdaq Capital Market. If we are not able to maintain the requirements for listing on The Nasdaq Capital Market, we could be delisted, which could have a materially adverse effect on our ability to raise additional funds as well as the price

and liquidity of our common stock.

We incur costs and demands upon management as a result of complying with the laws and regulations affecting public companies.

As a result of the Mergers, we will incur significant legal, accounting, and other expenses that Private Miragen did not incur as a private company, including costs associated with public company reporting requirements. We will also incur costs associated with corporate governance requirements, including requirements under the Sarbanes-Oxley Act, as well as new rules implemented by the SEC and The Nasdaq Stock Market LLC, or Nasdaq. These rules and regulations are expected to increase our legal and financial compliance costs and to make some activities more time-consuming and costly. For example, our management team consists of the executive officers of Private Miragen prior to the Merger, some of whom have not previously managed and operated a public company. These executive officers and other personnel will need to devote substantial time to gaining expertise regarding operations as a public company and compliance with applicable laws and regulations. These rules and regulations may also make it difficult and expensive for us to obtain directors' and officers' liability insurance. As a result, it may be more difficult for us to attract and retain qualified individuals to serve on our board of directors or as our executive officers, which may adversely affect investor confidence and could cause our business or stock price to suffer.

Anti-takeover provisions in our charter documents and under Delaware law could make an acquisition of us more difficult and may prevent attempts by our stockholders to replace or remove our management.

Provisions in our certificate of incorporation and bylaws may delay or prevent an acquisition or a change in management. These provisions include a prohibition on actions by written consent of our stockholders and the ability of our board of directors to issue preferred stock without stockholder approval. In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporate Law, which prohibits stockholders owning in excess of 15% of our outstanding voting stock from merging or combining with us. Although we believe these provisions collectively will provide for an opportunity to receive higher bids by requiring potential acquirers to negotiate with our board of directors, they would apply even if the offer may be considered beneficial by some stockholders. In addition, these provisions may frustrate or prevent any attempts by our stockholders to replace or remove then current management by making it more difficult for stockholders to replace members of the board of directors, which is responsible for appointing the members of management.

Our bylaws provide that the Court of Chancery of the State of Delaware is the exclusive forum for substantially all disputes between us and our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers, or other employees.

Our bylaws provide that the Court of Chancery of the State of Delaware is the sole and exclusive forum for any derivative action or proceeding brought on our behalf, any action asserting a breach of fiduciary duty owed by any of our directors, officers, or other employees to us or our stockholders, any action asserting a claim against us arising pursuant to any provisions of the Delaware General Corporation Law, our certificate of incorporation or our bylaws, or any action asserting a claim against us that is governed by the internal affairs doctrine. The choice of forum provision may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for disputes with us or our directors, officers, or other employees, which may discourage such lawsuits against our and our directors, officers, and other employees. If a court were to find the choice of forum provision contained in the bylaws to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions.

We do not anticipate that we will pay any cash dividends in the foreseeable future.

The current expectation is that we will retain our future earnings, if any, to fund the development and growth of our business. As a result, capital appreciation, if any, of our common stock will be your sole source of gain, if any, for the foreseeable future.

Historically, there has not been an active trading market for our common stock and we cannot guarantee an active market for our common stock will be sustained in the future. As a result, our stockholders may not be able to resell their shares of common stock for a profit, if at all.

Prior to the Merger, there had been no public market for Private Miragen's common stock. An active trading market for our shares of common stock may not develop or be sustained. If an active market for our common stock is not sustained, it may be difficult for our stockholders to sell their shares at an attractive price or at all.

Future sales of shares by existing stockholders could cause our stock price to decline.

If our stockholders sell, or indicate an intention to sell, substantial amounts of our common stock in the public market after legal restrictions on resale lapse, the trading price of our common stock could decline. In addition, shares of common stock that are subject to our outstanding options will become eligible for sale in the public market to the extent permitted by the provisions of various vesting agreements and Rules 144 and 701 under the Securities Act of 1933, as amended. In addition, each of our directors and executive officers and certain of our 5% stockholders have entered into lock-up agreements with the Underwriters in the Public Offering pursuant to which these stockholders have agreed not to sell any of our shares of common stock for a period of 90 days following the date of the final prospectus supplement in the Public Offering. If these shares are sold after the expiration of this lock-up period or the Underwriters release any of these stockholders from the restrictions of the lock-up, the trading price of our common stock could decline.

If equity research analysts do not publish research or reports, or publish unfavorable research or reports, about us, our business, or our market, our stock price and trading volume could decline.

The trading market for our common stock is influenced by the research and reports that equity research analysts publish about us and our business. Equity research analysts may elect not to provide research coverage of our common stock and such lack of research coverage may adversely affect the market price of our common stock. In the event we do have equity research analyst coverage, we will not have any control over the analysts or the content and opinions included in their reports. The price of our common stock could decline if one or more equity research analysts downgrade our stock or issue other unfavorable commentary or research. If one or more equity research analysts ceases coverage of us or fails to publish reports on us regularly, demand for our common stock could decrease, which in turn could cause our stock price or trading volume to decline.

If we fail to maintain proper and effective internal controls, our ability to produce accurate financial statements on a timely basis could be impaired.

We are subject to the reporting requirements of the Exchange Act, the Sarbanes-Oxley Act, and the rules and regulations of Nasdaq. The Sarbanes-Oxley Act requires, among other things, that we maintain effective disclosure controls and procedures and internal control over financial reporting. We must perform system and process evaluation and testing of our internal control over financial reporting to allow management to report on the effectiveness of our internal controls over financial reporting in our Annual Report filing for that year, as required by Section 404 of the Sarbanes-Oxley Act. As a private company, Private Miragen had never been required to test its internal controls within a specified period. This will require that we incur substantial professional fees and internal costs to expand our accounting and finance functions and that we expend significant management efforts. We may experience difficulty in meeting these reporting requirements in a timely manner for each period.

We may discover weaknesses in our system of internal financial and accounting controls and procedures that could result in a material misstatement of our financial statements. Our internal control over financial reporting will not prevent or detect all errors and all fraud. A control system, no matter how well designed and operated, can provide only reasonable, not absolute, assurance that the control system’s objectives will be met. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that misstatements due to error or fraud will not occur or that all control issues and instances of fraud will be detected.

If we are not able to comply with the requirements of Section 404 of the Sarbanes-Oxley Act, or if we are unable to maintain proper and effective internal controls, we may not be able to produce timely and accurate financial statements. If that were to happen, the market price of our common stock could decline, and it could be subject to sanctions or investigations by Nasdaq, the SEC, or other regulatory authorities.

ITEM 1B. UNRESOLVED STAFF COMMENTS

None.

ITEM 2. PROPERTIES

We lease 27,128 square feet of office and laboratory space in Boulder, Colorado under a lease that expires in August 2020, subject to two three-year renewal options prior to the expiration, and that includes rent escalation clauses through the lease term. We believe that this space is suitable for our current needs.

ITEM 3. LEGAL PROCEEDINGS

From time to time, we may be involved in legal proceedings in the ordinary course of business. We are currently not a party to any legal proceedings that we believe would have a material adverse effect on our business, financial condition, or results of operations.

ITEM 4. MINE SAFETY DISCLOSURES

Not applicable.

PART II

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

Market Information

On February 13, 2017, Signal and Private Miragen completed the Merger. Following the Merger, Private Miragen merged with and into Signal, with Signal as the surviving corporation. In connection with the Mergers, we changed the name of the combined company to Miragen Therapeutics, Inc. and changed the trading symbol for our common stock to "MGEN." Our common stock originally began trading on The Nasdaq Capital Market on June 17, 2014 under the trading symbol "SGNL." Prior to June 17, 2014, there was no public market for our common stock. The following table sets forth, for the periods indicated, our high and low sales prices on The Nasdaq Capital Market (as adjusted for the 1-for-15 reverse stock split of our common stock effected in November 2016).

The stock price information for the year ended December 31, 2016 and prior to February 13, 2017 in the year ended December 31, 2017 included in this Item 5 is that of Signal prior to the Mergers because the Mergers were consummated after such periods. Accordingly, the historical information included in this Annual Report for such periods, unless otherwise indicated or as the context otherwise requires, is that of Signal and its subsidiaries prior to the Mergers.

	High	Low
Year ended December 31, 2017		
Fourth quarter	$ 10.72	$ 6.02
Third quarter	15.91	7.67
Second quarter	13.50	7.39
First quarter	18.00	4.76
Year ended December 31, 2016		
Fourth quarter	$ 15.11	$ 1.80
Third quarter	9.45	6.00
Second quarter	11.10	6.00
First quarter	12.45	6.15

Holders

As of March 1, 2018, we had 18 registered holders of record of our common stock. A substantially greater number of holders of our common stock are "street name" or beneficial holders, whose shares of record are held by banks, brokers, other financial institutions, and registered clearing agencies.

Dividend Policy

We historically have not, and do not anticipate in the future, paying dividends on our common stock. We currently intend to retain all of our future earnings, as applicable, to finance the growth and development of our business. We are not subject to any legal restrictions respecting the payment of dividends, except that we may not pay dividends if the payment would render us insolvent. Any future determination as to the payment of cash dividends on our common stock will be at our board of directors' discretion and will depend on our financial condition, operating results, capital requirements and other factors that our board of directors considers to be relevant.

ITEM 6. SELECTED FINANCIAL DATA

The following selected consolidated financial data is derived from our audited consolidated financial statements and should be read in conjunction with the consolidated financial statements, the notes to such statements and "Management's Discussion and Analysis of Financial Condition and Results of Operations" included elsewhere in this Annual Report. Historical results are not necessarily indicative of the results to be expected in the future.

	Year Ended December 31,	
	2017	2016
	(in thousands, except share and per share data)	
Revenue:		
Collaboration revenue	$ 3,097	$ 2,814
Grant revenue	906	663
Total revenue	4,003	3,477
Operating expenses:		
Research and development	19,623	13,692
General and administrative	10,912	6,772
Total operating expenses	30,535	20,464
Loss from operations	(26,532)	(16,987)
Other income (expense):		
Interest and other income	403	39
Interest and other expense	(383)	(326)
Net loss	(26,512)	(17,274)
Accretion of redeemable convertible preferred stock to redemption value	(5)	(49)
Net loss available to common stockholders	$ (26,517)	$ (17,323)
Net loss per share, basic and diluted	$ (1.38)	$ (28.21)
Weighted-average shares used to compute basic and diluted net loss per share	19,244,605	614,017

	December 31,	
	2017	2016
	(in thousands)	
Cash and cash equivalents	$ 47,441	$ 22,104
Total assets	$ 52,481	$ 24,760
Notes payable, inclusive of current portion	$ 9,922	$ 4,789
Total liabilities	$ 13,971	$ 9,705
Redeemable convertible preferred stock	$ —	$ 76,976
Total stockholders' equity (deficit)	$ 38,510	$ (61,921)

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

Introduction

The following discussion and analysis should be read together with our consolidated financial statements and the related notes thereto appearing elsewhere in this Annual Report. This discussion and other parts of this report contain forward-looking statements reflecting our current expectations that involve risks and uncertainties. See "*Forward-Looking Statements*" for a discussion of the uncertainties, risks and assumptions associated with these statements. Actual results and the timing of events could differ materially from those discussed in our forward-looking statements as a result of many factors, including those set forth under "*Risk Factors*" and elsewhere in this Annual Report.

All references to 2017 and 2016 refer to calendar years ended December 31, 2017 and 2016, respectively.

Overview

We are a clinical-stage biopharmaceutical company discovering and developing proprietary RNA-targeted therapies with a specific focus on microRNAs and their role in certain diseases where there is a high unmet medical need. microRNAs regulate

gene expression and play vital roles in influencing the pathways responsible for many disease processes. A leader in microRNA therapeutics discovery and development, we have advanced two product candidates, cobomarsen and MRG-201, into clinical development. We are also developing MRG-110 under the Servier Collaboration Agreement with Servier.

Cobomarsen is an inhibitor of miR-155, which is found at abnormally high levels in malignant cells of several blood cancers, as well as certain cells involved in inflammation. In our Phase 1 clinical trial of cobomarsen in CTCL, 90% of patients treated systemically demonstrated improvement in mSWAT score.

MRG-201 is a replacement for miR-29, which is found at abnormally low levels in a number of pathological fibrotic conditions, including cutaneous, cardiac, renal, hepatic, pulmonary, and ocular fibrosis, as well as in systemic sclerosis. In a Phase 1 clinical trial of MRG-201, we observed a statistically-significant reduction in fibroplasia with no adverse effects on incisional wound healing when MRG-201 was given.

MRG-110 is an inhibitor of miR-92, a microRNA that is expressed in endothelial cells has been shown to accelerate the formation of new blood vessels in preclinical models of heart failure, peripheral ischemia, and dermal wounding. The compound is being developed for use in various indications in which enhanced vascular density is expected to provide clinical benefit. We retain all commercial rights to MRG-110 in the United States and Japan, and Servier has commercial rights in the rest of the world.

In addition to these programs, we continue to develop a pipeline of wholly-owned preclinical product candidates. We believe that our preclinical product candidates offer the potential to treat a number of indications including oncology, visual pathologies, neurodegeneration, and hearing loss. The goal of our translational medicine strategy is to progress rapidly to first-in-human trials once we have adequately established the pharmacokinetics (the movement of a drug into, through, and out of the body), pharmacodynamics (the effect and mechanism of action of a drug), safety, and manufacturability of the product candidate in preclinical studies.

Recent Developments

Mergers

On February 13, 2017, we, then named Signal Genetics, Inc., completed a merger with Private Miragen. Pursuant to the terms of the Merger Agreement, Merger Sub, our wholly-owned subsidiary, merged with and into Private Miragen, with Private Miragen surviving as our wholly-owned subsidiary. Immediately following the Merger, we completed the Short-Form Merger pursuant to which Private Miragen merged with and into us. In connection with the Short-Form Merger, we changed our corporate name to “Miragen Therapeutics, Inc.”, our board of directors and management team were replaced, and the operations from the merged Private Miragen became our primary business as discussed in the overview above. Our common stock began trading on The Nasdaq Capital Market under the ticker symbol “MGEN” on February 14, 2017.

Unless otherwise noted, the discussion herein gives retroactive effect to the Mergers.

Financing

In February 2017, immediately prior to the closing of the Merger, Private Miragen issued and sold an aggregate of approximately $40.7 million of shares of Private Miragen’s common stock in a common stock private placement.

In March 2017, we entered into a Common Stock Sales Agreement, or the ATM Agreement, with Cowen and Company, LLC, or Cowen, under which we may offer and sell, from time to time, at our sole discretion, shares of our common stock having an aggregate offering price of up to $50.0 million through Cowen as our sales agent. As of December 31, 2017, we had sold, pursuant to the terms of the ATM Agreement, 840,534 shares of our common stock for aggregate gross proceeds of approximately $7.9 million. Net proceeds received through December 31, 2017 were approximately $7.5 million, including commissions to Cowen as sales agent and initial expenses related to the “at the market offering”.

In November 2017, we entered into an Amended and Restated Loan and Security Agreement, or the Loan Agreement, with Silicon Valley Bank, or SVB. The Loan Agreement amended and restated the Loan and Security Agreement, dated as of April 30, 2015, by and between us and SVB, as amended by the First Loan Modification Agreement, dated as of December 22, 2016, and the Assumption Agreement, dated as of February 13, 2017, or, collectively, the Prior Loan Agreement. The Prior Loan Agreement was terminated in its entirety upon the effectiveness of the Loan Agreement.

Upon entry into the Loan Agreement, SVB made available to us a $10.0 million growth capital term loan, or the Loan. The per annum interest rate for the Loan under the Loan Agreement is a floating rate equal to the prime rate as reported in The Wall Street Journal, with changes to the rate to be effective on the effective date of any changes to the prime rate. Our obligations under the Loan Agreement are secured by a first priority security interest, right, and title in all business assets, excluding our intellectual property, which is subject to a negative pledge. We used a portion of the proceeds of the Loan to (i) repay the $2.8 million outstanding principal amount of the loan issued under the Prior Loan Agreement, and (ii) pay SVB a fee of $0.3 million due under the Prior Loan Agreement. We expect to use the remainder of the Loan for general corporate purposes. In connection with the Loan Agreement, in November 2017, we entered into a Warrant to Purchase Stock with SVB evidencing SVB's right to purchase shares of common stock at an exercise price of $7.15 per share, or the Warrant. The Warrant is exercisable for 24,097 shares of common stock. The exercise price and the number and type of shares underlying the Warrant are subject to adjustment in the event of specified events, including a reclassification of our common stock, a subdivision or combination of our common stock, or in the event of specified dividend payments. The Warrant is exercisable until November 14, 2024. Upon exercise, the aggregate exercise price may be paid, at SVB's election, in cash or on a net issuance basis, based upon the fair market value of our common stock at the time of exercise.

In February 2018, we entered into the Underwriting Agreement with the Underwriters relating to our Public Offering. In February 2018 we sold 7,414,996 shares of common stock at a price of $5.50 per share, which resulted in net proceeds of approximately $37.9 million after deducting underwriting commissions and discounts and other offering expenses payable by us.

Orphan-Drug Designation

On March 31, 2017, we announced that the FDA granted orphan-drug designation to our product candidate, cobomarsen, to treat MF. Additionally, on May 24, 2017, we announced that the European Commission granted orphan medicinal product designation to our product candidate, cobomarsen, to treat CTCL.

Servier Collaboration Agreement

In 2017, we amended the Servier Collaboration Agreement to replace all then existing targets with a new named target, miR-92, and to allow Servier to add one additional target through September 2019. Servier's rights to each named target is limited to therapeutics in the field of cardiovascular disease in their territory, which is worldwide except for the United States and Japan. We retain all other rights, including commercialization of therapeutics, under the Servier Collaboration Agreement in the field of cardiovascular disease in the United States and Japan.

Financial Operations Overview

Revenue

Our revenue consists primarily of upfront payments for licenses, milestone payments, and payments for other research services earned under our strategic alliance and collaboration agreement. We also recognize revenue for amounts received or receivable under certain grants we have been awarded.

In the future, we may generate revenue from a combination of license fees and other upfront payments, payments for research and development services, milestone payments, product sales, and royalties in connection with strategic alliances. We expect that any revenue we generate will fluctuate from quarter to quarter as a result of the timing of our achievement of preclinical, clinical, regulatory, and commercialization milestones, the timing and amount of payments relating to such milestones, and the extent to which any of our products are approved and successfully commercialized by us or our strategic alliance partners. If our strategic alliance partners do not elect or otherwise agree to fund our development costs pursuant to our strategic alliance agreements, or we or our strategic alliance partners fail to develop product candidates in a timely manner or to obtain regulatory approval for them, then our ability to generate future revenues, and our results of operations and financial position would be adversely affected.

Research and development expenses

Research and development costs are expensed as incurred and include costs associated with our research activities, drug discovery efforts, and development of our therapeutic programs, which includes:

- employee-related expenses, including salaries, benefits, travel, and share-based compensation expense;
- external research and development expenses incurred under arrangements with third parties, such as CROs, contract manufacturing organizations, or CMOs, other clinical trial-related vendors, consultants, and our scientific advisors;
- license fees; and
- facilities, depreciation, and other allocated expenses, which include direct and allocated expenses for rent and maintenance of facilities, depreciation of leasehold improvements and equipment, and laboratory and other supplies.

We occasionally make non-refundable advance payments for goods and services that will be used in future research and development activities. These payments are capitalized and recorded as expense in the period in which we receive the goods or when the services are performed.

We record upfront and milestone payments to acquire contractual rights to licensed technology as research and development expenses when incurred if there is uncertainty in our receiving future economic benefit from the acquired contractual rights. We consider future economic benefits from acquired contractual rights to licensed technology to be uncertain until such a drug candidate is approved by the FDA or when other significant risk factors are abated.

We expect our research and development expenses to increase for the foreseeable future as we continue to conduct our ongoing clinical trials, initiate additional clinical trials, and advance our preclinical research programs. The process of conducting clinical trials and preclinical studies necessary to obtain regulatory approval is costly and time consuming. We, or our strategic alliance partners, may never succeed in achieving marketing approval for any of our product candidates. The probability of success for each product candidate may be affected by numerous factors, including clinical data, preclinical data, competition, manufacturing capability, and commercial viability.

Successful development of future product candidates is highly uncertain and may not result in approved products. Completion dates and completion costs can vary significantly for each future product candidate and are difficult to predict. We anticipate we will make determinations as to which programs to pursue and how much funding to direct to each program on an ongoing basis in response to our ability to maintain or enter into new strategic alliances with respect to each program or potential product candidate, the scientific and clinical success of each future product candidate, and ongoing assessments as to each future product candidate's commercial potential. We will need to raise additional capital and may seek additional strategic alliances in the future in order to advance our various programs.

General and administrative expenses

General and administrative expenses consist primarily of salaries and related benefits, including share-based compensation, related to our finance, accounting, human resources, legal, business development, and other support functions, professional fees for auditing, tax, and legal services, as well as insurance, board of director compensation, and other administrative expenses. Leading up to the Merger, we incurred incremental expenses related to both the Merger and the result of becoming a public company following completion of the Merger.

Other income (expense), net

Other income (expense) consists primarily of interest income and expense, and various income or expense items of a non-recurring nature. We earn interest income from interest-bearing accounts and money market funds. Interest expense is comprised of interest incurred under our notes payable.

Critical Accounting Policies and Estimates

This discussion and analysis of financial condition and results of operations is based on our consolidated financial statements, which have been prepared in accordance with U.S. generally accepted accounting principles, or U.S. GAAP. The preparation of financial statements requires us to make estimates and judgments that affect the reported amounts of assets, liabilities, and expenses. On an ongoing basis, we evaluate these estimates and judgments. We base our estimates on historical experience and on various assumptions that we believe to be reasonable under the circumstances. These estimates and assumptions form the basis for making judgments about the carrying values of assets and liabilities and the recording of expenses that are not readily apparent from other sources. Actual results may differ materially from these estimates. We believe that the accounting policy discussed below is critical to understanding our historical and future performance, as this policy relates to the more significant areas involving our judgments and estimates.

Clinical Trial and Preclinical Study Accruals

We make estimates of our accrued expenses as of each balance sheet date in our consolidated financial statements based on certain facts and circumstances at that time. Our accrued expenses for preclinical studies and clinical trials are based on estimates of costs incurred for services provided by external service providers and for other trial-related activities. The timing and amount of expenses we incur though our external service providers depend on a number of factors, such as site initiation, patient screening, enrollment, delivery of reports, and other events. In accruing for these activities, we obtain information from various sources and estimate the level of effort or expense allocated to each period. Adjustments to our research and development expenses may be necessary in future periods as our estimates change.

Results of Operations

Comparison of the Year Ended December 31, 2017 and 2016

	Year Ended December 31,	
	2017	**2016**
	(in thousands)	
Revenue	$ 4,003	$ 3,477
Research and development expenses	(19,623)	(13,692)
General and administrative expenses	(10,912)	(6,772)
Other income (expense), net	20	(287)
Net loss	$ (26,512)	$ (17,274)

Revenue

Revenue increased to $4.0 million during the year ended December 31, 2017, from $3.5 million during the year ended December 31, 2016. The increase was due primarily to a $0.7 million increase in research and development activities reimbursable to us by Servier under the Servier Collaboration Agreement in 2017, following an amendment to our agreement that added the microRNA-92, or MRG-110, program. In addition, grant revenue recognized during 2017 increased by approximately $0.2 million. These increases were partially offset by a $0.5 million decrease in license revenue recognized in 2017 as a result of prior license payments becoming fully amortized to revenue in 2016.

Research and Development Expenses

Research and development expenses were $19.6 million during the year ended December 31, 2017, compared to $13.7 million during the year ended December 31, 2016. The increase in research and development expense of $5.9 million was driven primarily by:

- increased clinical and outsourced manufacturing expenses of $3.3 million, primarily related to expanded clinical development of cobomarsen in 2017; and

- increased salaries, wages, and benefits of $3.2 million, due primarily to an increase in our research and development team to support and expand our research and development capabilities; partially offset by

- decreases in other research and development expenses, including preclinical outsourced studies, of approximately $0.4 million, and fees associated with third party licenses of $0.3 million.

General and Administrative Expenses

General and administrative expenses were $10.9 million during the year ended December 31, 2017, compared to $6.8 million during the year ended December 31, 2016. The increase in general and administrative expenses of $4.1 million was driven primarily by:

- an increase in costs generally associated with becoming a public company of $1.8 million, which included accounting and tax support, consulting, insurance, general corporate legal expenses, and board of director compensation;

- increased salaries, wages, and benefits of $1.2 million, due primarily to an increase in share-based compensation charges following the merger as well as an increase in general and administrative employees during 2017; and

- increased costs related to patent filings, prosecution, and enforcement of approximately $0.6 million.

Other income (expense), net

Net other income was $20 thousand during the year ended December 31, 2017 compared to $0.3 million net other expense during the year ended December 31, 2016. The change in net other income (expense) was due primarily to an increase in interest income earned in 2017 on higher cash and cash equivalent balances.

Liquidity and Capital Resources

We have no products approved for commercial sale and have not generated any revenue from product sales. We have funded our operations to date principally through proceeds from equity financings of $120.7 million (including notes payable that previously converted to equity).

In February 2018, we entered into the Underwriting Agreement with the Underwriters relating to our Public Offering. We sold 7,414,996 shares of common stock at a price of $5.50 per share, which resulted in net proceeds of approximately $37.9 million after deducting underwriting commissions and discounts and other offering expenses.

In March 2017, we entered into the ATM Agreement with Cowen, under which we may offer and sell, from time to time, at our sole discretion, shares of our common stock having an aggregate offering price of up to $50.0 million through Cowen as our sales agent. As of December 31, 2017, we sold an aggregate of 840,534 shares of our common stock for aggregate gross proceeds of approximately $7.9 million. Net proceeds received during the year ended December 31, 2017 were approximately $7.5 million, including commissions to Cowen as sales agent and initial expenses for executing the “at the market offering”.

Since our inception and through December 31, 2017, we have generated cumulative losses of $93.6 million. Substantially all of our operating losses resulted from expenses incurred in connection with our research and development programs and from general and administrative costs associated with our operations.

We will continue to require substantial additional capital to continue our clinical development and potential commercialization activities. Accordingly, we will need substantial additional capital to continue to fund our operations. The amount and timing of future funding requirements will depend on many factors, including the pace and results of our clinical development efforts, continued performance under our Servier Collaboration Agreement, securing additional partnerships and collaborations, and issuing debt or other financing vehicles. Our ability to secure capital is dependent upon a number of factors, including success in developing our technology and drug product candidates. Failure to raise capital as and when needed, on favorable terms or at all, would have a negative impact on our financial condition and our ability to develop our product candidates. Changing circumstances may cause us to consume capital significantly faster or slower than we currently anticipate. If we are unable to acquire additional capital or resources, we will be required to modify our operational plans to complete future milestones. We have based these estimates on assumptions that may prove to be wrong, and we could exhaust our available financial resources sooner than we currently anticipate. We may be forced to reduce our operating expenses and raise additional funds to meet our working capital needs, principally through the additional sales of our securities or debt financings or entering into strategic collaborations.

We expect to incur significant expenses and increased operating losses for at least the next several years as we continue the clinical development of, and seek regulatory approval for, our product candidates and add personnel necessary to operate as a

public company with an advanced clinical candidate pipeline of product candidates. In addition, operating as a publicly-traded company involves the hiring of additional financial and other personnel, upgrading financial information systems, and incurring costs associated with operating as a public company. We expect that our operating losses will fluctuate significantly from quarter to quarter and year to year due to timing of clinical development programs and efforts to achieve regulatory approval.

If we raise additional funds through the issuance of debt, the obligations related to such debt could be senior to rights of holders of our capital stock and could contain covenants that may restrict our operations. Should additional capital not be available to us in the near term, or not be available on acceptable terms, we may be unable to realize value from our assets and discharge our liabilities in the normal course of business, which may, among other alternatives, cause us to further delay, substantially reduce, or discontinue operational activities to conserve our cash resources.

As of December 31, 2017, we had cash and cash equivalents of $47.4 million. We believe our current resources, together with net proceeds of approximately $37.9 million received in February 2018 from our Public Offering, will be sufficient to fund our operations in the normal course of business and allow us to meet our liquidity needs into early 2020.

Summarized cash flows for the year ended December 31, 2017 and 2016 are as follows:

	Year Ended December 31,		
	2017	2016	Change
	(in thousands)		
Net cash used in operating activities	$ (28,167)	$ (14,755)	$ (13,412)
Net cash provided by (used in) investing activities	1,034	(250)	1,284
Net cash provided by financing activities	52,470	15,874	36,596
Net increase in cash and cash equivalents	$ 25,337	$ 869	$ 24,468

Operating Activities

Net cash used in operating activities was $28.2 million for the year ended December 31, 2017, compared to $14.8 million for the year ended December 31, 2016. The $13.4 million increase in cash used in operating activities during the year ended December 31, 2017 compared to year ended December 31, 2016 was primarily the result of a $9.2 million increase in net loss, a $6.0 million increase in use of working capital, offset by a $1.8 million increase in non-cash charges primarily associated with share-based compensation. The increase in net loss was largely driven by increased personnel costs incurred as we grew our workforce, increased research and development expenses as we advanced our programs further into clinical development, and increased legal expense and other professional fees related to the Merger and operating as a public company.

Investing Activities

Net cash provided by investing activities was $1.0 million during the year ended December 31, 2017 compared to net cash used by investing activities of $0.3 million during the year ended December 31, 2016. The increase in cash provided by investing activities was primarily the result of $1.3 million of cash acquired in the Merger.

Financing Activities

Net cash provided by financing activities was $52.5 million for the year ended December 31, 2017, compared to $15.9 million during the year ended December 31, 2016. The increase of $36.6 million was primarily due to an increase in the number and extent of financing activities in 2017. In 2017, we received net proceeds of: (i) $39.5 million from a private placement of common stock; (ii) $7.5 million from sales of our common stock under our ATM Agreement; and (iii) a net cash inflow of $5.3 million from our notes payable transactions during 2017 (which included principal payments). In 2016, we received net proceeds of $15.9 million from the sale of Private Miragen's Series C preferred stock.

Contractual Obligations and Commitments

As of December 31, 2017, we had no material commitments other than the liabilities reflected and commitments disclosed in our consolidated financial statements.

Off-Balance Sheet Arrangements

We have not entered into any off-balance sheet arrangements and do not have any holdings in variable interest entities.

The JOBS Act

In April 2012, the Jumpstart Our Business Startups Act, or the JOBS Act, was enacted. Section 107 of the JOBS Act provides that an emerging growth company can take advantage of an extended transition period for complying with new or revised accounting standards. Thus, an emerging growth company can delay the adoption of certain accounting standards until those standards would otherwise apply to private companies. We have elected to avail ourselves of the extended transition period for adopting new or revised accounting standards. As a result of this election, our financial statements may not be comparable to companies that comply with public company effective dates.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Not applicable.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

The financial statements and supplemental data required by this item are set forth at the pages indicated in Part IV, Item 15(a)(1) of this Annual Report.

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

Not applicable.

ITEM 9A. CONTROLS AND PROCEDURES

Evaluation of Disclosure Controls and Procedures

We maintain disclosure controls and procedures that are designed to ensure that information required to be disclosed in the reports that we file under the Securities Exchange Act of 1934, as amended, or the Exchange Act, is recorded, processed, summarized, and reported within the time periods specified in the rules and forms of the SEC, and that such information is accumulated and communicated to our management, including our principal executive officer and principal financial officer, as appropriate, to allow timely decisions regarding required disclosures. In designing and evaluating the disclosure controls and procedures, management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving the desired control objectives, and management is required to apply its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based on this evaluation, our principal officer and principal financial officer have concluded that our disclosure controls and procedures were effective as of the end of the period covered by this annual report.

Management’s Report on Internal Control Over Financial Reporting

Internal control over financial reporting refers to the process designed by, or under the supervision of, our principal officer and principal financial officer, and effected by our board of directors, management and other personnel, 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, and includes those policies and procedures that: (1) pertain to the maintenance of records that in reasonable detail accurately and fairly reflect the transactions and dispositions of our assets, (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that our receipts and expenditures are being made only in accordance with authorizations of our management and directors, and (3) 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.

Internal control over financial reporting cannot provide absolute assurance of achieving financial reporting objectives because of its inherent limitations. Internal control over financial reporting is a process that involves human diligence and compliance and is subject to lapses in judgment and breakdowns resulting from human failures. Internal control over financial reporting also can be circumvented by collusion or improper management override. Because of such limitations, there is a risk that

material misstatements may not be prevented or detected on a timely basis by internal control over financial reporting. However, these inherent limitations are known features of the financial reporting process. Therefore, it is possible to design into the process safeguards to reduce, though not eliminate, this risk.

Management is responsible for establishing and maintaining adequate internal control over our financial reporting, as such term is defined in Rule 13a-15(f) under the Exchange Act. Under the supervision and with the participation of our management, including our principal executive officer and principal financial officer, we conducted an evaluation of the effectiveness of our internal control over financial reporting. Management has used the framework set forth in the report entitled “Internal Control — Integrated Framework (2013 Framework)” published by the Committee of Sponsoring Organizations of the Treadway Commission to evaluate the effectiveness of our internal control over financial reporting. Based on its evaluation, management has concluded that our internal control over financial reporting was effective as of December 31, 2017, the end of our most recent fiscal year.

Changes in Internal Control Over Financial Reporting

There have been no changes in our internal control over financial reporting that occurred during our most recent fiscal quarter that have materially affected, or are reasonably likely to materially effect, our internal control over financial reporting.

ITEM 9B. OTHER INFORMATION

Not applicable.

PART III

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS, AND CORPORATE GOVERNANCE

The following table lists the names and ages as of March 15, 2018 and positions of the individuals who are currently serving as our executive officers and directors:

Name	Age	Position(s)
Executive Officers		
William S. Marshall, Ph.D.	54	President, Chief Executive Officer, and Director
Jason A. Leverone	44	Chief Financial Officer, Secretary, and Treasurer
Adam S. Levy	39	Chief Business Officer
Paul D. Rubin, M.D.	64	Executive Vice President, Research and Development
Non-Employee Directors		
Bruce L. Booth, Ph.D.	43	Director
Christopher J. Bowden, M.D.	56	Director
Jeffrey S. Hatfield	60	Director
Thomas E. Hughes, Ph.D.	58	Director
Kevin Koch, Ph.D.	57	Director
Arlene M. Morris	66	Director
Joseph L. Turner	66	Director

Executive Officers

William S. Marshall, Ph.D. Dr. Marshall has served as our president and chief executive officer and as a director since February 2017. Prior to joining us, Dr. Marshall was the president, chief executive, and a director of Private Miragen since the company was founded in September 2007. Prior to founding Private Miragen, Dr. Marshall was vice president of technology and business development for bioscience at Thermo Fisher Scientific Inc., a serving science company, from April 2005 to July 2007. Dr. Marshall was one of the scientific founders of Dharmacon, Inc., a biotechnology company, which was acquired by Fisher Scientific International Inc. in April 2004, and he served as the executive vice president for research and operations and general manager of Dharmacon from August 2002 to April 2005. Prior to joining Dharmacon, Dr. Marshall served in multiple positions at Amgen, Inc., a biotechnology company, most recently as associate director of research, site head for research and head of the nucleic acid and peptide technology department. Dr. Marshall earned a B.S. in Biochemistry from the University of Wisconsin-Madison and his Ph.D. in Chemistry at the University of Colorado at Boulder.

We believe that Dr. Marshall's role as our chief executive, prior board of director service, and extensive experience and innovations in the field of biotechnology enable him to bring a unique perspective to our board of directors. In addition, Dr. Marshall's academic expertise and accomplishments provide the board of directors with in-depth product and field knowledge.

Jason A. Leverone. Mr. Leverone has served as our chief financial officer, secretary, and treasurer since February 2017. Prior to joining us, Mr. Leverone joined Private Miragen in November 2008 as its senior director of finance and operations and was appointed vice president, finance in March 2010. Mr. Leverone was appointed as Private Miragen's chief financial officer in February 2012. Prior to joining Private Miragen, Mr. Leverone was senior director of finance and controller for Replidyne, Inc., a publicly-traded biotechnology company, from November 2005 to November 2008. Prior to joining Replidyne, Mr. Leverone was the corporate controller for CreekPath System, Inc., an international software development company, from September 2002 to October 2005. He commenced his professional career with the accounting firm of Ernst and Young LLP, where he last served as a senior accountant, and then Arthur Andersen LLP, where he last served as an audit manager. Mr. Leverone is a Certified Public Accountant and earned a B.S. in Business Administration from Bryant University.

Adam S. Levy. Mr. Levy has served as our chief business officer since February 2017. Prior to joining us, Mr. Levy served as Private Miragen's chief business officer since May 2016. Prior to joining Private Miragen, Mr. Levy served as a senior vice president of healthcare investment banking at Wedbush Securities Inc. from September 2013 to May 2016. From May 2011 to August 2012, Mr. Levy was employed by Merrill Lynch, Pierce, Fenner & Smith, Incorporated as vice president of healthcare investment banking. Prior to joining Merrill Lynch, Mr. Levy served as vice president of healthcare investment banking at

Wedbush from October 2009 through April 2011. Between 2000 through 2009, Mr. Levy held multiple investment banking positions at Merrill Lynch, Pierce, Fenner & Smith, and Jefferies Group. Mr. Levy earned a B.S. in Applied Economics from Cornell University.

Paul D. Rubin, M.D. Dr. Rubin has served as our executive vice president, research and development since February 2017. Prior to joining us, Dr. Rubin served as Private Miragen's executive vice president, research and development since November 2016. Prior to joining Private Miragen, Dr. Rubin served as senior vice president, research and development and chief medical officer of Xoma Corporation, a publicly-traded biotechnology company, from November 2011 to November 2016, having joined Xoma in June 2011 as its vice president, clinical development, and chief medical officer. Prior to joining Xoma, Dr. Rubin was the chief medical officer at Funxional Therapeutics Ltd., a pharmaceutical company from February 2011 to June 2011. He served as chief executive officer of Resolvyx Pharmaceuticals, Inc. from 2007 to 2009 and president and chief executive officer of Critical Therapeutics, Inc. from 2002 to 2007. From 1996 to 2002, Dr. Rubin served as senior vice president, development, and later as executive vice president, research and development at Sepracor, Inc. From 1993 to 1996, Dr. Rubin held senior level positions at Glaxo-Wellcome Pharmaceuticals, most recently as vice president of worldwide clinical pharmacology and early clinical development. During his tenure with Abbott Laboratories from 1987 to 1993, Dr. Rubin served as vice president, immunology and endocrinology. Dr. Rubin received a B.A. from Occidental College and his M.D. from Rush Medical College. He completed his training in internal medicine at the University of Wisconsin.

Non-Employee Directors

Bruce L. Booth, Ph.D. Dr. Booth has served as a member of our board of directors since February 2017 and, prior to joining our board of directors, he served as a member of Private Miragen's board of directors since September 2007. Dr. Booth joined Atlas Venture in 2005, and currently serves as partner. Prior to joining Atlas Venture, from 2004 to 2005, Dr. Booth was a principal at Caxton Health Holdings L.L.C., a healthcare-focused investment firm. Prior to joining Caxton, from 1999 to 2004, Dr. Booth was an associate principal at McKinsey & Company, a global strategic management consulting firm. Dr. Booth serves on the board of Zafgen, Inc., a publicly-traded biopharmaceutical company, and several privately-held companies. Dr. Booth earned a Ph.D. in molecular immunology from Oxford University's Nuffield Department of Medicine and a B.S. in biochemistry from Pennsylvania State University.

We believe Dr. Booth is qualified to serve on our board of directors due to his years of investment in the healthcare industry and his continued service leading the boards of directors of both private and public companies, which will enable him to contribute important strategic insight to our board of directors.

Christopher Bowden, M.D. Dr. Bowden, currently chief medical officer of Agios Pharmaceuticals, Inc., has served as a member of our board of directors since August 2017. Prior to joining Agios Pharmaceuticals, Inc., he served as vice president, product development oncology, franchise lead (Signaling Group) at Genentech, Inc., a member of the Roche Group. Dr. Bowden received his M.D. from Hahnemann University School of Medicine in Philadelphia followed by internal medicine training at Roger Williams Medical Center and Providence VA Medical Center, Rhode Island. He completed his medical oncology fellowship at the National Cancer Institute Medicine Branch and is board certified in internal medicine and medical oncology.

We believe Dr. Bowden is qualified to serve on our board of directors due to his years of experience in the biotechnology industry and substantial experience in clinical drug development, which will enable him to contribute important strategic insight to our board of directors.

Jeffrey S. Hatfield. Mr. Hatfield has served as a member of our board of directors since August 2017. Mr. Hatfield is currently the chief executive officer of Zafgan, Inc., and prior to Zafgan, served as president and chief executive officer of Vitae Pharmaceuticals, Inc., until its acquisition by Allergan in 2016. Prior to working at Vitae Pharmaceuticals, Inc, Mr. Hatfield was with Bristol-Myers Squibb Company, serving in numerous executive capacities, including senior vice president of Bristol-Myers's Immunology and Virology divisions. Mr. Hatfield currently serves as a director on the boards of aTyr Pharma, Inc., a publicly traded biotechnology company, and InVivo Therapeutics Corp., a publicly traded medical therapeutic company, and has previously served as a director of Ambit Biosciences Corporation before it was acquired by Daiichi Sankyo Company, Ltd. He is an adjunct professor and is a dean's advisory board member for Purdue University's College of Pharmacy. He earned a B.S. degree in pharmacy from Purdue University's College of Pharmacy and an M.B.A. degree from The Wharton School at the University of Pennsylvania.

We believe Mr. Hatfield is qualified to serve on our board of directors due to his relevant industry experience in the biotechnology industry and experience in serving on public, biopharmaceutical company boards of directors, which will enable him to contribute important strategic insight to our board of directors.

Thomas E. Hughes, Ph.D. Dr. Hughes has served as a member of our board of directors since February 2017 and, prior to joining our board of directors, he served as a member of Private Miragen's board of directors since September 2009. Dr. Hughes joined Zafgen, Inc., a publicly-traded biopharmaceutical company, as the chief executive officer and as a director in October 2008 and also served as its president from October 2008 until June 2014. From 1987 to 2008, Dr. Hughes held several positions at Novartis AG (formerly Sandoz Pharmaceuticals), including vice president and global head of the cardiovascular and metabolic diseases therapeutic area at the Novartis Institutes for BioMedical Research in Cambridge, MA. Dr. Hughes also serves as a member of the scientific advisory board for Navitor Therapeutics, a discovery-stage biopharmaceutical company, and as a member of the strategic advisory board for Broadview Ventures, an early-stage investment company. Dr. Hughes earned a Ph.D. in nutritional biochemistry from Tufts University, an M.S. in Zoology from Virginia Polytechnic Institute and State University and a B.A. in biology from Franklin and Marshall College.

We believe Dr. Hughes is qualified to serve on our board of directors due to his years of experience in the biotechnology industry and service on both public and private boards of directors of biopharmaceutical companies, which will enable him to contribute important strategic insight to our board of directors.

Kevin Koch, Ph.D. Dr. Koch has served as a member of our board of directors since February 2017 and, prior to joining our board of directors, he served as a member of Private Miragen's board of directors since July 2016. Dr. Koch has served as the president and chief executive officer of Edgewise Therapeutics since July 2017 and has served as a venture partner at OrbiMed Advisors, LLC since May 2016. Prior to joining OrbiMed, Dr. Koch acted as a consultant in the biotech industry from September 2015 to May 2016. Prior to acting as a consultant, Dr. Koch served as the senior vice president, drug discovery, chemical and molecular therapeutics, at Biogen, Inc. from December 2013 to September 2015. Prior to joining Biogen, Dr. Koch founded Array BioPharma Inc., a publicly-traded biopharmaceutical company, and served as its president, chief scientific officer, and a member of its board of directors from May 1998 to November 2013. Prior to forming Array, Dr. Koch was an associate director of medicinal chemistry and project leader for the protease inhibitor and new technologies group for Amgen Inc. from 1995 to 1998. From 1988 until 1995, Dr. Koch held various research positions within the Central Research Division of Pfizer, Inc., including senior research investigator and senior research scientist. Dr. Koch earned a B.S. in chemistry and in biochemistry from the State University of New York at Stony Brook and a Ph.D. in synthetic organic chemistry from the University of Rochester.

We believe Dr. Koch is qualified to serve on our board of directors due to his years of experience in the biotechnology industry and service on both public and private boards of biopharmaceutical companies, which will enable him to contribute important strategic insight to our board of directors.

Arlene M. Morris. Ms. Morris has served as a member of our board of directors since January 2018. Ms. Morris has served as chief executive officer at Willow Advisors, LLC, a consultancy advising biotech companies on financing, strategy, and business development, since May 2015. From April 2012 until May 2015, Ms. Morris served as the chief executive officer of Syndax Pharmaceuticals, Inc., a privately-held oncology company focused on the development and commercialization of therapies for treatment-resistant cancers. She also served as a member of the Syndax Pharmaceuticals board of directors from June 2011 until May 2015. From 2003 to January 2011, Ms. Morris served as the president, chief executive officer, and a member of the board of directors of Affymax, Inc., a publicly-traded biotechnology company. Ms. Morris also held various management and executive positions at Clearview Projects, Inc., a corporate advisory firm; Coulter Pharmaceutical, Inc., a publicly-traded pharmaceutical company; Scios Inc., a publicly-traded biopharmaceutical company; and Johnson & Johnson, a publicly-traded healthcare company. She is currently a member of the board of directors of Viveve Medical, Inc., a publicly-traded medical device company; Palatin Technologies, a publicly-traded biotechnology company; and Neovacs, SA, a French publicly-traded biotechnology company. She was a director of Biodel Inc., a publicly-traded specialty pharmaceutical company, from 2015 until its merger with Albireo Limited in 2016; and Dimension Therapeutics, a publicly-traded gene therapy company, until it was acquired by Ultragenyx in 2017. She has also served as a board chair for the Foundation for Research and Development at the Medical University of South Carolina and as a trustee of Carlow University. Ms. Morris received a B.A. in biology and chemistry from Carlow College.

We believe Ms. Morris is qualified to serve on our board of directors due to her relevant industry experience and a breadth of expertise from past and continued service on the boards of directors of publicly traded biotechnology companies, which will enable her to contribute important strategic insight to our board of directors.

Joseph L. Turner. Mr. Turner has served as a member of our board of directors since February 2017. Mr. Turner currently serves on the board of directors of BioClin Therapeutics, Inc. Prior to joining our board of directors, Mr. Turner served on the boards of directors and was the chair of the audit committees of Corcept Therapeutics, Inc., a publicly-traded pharmaceutical company, from 2012 to May 2016, Kythera Biopharmaceuticals, Inc., a publicly-traded pharmaceutical company, from 2008

until Kythera's acquisition by Allergan Inc. October 2015, and Sophiris Bio, a publicly-traded pharmaceutical company from 2013 to May 2016. From July 2010 until its acquisition by Grupo Ferrer Internacional, S.A. in June 2016, Mr. Turner served on the board of directors and as a chair of the audit committee of Alexza Pharmaceuticals, Inc., a publicly-traded pharmaceutical company. In 2012, Mr. Turner served on the board of directors and as chair of the audit committee of Allos Therapeutics, Inc., a publicly-traded pharmaceutical company, until its acquisition by Spectrum Pharmaceuticals Inc. in September 2012. From 2010 through 2012, he served on the board of directors and as a member of the audit committee of QLT Inc., a publicly-traded biotechnology company. In 2008, Mr. Turner served as a director and member of the audit committee of SGX Pharmaceuticals Inc., a publicly-traded pharmaceutical company. Mr. Turner served as chief financial officer at Myogen, Inc., a publicly-traded biopharmaceutical company, from 1999 until it was acquired by Gilead Sciences in 2006. Previously, Mr. Turner was the chief financial officer at Centaur Pharmaceuticals, Inc. and served as chief financial officer and vice president, finance and administration at Cortech, Inc. Since 2009, Mr. Turner has also served on the board of managers of Swarthmore College where at various times he has served on its executive committee, finance committee, audit committee, academic affairs committee, student affairs committee, and property committee. In 2013 until 2015, Mr. Turner served on the board of directors of the Linda Crnic Institute for Down Syndrome at the University of Colorado Medical School. Mr. Turner has an M.B.A. from the University of North Carolina at Chapel Hill, an M.A. in molecular biology from the University of Colorado and a B.A. in chemistry from Swarthmore College.

We believe Mr. Turner is qualified to serve on our board of directors due to his years of service on both public and private boards of directors of pharmaceutical companies, including service on audit committees and extensive finance experience, which will enable him to contribute important strategic insight to our board of directors.

Audit Committee and Financial Expert

The audit committee of our board of directors was established by our board of directors in accordance with Section 3(a)(58)(A) of the Exchange Act to oversee our corporate accounting and financial reporting processes and audits of our financial statements. Our audit committee is currently composed of Mr. Turner, who serves as chairman, and Dr. Booth and Mr. Hatfield, each of whom our board of directors has determined satisfies Nasdaq and SEC independence requirements. Our board of directors has also determined that Mr. Turner qualifies as an "audit committee financial expert," as defined in applicable SEC rules.

Section 16(a) Beneficial Ownership Reporting Compliance

Section 16(a) of the Exchange Act requires our directors and executive officers, and persons who own more than ten percent of a registered class of our equity securities, to file with the SEC initial reports of ownership within 10 days after he or she becomes a beneficial owner, director or officer and reports of changes in ownership of our common stock and other equity securities within two business days after the transaction is executed. Our officers, directors and greater than ten percent stockholders are required by SEC regulations to furnish us with copies of all Section 16(a) forms they file. To our knowledge, based solely on a review of the copies of such reports furnished to us and written representations that no other reports were required, during the fiscal year ended December 31, 2017, all Section 16(a) filing requirements applicable to our officers, directors and greater than ten percent beneficial owners were in compliance.

Code of Ethics

We have adopted a written code of business conduct and ethics that applies to our directors, officers, and employees, including our principal executive officer, principal financial officer, principal accounting officer or controller, or persons performing similar functions. A current copy of the code is posted on our website, which is located at *www.miragen.com*. If we make any substantive amendments to, or grant any waivers from, the code of business conduct and ethics for any officer or director, we will disclose the nature of such amendment or waiver on our website or in a current report on Form 8-K.

ITEM 11. EXECUTIVE COMPENSATION

Our named executive officers for the year ended December 31, 2017, which consist of each person who served as our principal executive officer for the year ended December 31, 2017, and our two other most highly compensated executive officers for the year ended December 31, 2017, consisted of the following:

Officer	Title
William S. Marshall, Ph.D.	Chief Executive Officer and Director (Principal Executive Officer)
Adam S. Levy	Chief Business Officer
Paul D. Rubin, M.D.	Executive Vice President, Research and Development
Samuel D. Riccitelli (1)	Chief Executive Officer and President

(1) Mr. Riccitelli resigned as our chief executive officer and president in February 2017 in connection with the closing of the Merger. Thereafter Dr. Marshall was appointed as our chief executive officer.

Summary Compensation Table

The following table sets forth the information as to compensation paid to or earned by our president and chief executive officer and our other executive officers during the fiscal years noted below whose total compensation exceeded $100,000. The persons listed in the following table are referred to herein as the "named executive officers."

Name	Principal Position	Fiscal Year	Salary	Bonus	Stock Award(s) (1)	Option Award (s)(1)	All Other Compensation	Total
William S. Marshall, Ph.D.	Chief Executive Officer and President	2017	$ 400,000	$ 180,000	$ —	$ 1,609,483	$ —	$ 2,189,483
		2016	$ 347,086	$ 200,056	$ —	$ 109,754	$ —	$ 656,896
Adam S. Levy	Chief Business Officer	2017	$ 300,000	$ 108,000	$ —	$ 704,149	$ —	$ 1,112,149
		2016	$ 187,500	$ 150,000	$ —	$ 113,633	$ 20,385 (4)	$ 471,518
Paul D. Rubin, M.D.	Executive Vice President, Research and Development	2017	$ 395,000	$ 142,200	$ —	$ 704,149	$ —	$ 1,241,349
		2016	$ 124,375	$ 33,575	$ —	$ 809,639	$ —	$ 967,589
Samuel D. Riccitelli	Former Chief Executive Officer	2017	$ 56,495	$ 144,450	$ —	$ —	$ 499,543 (3)	$ 700,488
		2016	$ 450,000	$ 135,000 (2)	$ 102,000	$ —	$ —	$ 687,000

(1) Represents the aggregate grant date fair value of stock awards or options for common stock computed in accordance with FASB ASC Topic 718.

(2) Represents discretionary bonus for services rendered in our year ended December 31, 2016 granted in January 2017, which was not made pursuant to any contractual arrangement.

(3) Includes a severance payment of $450,000 paid in February 2017 and the remainder relates to paid vacation accruals at the date of termination.

(4) Includes reimbursement for travel and relocation expenses.

Current Executive Officer Employment Agreements

Marshall Employment Agreement

In December 2016, Private Miragen entered into an employment agreement with Dr. Marshall to be effective, and which we assumed, upon the closing of the Merger. Under this employment agreement, Dr. Marshall is entitled to an annual base salary (subject to periodic review and adjustment by our board of directors or compensation committee) of $400,000 and a discretionary annual cash bonus equal to 50% of Dr. Marshall's then effective base salary (subject to review and adjustment in the sole discretion of the board of directors or our compensation committee of the board of directors). Dr. Marshall is also eligible to participate in, subject to applicable eligibility requirements, all of our benefits plans and fringe benefits and programs that may be provided to our senior executives of from time to time.

The employment agreement provides that either party may terminate the agreement at-will. In addition, the agreement provides that if we terminate Dr. Marshall's employment without cause or Dr. Marshall resigns for good reason, Dr. Marshall will be eligible to receive the following severance benefits: (i) an amount equal to 12 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting of the equivalent of 12 months on all of Dr. Marshall's stock options or other equity awards that were outstanding as of the effective date of Dr. Marshall's employment agreement; and (iii) 12 months of continued health coverage. Although, if such termination or resignation occurs within one month prior to or 12 months following a change of control, Dr. Marshall will be eligible to receive the following severance benefits: (i) an amount equal to 24 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting in full of all of his then outstanding stock options or other equity awards then outstanding and subject to time-based vesting; and (iii) 12 months of continued health coverage.
The following definitions have been adopted in Dr. Marshall's employment agreement:

- "cause" means (i) Dr. Marshall's commission of any felony or any crime involving fraud, dishonesty or moral turpitude under the laws of the United States or any state thereof; (ii) Dr. Marshall's attempted commission of, or participation in, a fraud or act of dishonesty against us; (iii) Dr. Marshall's intentional, material violation of any contract or agreement between Dr. Marshall and us or any statutory duty Dr. Marshall owes to us, in each case, which remains uncured for 30 days after we provide written notice of such action or conduct to Dr. Marshall; (iv) Dr. Marshall's unauthorized use or disclosure of our confidential information or trade secrets; or (v) Dr. Marshall's gross misconduct which remains uncured for 30 days after we provide written notice of such action or conduct to Dr. Marshall.

- "good reason" means the occurrence, without Dr. Marshall's consent, of any one or more of the following: (i) a material reduction in his base salary of 10% or more (unless such reduction is pursuant to a salary reduction program applicable generally to our similarly situated executives); (ii) a material reduction in Dr. Marshall's authority, duties or responsibilities; (iii) a relocation of Dr. Marshall's principal place of employment to a place that increases Dr. Marshall's one-way commute by more than 25 miles; or (iv) material breach by us of any material provision of Dr. Marshall's employment agreement.

All severance benefits payable to Dr. Marshall under his employment agreement are subject to him signing, not revoking, and complying with a release of claims.

Leverone Employment Agreement

In December 2016, Private Miragen entered into an employment agreement with Mr. Leverone to be effective, and which we assumed, upon the closing of the Merger. Under this employment agreement, Mr. Leverone is entitled to an annual base salary (subject to periodic review and adjustment by our board of directors or compensation committee) of $280,000 and a discretionary annual cash bonus equal to 35% of Mr. Leverone's then effective base salary (subject to review and adjustment in the sole discretion of the board of directors or our compensation committee of the board of directors). Mr. Leverone is also eligible to participate in, subject to applicable eligibility requirements, all of our benefits plans and fringe benefits and programs that may be provided to our senior executives from time to time.

The employment agreement provides that either party may terminate the agreement at-will. In addition, the agreement provides that if we terminate Mr. Leverone's employment without cause or Mr. Leverone resigns for good reason, Mr. Leverone will be eligible to receive the following severance benefits: (i) an amount equal to 12 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting of the equivalent of 12 months on all of Mr. Leverone's stock options or other equity awards that were outstanding as of the effective date of Mr. Leverone's employment agreement; and (iii) 12 months of continued health coverage. Although, if such termination or resignation occurs

within one month prior to or 12 months following a change of control, Mr. Leverone will be eligible to receive the following severance benefits: (i) an amount equal to 12 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting in full of all of Mr. Leverone's then outstanding stock options or other equity awards subject to time-based vesting; and (iii) twelve months of continued health coverage.

The following definitions have been adopted in Mr. Leverone's employment agreement:

- "cause" means (i) Mr. Leverone's commission of any felony or any crime involving fraud, dishonesty or moral turpitude under the laws of the United States or any state thereof; (ii) Mr. Leverone's attempted commission of, or participation in, a fraud or act of dishonesty against us; (iii) Mr. Leverone's intentional, material violation of any contract or agreement between Mr. Leverone and us or any statutory duty Mr. Leverone owes to us, in each case, which remains uncured for 30 days after we provide written notice of such action or conduct to Mr. Leverone; (iv) Mr. Leverone's unauthorized use or disclosure of our confidential information or trade secrets; or (v) Mr. Leverone's gross misconduct which remains uncured for 30 days after we provide written notice of such action or conduct to Mr. Leverone.

- "good reason" means the occurrence, without Mr. Leverone's consent, of any one or more of the following: (i) a material reduction in his base salary of 10% or more (unless such reduction is pursuant to a salary reduction program applicable generally to our similarly situated executives); (ii) a material reduction in Mr. Leverone's authority, duties or responsibilities; (iii) a relocation of Mr. Leverone's principal place of employment to a place that increases Mr. Leverone's one-way commute by more than 25 miles; or (iv) material breach by us of any material provision of Mr. Leverone's employment agreement.

All severance benefits payable to Mr. Leverone under his employment agreement are subject to him signing, not revoking, and complying with a release of claims.

Levy Employment Agreement

In December 2016, Private Miragen entered into an employment agreement with Mr. Levy to be effective, and which we assumed, upon the closing of the Merger. Under this employment agreement, Mr. Levy is entitled to an annual base salary (subject to periodic review and adjustment by our board of directors or compensation committee) of $300,000 and a discretionary annual cash bonus equal to 40% of Mr. Levy's then effective base salary (subject to review and adjustment in the sole discretion of the board of directors or our compensation committee of the board of directors). Mr. Levy is also eligible to participate in, subject to applicable eligibility requirements, all of our benefits plans and fringe benefits and programs that may be provided to our senior executives of from time to time.

The employment agreement provides that either party may terminate the agreement at-will. In addition, the agreement provides that if we terminate Mr. Levy's employment without cause or Mr. Levy resigns for good reason, Mr. Levy will be eligible to receive the following severance benefits: (i) an amount equal to 12 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting of the equivalent of 12 months on all of Mr. Levy's stock options or other equity awards that were outstanding as of the effective date of Mr. Levy's employment agreement; and (iii) 12 months of continued health coverage. Although, if such termination or resignation occurs within one month prior to or 12 months following a change of control, Mr. Levy will be eligible to receive the following severance benefits: (i) an amount equal to 12 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting in full of all of Mr. Levy's then outstanding stock options or other equity awards subject to time-based vesting; and (iii) twelve months of continued health coverage.

The following definitions have been adopted Mr. Levy's employment agreement:

- "cause" means (i) Mr. Levy's commission of any felony or any crime involving fraud, dishonesty or moral turpitude under the laws of the United States or any state thereof; (ii) Mr. Levy's attempted commission of, or participation in, a fraud or act of dishonesty against us; (iii) Mr. Levy's intentional, material violation of any contract or agreement between Mr. Levy and us or any statutory duty Mr. Levy owes to us, in each case, which remains uncured for 30 days after we provide written notice of such action or conduct to Mr. Levy; (iv) Mr. Levy's unauthorized use or disclosure of our confidential information or trade secrets; or (v) Mr. Levy's gross misconduct which remains uncured for 30 days after we provide written notice of such action or conduct to Mr. Levy.

- "good reason" means the occurrence, without Mr. Levy's consent, of any one or more of the following: (i) a material reduction in his base salary of 10% or more (unless such reduction is pursuant to a salary reduction program

applicable generally to our similarly situated executives); (ii) a material reduction in Mr. Levy's authority, duties or responsibilities; (iii) a relocation of Mr. Levy's principal place of employment to a place that increases Mr. Levy's one-way commute by more than 25 miles; or (iv) material breach by us of any material provision of Mr. Levy's employment agreement.

All severance benefits payable to Mr. Levy under his employment agreement are subject to him signing, not revoking, and complying with a release of claims.

Rubin Employment Agreement

In December 2016, Private Miragen entered into an employment agreement with Dr. Rubin to be effective, and which we assumed, upon the closing of the Merger. Under this employment agreement, Dr. Rubin is entitled to an annual base salary (subject to periodic review and adjustment by our board of directors or compensation committee) of $395,000 and a discretionary annual cash bonus equal to 40% of Dr. Rubin's then effective base salary (subject to review and adjustment in the sole discretion of the board of directors or our compensation committee of the board of directors). Dr. Rubin is also eligible to participate in, subject to applicable eligibility requirements, all of our benefits plans and fringe benefits and programs that may be provided to our senior executives of from time to time.

The employment agreement provides that either party may terminate the agreement at-will. In addition, the agreement provides that if we terminate Dr. Rubin's employment without cause or Dr. Rubin resigns for good reason, Dr. Rubin will be eligible to receive the following severance benefits: (i) an amount equal to 12 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting of the equivalent of 12 months on all of Dr. Rubin's stock options or other equity awards that were outstanding as of the effective date of Dr. Rubin's employment agreement; and (iii) 12 months of continued health coverage. Although, if such termination or resignation occurs within one month prior to or 12 months following a change of control, Dr. Rubin will be eligible to receive the following severance benefits: (i) an amount equal to 12 months of his annual base salary, less applicable deductions, payable in accordance with our normal payroll schedule; (ii) the vesting in full of all of Dr. Rubin's then outstanding stock options or other equity awards subject to time-based vesting; and (iii) twelve months of continued health coverage.

The following definitions have been adopted in Dr. Rubin's employment agreement:

- "cause" means (i) Dr. Rubin's commission of any felony or any crime involving fraud, dishonesty or moral turpitude under the laws of the United States or any state thereof; (ii) Dr. Rubin's attempted commission of, or participation in, a fraud or act of dishonesty against us; (iii) Dr. Rubin's intentional, material violation of any contract or agreement between Dr. Rubin and us or any statutory duty Dr. Rubin owes to us, in each case, which remains uncured for 30 days after we provide written notice of such action or conduct to Dr. Rubin; (iv) Dr. Rubin's unauthorized use or disclosure of our confidential information or trade secrets; or (v) Dr. Rubin's gross misconduct which remains uncured for 30 days after we provide written notice of such action or conduct to Dr. Rubin.

- "good reason" means the occurrence, without Dr. Rubin's consent, of any one or more of the following: (i) a material reduction in his base salary of 10% or more (unless such reduction is pursuant to a salary reduction program applicable generally to our similarly situated executives); (ii) a material reduction in Dr. Rubin's authority, duties or responsibilities; (iii) a relocation of Dr. Rubin's principal place of employment to a place that increases Dr. Rubin's one-way commute by more than 25 miles; or (iv) material breach by us of any material provision of Dr. Rubin's employment agreement.

All severance benefits payable to Dr. Rubin under his employment agreement are subject to him signing, not revoking, and complying with a release of claims.

Payments to our Former Executive Officers

The employment agreements we previously entered into with Mr. Riccitelli and Tamara Seymour, who resigned as our chief financial officer in February 2017, each individual referred to herein as the Executive, entitled each Executive to receive certain payments upon the termination of such person's employment under certain circumstance as described below.

Termination for Cause - In the event an Executive's employment was terminated for "Cause," the Executive's sole remedy would be to collect all unpaid base salary, all accrued personal time off and all unreimbursed expenses payable for all periods through the effective date of termination, as well as any amount arising from his participation in, or benefits under, any employee benefit plan, program, or arrangement, payable in accordance with the terms of such plan, program, or arrangement.

Termination Without Cause - In the event an Executive's employment was terminated without "Cause," he or she would be entitled to receive all unpaid base salary, accrued annual bonus or incentive compensation (including any unpaid, accrued annual bonus or incentive compensation from the immediately preceding year), accrued personal time off, and all unreimbursed expenses payable for all periods through the effective date of termination (with such amounts to be paid on the date of termination).

For the purposes above, "Cause" means (1) expiration of the term of the applicable agreement, (2) a material breach by Executive of his or her fiduciary duty to the Company that results in material harm to the Company; (3) a material breach by Executive of the terms of the applicable employment agreement or any other agreement between Executive and the Company, which remains uncured for a period of 30 days following the receipt of written notice specifying the nature of the breach; (4) the willful commission by Executive of any act of embezzlement, fraud, larceny or theft on or from the Company; (5) substantial and continuing willful neglect or inattention by Executive of the duties of such person's employment, refusal to perform the lawful and reasonable directions of the board of directors or the willful misconduct or gross negligence of Executive in connection with the performance of such duties which remain uncured for a period of 30 days following the receipt of written notice specifying the nature of the breach; (6) the willful commission by Executive of any crime involving moral turpitude or a felony; and (7) Executive's performance or omission of any act which, in the judgment of our board of directors, if known to the customers, clients, stockholders or any regulators of the Company, would have a material adverse impact on the business of the Company.

In addition, should Mr. Riccitelli's termination occur after June 23, 2015, he would be entitled to receive a severance payment, equal to his then-current base salary for a period of twelve months.

In the event Ms. Seymour's employment was terminated without Cause, Ms. Seymour would be entitled to continue to receive her then-current base salary for twelve months and accelerated vesting of all time-based equity compensation awards then held by her to the extent that such awards would have vested during the twelve months following her termination.

Neither Executive would be required to mitigate the amount of any severance payments received by seeking other employment during the term of the severance period. However, should the Executive obtain other employment during the term of the severance period, we would pay such person, for the remaining length of the severance period, only the difference between such person's new salary and base salary (as in effect at the time of termination), if the new salary is less than such person's base salary (i.e., we will not be obligated to make any severance payments to Executive if such person's new salary is greater than such person's applicable base salary). The severance payment (less all applicable withholdings) would be paid in equal monthly installments over the applicable period immediately following the termination of Executive's employment. We will also reimburse Executive for premiums for COBRA coverage for Executive (and to the extent he or she has family coverage, his family), provided that Executive elects such coverage, during the applicable period when such person is receiving severance payments, until such time as Executive obtains other employment and is entitled to comparable health coverage from such employer.

In connection with the Merger, the compensation committee of our board of directors deemed it advisable and in the best interests of our stockholders to permit lump sum payment of the severance arrangements of Mr. Riccitelli and Ms. Seymour upon his or her termination to the extent permitted under Section 409A of the Code, as opposed to the monthly payments originally contemplated therein to avoid a potential acquirer from having to make continued payments following the closing of a merger. Therefore, on October 11, 2016, the compensation committee of our board of directors approved modifications to the severance arrangements of Mr. Riccitelli and Ms. Seymour to allow for the payment of severance in a lump sum to the extent such payments can be made in compliance with Section 409A of the Code. In February 2017, we paid to Mr. Riccitelli a lump sum severance payment of $450,000 and we paid to Ms. Seymour a lump sum severance payment of $350,000.

Outstanding Equity Awards at December 31, 2017

The following table provides information about the number of outstanding equity awards held by our named executive officers at December 31, 2017. Mr. Riccitelli is not included in the table below because he did not hold any outstanding equity awards at December 31, 2017.

Name	Grant Date	Vesting Commencement Date		Number of securities underlying unexercised options exercisable	Number of securities underlying unexercised options unexercisable	Option exercise price	Option Expiration Date
William S. Marshall, Ph.D.	7/31/2008	5/16/2008	(1)	115,818	—	$0.57	7/30/2018
	6/15/2012	6/15/2012	(2)	230,968	—	$1.22	6/13/2022
	2/22/2016	2/22/2016	(2)	71,862	84,929	$1.05	2/19/2026
	2/16/2017	2/16/2017	(2)	41,666	158,334	$11.01	2/16/2027
Adam S. Levy	6/15/2016	5/16/2016	(1)	64,257	98,076	$1.05	6/13/2026
	2/16/2017	2/16/2017	(2)	18,229	69,271	$11.01	2/16/2027
Paul D. Rubin, M.D.	11/30/2016	11/16/2016	(1)	54,956	147,961	$5.69	11/30/2026
	2/16/2017	2/16/2017	(2)	18,229	69,271	$11.01	2/16/2027

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(1) Twenty-five percent of the shares subject to the option vest on the first anniversary of the vesting commencement date, and the remainder vest thereafter in 36 equal installments.

(2) The option vests as to 1/48 of the shares in monthly installments measured from vesting commencement date.

Payments Due Upon Termination of Employment or a Change in Control

Employment Agreements

Mr. Riccitelli's CEO Agreement and Ms. Seymour's CFO Agreement entitle each of them, each individual referred to herein as the Executive, to receive certain payments upon the termination of such person's employment under certain circumstance as described below.

Termination for Cause - In the event Executive's employment is terminated for "Cause," Executive's sole remedy will be to collect all unpaid base salary, all accrued personal time off, and all unreimbursed expenses payable for all periods through the effective date of termination, as well as any amount arising from his participation in, or benefits under, any employee benefit plan, program, or arrangement, payable in accordance with the terms of such plan, program, or arrangement.

Termination Without Cause - In the event the Executive's employment is terminated without "Cause," he will be entitled to receive all unpaid base salary, accrued annual bonus or incentive compensation (including any unpaid, accrued annual bonus or incentive compensation from the immediately preceding year), accrued personal time off, and all unreimbursed expenses payable for all periods through the effective date of termination (with such amounts to be paid on the date of termination).

For the purposes above, "Cause" means (1) expiration of the term of the CEO Agreement or CFO Agreement (as applicable), (2) a material breach by Executive of his or her fiduciary duty to the Company that results in material harm to the Company; (3) a material breach by Executive of the terms of the CEO Agreement or CFO Agreement (as applicable) or any other agreement between Executive and the Company, which remains uncured for a period of 30 days following the receipt of written notice specifying the nature of the breach; (4) the willful commission by Executive of any act of embezzlement, fraud, larceny or theft on or from the Company; (5) substantial and continuing willful neglect or inattention by Executive of the duties of such person's employment, refusal to perform the lawful and reasonable directions of the board of directors or the willful misconduct or gross negligence of Executive in connection with the performance of such duties which remain uncured for a period of 30 days following the receipt of written notice specifying the nature of the breach; (6) the willful commission by Executive of any crime involving moral turpitude or a felony; and (7) Executive's performance or omission of any act which, in the judgment of our board of directors, if known to the customers, clients, stockholders or any regulators of the Company, would have a material adverse impact on the business of the Company.

In addition, should Mr. Riccitelli's termination occur after June 23, 2015, he will be entitled to receive a severance payment, equal to his then-current base salary for a period of twelve months.

In the event Ms. Seymour's employment is terminated without Cause, Ms. Seymour will be entitled to continue to receive her then-current base salary for twelve months and accelerated vesting of all time-based equity compensation awards then held by Executive to the extent that such awards would have vested during the twelve months following the Executive's termination.

Neither Executive will be required to mitigate the amount of any severance payments received by seeking other employment during the term of the severance period. However, should the Executive obtain other employment during the term of the severance period, we will pay such person, for the remaining length of the severance period, only the difference between such person's new salary and base salary (as in effect at the time of termination), if the new salary is less than such person's base salary (i.e., we will not be obligated to make any severance payments to Executive if such person's new salary is greater than such person's applicable base salary). The severance payment (less all applicable withholdings) will be paid in equal monthly installments over the applicable period immediately following the termination of Executive's employment. We will also reimburse Executive for premiums for COBRA coverage for Executive (and to the extent he or she has family coverage, his family), provided that Executive elects such coverage, during the applicable period when such person is receiving severance payments, until such time as Executive obtains other employment and is entitled to comparable health coverage from such employer.

In connection with the Merger, the compensation committee of our board of directors deemed it advisable and in the best interests of our stockholders to permit lump sum payment of the severance arrangements of Mr. Riccitelli and Ms. Seymour upon his or her termination to the extent permitted under Section 409A of the Code, as opposed to the monthly payments originally contemplated therein to avoid a potential acquirer from having to make continued payments following the closing of a merger. Therefore, on October 11, 2016, the compensation committee of our board of directors approved modifications to the severance arrangements of Mr. Riccitelli and Ms. Seymour to allow for the payment of severance in a lump sum to the extent such payments can be made in compliance with Section 409A of the Code.

Termination After Disability or Death - In the event that Executive's employment is terminated due to disability (as described in the CEO Agreement or CFO Agreement (as applicable) or on account of such person's death, then Executive (or such person's estate or personal representative, as applicable) will be entitled to receive all unpaid base salary, accrued annual bonus or incentive compensation (including any unpaid, accrued annual bonus or incentive compensation from the immediately preceding year), accrued personal time off, and all unreimbursed expenses payable for all periods through the effective date of termination. In the case of disability only, Executive will be entitled to receive, in addition to the amounts specified above, for a period of six months, a series of monthly payments equal to such person's then-current monthly base salary payments such person received during his or her employment if and only if Executive does not receive any payments as a result of the short-term and long-term disability insurance benefits that we obtain on such person's behalf pursuant to the CEO Agreement or CFO Agreement (as applicable), which payments will be paid in equal installments over the applicable period. If Executive is provided with such insurance payments, then such person will only be entitled to receive the difference between the insurance payments and such person's base salary, if the payments are less than such person's base salary.

Termination by Executive for Good Reason - In the event that Executive's employment is terminated by such person for "Good Reason," then Executive will be entitled to receive all unpaid base salary, accrued annual bonus or incentive compensation (including any such unpaid, accrued compensation from the immediately preceding year), accrued personal time off and all unreimbursed expenses payable for all periods through the effective date of such person's termination. In addition, Executive will be entitled to receive the same severance payment such person would be entitled to receive if his or her employment were terminated by us without Cause

"Good Reason" means (1) we have materially breached the CEO Agreement or CFO Agreement (as applicable) and we have failed to cure or remedy such breach after 30-days written notice from Executive (provided that Executive must resign within 30 days after expiration of the 30-day period following written notice without cure or remedy by us), (2) there has occurred any material and substantial diminution or reduction in duties, base salary, title, health care coverage (but only if such diminution is disproportionate to a diminution in health care coverage applicable to other of our employees), authority or responsibilities of Executive, whether is scope or nature, and we have failed to cure or remedy such breach after 30-days written notice from Executive; or (3) we have required that Executive perform any act or refrain from performing any act that would be in violation of applicable law.

Termination by Executive without Good Reason - In the event Executive terminates his or her employment without Good Reason, such person will only be entitled to receive all unpaid base salary, all accrued personal time off and all unreimbursed

expenses payable for all periods through the effective date of termination and Executive will not be entitled to any compensation or other amounts from us following the effective date of termination.

In addition to the severance payments for our previous executive officers described herein, we have also entered employment agreements with Drs. Marshall and Rubin and Messrs. Levy and Leverone pursuant to which we have agreed to certain payments to our executive officers upon their termination or a change of control of the company. These obligations are discussed above under the heading "*Current Executive Officer Employment Agreements.*"

Employee Benefit Plans

2016 Equity Incentive Plan

Purpose

Our 2016 Equity Incentive Plan, or the 2016 Plan, was adopted by us, and approved by our stockholders in connection with the Merger. The 2016 Plan is designed to secure and retain the services of our employees, directors, and consultants, provide incentives for such, directors and consultants to exert maximum efforts for our success and to provide a means by our employees, directors and consultants may be given an opportunity to benefit from increases in the value of its common stock. The 2016 Plan was adopted to replace and supersede our 2014 Stock Incentive Plan, or the 2014 Plan.

As of December 31, 2017, outstanding equity awards under the 2016 Plan were exercisable for an aggregate of 940,298 shares of our common stock.

Types of Awards

The terms of the 2016 Plan provide for the grant of incentive stock options, nonstatutory stock options, stock appreciation rights, restricted stock awards, restricted stock unit awards, other stock awards, and performance awards that may be settled in cash, stock, or other property.

Shares Available for Awards

The aggregate number of shares of our common stock that may be issued under the 2016 Plan, or the Share Reserve, will not exceed 4,182,404 shares, which number is the sum of: (i) 1,681,294 shares, plus (ii) the number of shares subject to outstanding stock awards that were granted under the Private Miragen 2008 Equity Incentive Plan, or the Miragen 2008 Plan, that, from and after the closing date of the Merger, expire or terminate for any reason prior to exercise or settlement, are forfeited because of the failure to meet a contingency or condition required to vest such shares, or are reacquired, withheld or not issued to satisfy a tax withholding obligation in connection with an award or to satisfy the purchase price or exercise price of a stock award, if any, as such shares become available from time to time, plus (iii) 902,720 shares from previous automatic increases to the share reserve (as described in more detail below), including the automatic increase of 902,720 shares effected on January 1, 2018. In addition, the share reserve will automatically increase on January 1 of each year, for a period of not more than ten years, commencing on January 1 of the year following the year in which the effective date of the 2016 Plan occurs, and ending on (and including) January 1, 2026, in an amount equal to 4% of the shares of common stock outstanding on December 31st of the preceding calendar year; however the board of directors or compensation committee may act prior to January 1 of a given year to provide that there will be no January 1st increase in the share reserve for such year or that the increase in the share reserve for such year will be a lesser number of shares of common stock than would otherwise occur pursuant to the automatic increase.

The following shares of common stock will become available again for issuance under the 2016 Plan: (i) any shares subject to a stock award that are not issued because such stock award expires or otherwise terminates without all of the shares covered by such stock award having been issued; (ii) any shares subject to a stock award that are not issued because such stock award is settled in cash; (iii) any shares issued pursuant to a stock award that are forfeited back to or repurchased by us because of the failure to meet a contingency or condition required for the vesting of such shares; and (iv) any shares reacquired by us in satisfaction of tax withholding obligations on a stock award or as consideration for the exercise or purchase price of a stock award.

Eligibility

All of our employees and non-employee directors are eligible to participate in the 2016 Plan and may receive all types of awards other than incentive stock options. Incentive stock options may be granted under the 2016 Plan only to our employees (including officers) and employees of our affiliates.

Section 162(m) Limits

Under the 2016 Plan, subject to adjustment for specified changes in our capitalization, no participant will be eligible to be granted performance-based compensation during any calendar year more than: (i) a maximum of 1,500,000 shares of common stock subject to stock options and stock appreciation rights whose value is determined by reference to an increase over an exercise or strike price of at least 100% of the fair market value of a share of common stock on the date of grant; (ii) a maximum of 1,500,000 shares of common stock subject to performance stock awards; and (iii) a maximum of $3,000,000 subject to performance cash awards. These limits are designed to allow us to grant awards that are intended to be exempt from the $1.0 million limitation on the income tax deductibility of compensation paid per covered employee imposed by Section 162(m) of the Code, and will not apply to awards that our board of directors determines will not be treated as performance-based compensation.

Non-Employee Director Compensation Limit

Under the 2016 Plan, the maximum number of shares of common stock subject to stock awards granted under the 2016 Plan or otherwise during any one calendar year to any non-employee director, taken together with any cash fees paid us to such non-employee director during such calendar year for services on its board of directors, will not exceed $500,000 in total value (calculating the value of any such stock awards based on the grant date fair value of such stock awards for financial reporting purposes), or, with respect to the calendar year in which a non-employee director is first appointed or elected to our board of directors, $1,000,000.

Administration

The 2016 Plan is administered by our board of directors, which may in turn delegate authority to administer the 2016 Plan to a committee. Our board of directors has delegated concurrent authority to administer the 2016 Plan to its compensation committee, but may, at any time, revest in itself some or all of the power delegated to its compensation committee. Our board of directors and its compensation committee are each considered to be a Plan Administrator for purposes of the 2016 Plan. Subject to the terms of the 2016 Plan, the Plan Administrator may determine the recipients, the types of awards to be granted, the number of shares of common stock subject to or the cash value of awards, and the terms and conditions of awards granted under the 2016 Plan, including the period of their exercisability and vesting. The Plan Administrator also has the authority to provide for accelerated exercisability and vesting of awards. Subject to the limitations set forth below, the Plan Administrator also determines the fair market value applicable to a stock award and the exercise or strike price of stock options and stock appreciation rights granted under the 2016 Plan.

The Plan Administrator may also delegate to one or more officers the authority to designate employees who are not officers to be recipients of certain stock awards and the number of shares of common stock subject to such stock awards. Under any such delegation, the Plan Administrator will specify the total number of shares of common stock that may be subject to the stock awards granted by such officer. The officer may not grant a stock award to himself or herself.

Repricing; Cancellation and Re-Grant of Stock Awards

Under the 2016 Plan, the Plan Administrator does not have the authority to reprice any outstanding stock option or stock appreciation right by reducing the exercise or strike price of the stock option or stock appreciation right or to cancel any outstanding stock option or stock appreciation right that has an exercise or strike price greater than the then-current fair market value of a share of common stock in exchange for cash or other stock awards without obtaining the approval of our stockholders. Such approval must be obtained within 12 months prior to such an event.

Stock Options

Stock options may be granted under the 2016 Plan pursuant to stock option agreements. The 2016 Plan permits the grant of stock options that are intended to qualify as ISOs and NSOs.

The exercise price of a stock option granted under the 2016 Plan may not be less than 100% of the fair market value of the common stock subject to the stock option on the date of grant and, in some cases (see "*Limitations on Incentive Stock Options*" below), may not be less than 110% of such fair market value.

The term of stock options granted under the 2016 Plan may not exceed ten years and, in some cases (see "*Limitations on Incentive Stock Options*" below), may not exceed five years. Except as otherwise provided in a participant's stock option agreement or other written agreement with us or one of our affiliates, if a participant's service relationship with us or any of our affiliates, referred to herein as continuous service, terminates (other than for cause and other than upon the participant's death or disability), the participant may exercise any vested stock options for up to three months following the participant's termination of continuous service. Except as otherwise provided in a participant's stock option agreement or other written agreement with us or one of our affiliates, if a participant's continuous service terminates due to the participant's disability or death (or the participant dies within a specified period, if any, following termination of continuous service), the participant, or his or her beneficiary, as applicable, may exercise any vested stock options for up to 12 months following the participant's termination due to the participant's disability or for up to 18 months following the participant's death. Except as explicitly provided otherwise in a participant's stock option agreement or other written agreement with us or one of our affiliates, if a participant's continuous service is terminated for cause (as defined in the 2016 Plan), all stock options held by the participant will terminate upon the participant's termination of continuous service and the participant will be prohibited from exercising any stock option from and after such termination date. Except as otherwise provided in a participant's stock option agreement or other written agreement with us or one of its affiliates, the term of a stock option may be extended if the exercise of the stock option following the participant's termination of continuous service (other than for cause and other than upon the participant's death or disability) would be prohibited by applicable securities laws or if the sale of any common stock received upon exercise of the stock option following the participant's termination of continuous service (other than for cause) would violate our insider trading policy. In no event, however, may a stock option be exercised after its original expiration date.

Acceptable forms of consideration for the purchase of common stock pursuant to the exercise of a stock option under the 2016 Plan will be determined by the Plan Administrator and may include payment: (i) by cash, check, bank draft or money order payable to us; (ii) pursuant to a program developed under Regulation T as promulgated by the Federal Reserve Board; (iii) by delivery to us of shares of common stock (either by actual delivery or attestation); (iv) by a net exercise arrangement (for NSOs only); or (v) in other legal consideration approved by the Plan Administrator.

Stock options granted under the 2016 Plan may vest as determined by the Plan Administrator at the rate specified in the stock option agreement. Shares covered by different stock options granted under the 2016 Plan may be subject to different vesting schedules as the Plan Administrator may determine.

The Plan Administrator may impose limitations on the transferability of stock options granted under the 2016 Plan in its discretion. Generally, a participant may not transfer a stock option granted under the 2016 Plan other than by will or the laws of descent and distribution or, subject to approval by the Plan Administrator, pursuant to a domestic relations order or an official marital settlement agreement. However, the Plan Administrator may permit transfer of a stock option in a manner that is not prohibited by applicable tax and securities laws. In addition, subject to approval by the Plan Administrator, a participant may designate a beneficiary who may exercise the stock option following the participant's death.

Limitations on Incentive Stock Options

The aggregate fair market value, determined at the time of grant, of shares of common stock with respect to ISOs that are exercisable for the first time by a participant during any calendar year under all of our stock plans may not exceed $100,000. The stock options or portions of stock options that exceed this limit or otherwise fail to qualify as ISOs are treated as NSOs. No ISO may be granted to any person who, at the time of grant, owns or is deemed to own stock possessing more than 10% of our total combined voting power or that of any affiliate unless the following conditions are satisfied:

- the exercise price of the ISO must be at least 110% of the fair market value of the common stock subject to the ISO on the date of grant; and
- the term of the ISO must not exceed five years from the date of grant.

Subject to adjustment for specified changes in capitalization, the aggregate maximum number of shares of common stock that may be issued pursuant to the exercise of ISOs under the 2016 Plan is 20,912,020 shares.

Stock Appreciation Rights

Stock appreciation rights may be granted under the 2016 Plan pursuant to stock appreciation right agreements. Each stock appreciation right is denominated in common stock share equivalents. The strike price of each stock appreciation right will be determined by the Plan Administrator, but will in no event be less than 100% of the fair market value of the common stock subject to the stock appreciation right on the date of grant. The Plan Administrator may also impose restrictions or conditions upon the vesting of stock appreciation rights that it deems appropriate. The appreciation distribution payable upon exercise of a stock appreciation right may be paid in shares of our common stock, in cash, in a combination of cash and stock, or in any other form of consideration determined by the Plan Administrator and set forth in the stock appreciation right agreement. Stock appreciation rights will be subject to the same conditions upon termination of continuous service and restrictions on transfer as stock options under the 2016 Plan.

Restricted Stock Awards

Restricted stock awards may be granted under the 2016 Plan pursuant to restricted stock award agreements. A restricted stock award may be granted in consideration for cash, check, bank draft or money order payable to us, the participant's services performed for us or any of ours affiliates, or any other form of legal consideration acceptable to the Plan Administrator. Shares of common stock acquired under a restricted stock award may be subject to forfeiture to or repurchase by us in accordance with a vesting schedule to be determined by the Plan Administrator. Rights to acquire shares of common stock under a restricted stock award may be transferred only upon such terms and conditions as are set forth in the restricted stock award agreement. A restricted stock award agreement may provide that any dividends paid on restricted stock will be subject to the same vesting conditions as apply to the shares subject to the restricted stock award. Upon a participant's termination of continuous service for any reason, any shares subject to restricted stock awards held by the participant that have not vested as of such termination date may be forfeited to or repurchased by us.

Restricted Stock Unit Awards

Restricted stock unit awards may be granted under the 2016 Plan pursuant to restricted stock unit award agreements. Payment of any purchase price may be made in any form of legal consideration acceptable to the Plan Administrator. A restricted stock unit award may be settled by the delivery of shares of Signal common stock, in cash, in a combination of cash and stock, or in any other form of consideration determined by the Plan Administrator and set forth in the restricted stock unit award agreement. Restricted stock unit awards may be subject to vesting in accordance with a vesting schedule to be determined by the Plan Administrator. Dividend equivalents may be credited in respect of shares of common stock covered by a restricted stock unit award, provided that any additional shares credited by reason of such dividend equivalents will be subject to all of the same terms and conditions of the underlying restricted stock unit award. Except as otherwise provided in a participant's restricted stock unit award agreement or other written agreement with us or one of our affiliates, restricted stock units that have not vested will be forfeited upon the participant's termination of continuous service for any reason.

Performance Awards

The 2016 Plan allows us to grant performance stock and cash awards, including such awards that may qualify as performance-based compensation that is not subject to the $1 million limitation on the income tax deductibility of compensation paid per covered employee imposed by Section 162(m) of the Code.

A performance stock award is a stock award that is payable (including that may be granted, may vest, or may be exercised) contingent upon the attainment of pre-determined performance goals during a performance period. A performance stock award may require the completion of a specified period of continuous service. The length of any performance period, the performance goals to be achieved during the performance period, and the measure of whether and to what degree such performance goals have been attained will be determined by the compensation committee of our board of directors, except that the Plan Administrator also may make any such determinations to the extent that the award is not intended to qualify as performance-based compensation under Section 162(m) of the Code. In addition, to the extent permitted by applicable law and the performance stock award agreement, the Plan Administrator may determine that cash may be used in payment of performance stock awards.

A performance cash award is a cash award that is payable contingent upon the attainment of pre-determined performance goals during a performance period. A performance cash award may require the completion of a specified period of continuous service. The length of any performance period, the performance goals to be achieved during the performance period, and the measure of whether and to what degree such performance goals have been attained will be determined by the compensation committee of our board of directors, except that the Plan Administrator also may make any such determinations to the extent

that the award is not intended to qualify as performance-based compensation under Section 162(m) of the Code. The Plan Administrator may specify the form of payment of performance cash awards, which may be cash or other property, or may provide for a participant to have the option for his or her performance cash award to be paid in cash or other property.

In granting a performance stock or cash award intended to qualify as "performance-based compensation" under Section 162(m) of the Code, the compensation committee of our board of directors will set a period of time, or a performance period, over which the attainment of one or more goals, or performance goals, will be measured. Within the time period prescribed by Section 162(m) of the Code (no later than the earlier of the 90th day of a performance period and the date on which 25% of the performance period has elapsed, and in any event at a time when the achievement of the performance goals remains substantially uncertain), the compensation committee of our board of directors will establish the performance goals, based upon one or more criteria, or performance criteria, enumerated in the 2016 Plan and described below. As soon as administratively practicable following the end of the performance period, the compensation committee of our board of directors will certify in writing whether the performance goals have been satisfied.

Performance goals under the 2016 Plan will be based on any one or more of the following performance criteria: (i) earnings (including earnings per share and net earnings); (ii) earnings before interest, taxes and depreciation; (iii) earnings before interest, taxes, depreciation and amortization; (iv) earnings before interest, taxes, depreciation, amortization and legal settlements; (v) earnings before interest, taxes, depreciation, amortization, legal settlements and other income (expense); (vi) earnings before interest, taxes, depreciation, amortization, legal settlements, other income (expense) and stock-based compensation; (vii) earnings before interest, taxes, depreciation, amortization, legal settlements, other income (expense), stock-based compensation and changes in deferred revenue; (viii) earnings before interest, taxes, depreciation, amortization, legal settlements, other income (expense), stock-based compensation, other non-cash expenses and changes in deferred revenue; (ix) total stockholder return; (x) return on equity or average stockholder's equity; (xi) return on assets, investment, or capital employed; (xii) stock price; (xiii) margin (including gross margin); (xiv) income (before or after taxes); (xv) operating income; (xvi) operating income after taxes; (xvii) pre-tax profit; (xviii) operating cash flow; (xix) sales or revenue targets; (xx) increases in revenue or product revenue; (xxi) expenses and cost reduction goals; (xxii) improvement in or attainment of working capital levels; (xxiii) economic value added (or an equivalent metric); (xxiv) market share; (xxv) cash flow; (xxvi) cash flow per share; (xxvii) cash balance; (xxviii) cash burn; (xxix) cash collections; (xxx) share price performance; (xxxi) debt reduction; (xxxii) implementation or completion of projects or processes (including, without limitation, clinical trial initiation, clinical trial enrollment and dates, clinical trial results, regulatory filing submissions, regulatory filing acceptances, regulatory or advisory committee interactions, regulatory approvals, new and supplemental indications for existing products, and product supply); (xxxiii) stockholders' equity; (xxxiv) capital expenditures; (xxxv) debt levels; (xxxvi) operating profit or net operating profit; (xxxvii) workforce diversity; (xxxviii) growth of net income or operating income; (xxxix) billings; (xl) bookings; (xli) employee retention; (xlii) initiation of phases of clinical trials and/or studies by specific dates; (xliii) acquisition of new customers, including institutional accounts; (xliv) customer retention and/or repeat order rate; (xlv) number of institutional customer accounts (xlvi) budget management; (xlvii) improvements in sample and test processing times; (xlviii) regulatory milestones; (xlix) progress of internal research or clinical programs; (l) progress of partnered programs; (li) partner satisfaction; (lii) milestones related to samples received and/or tests run; (liii) expansion of sales in additional geographies or markets; (liv) research progress, including the development of programs; (lv) submission to, or approval by, a regulatory body (including, but not limited to the FDA) of an applicable filing or a product; (lvi) timely completion of clinical trials; (lvii) milestones related to samples received and/or tests or panels run; (lviii) expansion of sales in additional geographies or markets; (lix) research progress, including the development of programs; (lx) patient samples processed and billed; (lxi) sample processing operating metrics (including, without limitation, failure rate maximums and reduction of repeat rates); (lxii) strategic partnerships or transactions (including in-licensing and out-licensing of intellectual property); (lxiii) preclinical development related to compound goals; (lxiv) customer satisfaction; and (lxv) and to the extent that an award is not intended to comply with Section 162(m) of the Code, other measures of performance selected by our board of directors.

Performance goals may be based on a company-wide basis, with respect to one or more business units, divisions, affiliates, or business segments, and in either absolute terms or relative to the performance of one or more comparable companies or the performance of one or more relevant indices. The compensation committee our board of directors (or, to the extent that an award is not intended to qualify as "performance-based compensation" under Section 162(m) of the Code, the Plan Administrator) is authorized to make appropriate adjustments in the method of calculating the attainment of performance goals for a performance period as follows; *provided, however*, that to the extent that an award is intended to qualify as "performance-based compensation" under Section 162(m) of the Code, any such adjustment may be made only if such adjustment is objectively determinable and specified in the award agreement at the time the award is granted or in such other document setting forth the performance goals for the award at the time the performance goals are established: (i) to exclude restructuring and/or other nonrecurring charges; (ii) to exclude exchange rate effects; (iii) to exclude the effects of changes to U.S. GAAP; (iv) to exclude the effects of any statutory adjustments to corporate tax rates; (v) to exclude the effects of items that are unusual in nature or occur infrequently as determined under U.S. GAAP; (vi) to exclude the dilutive effects of acquisitions or joint

ventures; (vii) to assume that any business divested by us achieved performance objectives at targeted levels during the balance of a performance period following such divestiture; (viii) to exclude the effect of any change in the outstanding shares of our common stock by reason of any stock dividend or split, stock repurchase, reorganization, recapitalization, merger, consolidation, spin-off, combination or exchange of shares or other similar corporate change, or any distributions to common stockholders other than regular cash dividends; (ix) to exclude the effects of stock based compensation and the award of bonuses under our bonus plans; (x) to exclude costs incurred in connection with potential acquisitions or divestitures that are required to be expensed under U.S. GAAP; and (xi) to exclude the goodwill and intangible asset impairment charges that are required to be recorded under U.S. GAAP.

In addition, the compensation committee of our board of directors (or, to the extent that an award is not intended to qualify as "performance-based compensation" under Section 162(m) of the Code, the Plan Administrator) retains the discretion to reduce or eliminate the compensation or economic benefit due upon the attainment of any performance goals and to define the manner of calculating the performance criteria it selects to use for a performance period.

Other Stock Awards

Other forms of stock awards valued in whole or in part by reference to, or otherwise based on, common stock may be granted either alone or in addition to other stock awards under the 2016 Plan. The Plan Administrator will have sole and complete authority to determine the persons to whom and the time or times at which such other stock awards will be granted, the number of shares of common stock to be granted and all other terms and conditions of such other stock awards.

Clawback Policy

Awards granted under the 2016 Plan will be subject to recoupment in accordance with any clawback policy that the we are required to adopt pursuant to the listing standards of any national securities exchange or association on which our securities are listed or as is otherwise required by the Dodd-Frank Wall Street Reform and Consumer Protection Act or other applicable law. In addition, the Plan Administrator may impose other clawback, recovery or recoupment provisions in an award agreement as the Plan Administrator determines necessary or appropriate, including a reacquisition right in respect of previously acquired shares of common stock or other cash or property upon the occurrence of cause.

Changes to Capital Structure

In the event of certain capitalization adjustments, the Plan Administrator will appropriately adjust: (i) the class(es) and maximum number of securities subject to the 2016 Plan and by which the share reserve may increase automatically each year; (ii) the class(es) and maximum number of securities that may be issued pursuant to the exercise of ISOs; (iii) the class(es) and maximum number of securities that may be awarded to any participant pursuant to Section 162(m) limits; (iv) the class and maximum number of shares that may be awarded to any non-employee director; and (v) the class(es) and number of securities and price per share of stock subject to outstanding stock awards.

Corporate Transaction

In the event of a corporate transaction (as defined in the 2016 Plan and described below), the Plan Administrator may take one or more of the following actions with respect to stock awards, contingent upon the closing or consummation of the corporate transaction, unless otherwise provided in the instrument evidencing the stock award, in any other written agreement between us or one of our affiliates and the participant or in our director compensation policy, or unless otherwise provided by the Plan Administrator at the time of grant of the stock award:

- arrange for the surviving or acquiring corporation (or its parent company) to assume or continue the stock award or to substitute a similar stock award for the stock award (including an award to acquire the same consideration paid to our stockholders pursuant to the corporate transaction);

- arrange for the assignment of any reacquisition or repurchase rights held by us in respect of common stock issued pursuant to the stock award to the surviving or acquiring corporation (or its parent company);

- accelerate the vesting (and, if applicable, the exercisability) of the stock award to a date prior to the effective time of the corporate transaction as determined by the Plan Administrator (or, if the Plan Administrator does not determine such a date, to the date that is five days prior to the effective date of the corporate transaction), with the stock award terminating if not exercised (if applicable) at or prior to the effective time of the corporate transaction; provided,

however, that the Plan Administrator may require participants to complete and deliver to us a notice of exercise before the effective date of a corporate transaction, which is contingent upon the effectiveness of the corporate transaction;

- arrange for the lapse of any reacquisition or repurchase rights held by us with respect to the stock award;

- cancel or arrange for the cancellation of the stock award, to the extent not vested or not exercised prior to the effective time of the corporate transaction, and pay such cash consideration (including no consideration) as the Plan Administrator may consider appropriate; and

- cancel or arrange for the cancellation of the stock award, to the extent not vested or not exercised prior to the effective time of the corporate transaction, in exchange for a payment, in such form as may be determined by our board of directors equal to the excess, if any, of (i) the per share amount payable to holders of common stock in connection with the corporate transaction, over (ii) the per share exercise price under the applicable award. For clarity, this payment may be zero if the value of the property is equal to or less than the exercise price. In addition, any escrow, holdback, earnout or similar provisions in the definitive agreement for the corporate transaction may apply to such payment to the same extent and in the same manner as such provisions apply to the holders of common stock.

The Plan Administrator is not required to take the same action with respect to all stock awards or portions of stock awards or with respect to all participants. The Plan Administrator may take different actions with respect to the vested and unvested portions of a stock award.

In the event of a corporate transaction, unless otherwise provided in the instrument evidencing a performance cash award or any other written agreement between us or one of our affiliates and the participant, or unless otherwise provided by the Plan Administrator, all performance cash awards will terminate prior to the effective time of the corporate transaction.

For purposes of the 2016 Plan, a corporate transaction generally will be deemed to occur in the event of the consummation of: (i) a sale or other disposition of all or substantially all of our consolidated assets; (ii) a sale or other disposition of more than 50% of our outstanding securities; (iii) a merger, consolidation or similar transaction following which we are not the surviving corporation; or (iv) a merger, consolidation or similar transaction following which we are the surviving corporation but the shares of common stock outstanding immediately prior to the transaction are converted or exchanged into other property by virtue of the transaction.

Change in Control

Under the 2016 Plan, a stock award may be subject to additional acceleration of vesting and exercisability upon or after a change in control (as defined in the 2016 Plan and described below) as may be provided in the participant's stock award agreement, in any other written agreement with us or one of our affiliates or in any director compensation policy, but in the absence of such provision, no such acceleration will occur.

2008 Equity Incentive Plan

The Miragen 2008 Plan was adopted by Private Miragen's board of directors and approved by its stockholders in May 2008, and was subsequently amended by its board of directors and stockholders, most recently in October 2015. No further awards will be made under the Miragen 2008 Plan, but all awards outstanding under the 2008 Miragen Plan as of the effective time of the Merger remain subject to the terms and conditions of the 2008 Miragen Plan.

As of December 31, 2017, there were outstanding stock options to purchase 1,922,261 shares of our common stock under the Miragen 2008 Plan.

All awards granted under the Miragen 2008 Plan that, from and after the effective date of the Merger, expire or terminate for any reason prior to exercise or settlement, are forfeited because of the failure to meet a contingency or condition required to vest, or are reacquired, withheld or not issued to satisfy a tax withholding obligation in connection with an award or to satisfy the exercise price of a stock award, will become available for grant under the 2016 Plan in accordance with its terms.

Stock Awards

The Miragen 2008 Plan provides for the grant of ISO, NSOs, stock appreciation rights, restricted stock awards and restricted stock unit awards (collectively, stock awards), all of which may be granted to employees, including officers, non-employee directors and consultants of Private Miragen. ISOs may be granted only to employees. All other awards may be granted to employees, including officers, and to non-employee directors and consultants. Private Miragen only granted stock options under the Miragen 2008 Plan.

Administration

Our board of directors or the compensation committee of our board of directors may act as the administrator of the Miragen 2008 Plan. The administrator has the complete discretion to make all decisions relating to the plan and outstanding awards. The administrator has the authority to modify outstanding awards under the Miragen 2008 Plan. Subject to the terms of the Miragen 2008 Plan, the administrator has the authority to reduce the exercise or strike price of any outstanding stock award, cancel any outstanding stock award in exchange for new stock awards, cash, or other consideration, or take any other action that is treated as a repricing under U.S. GAAP, with the consent of any adversely affected participant.

Terms of Awards

Subject to the terms of the Miragen 2008 Plan, the administrator determines the terms of all awards. The exercise price for stock options granted under the Miragen 2008 Plan may not be less than 100% of the fair market value of Miragen common stock on the grant date; however, the exercise price for an incentive stock option granted to a holder of more than 10% of Miragen's stock may not be less than 110% of such fair market value on the grant date. Options are generally transferable only by will or the laws of descent and distribution, and may be exercised during the holder's lifetime only by the holder.

The term of options granted under the Miragen 2008 Plan may not exceed ten years and will generally expire sooner if the optionee's service terminates. Options vest at the times determined by the administrator. Shares may be awarded under the terms of the Miragen 2008 Plan in consideration for services rendered to Private Miragen, or sold under the terms of the Miragen 2008 Plan. Shares awarded or sold under the Miragen 2008 Plan may be fully vested at grant or subject to special forfeiture conditions or rights of repurchase as determined by the administrator.

Changes in Capitalization

If any change is made in the shares of common stock by reason of any merger, consolidation, reorganization, recapitalization, stock dividend, split up, combination of shares, exchange of shares, change in corporate structure, or otherwise, appropriate adjustments will be made by the administrator to the class and maximum number of shares reserved for issuance under the Miragen 2008 Plan, the class and maximum number of shares that may be issued upon the exercise of ISOs and the class and number of shares and price per share of stock subject to each outstanding award under the Miragen 2008 Plan. Any increase in the shares, or the right to acquire shares, as the result of such an adjustment will be subject to the same terms and conditions that apply to the award for which such increase was received.

Corporate Transaction

In the event of certain specified significant corporate transactions, outstanding stock awards shall be assumed, continued, or substituted for similar stock awards by the surviving or acquiring corporation. If any surviving or acquiring corporation fails to assume, continue, or substitute such stock awards, stock awards held by participants whose continuous service has not terminated will accelerate vesting in full prior to the corporate transaction, and all stock awards will terminate at or prior to the corporate transaction. In addition, in the event a stock award will terminate if not exercised before a corporate transaction, our board of directors may, in its sole discretion, provide that the holder of the stock award may not exercise the stock award but will receive a payment equal to the excess, if any, of (i) the value of our common stock the holder would have received upon exercise of the stock awards, over (ii) any exercise price payable by the holder in connection with the exercise.

Under the Miragen 2008 Plan, a corporate transaction is generally the consummation of (i) a sale or other disposition of all or substantially all of our consolidated assets, (ii) a sale or other disposition of at least 90% of our outstanding securities, (iii) a merger, consolidation or similar transaction following which we are not the surviving corporation, or (iv) a merger, consolidation or similar transaction following which we are the surviving corporation but the shares of our common stock outstanding immediately prior to such transaction are converted or exchanged into other property by virtue of the transaction.

Change in Control

The Miragen 2008 Plan provides that if a change in control of us occurs and as of, or within thirteen (13) months after, the effective time of such change in control, the service of an award holder is terminated due to an involuntary termination without cause (not including death or disability), or due to a voluntary termination with good reason, then the vesting and exercisability of the holder's awards will be accelerated in full. In addition, the administrator may provide, in an individual award agreement or in any other written agreement between a participant and us, that the stock award will be subject to additional acceleration of vesting and exercisability in the event of a change in control.

Under the Miragen 2008 Plan, a change of control is generally (i) the acquisition by a person or entity of more than 50% of our combined voting power other than by merger, consolidation or similar transaction; (ii) a consummated merger, consolidation or similar transaction involving us immediately after which our stockholders cease to own more than 50% of the combined voting power of the surviving entity or of its parent entity; (iii) a consummated sale, lease or exclusive license or other disposition of all or substantially of our consolidated assets; or (v) when a majority of our board of directors becomes comprised of individuals who were not serving on the board on the date of adoption of the Miragen 2008 Plan, or whose nomination, appointment, or election was not approved by a majority of the incumbent board then still in office. The Merger did not constitute a change in control for purposes of the Miragen 2008 Plan, but the change in control provisions could be triggered by a subsequent transaction.

Amendment and Termination

Our board of directors may at any time amend the Miragen 2008 Plan. However, our board of directors must obtain approval of our stockholders or any amendment requiring such approval under federal tax or federal securities laws. In addition, our board of directors may not alter or impair any award previously granted under the Miragen 2008 Plan without the consent of the holder of such award. The Miragen 2008 Plan will terminate on the earliest of ten years after the date the Miragen 2008 Plan was adopted by Private Miragen's board of directors, ten years after the date Private Miragen's stockholder approved the Miragen 2008 Plan or a date determined by our board of directors.

2017 Director Compensation

Annual Compensation

Effective upon the closing of the Merger, we assumed a non-employee director cash and equity compensation policy. Under this policy, we compensate each of our non-employee directors for service on our board of directors and, if applicable, our audit committee, compensation committee, and nominating and corporate governance committee. Each of our non-employee directors will receive compensation for serving as the chairperson of our compensation committee, nominating and corporate governance committee, or audit committee, or serves as the non-executive chairperson. The compensation due to each non-employee director for service on our board of directors are as follows for fiscal year 2017:

	Member Annual Service (1)	Chairperson Annual Service (1) (2)
Board of directors	$ 35,000	$ —
Non-executive chairperson	30,000	N/A
Audit committee	7,500	15,000
Compensation committee	5,000	10,000
Nominating and corporate governance committee	3,750	7,500

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(1) Each non-employee director has the right to elect to receive all or a portion of annual cash compensation under the policy in the form of either cash, quarterly restricted common stock based on the closing price of our common stock on The Nasdaq Capital Market on the date of grant, or stock options to purchase common stock based on the Black-Scholes option-pricing model as of the date of grant. Any such election will be made before the start of the fiscal year or within thirty days of first becoming eligible to receive compensation under this policy and with any such stock options or restricted common stock elected by the directors to vest on a quarterly basis in arrears, with stock options to expire ten years from the date of grant.

(2) Chairpersons will not receive cash compensation for being a member of the applicable committee.

Equity Awards granted upon annual re-election to the Board of Directors

In addition to the compensation described above, each member of our board of directors will receive an automatic option grant to purchase 12,000 shares of our common stock (subject to adjustment for stock splits and similar matters) at each annual meeting once re-elected with an exercise price equal to the fair market value of a share of our common stock on such date. Each equity grant will vest in full on the earlier of the one-year anniversary of the date of grant or our next annual meeting.

Equity Awards granted upon appointment to the Board of Directors

Each new director elected or appointed to our board of directors will receive an initial equity grant of options to purchase 24,000 shares of our common stock (subject to adjustment for stock splits and similar matters) upon appointment or election with an exercise price equal to the fair market value of a share of our common stock on such date. Each option grant will vest in 36 equal monthly installments.

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

Security Ownership of Certain Beneficial Owners and Management

The following table sets forth certain information with respect to the beneficial ownership of our capital stock as of March 1, 2018 (except where otherwise indicated) for:

- each person, or group of affiliated persons, who are known by us to beneficially own more than 5% of the outstanding shares of our capital stock;
- each of our directors as of March 1, 2018;
- each of our named executive officers as of March 1, 2018; and
- all of our current directors and executive officers of as a group.

Applicable percentages are based on 30,172,086 shares outstanding on March 1, 2018, adjusted as required by rules promulgated by the SEC. Beneficial ownership is determined under SEC rules and includes sole or shared power to vote or dispose of shares of our common stock. The number and percentage of shares beneficially owned by a person or entity also include shares of common stock subject to stock options that are currently exercisable or become exercisable within 60 days of March 1, 2018. However, these shares are not deemed to be outstanding for the purpose of computing the percentage of shares beneficially owned of any other person or entity. Except as indicated in footnotes to the table below or, where applicable, to the extent authority is shared by spouses under community property laws, the beneficial owners named in the table have, to our knowledge, sole voting and dispositive power with respect to all shares of common stock shown to be beneficially owned by them based on information provided to us by such stockholders. Unless otherwise indicated, the address for each stockholder listed is: c/o Miragen Therapeutics, Inc., 6200 Lookout Road Boulder, Colorado 80301.

Name	Number of Shares Beneficially Owned		Percentage Ownership
5% or Greater Stockholders			
Entities affiliated with Atlas Venture VII, L.P.	4,493,670	(1)	14.9%
FMR, LLC	3,124,888	(2)	10.4%
Remeditex Ventures LLC	2,706,563	(3)	9.0%
Directors and Named Executive Officers			
Samuel D. Riccitelli	11,274	(4)	*
William S. Marshall, Ph.D.	656,437	(5)	2.2%
Adam S. Levy	120,094	(6)	*
Paul D. Rubin, M.D.	102,698	(7)	*
Bruce L. Booth, Ph.D.	4,502,944	(1)	14.9%
Christopher J. Bowden, M.D.	5,333	(8)	*
Jeffrey S. Hatfield	5,333	(9)	*
Thomas E. Hughes, Ph.D.	25,243	(10)	*
Kevin Koch, Ph.D.	14,624	(11)	*
Arlene M. Morris	2,000	(12)	*
Joseph L. Turner	9,333	(13)	*
All directors and officers as a group (11 persons)	5,582,066	(14)	18.5%

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* Represents beneficial ownership of less than 1% of class.

(1) Includes 3,142,580 shares of common stock held directly by Atlas Venture VII, L.P. (“Atlas Venture VII”) and 1,351,090 shares of common stock held directly by Atlas Venture Fund X, L.P. (“Atlas Venture X”). Atlas Venture Associates VII, L.P. (“AVA VII LP”) is the general partner of Atlas Venture VII, and Atlas Venture Associates VII,

Inc. (“AVA VII Inc.”) is the general partner of AVA VII LP. Atlas Venture Associates X, L.P. (“AVA X LP”) is the general partner of Atlas Venture X, and Atlas Venture Associates X, LLC (“AVA X LLC”) is the general partner of AVA X LP. Bruce L. Booth is a member of our Board and is a director AVA VII Inc. and a member of AVA X LLC. Dr. Booth also has dispositive and voting power over 9,274 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018, but has granted a pecuniary interest in such shares to an affiliate of Atlas Venture VII and Atlas Venture X. Since Dr. Booth is the sole party with dispositive and voting power over these shares of common stock, he is deemed the sole beneficial owner of such shares in the table above. The principal business address of (i) Atlas Venture VII is 25 First Street, Suite 303, Cambridge, MA 02141 and (ii) Atlas Venture X is 400 Technology Sq., 10th Floor, Cambridge, MA 02139.

(2) Based solely upon a Schedule 13G filed with the SEC on March 10, 2017. The address for FMR, LLC is 245 Summer Street, Boston, MA 02110.

(3) Based solely upon a Schedule 13G filed with the SEC on February 17, 2017. The principal business address of Remeditex is 2727 N. Harwood Street, Suite 200, Dallas, TX 75201.

(4) Mr. Riccitelli’s service to Miragen terminated in February 2017.

(5) Includes 266,896 shares of common stock and 389,541 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(6) Includes 11,790 shares of common stock and 108,304 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(7) Includes 102,698 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(8) Includes 5,333 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(9) Includes 5,333 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(10) Includes 2,827 shares of common stock and 22,416 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(11) Includes 14,624 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(12) Includes 2,000 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(13) Includes 9,333 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018.

(14) Includes 4,776,390 shares of common stock and 805,676 shares of common stock issuable upon exercise of options to purchase our common stock within 60 days of March 1, 2018 held by our current directors and executive officers, including William S. Marshall, Ph.D., Jason A. Leverone, Adam S. Levy, Paul D. Rubin, M.D., Bruce L. Booth, Ph.D., Christopher J. Bowden, M.D., Jeffrey S. Hatfield, Thomas E. Hughes, Ph.D., Kevin Koch, Ph.D., Arlene M. Morris and Joseph L. Turner, and their affiliates. Samuel D. Riccitelli and Tamara A. Seymour are not included among our directors and executive officers, as neither is a director or officer of our company as of March 1, 2018.

Securities Authorized for Issuance Under Equity Compensation Plans

As of December 31, 2017, we had two equity compensation plans in place under which shares of our common stock were authorized for issuance:

Plan Category	Number of securities to be issued upon exercise of outstanding options, warrants and rights		Weighted average exercise price of outstanding options, warrants and rights	Number of securities remaining available for future issuance under equity compensation plans (excluding securities reflected in first column)
Equity compensation plans approved by stockholders (1)	2,862,559	(2)	$ 4.85	742,058
Equity compensation plans not approved by stockholders	—		$ —	—
Total	2,862,559		$ 4.85	742,058

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(1) The 2016 Plan includes an "evergreen" feature, which provides that an additional number of shares will automatically be added to the shares reserved for issuance under the 2016 Plan on January 1st of each year, beginning on January 1, 2018 and ending on (and including) January 1, 2026. The number of shares added each calendar year will equal the lesser of: (i) 4% of the total number of shares of our common stock outstanding on December 31st of the preceding calendar year or (ii) a lesser number of shares determined by the board of directors.

(2) Represents outstanding options or warrants to purchase shares of common stock.

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS AND DIRECTOR INDEPENDENCE

Related-Person Transaction Policy and Procedures

In February 2017, we adopted a related person transaction policy that sets forth our procedures for the identification, review, consideration and approval or ratification of related person transactions. For purposes of our policy only, a related person transaction is a transaction, arrangement or relationship, or any series of similar transactions, arrangements, or relationships, in which we and any related person are, were or will be participants in which the amount involved exceeds the lesser of (x) $120,000 or (y) 1% of the average of our total assets at year end for the last two completed fiscal years. Transactions involving compensation for services provided to us as an employee or director are not covered by this policy. A related person is any executive officer, director, or beneficial owner of more than 5% of any class of our voting securities, including any of their immediate family members and any entity owned or controlled by such persons.

Under the policy, if a transaction has been identified as a related person transaction, including any transaction that was not a related person transaction when originally consummated or any transaction that was not initially identified as a related person transaction prior to consummation, our management must present information regarding the related person transaction to our audit committee, or, if audit committee approval would be inappropriate, to another independent body of our board of directors, for review, consideration and approval or ratification. The presentation must include a description of, among other things, the material facts, the interests, direct and indirect, of the related persons, the benefits to us of the transaction and whether the transaction is on terms that are comparable to the terms available to or from, as the case may be, an unrelated third party or to or from employees generally. Under the policy, we will collect information that we deem reasonably necessary from each director, executive officer and, to the extent feasible, significant stockholder to enable us to identify any existing or potential related-person transactions and to effectuate the terms of the policy. In addition, under our code of business conduct and ethics, our employees and directors will have an affirmative responsibility to disclose any transaction or relationship that reasonably could be expected to give rise to a conflict of interest. In considering related person transactions, our audit committee, or other independent body of our board of directors, will take into account the relevant available facts and circumstances including, but not limited to:

- the risks, costs, and benefits to us;
- the impact on a director's independence in the event that the related person is a director, immediate family member of a director or an entity with which a director is affiliated;

- the availability of other sources for comparable services or products; and

- the terms available to or from, as the case may be, unrelated third parties or to or from employees generally.

The policy requires that, in determining whether to approve, ratify or reject a related person transaction, our audit committee, or other independent body of our board of directors, must consider, in light of known circumstances, whether the transaction is in, or is not inconsistent with, our best interests and those of our stockholders, as our audit committee, or other independent body of our board of directors, determines in the good faith exercise of its discretion.

Certain Related-Person Transactions

Described below are the transactions and series of similar transactions since January 1, 2016 in which:

- the amounts involved exceeded or will exceed the lesser of (x) $120,000 or (y) 1% of the average of our total assets at year end for the last two completed fiscal years; and

- any of the directors, executive officers, holders of more than 5% of our capital stock (sometimes refer to as 5% stockholders below) or any member of their immediate family had or will have a direct or indirect material interest.

Public Offering of Common Stock

In February 2018, we entered into the Underwriting Agreement with the Underwriters relating to our Public Offering. Pursuant to the Underwriting Agreement, in February 2018 we sold 7,414,996 shares of common stock at a price of $5.50 per share, which resulted in net proceeds of approximately $37.9 million after deducting underwriting commissions and discounts and other offering expenses payable by us.

The table below sets forth the number of shares of our common stock purchased by and the purchase price for the shares of common stock for each purchaser that is a director, executive officer or 5% stockholder, and their affiliates.

Name of Purchaser	Shares of Common Stock	Purchase Price
Atlas Venture Fund X, L.P. (1)	545,454	$ 2,999,997
Adam Levy	9,090	$ 49,995

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(1) The Atlas Venture Funds, together, hold more than 5% of our outstanding capital stock. Dr. Booth is a member of our board of directors and a director of Atlas Venture Associates VII, Inc. and Atlas Venture Associates X, Inc., which are affiliated with the Atlas Venture Funds.

Amendment to the Bennet S. Lebow Promissory Note

In connection with our initial public offering in 2014, Bennett S. LeBow advanced $1,000,000 to us to pay for certain offering expenses. Following the offering, this amount, along with an additional $45,000, which was advanced to pay for certain additional offering expenses, was reclassified as amounts due to related party on our consolidated balance sheet. This aggregate amount was non-interest bearing and due on demand.

On March 6, 2015, we issued the Note to Mr. Lebow, who was then a member of our board of directors and our largest stockholder. When issued, the terms of the Note provided: (i) for a principal amount of $1,105,009, which accrued interest computed on the basis of the actual number of days elapsed in a 360-day year, at a rate per annum of 8%; (ii) that at any time on or after June 30, 2015, Mr. LeBow may demand payment of the entire outstanding principal of the Note and all unpaid interest accrued thereon; and (iii) that upon the occurrence and during the continuance of any event of default by Signal under the Note, the principal balance of the Note shall accrue interest at a rate of 11%.

On October 31, 2016, prior to the execution of the Merger Agreement, we entered into the Note Amendment with Mr. LeBow. The Note Amendment (i) made the outstanding principal balance and all accrued interest on the Note, plus a premium of 11% on the outstanding balance, automatically convertible into shares our common stock immediately prior to the effective time of the Merger at a conversion price of $5.39 per share, which was the closing price of our common stock on the effective date of the Note Amendment, and (ii) modified the principal amount of the Note to $1,045,000, the original amount advanced to us as

of June 17, 2014, and the interest of the Note to a rate per annum of 11% commencing on June 17, 2014, with interest computed on the basis of the actual number of days in a 360-day year. The terms of the Note Amendment were approved by our stockholders on February 10, 2017. Upon the closing of the Merger, the Note converted into 279,067 shares of our common stock.

Private Placement of Common Stock

On October 31 2016, Private Miragen entered into the Subscription Agreement with certain stockholders of Private Miragen and certain new investors pursuant to which the purchasers agreed to purchase an aggregate of 9,045,126 shares of Private Miragen's common stock at a price per share of $4.50, or 6,359,617 shares of common stock at a price per share of $6.40 as adjusted for the subsequent conversion as of the Merger Date, for an aggregate consideration of approximately $40.7 million immediately prior to the consummation of the Merger, subject to specified conditions in the Subscription Agreements. The table below sets forth the number of shares of Private Miragen's common stock agreed to be purchased and the purchase price for the shares of common stock for each purchaser that is a director, executive officer or 5% stockholder, and their affiliates. As a result of the Merger, these stockholders received 0.7031 shares of our common stock in exchange for each share of Private Miragen's common stock held immediately prior to the Merger, which is reflected in the table below.

Name of Purchaser	Shares of Common Stock PreMerger	Shares of Common Stock PostMerger	Purchase Price
Fidelity Select Portfolios: Biotechnology Portfolio (1)	3,507,819	2,466,347	$ 15,785,186
Fidelity Advisor Series VII: Fidelity Advisor Biotechnology Fund (1)	936,625	658,541	$ 4,214,813
Atlas Venture Fund X, L.P. (2)	1,145,835	805,636	$ 5,156,258
Boulder Ventures VI, L.P. (3)	147,419	103,650	$ 663,386
MRL Ventures Fund, LLC (4)	412,774	290,221	$ 1,857,483
JAFCO SV4 Investment Limited Partnership (5)	353,806	248,760	$ 1,592,127
Remeditex Ventures LLC (6)	797,308	560,587	$ 3,587,886
BraMira LLC (7)	1,111,111	781,222	$ 5,000,000

(1) Fidelity Select Portfolios: Biotechnology Portfolio and Fidelity Advisor Series VII: Fidelity Advisor Biotechnology Fund, together, held more than 5% of our outstanding capital stock.

(2) The Atlas Venture Funds, together, hold more than 5% of our outstanding capital stock. Dr. Booth is a member of our board of directors and a director of Atlas Venture Associates VII, Inc. and Atlas Venture Associates X, Inc., which are affiliated with the Atlas Venture Funds.

(3) Boulder Ventures held more than 5% of our outstanding capital stock. At the time of this transaction, Mr. Lefkoff was a member of our board of directors and a managing member of BV Partners V, L.L.C. and BV Partners VI, L.L.C., which are each affiliated with Boulder Ventures.

(4) MRL Ventures Fund, LLC holds more than 5% of our outstanding capital stock.

(5) JAFCO SV4 Investment Limited Partnership, or JAFCO, holds more than 5% of our outstanding capital stock.

(6) Remeditex Ventures LLC holds more than 5% of our outstanding capital stock. At the time of the transaction, Mr. Creecy was a member of our board of directors and the chief executive officer of Remeditex Ventures LLC.

(7) BraMira LLC, together with its affiliates, holds more than 5% of our outstanding capital stock.

Issuance of Series C Convertible Preferred Stock

In October 2015 and September 2016, Private Miragen issued and sold in two closings an aggregate of 9,268,563 shares of Private Miragen's Series C convertible preferred stock at a price per share of $4.43 for an aggregate consideration of approximately $41.1 million, inclusive of the conversion, at a price per share equal to $4.43, of approximately $8.9 million of principal and accrued interest on then outstanding convertible promissory notes previously issued by Private Miragen. The table below sets forth the number of shares of Series C convertible preferred stock purchased and the purchase price for the shares of Series C convertible preferred stock for each purchaser that is a director, executive officer or 5% stockholder, and their affiliates. Immediately prior to the closing of the Merger each outstanding share of Private Miragen's Series C convertible preferred stock converted into one share of Private Miragen's common stock. As a result of the Merger, these stockholders received 0.7031 shares of our common stock in exchange for each share of Private Miragen's common stock held immediately prior to the Merger, as presented in the table below.

Name of Purchaser	Shares of Series C Convertible Preferred Stock PreMerger	Shares of Common Stock PostMerger	Purchase Price
Atlas Venture Fund VII, L.P. (1)	1,245,502	875,712	$ 5,517,574
Boulder Ventures V, L.P. (2)	233,089	163,884	$ 1,032,584
Boulder Ventures VI, L.P. (2)	564,334	396,783	$ 2,500,000
MRL Ventures Fund, LLC (3)	1,580,135	1,110,992	$ 6,999,998
JAFCO SV4 Investment Limited Partnership (4)	1,354,402	952,280	$ 6,000,001
Remeditex Ventures LLC (5)	1,968,830	1,384,284	$ 8,721,917
BraMira LLC (6)	1,128,668	793,566	$ 4,999,999
William S. Marshall, Ph.D. (7)	17,263	12,137	$ 76,475

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(1) Atlas Venture Fund VII, L.P. holds more than 5% of our outstanding capital stock. Dr. Booth is a member of our board of directors and a director of Atlas Venture Associates VII, Inc., which is affiliated with the Atlas Venture Fund VII, L.P.

(2) Boulder Ventures held more than 5% of our outstanding capital stock. At the time of the transaction, Mr. Lefkoff was a member of our board of directors and a managing member of BV Partners V, L.L.C. and BV Partners VI, L.L.C., which are each affiliated with Boulder Ventures.

(3) MRL Ventures Fund, LLC holds more than 5% of our outstanding capital stock.

(4) JAFCO holds more than 5% of our outstanding capital stock.

(5) Remeditex Ventures LLC holds more than 5% of our outstanding capital stock. At the time of the transaction, Mr. Creecy was a member of our board of directors and the chief executive officer of Remeditex Ventures LLC.

(6) BraMira LLC, together with its affiliates, holds more than 5% of our outstanding capital stock.

(7) Dr. Marshall is a member of our board of directors and serves as our president and chief executive officer.

Director and Officer Indemnification and Insurance

We have entered into indemnification agreements with each of our executive officers and directors and purchased directors' and officers' liability insurance. Our indemnification agreements and bylaws require us to indemnify our directors and officers to the fullest extent permitted under Delaware law.

Director Independence

Nasdaq's listing standards require that our board of directors consist of a majority of independent directors, as determined under the applicable rules and regulations of Nasdaq. Based upon information requested from and provided by each director concerning his or her background, employment, and affiliations, including family relationships, other than Dr. Marshall by virtue of his position as our chief executive officer, our board of directors believes that Drs. Booth, Bowden, Hughes, and Koch and Messrs. Hatfield, and Turner, and Ms. Morris each qualify as an independent director.

ITEM 14. PRINCIPAL ACCOUNTING FEES AND SERVICES

Current Independent Registered Public Accounting Firm Fees

The following table sets forth the fees for professional services rendered by KPMG LLP, our independent registered public accounting firm, in connection with the audits of our annual financial statements (including the financial statements of Private Miragen) for the years ended December 31, 2017 and 2016 and for other services rendered by KPMG LLP during those periods.

	Year Ended	
	December 31, 2017	December 31, 2016
	(in thousands)	
Audit fees (1)	$ 300	$ 279
Audit-related fees (2)	—	—
Tax fees (3)	—	—
All other fees (4)	—	—
Total fees	$ 300	$ 279

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(1) Audit fees consist of fees billed for professional services for audit and quarterly review of our financial statements and review of our registration statement for the Merger, and related services that are normally provided in connection with statutory and regulatory filings or engagements.
(2) Audit-related fees include services relating to accounting consultations and reviews and due diligence services.
(3) Tax fees include services relating to tax compliance, tax advice, and tax planning in the United States.
(4) All other fees include the aggregate of the fees billed for products and services provided by the principal accountant other than the products and services disclosed as audit fees, audit-related fees, and tax fees.

All fees described above were pre-approved by our audit committee.

Other Auditors

The following table presents the fees for professional services earned by BDO USA, LLP, or BDO, for services rendered for the year ended December 31, 2017, and for services rendered our independent registered public accounting firm for the year ended December 31, 2016:

	Year Ended	
	December 31, 2017	December 31, 2016
	(in thousands)	
Audit fees (1)	$ 56	$ 205
Audit-related fees (2)	—	—
Tax fees (3)	—	—
All other fees (4)	—	—
Total fees	$ 56	$ 205

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(1) Audit fees consist of fees billed for professional services for audit and quarterly review of our financial statements and review of our registration statement for the Merger, and related services that are normally provided in connection with statutory and regulatory filings or engagements.
(2) Audit-related fees include services relating to accounting consultations and reviews and due diligence services.
(3) Tax fees include services relating to tax compliance, tax advice, and tax planning in the United States.
(4) All other fees include the aggregate of the fees billed for products and services provided by the principal accountant other than the products and services disclosed as audit fees, audit-related fees, and tax fees.

BDO served as the independent registered public accounting firm for the audit of the financial statements for Miragen Therapeutics, Inc. (formerly Signal Genetics, Inc.), for the years ended December 31, 2016 and 2015 through the closing of the Merger. On February 13, 2017, following the closing of the Merger, the audit committee approved the dismissal of BDO.

The reports of BDO on the financial statements of Signal Genetics, Inc., for each of the two years ended December 31, 2016 and 2015, did not contain an adverse opinion or a disclaimer of opinion, nor were they qualified or modified as to uncertainty, audit scope or accounting principles.

All fees described above were pre-approved by our audit committee.

Pre-Approval Policies and Procedures

BDO served as our independent registered public accounting firm for the year ended December 31, 2016 and has served in that capacity since July 15, 2013. The decision to engage BDO as our independent registered public accounting firm for the year ended December 31, 2016 was approved by our audit committee. On February 13, 2017, our audit committee approved the appointment of KPMG LLP as our independent registered public accounting firm to audit our financial statements for the year ended December 31, 2017, in place of BDO.

Our audit committee considered the independence of BDO and KPMG LLP, as applicable, and whether the audit and non-audit services each provided to us are compatible with maintaining that independence. Our audit committee has adopted a set of policies governing the provision of non-audit services by our independent registered public accounting firm. Our audit committee has adopted procedures by which our audit committee must approve in advance all services provided by and fees paid to our independent registered public accounting firm. The advance approval requirement was not waived in any instance during the past year.

Change in Independent Registered Public Accounting Firm

On February 13, 2017, our audit committee approved the appointment of KPMG LLP as our independent registered public accounting firm to audit our financial statements for the year ended December 31, 2017, in place of BDO. The decision to change our accounting firm was authorized by our audit committee. On March 24, 2017, following completion of our audit for the fiscal year ended December 31, 2016, our audit committee approved the dismissal of BDO as our independent registered public accounting firm, effective immediately.

The reports of BDO on the Company's financial statements for each of the years ended December 31, 2016, and December 31, 2015, did not contain an adverse opinion or a disclaimer of opinion, nor were they qualified or modified as to uncertainty, audit scope or accounting principles.

In connection with the audits of our financial statements for the years ended December 31, 2016 and 2015, and the subsequent interim periods through March 24, 2017, there were no (i) "disagreements" (as that term is defined in Item 304(a)(1)(iv) of Regulation S-K and related instructions) between the company and BDO on any matter of accounting principles or practices, financial statement disclosure or auditing scope or procedures which, if not resolved to the satisfaction of BDO, would have caused BDO to make reference to the subject matter of the disagreement in their reports, or (ii) "reportable events" (as that term is defined in Item 304(a)(1)(v) of Regulation S-K). BDO's letter to the SEC stating its agreement with the statements in this paragraph was filed as an exhibit to the company's current report on Form 8-K dated March 30, 2017.

During our fiscal year ended December 31, 2016, and the subsequent interim period through March 24, 2017, we nor anyone on our behalf consulted with KPMG LLP regarding either (i) the application of accounting principles to a specific transaction, completed or proposed, or the type of audit opinion that might be rendered on our financial statements, and neither a written report nor oral advice was provided to us that KPMG LLP concluded was an important factor considered by us in reaching a decision as to any accounting, auditing or financial reporting issue or (ii) any matter that was either the subject of a disagreement (as defined in Item 304(a)(1)(iv) of Regulation S-K and the related instructions) or a reportable event (as described in Item 304(a)(1)(v) of Regulation S-K).

We have furnished the foregoing disclosure to BDO and KPMG LLP.

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES

(a)(1) Financial Statements

The financial statements required by this item are submitted in a separate section beginning on page F-1 of this annual report.

(a)(2) Financial Statement Schedules

Financial statement schedules have been omitted because they are either not required, not applicable, or the information is otherwise included.

(a)(3) Exhibits

See Exhibit Index, which is incorporated herein by reference.

ITEM 16. FORM 10-K SUMMARY

None.

EXHIBIT INDEX

The exhibits listed in the Exhibit Index are required by Item 601 of Regulation S-K. Each management contract or compensatory plan or arrangement required to be filed as an exhibit to this Annual Report has been identified. The SEC file number for all items incorporated by reference herein from reports on Forms 10-K, 10-Q, and 8-K is 001-36483.

		Incorporated by Reference			
Exhibit Number	**Description of Exhibit**	**Form**	**Filing Date**	**Number**	**Filed Herewith**
2.1^	Agreement and Plan of Merger, dated as of October 31, 2016, by and among Registrant, Signal Merger Sub, Inc. and Private Miragen.	8-K	11/01/2016	2.1	
2.2^	Subscription Agreement, dated as of October 31, 2016, by and among Private Miragen and each purchaser listed on Annex A thereto.	S-4	12/02/2016	2.4	
2.3^	Intellectual Property Purchase Agreement, dated as of November 29, 2016 by and between Registrant and Quest Diagnostics Investments LLC.	S-4	12/02/2016	2.5	
3.1	Certificate of Incorporation of the Registrant.	10-Q	08/14/2014	3.1	
3.2	Certificate of Amendment of Certificate of Incorporation of the Registrant.	S-4	12/02/2016	3.3	
3.3	Certificate of Amendment of Certificate of Incorporation of the Registrant.	8-K	02/13/2017	3.1	
3.4	Certificate of Amendment of Certificate of Incorporation of the Registrant.	8-K	02/13/2017	3.2	
3.5	Amended and Restated Bylaws of the Registrant.	10-Q	08/15/2016	3.1	
3.6	Amendment to the Amended and Restated Bylaws of the Registrant.	8-K	02/13/2017	3.3	
3.7	Certificate of Ownership and Merger of the Registrant.	8-K	02/13/2017	3.4	
4.1	Specimen Common Stock Certificate.	S-1	03/19/2014	4.1	
4.2	Warrant to Purchase Stock between Miragen Therapeutics, Inc. and Silicon Valley Bank, dated April 30, 2015.	10-K	03/15/2018	4.2	•
4.3	Warrant to Purchase Stock between Miragen Therapeutics, Inc. and Silicon Valley Bank, dated November 14, 2017.	8-K	11/15/2017	10.2	
10.1	Form of Indemnification Agreement between Registrant and each of its directors and executive officers.	S-1	03/19/2014	10.14	
10.1.1*	Form of Indemnity Agreement between the Registrant and each of its directors and executive officers.	S-4	12/02/2016	10.32	
10.2*	Form of 2016 Equity Incentive Plan.	S-4	12/02/2016	10.37	
10.2.1*	Form of Stock Option Grant Notice and Stock Option Agreement under 2016 Equity Incentive Plan.	S-4	12/02/2016	10.38	
10.2.2*	Form of Restricted Stock Award Agreement under the 2016 Equity Incentive Plan.	10-Q	05/11/2017	10.12	
10.3*	Form of 2008 Equity Incentive Plan.	S-4	12/02/2016	10.48	
10.3.1*	Form of Stock Option Grant Notice and Stock Option Agreement under the Registrant 2008 Equity Incentive Plan.	S-4	12/02/2016	10.49	
10.4*	2016 Employee Stock Purchase Plan (incorporated by reference to Exhibit 10.39 to the Registrant's Registration Statement on S-4 (File No. 333-214893), as filed with the SEC on December 2, 2016).	S-4	12/02/2016	10.39	
10.5*	Amended and Restated Non-Employee Director Compensation Policy.	10-Q	05/11/2017	10.13	

10.6*	Amended and Restated Employment Agreement, dated June 17, 2014, by and between Registrant and Samuel D. Riccitelli.	10-Q	08/14/2014	10.4
10.6.1*	Amendment to Amended and Restated Employment Agreement, dated July 23, 2014, by and between Registrant and Samuel D. Riccitelli.	8-K	07/23/2014	10.2
10.7*	Employment Agreement, dated August 4, 2014, by and between Registrant and Tamara A. Seymour.	8-K	07/23/2014	10.1
10.8*	Employment Agreement by and between the Registrant and William S. Marshall, Ph.D., dated as of December 2, 2016.	S-4	12/02/2016	10.33
10.9*	Employment Agreement by and between the Registrant and Jason A. Leverone, dated as of December 2, 2016.	S-4	12/02/2016	10.34
10.10*	Employment Agreement by and between the Registrant and Adam S. Levy, dated as of December 2, 2016.	S-4	12/02/2016	10.35
10.11*	Employment Agreement by and between the Registrant and Paul D. Rubin, M.D., dated as of December 2, 2016.	S-4	12/02/2016	10.36
10.12	Lease by and between Registrant and Crestview, LLC, dated as of December 16, 2010.	S-4	12/02/2016	10.40
10.12.1	First Addendum to Lease by and between Registrant and Crestview, LLC, dated as of February 18, 2015.	S-4	12/02/2016	10.40.1
10.12.2	Second Addendum to Lease by and between Registrant and Crestview, LLC, dated as of October 23, 2015.	S-4	12/02/2016	10.40.2
10.13†	Exclusive Patent License Agreement, dated as of April 16, 2008, by and between Registrant and Board of Regents of The University of Texas System.	S-4	12/02/2016	10.41
10.14†	Exclusive Patent License Agreement, dated as of April 16, 2008, by and between Registrant and Board of Regents of The University of Texas System.	S-4	12/02/2016	10.42
10.15†	License and Collaboration Agreement, dated as of October 20, 2010, by and between Registrant and T2Cure GmbH.	S-4	12/02/2016	10.43
10.15.1	Amendment No. 1 to License and Collaboration Agreement, dated as of July 8, 2014, by and between Registrant and T2cure GmbH.	S-4	12/02/2016	10.43.1
10.16†	Amended and Restated License Agreement, dated as of December 31, 2012, by and between Registrant and Santaris Pharma A/S.	S-4	12/02/2016	10.44
10.17†	License and Collaboration Agreement, dated as of October 12, 2011, by and between Registrant and Les Laboratoires Servier, on the first part, and Institut de Recherches Servier, on the second part.	S-4	12/02/2016	10.45
10.17.1†	First Amendment of the License and Collaboration Agreement, effective as of May 13, 2013, by and between Registrant and Les Laboratoires Servier, on the first part, and Institut de Recherches Servier, on the second part.	S-4	12/02/2016	10.45.1
10.17.2†	Second Amendment of the License and Collaboration Agreement, effective as of April 10, 2014, by and between Registrant and Les Laboratoires Servier, on the first part, and Institut de Recherches Servier, on the second part.	S-4	12/02/2016	10.45.2
10.17.3†	Third Amendment of the License and Collaboration Agreement, effective as of May 28, 2015, by and between Registrant and Les Laboratoires Servier, on the first part, and Institut de Recherches Servier, on the second part.	S-4	12/02/2016	10.45.3

10.17.4	Fourth Amendment of the License and Collaboration Agreement, effective as of September 22, 2016, by and between Registrant and Les Laboratoires Servier, on the first part, and Institut de Recherches Servier, on the second part.	S-4	12/02/2016	10.45.4	
10.17.5†	Fifth Amendment of the License and Collaboration Agreement, effective as May 2, 2017, by and between Registrant and Les Laboratoires Servier, on the first part, and Institut de Recherches Servier, on the second part.	10-Q	08/11/2017	10.1	
10.17.6†	Sixth Amendment of the License and Collaboration Agreement, effective as September 27, 2017, by and between Registrant and Les Laboratoires Servier, on the first part, and Institut de Recherches Servier, on the second part.	10-Q	11/09/2017	10.1	
10.18†	Exclusive Patent License Agreement, dated as of May 10, 2016, by and between Registrant and The Brigham and Women's Hospital, Inc.	S-4	12/02/2016	10.46	
10.19†	Research Subaward Agreement, dated as of October 1, 2016, by and between Registrant and Yale University, as amended.	S-4	12/02/2016	10.51	
10.19.1†	Amendment to Research Subaward Agreement, effective as of October 27, 2016, by and between Registrant and Yale University.	10-Q/A	06/07/2017	10.14	
10.19.2†	Amendment to Research Subaward Agreement, effective as of July 1, 2017, by and between Registrant and Yale University.	10-Q	11/09/2017	10.2	
10.20	Loan and Security Agreement, dated as of April 30, 2015, by and between the Registrant and Silicon Valley Bank.	S-4	12/02/2016	10.47	
10.20.1	First Loan Modification Agreement, dated as of December 22, 2016, by and between the Registrant and Silicon Valley Bank.	S-4	01/04/2017	10.47.1	
10.21	Amended and Restated Loan and Security Agreement between Miragen Therapeutics, Inc. and Silicon Valley Bank, dated November 14, 2017.	8-K	11/15/2017	10.1	
10.22	Common Stock Sales Agreement, dated March 31, 2017, by and between the Registrant and Cowen and Company, LLC.	8-K	03/31/2017	10.1	
21.1	Subsidiaries of the Registrant.	10-K	03/15/2018	21.1	•
23.1	Consent of Independent Registered Public Accounting Firm.	10-K	03/15/2018	23.1	•
24.1	Power of Attorney (included on signature page hereto).	10-K	03/15/2018	24.1	•
31.1	Certification of Principal Executive Officer pursuant to Rule13a-14(a) and Rule 15d-14(a) of the Securities and Exchange Act, as amended.	10-K	03/15/2018	31.1	•
31.2	Certification of Principal Financial Officer pursuant to Rule13a-14(a) and Rule 15d-14(a) of the Securities and Exchange Act, as amended.	10-K	03/15/2018	31.2	•
32.1**	Certification of Principal Executive Officer and Principal Financial Officer pursuant to 18 U.S.C. 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002. (1)	10-K	03/15/2018	32.1	•
101.INS***	XBRL Instance Document	10-K	03/15/2018		•
101.SCH***	XBRL Taxonomy Extension Schema Document	10-K	03/15/2018		•
101.CAL***	XBRL Taxonomy Extension Calculation Linkbase Document	10-K	03/15/2018		•
101.DEF***	XBRL Taxonomy Extension Definition Linkbase Document	10-K	03/15/2018		•
101.LAB***	XBRL Taxonomy Extension Label Linkbase Document	10-K	03/15/2018		•

101.PRE***	XBRL Taxonomy Extension Presentation Linkbase Document	10-K	03/15/2018	•

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

† Confidential treatment granted as to portions of the exhibit. Confidential materials omitted and filed separately with the SEC.

* Management contract or compensatory plans or arrangements.

** This certification is being furnished pursuant to 18 U.S.C. Section 1350, and is not being filed for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, and is not to be incorporated by reference into any filing of the Registrant, whether made before or after the date hereof.

*** In accordance with Rule 406T of Regulation S-T, the Interactive Data Files in Exhibit 101 are deemed not filed or part of a registration statement or prospectus for purposes of Sections 11 or 12 of the Securities Act of 1933, as amended, are deemed not filed for purposes of Section 18 of the Exchange Act of 1934, as amended, and otherwise are not subject to liability under these sections.

SIGNATURES

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

MIRAGEN THERAPEUTICS, INC.

Date: March 15, 2018

By: /s/ William S. Marshall
William S. Marshall, Ph.D.
Chief Executive Officer
(Principal Executive Officer)

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints William S. Marshall and Jason A. Leverone, and each of them, as his attorneys-in-fact, with the power of substitution, for him in any and all capacities, to sign any amendments to this Annual Report, and to file the same, with exhibits thereto and other documents in connection therewith with the Securities and Exchange Commission, hereby ratifying and confirming all that said attorneys-in-fact, and each of them, or his substitute or substitutes may do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Exchange Act of l934, this Annual 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
/s/ William S. Marshall, Ph.D. **William S Marshall, Ph.D.**	Chief Executive Officer and Director (Principal Executive Officer)	March 15, 2018
/s/ Jason A. Leverone **Jason A. Leverone**	Chief Financial Officer, Treasurer, and Secretary (Principal Financial Officer; Principal Accounting Officer)	March 15, 2018
/s/ Bruce L. Booth, Ph.D. **Bruce L. Booth, Ph.D.**	Chairman of the Board	March 15, 2018
/s/ Christopher Bowden, M.D. **Christopher Bowden, M.D.**	Director	March 15, 2018
/s/ Jeffrey S. Hatfield **Jeffrey S. Hatfield**	Director	March 15, 2018
/s/ Thomas E. Hughes, Ph.D. **Thomas E. Hughes, Ph.D.**	Director	March 15, 2018
/s/ Kevin Koch, Ph.D. **Kevin Koch, Ph.D.**	Director	March 15, 2018
/s/ Joseph L. Turner **Joseph L. Turner**	Director	March 15, 2018
/s/ Arlene M. Morris **Arlene M. Morris**	Director	March 15, 2018

MIRAGEN THERAPEUTICS, INC.
INDEX TO CONSOLIDATED FINANCIAL STATEMENTS

Report of Independent Registered Public Accounting Firm

To the Stockholders and Board of Directors
Miragen Therapeutics, Inc.:

Opinion on the Consolidated Financial Statements

We have audited the accompanying consolidated balance sheets of Miragen Therapeutics, Inc. (and subsidiary) (the Company) as of December 31, 2017 and 2016, the related consolidated statements of operations, changes in preferred stock and stockholders' equity (deficit), and cash flows for the years then ended, and the related notes (collectively, the consolidated financial statements). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2017 and 2016, and the results of its operations and its cash flows for the years then ended, in conformity with U.S. generally accepted accounting principles.

Basis for Opinion

These consolidated financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these consolidated financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the consolidated financial statements are free of material misstatement, whether due to error or fraud. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits, we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion.

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

/s/ KPMG LLP

We have served as the Company's auditor since 2009.

Denver, Colorado
March 15, 2018

MIRAGEN THERAPEUTICS, INC.
CONSOLIDATED BALANCE SHEETS
(in thousands, except share and per share data)

	December 31,	
	2017	**2016**
Assets		
Current assets:		
Cash and cash equivalents	$ 47,441	$ 22,104
Accounts receivable	1,456	20
Prepaid expenses and other current assets	2,971	1,753
Total current assets	51,868	23,877
Property and equipment, net	563	625
Other assets	50	258
Total assets	$ 52,481	$ 24,760
Liabilities, Preferred Stock, and Stockholders' Equity (Deficit)		
Current liabilities:		
Accounts payable	$ 906	$ 1,007
Accrued liabilities	2,991	3,909
Current portion of notes payable	—	1,969
Total current liabilities	3,897	6,885
Notes payable, less current portion	9,922	2,820
Other liabilities	152	—
Total liabilities	13,971	9,705
Commitments and contingencies		
Series A redeemable convertible preferred stock, $0.001 par value; 7,169,176 shares authorized; 7,149,176 shares issued and outstanding and liquidation preference of $21,448 at December 31, 2016	—	23,124
Series B redeemable convertible preferred stock, $0.001 par value; 2,183,318 shares authorized; 2,166,651 shares issued and outstanding and liquidation preference of $13,000 at December 31, 2016; stated at accreted redemption value	—	12,975
Series C redeemable convertible preferred stock, $0.001 par value; 9,303,000 shares authorized; 9,268,563 shares issued and outstanding and liquidation preference of $41,060 at December 31, 2016; stated at accreted redemption value	—	40,877
Stockholders' equity (deficit):		
Common stock, $0.01 par value; 100,000,000 shares authorized; 22,568,006 and 833,744 shares issued and outstanding at December 31, 2017 and December 31, 2016, respectively	226	8
Additional paid-in capital	131,877	5,147
Accumulated deficit	(93,593)	(67,076)
Total stockholders' equity (deficit)	38,510	(61,921)
Total liabilities, preferred stock, and stockholders' equity (deficit)	$ 52,481	$ 24,760

See accompanying notes to these consolidated financial statements.

MIRAGEN THERAPEUTICS, INC.
CONSOLIDATED STATEMENTS OF OPERATIONS
(in thousands, except share and per share data)

	Year Ended December 31,	
	2017	**2016**
Revenue:		
Collaboration revenue	$ 3,097	$ 2,814
Grant revenue	906	663
Total revenue	4,003	3,477
Operating expenses:		
Research and development	19,623	13,692
General and administrative	10,912	6,772
Total operating expenses	30,535	20,464
Loss from operations	(26,532)	(16,987)
Other income (expense):		
Interest and other income	403	39
Interest and other expense	(383)	(326)
Net loss	(26,512)	(17,274)
Accretion of redeemable convertible preferred stock to redemption value	(5)	(49)
Net loss available to common stockholders	$ (26,517)	$ (17,323)
Net loss per share, basic and diluted	$ (1.38)	$ (28.21)
Weighted-average shares used to compute basic and diluted net loss per share	19,244,605	614,017

See accompanying notes to these consolidated financial statements.

MIRAGEN THERAPEUTICS, INC
CONSOLIDATED STATEMENTS OF CHANGES IN PREFERRED STOCK
AND STOCKHOLDERS' EQUITY (DEFICIT)
(in thousands, except share data)

	Redeemable Convertible Preferred Stock		Common Stock		Additional Paid-in Capital	Accumulated Deficit	Total Stockholders' Equity (Deficit)
	Shares	Amount	Shares	Amount			
Balance at December 31, 2015	14,952,053	$ 60,850	601,667	$ 6	$ 4,457	$ (49,753)	$ (45,290)
Issuance of Series C redeemable convertible preferred stock	3,632,337	16,077	—	—	—	—	—
Issuance of common stock under subscription agreement	—	—	49,374	—	281	—	281
Exercises of stock options	—	—	182,703	2	211	—	213
Share-based compensation expense	—	—	—	—	198	—	198
Accretion of preferred stock to current redemption value	—	49	—	—	—	(49)	(49)
Net loss	—	—	—	—	—	(17,274)	(17,274)
Balance at December 31, 2016	18,584,390	76,976	833,744	8	5,147	(67,076)	(61,921)
Issuance of common stock, net of issuance cost; private financing	—	—	6,359,628	64	39,092	—	39,156
Issuance of common stock, net of issuance cost; at the market	—	—	840,534	8	7,595	—	7,603
Accretion of redeemable convertible preferred stock to redemption value	—	5	—	—	—	(5)	(5)
Conversion of preferred stock to common stock	(18,584,390)	(76,981)	13,066,666	131	76,850	—	76,981
Issuance of common stock upon reverse merger	—	—	1,024,960	10	194	—	204
Reclassification of warrant liability to equity	—	—	—	—	51	—	51
Issuance of common stock upon cashless exercise of warrant	—	—	16,387	—	—	—	—
Exercises of stock options and issuance of restricted stock awards	—	—	412,894	5	302	—	307
Issuance of common stock for cash under employee stock purchase plan	—	—	13,193	—	110	—	110
Issuance of warrant classified as equity	—	—	—	—	127		127
Share-based compensation expense	—	—	—	—	2,409	—	2,409
Net loss	—	—	—	—	—	(26,512)	(26,512)
Balance at December 31, 2017	—	$ —	22,568,006	$ 226	$ 131,877	$ (93,593)	$ 38,510

See accompanying notes to these consolidated financial statements.

MIRAGEN THERAPEUTICS, INC.
CONSOLIDATED STATEMENTS OF CASH FLOWS
(in thousands)

	Year Ended December 31,	
	2017	**2016**
Cash flows from operating activities:		
Net loss	$ (26,512)	$ (17,274)
Adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization	308	341
Issuance of common stock under subscription agreement	—	281
Share-based compensation expense	2,409	198
Non-cash interest expense	94	158
Change in fair value of preferred stock warrants	—	3
Changes in operating assets and liabilities:		
Accounts receivable	(1,436)	(20)
Prepaid expenses and other assets	(724)	(426)
Deferred revenue	—	(519)
Accounts payable	(101)	292
Accrued and other liabilities	(2,205)	2,211
Net cash used in operating activities	(28,167)	(14,755)
Cash flows from investing activities:		
Cash acquired in reverse merger	1,280	—
Purchases of property and equipment	(246)	(250)
Purchases of short-term investments	—	(1,000)
Maturity of short-term investments	—	1,000
Net cash provided by (used in) investing activities	1,034	(250)
Cash flows from financing activities:		
Proceeds from the sale of common stock - private financing	40,703	—
Payment of issuance costs associated with the sale of common stock - private financing	(1,216)	—
Proceeds from the sale of common stock - at the market	7,862	—
Payment of issuance costs associated with the sale of common stock - at the market	(330)	—
Payment of issuance costs associated with the shelf registration	(299)	—
Proceeds from issuance of notes payable	10,000	—
Payments of principal on notes payable	(4,667)	(333)
Proceeds from the exercise of stock options	307	213
Proceeds from stock purchases under employee stock purchase plan	110	—
Proceeds from issuance of redeemable convertible preferred stock	—	16,091
Payment of redeemable convertible preferred stock issuance costs		(91)
Payment of notes payable issuance costs	—	(6)
Net cash provided by financing activities	52,470	15,874
Net increase in cash and cash equivalents	25,337	869
Cash and cash equivalents at beginning of period	22,104	21,235
Cash and cash equivalents at end of period	$ 47,441	$ 22,104
Supplemental disclosure of cash flow information		
Interest paid	$ 446	$ 164
Supplemental disclosure of non-cash investing and financing activities		
Conversion of preferred stock to common stock	$ 76,981	$ —
Liabilities assumed, net of non-cash assets received in reverse merger	$ 1,076	$ —

Transfer of common stock issuance costs from prepaid expenses and other current assets to equity (private financing and at the market sales)	$ 331	$ —
Transfer of common stock issuance costs from prepaid expenses and other current assets to equity (At the market / shelf costs)	$ 23	$ —
Issuance of warrant classified as equity	$ 127	$ —
Reclassification of preferred stock warrant (accrued liability) to common stock warrant (equity)	$ 51	$ —
Accretion of redeemable convertible preferred stock to redemption value	$ 5	$ 49

See accompanying notes to these consolidated financial statements.

MIRAGEN THERAPEUTICS, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

1. DESCRIPTION OF BUSINESS

Miragen Therapeutics, Inc., a Delaware corporation (the "Company" or "Miragen"), is a clinical-stage biopharmaceutical company discovering and developing proprietary RNA-targeted therapies and their role in certain diseases where there is a high unmet medical need. microRNAs are short RNA molecules, or oligonucleotides, that regulate gene expression and play vital roles in influencing the pathways responsible for many disease processes. A leader in microRNA therapeutics discovery and development, the Company has advanced two product candidates, cobomarsen, also known as MRG-106, and MRG-201, into clinical development. The Company is also developing MRG-110 under a license and collaboration agreement (the "Servier Collaboration Agreement") with Les Laboratoires Servier and Institut de Recherches Servier (collectively, "Servier").

Cobomarsen is an inhibitor of microRNA-155 ("miR-155"), which is found at abnormally high levels in malignant cells of several blood cancers, as well as certain cells involved in inflammation. In the Company's Phase 1 clinical trial of cobomarsen in CTCL, 90% of patients treated systemically demonstrated improvement in modified Severity Weighted Assessment Tool ("mSWAT") score, which is a measurement of the severity of skin disease over a patient's entire body.

MRG-201 is a replacement for microRNA-29 ("miR-29"), which is found at abnormally low levels in a number of pathological fibrotic conditions, including cutaneous, cardiac, renal, hepatic, pulmonary, and ocular fibrosis, as well as in systemic sclerosis. In a Phase 1 clinical trial of MRG-201, the Company observed a statistically-significant reduction in fibroplasia, or scar tissue deposition, with no adverse effects on incisional wound healing when MRG-201 was given.

MRG-110 is an inhibitor of microRNA-92 ("miR-92"), a microRNA that is expressed in endothelial cells and has been shown to accelerate the formation of new blood vessels in preclinical models of heart failure, peripheral ischemia, and dermal wounding. The compound is being developed for use in various indications in which enhanced vascular density is expected to provide clinical benefit. The Company retains all commercial rights to MRG-110 in the United States and Japan, and Servier has commercial rights in the rest of the world.

In addition to these programs, the Company continues to develop a pipeline of wholly-owned preclinical product candidates. The Company believes that its preclinical product candidates offer the potential to treat a number of indications including oncology, visual pathologies, neurodegeneration, and hearing loss. The goal of the Company's translational medicine strategy is to progress rapidly to first-in-human trials once it has adequately established the pharmacokinetics (the movement of a drug into, through, and out of the body), pharmacodynamics (the effect and mechanism of action of a drug), safety, and manufacturability of the product candidate in preclinical studies.

Miragen Therapeutics Europe Limited ("Miragen Europe"), the Company's wholly-owned subsidiary, was formed in January 2011 for the sole purpose of submitting regulatory filings in Europe. Miragen Europe has no employees or operations.

On February 13, 2017, the Company, then known as Signal Genetics, Inc. ("Signal"), completed its merger with Miragen Therapeutics, Inc., a then privately-held Delaware corporation ("Private Miragen"). Pursuant to the Agreement and Plan of Merger and Reorganization (the "Merger Agreement") by and among the Company, Private Miragen, and Signal Merger Sub, Inc., a wholly-owned subsidiary of the Company ("Merger Sub"), Merger Sub merged with and into Private Miragen, with Private Miragen surviving as a wholly-owned subsidiary of the Company (the "Merger"). Immediately, following the Merger, Private Miragen merged with and into the Company, with the Company as the surviving corporation (the "Short-Form Merger" and, together with the Merger, the "Mergers"). In connection with the Short-Form Merger, the Company changed its corporate name to "Miragen Therapeutics, Inc."

The holders of shares of Private Miragen common stock outstanding immediately prior to the Merger received approximately 0.7031 shares of the Company's common stock in exchange for each share of Private Miragen common stock in the Merger. Following the Merger on February 13, 2017, the combined company had 21,309,440 shares of common stock outstanding at a par value of $0.01 per share (the "Common Stock") as compared to the par value of Private Miragen's common stock of $0.001 per share. The accompanying consolidated financial statements and notes to the consolidated financial statements give retroactive effect to the exchange ratio and change in par value for all periods presented.

Liquidity

The Company has incurred annual net operating losses since its inception. As of December 31, 2017, the Company had an accumulated deficit of $93.6 million and a net loss of $26.5 million for the year ended December 31, 2017.

In February 2018, the Company entered into an underwriting agreement (the "Underwriting Agreement") with Jefferies LLC, Evercore Group L.L.C., and Deutsche Bank Securities Inc., as representatives (the "Representatives") of several underwriters (collectively with the Representatives, the "Underwriters"), relating to a public offering of its Common Stock. Under the Underwriting Agreement, in February 2018 the Company sold 7,414,996 shares of Common Stock at a price of $5.50 per share, which resulted in net proceeds of approximately $37.9 million after deducting underwriting commissions and discounts and other offering expenses payable by the Company.

The Company's management believes that the $47.4 million of cash and cash equivalents on hand at December 31, 2017, combined with the proceeds received from the February 2018 public offering, will be sufficient to fund its operations in the normal course of business and allow the Company to meet its liquidity needs into early 2020.

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of Presentation

The accompanying consolidated financial statements include the accounts of the Company and its wholly-owned subsidiary, Miragen Europe. The consolidated financial statements have been prepared in accordance with U.S. generally accepted accounting principles ("U.S. GAAP") and include all adjustments necessary for the fair presentation of the Company's financial position, results of operations, and cash flows for the periods presented. All significant intercompany balances have been eliminated in consolidation. The Company's management performed an evaluation of its activities through the date of filing of these financial statements and concluded that there are no subsequent events requiring disclosure, other than as disclosed.

Use of Estimates

The Company's consolidated financial statements are prepared in accordance with U.S. GAAP, which requires it to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and contingent liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Although these estimates are based on the Company's knowledge of current events and actions it may take in the future, actual results may ultimately differ from these estimates and assumptions.

Revenue Recognition

The Company recognizes revenue principally from its strategic alliance and collaboration agreement. Revenue is recognized from upfront payments for licenses and milestone payments that are generated from defined research or development events, as well as from the reimbursement of amounts for research and development services under its strategic alliance and collaboration agreement. The Company recognizes revenue when all four of the following criteria are met: (1) persuasive evidence of an arrangement exists; (2) products have been delivered or services rendered; (3) the selling price is fixed or determinable; and (4) collectability is reasonably assured.

Multiple-element arrangements are examined to determine whether the deliverables can be separated or must be accounted for as a single unit of accounting. The Servier Collaboration Agreement with Servier, for example, includes a combination of upfront license fees, payments for research and development activities, and milestone payments that are evaluated to determine whether each deliverable under the agreement has value to the customer on a stand-alone basis and whether reliable evidence of fair value for the deliverable exists. Deliverables in an arrangement that do not meet this separation criteria are treated as a single unit of accounting, generally applying applicable revenue recognition guidance for the final deliverable to the combined unit of accounting.

The Company recognizes revenue from non-refundable upfront license fees over the term of performance under the Servier Collaboration Agreement. When the performance period is not specified, the Company estimates the performance period based upon provisions contained within the agreement, such as the duration of the research or development term, the existence, or likelihood, of achievement of development commitments, and any other significant commitments. These advance payments are deferred and recorded as deferred revenue upon receipt, pending recognition, and are classified as a short-term or long-term liability in the accompanying consolidated balance sheets. Expected performance periods are reviewed periodically and, if applicable, the amortization period is adjusted, which may accelerate or decelerate revenue recognition. The timing of revenue recognition, specifically as it relates to the amortization of upfront license fees, is significantly influenced by the Company's estimates.

The Company applies the milestone method of accounting to recognize revenue from milestone payments when earned, as evidenced by persuasive evidence that the milestone has been achieved and the payment is non-refundable, provided that the milestone event is substantive. A milestone event is defined as an event (i) that can only be achieved based in whole or in part on either the Company's performance or on the occurrence of a specific outcome resulting from the Company's performance; (ii) for which there is substantive uncertainty at the inception of the arrangement that the event will be achieved; and (iii) that would result in additional payments being due to the Company. Events for which the occurrence is either contingent solely upon the passage of time or the result of a counterparty's performance are not considered to be milestone events. A milestone event is substantive if all of the following conditions are met: (i) the consideration is commensurate with either the Company's performance to achieve the milestone, or the enhancement of the value to the delivered item(s) as a result of a specific outcome resulting from the Company's performance to achieve the milestone; (ii) the consideration relates solely to past performance; and (iii) the consideration is reasonable relative to all the deliverables and payment terms (including other potential milestone consideration) within the arrangement. The Company assesses whether a milestone is substantive at the inception of each arrangement. If a milestone is deemed non-substantive, the Company accounts for the milestone payment using a method consistent with the related units of accounting for the arrangement over the estimated performance period.

Share-Based Compensation

The Company accounts for share-based compensation expense related to stock options granted to employees and members of its board of directors under its 2008 Equity Incentive Plan (the "2008 Plan") and under its 2016 Equity Incentive Plan (the "2016 Plan") by estimating the fair value of each stock option or award on the date of grant using the Black-Scholes option pricing model. The Company recognizes share-based compensation expense on a straight-line basis over the vesting term.

The Company accounts for stock options issued to non-employees by valuing the award using an option pricing model and remeasuring such awards to the current fair value until the awards are vested or a performance commitment has otherwise been reached.

Research and Development

Research and development costs are expensed as incurred in performing research and development activities. The costs include employee-related expense including salaries, benefits, share-based compensation, fees for acquiring and maintaining licenses under third party license agreements, consulting fees, costs of research and development activities conducted by third parties on the Company's behalf, laboratory supplies, depreciation, and facilities and overhead costs. The Company defers and capitalizes non-refundable advance payments for research and development activities until the related goods are received or services performed. In circumstances where amounts have been paid in excess of costs incurred, the Company records a prepaid expense.

The Company records upfront and milestone payments to acquire contractual rights to licensed technology as research and development expenses when incurred if there is uncertainty in the Company receiving future economic benefit from the acquired contractual rights. The Company considers future economic benefits from acquired contractual rights to licensed technology to be uncertain until such a drug candidate is approved by the U.S. Food and Drug Administration or when other significant risk factors are abated.

Clinical Trial and Preclinical Study Accruals

The Company makes estimates of accrued expenses as of each balance sheet date in its consolidated financial statements based on certain facts and circumstances at that time. The Company's accrued expenses for clinical trials and preclinical studies are based on estimates of costs incurred for services provided by clinical research organizations, manufacturing organizations, and other providers. Payments under the Company's agreements with external service providers depend on a number of factors, such as site initiation, patient screening, enrollment, delivery of reports, and other events. In accruing for these activities, the Company obtains information from various sources and estimates the level of effort or expense allocated to each period. Adjustments to the Company's research and development expenses may be necessary in future periods as its estimates change.

Cash and Cash Equivalents

All highly-liquid investments that have maturities of 90 days or less at the date of purchase are classified as cash equivalents. Cash equivalents are reported at cost, which approximates fair value due to the short maturities of these instruments.

Fair Value of Financial Instruments

The following tables present information about the Company's financial assets and liabilities that have been measured at fair value and indicate the fair value of the hierarchy of the valuation inputs utilized to determine such fair value. In general, fair values determined by Level 1 inputs utilize quoted prices (unadjusted) in active markets for identical assets or liabilities. Fair value determined by Level 2 inputs utilize observable inputs other than Level 1 prices, such as quoted prices, for similar assets or liabilities, quoted market prices in markets that are not active, or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the related assets or liabilities. Fair values determined by Level 3 inputs are unobservable data points for the asset or liability, and include situations where there is little, if any, market activity for the asset or liability.

	December 31, 2017		December 31, 2016	
	Level 1	Level 3	Level 1	Level 3
	(in thousands)			
Assets:				
Money market funds (included in cash and cash equivalents) (1)	$ 47,653	$ —	$ 22,189	$ —
Liabilities:				
Preferred and common stock warrants (included in accrued and other liabilities)	$ —	$ 82	$ —	$ 133

(1) Amounts presented for each period above differ from cash and cash equivalents reported in the consolidated balance sheets due to outstanding disbursements and deposits.

A reconciliation of the beginning and ending balances of the Company's liabilities measured at fair value using significant unobservable, or Level 3, inputs are as follows for the years ended December 31 (in thousands):

Balance of liability as of December 31, 2015	$ 169
Other	(39)
Change in estimated value of warrants	3
Balance of liability as of December 31, 2016	133
Reclassification of warrant liability to equity	(51)
Balance of liability as of December 31, 2017	$ 82

Certain of the Company's financial instruments are not measured at fair value on a recurring basis but are recorded at amounts that approximate their fair value due to the short-term nature of their maturities, such as cash and cash equivalents, accounts receivable, accounts payable, and accrued expenses. The carrying amount of the Company's note payable approximates its fair value (a Level 2 fair value measurement), reflecting interest rates currently available to the Company.

The Company accounts for warrants to purchase its stock pursuant to ASC Topic 470, Debt, and ASC Topic 480, *Distinguishing Liabilities from Equity*, and classifies warrants for redeemable preferred stock and certain warrants for common stock as liabilities or equity. The warrants classified as liabilities are reported at their estimated fair value and any changes in fair value are reflected in interest expense and other related expenses. The warrants classified as equity are reported at their estimated fair value with no subsequent remeasurement.

Concentrations of Credit Risk

Financial instruments that potentially subject the Company to concentrations of credit risk consist primarily of cash equivalents, which include short-term investments that have maturities of less than three months. The Company maintains deposits in federally insured financial institutions in excess of federally insured limits. The Company has not experienced any losses in such accounts. The Company invests its excess cash primarily in deposits and money market funds held with one financial institution.

Property and Equipment

The Company carries its property and equipment at cost, less accumulated depreciation and amortization. Depreciation is computed using the straight-line method over the estimated useful lives of the assets, generally three to five years. Leasehold improvements are amortized over the shorter of the life of the lease (including any renewal periods that are deemed to be reasonably assured) or the estimated useful life of the assets. Construction in progress is not depreciated until placed in service. Repairs and maintenance costs are expensed as incurred and expenditures for major improvements are capitalized.

Impairment of Long-Lived Assets

The Company assesses the carrying amount of its property and equipment whenever events or changes in circumstances indicate the carrying amount of such assets may not be recoverable. No impairment charges were recorded during the years ended December 31, 2017 and 2016.

Net Loss per Share

Basic net loss per share is calculated by dividing the net loss applicable to common stockholders by the weighted average number of shares of Common Stock outstanding during the period without consideration of Common Stock equivalents. Since the Company was in a loss position for all periods presented, diluted net loss per share is the same as basic net loss per share for all periods, as the inclusion of all potential common shares outstanding is anti-dilutive.

Comprehensive Loss

Comprehensive loss is defined as the change in equity during a period from transactions and other events and/or circumstances from non-owner sources. If the Company had comprehensive gains (losses), they would be reflected in the statement of operations and comprehensive loss and as a separate component in the statement of stockholders' equity (deficit). There were no elements of comprehensive loss during the years ended December 31, 2017 and 2016.

Income Taxes

The Company accounts for income taxes by using an asset and liability method of accounting for deferred income taxes. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases. A valuation allowance is recorded to the extent it is more likely than not that a deferred tax asset will not be realized. 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 rates is recognized in operations in the period that includes the enactment date.

The Company's significant deferred tax assets are for net operating loss carryforwards, tax credits, accruals and reserves, and capitalized start-up costs. The Company has provided a valuation allowance for its entire net deferred tax assets since inception as, due to its history of operating losses, the Company has concluded that it is more likely than not that its deferred tax assets will not be realized.

The Company has no unrecognized tax benefits. The Company classifies interest and penalties arising from the underpayment of income taxes in the consolidated statements of operations as general and administrative expenses. No such expenses have been recognized during the years ended December 31, 2017 and 2016.

The Tax Cuts and Jobs Act ("Tax Act") was signed into law on December 22, 2017. The Tax Act includes significant changes to the U.S. corporate income tax system, including: (i) a federal corporate rate reduction from 35% to 21%; (ii) limitations on the deductibility of interest expense and executive compensation; (iii) elimination of the corporate alternative minimum tax ("AMT") and a change in how existing AMT credits can be realized; (iv) change in the rules related to uses and limitations of net operating loss carryforwards created in tax years beginning after December 31, 2017; (v) reduction to the orphan drug credit from 50% to 25%; and (vi) transition of U.S. international taxation from a worldwide tax system to a territorial tax system.

Segment Information

The Company operates in one operating segment and, accordingly, no segment disclosures have been presented herein. All equipment, leasehold improvements, and other fixed assets are physically located within the United States and all agreements with the Company's partners are denominated in U.S. dollars, except where noted.

Recent Accounting Pronouncements – Adopted

Share-based Compensation

In March 2016, the Financial Accounting Standards Board ("FASB") issued Accounting Standards Update ("ASU") No. 2016-09, *Compensation—Stock Compensation (Topic 718): Improvements to Employee Share-Based Payment Accounting*, which is intended to simplify accounting for equity share-based payment transactions, including the income tax consequences, classification of awards as either equity or liabilities, accounting for forfeitures, and classification on the statement of cash flows. Certain aspects of this standard require retrospective or prospective adoption. The adoption of this standard in 2017 did not have a material impact on the Company's consolidated financial statements.

Deferred Taxes

In November 2015, the FASB issued ASU No. 2015-17, *Balance Sheet Classification of Deferred Taxes*. ASU No. 2015-17 requires that deferred tax liabilities and assets be classified as noncurrent in a classified statement of financial position. The adoption of this standard did not have a material impact on the Company's consolidated financial statements due to the full valuation allowance on all net deferred tax assets.

Recent Accounting Pronouncements – Not Yet Adopted

Revenue Recognition

In May 2014, the FASB issued ASU No. 2014-09, *Revenue from Contracts with Customers (Topic 606)*, which outlines a single comprehensive model for entities to use in accounting for revenue arising from contracts with customers and supersedes most current revenue recognition guidance, including industry-specific guidance. The core principle of the revenue model is that "an entity recognizes revenue to depict the transfer of promised goods or services to customers in an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services." The standard provides enhancements to the quality and consistency of how revenue is reported by companies, while also improving comparability in the financial statements of companies reporting using International Financial Reporting Standards or U.S. GAAP. The new standard also will require enhanced revenue disclosures, provide guidance for transactions that were not previously addressed comprehensively, and improve guidance for multiple-element arrangements. This accounting standard becomes effective for the Company for reporting periods beginning after December 15, 2018, and interim reporting periods thereafter. Early adoption is permitted for annual reporting periods (including interim periods) beginning after December 15, 2016. This new standard permits the use of either the retrospective or cumulative effect transition method.

In March 2016, the FASB issued ASU No. 2016-08, *Revenue from Contracts with Customers (Topic 606): Principal versus Agent Considerations*. The purpose of this standard is to clarify the implementation of guidance on principal versus agent considerations related to ASU 2014-09. The standard has the same effective date as ASU 2014-09 described above.

In April 2016, the FASB issued ASU No. 2016-10, *Revenue from Contracts with Customer*, which provides clarity related to ASU 2014-09 regarding identifying performance obligations and licensing implementation. The standard has the same effective date as ASU 2014-09 described above.

In May 2016, the FASB issued ASU 2016-12: *Revenue from Contracts with Customers (Topic 606): Narrow-Scope Improvements and Practical Expedients*, which provides narrow scope improvements and practical expedients related to ASU 2014-09. The purpose of this standard is to clarify certain narrow aspects of ASU 2014-09, such as assessing the collectability criterion, presentation of sales taxes, and other similar taxes collected from customers, noncash consideration, contract modifications at transition, completed contracts at transition, and technical correction. The standard has the same effective date as ASU 2014-09 described above.

In December 2016, the FASB issued ASU 2016-20: *Technical Corrections and Improvements to Topic 606, Revenue from Contracts with Customers*. The amendments in this standard affect narrow aspects of guidance issued in ASU 2014-09. The standard has the same effective date as ASU 2014-09 described above.

The Company plans to adopt these new standards in the first quarter of 2019. As of December 31, 2017, there were limited contracts that will be in effect (actively) as of the transition date and, accordingly, the Company has not yet determined the effect of the standard on its consolidated financial statements. The Company's selected implementation transition method will be dependent upon contracts that are in place closer to the transition date.

Leases

In February 2016, the FASB issued ASU No. 2016-02, *Leases (Topic 842), which supersedes FASB ASC Topic 840, Leases (Topic 840),* and provides principles for the recognition, measurement, presentation and disclosure of leases for both lessees and lessors. In September 2017, the FASB issued ASU 2017-13, *Revenue Recognition (Topic 605), Revenue from Contracts with Customers (Topic 606), Leases (Topic 840), and Leases (Topic 842),* which provides additional implementation guidance on the previously issued ASU 2016-02 *Leases (Topic 842).* ASU 2016-02 requires lessees to apply a dual approach, classifying leases as either finance or operating leases based on the principle of whether or not the lease is effectively a financed purchase by the lessee. This classification will determine whether lease expense is recognized based on an effective interest method or on a straight-line basis over the term of the lease, respectively. A lessee is also required to record a right-of-use asset and a lease liability for all leases with a term of greater than twelve months regardless of classification. Leases with a term of twelve months or less will be accounted for similar to existing guidance for operating leases. The standard is effective for the Company for fiscal years beginning after December 15, 2019, and interim periods thereafter, with early adoption permitted. At adoption, this update will be applied using a modified retrospective approach. The Company is currently evaluating the impact of this standard on its consolidated financial statements.

Other new pronouncements issued but not effective as of December 31, 2017 are not expected to have a material impact on the Company's consolidated financial statements.

3. STRATEGIC ALLIANCE AND COLLABORATION WITH SERVIER

In October 2011, the Company entered into the Servier Collaboration Agreement with Servier for the research, development, and commercialization of RNA-targeting therapeutics in cardiovascular disease. Under the Servier Collaboration Agreement, as amended, the Company granted Servier an exclusive license to research, develop, manufacture, and commercialize RNA-targeting therapeutics for certain microRNA targets in the cardiovascular field. In 2017, the Company and Servier agreed to amend the Servier Collaboration Agreement to remove all existing targets, add one new target (microRNA-92), and grant Servier with the right to add one additional target through September 2019. Under the terms of the amended agreement, the term of the research collaboration has been extended through September 2019.

Servier's rights to each named target is limited to therapeutics in the field of cardiovascular disease, as defined, and in their territory, which is worldwide except for the United States and Japan. The Company retains all other rights including commercialization of therapeutics developed under the Servier Collaboration Agreement in the field of cardiovascular disease in the United States and Japan.

The Company is eligible to receive non-refundable development milestone payments of €5.8 million to €13.8 million ($6.9 million to $16.5 million as of December 31, 2017) and regulatory milestone payments of €10.0 million to €40.0 million ($12.0 million to $47.9 million as of December 31, 2017) for each target. Additionally, the Company may receive up to €175.0 million ($209.6 million as of December 31, 2017) in commercialization milestones, as well as quarterly royalty payments expressed in percentages ranging from the low-double digits to the mid-teens (subject to reductions for patent expiration, generic competition, third-party royalty, and costs of goods) on the net sales of any licensed product commercialized by Servier. Servier is obligated to make royalty payments for a period specified under the Servier Collaboration Agreement.

As part of the Servier Collaboration Agreement, the Company established a multiple-year research collaboration, under which it jointly performs agreed upon research activities directed to the identification and characterization of named targets and oligonucleotides in the cardiovascular field, which is referred to as the Research Collaboration. The current term of the Research Collaboration extends through September 2019. Servier is responsible for funding the costs of the Research Collaboration, as defined under the Servier Collaboration Agreement. During the year ended December 31, 2017 and 2016, the Company recognized as revenue amounts reimbursable under the Servier Collaboration Agreement of $3.1 million and $2.3 million, respectively.

The development of each product candidate (commencing with registration enabling toxicology studies) under the Servier Collaboration Agreement is performed pursuant to a mutually agreed upon development plan to be conducted by the parties as necessary to generate data useful for both parties to obtain regulatory approval of such product candidates. Servier is

responsible for a specified percentage of the cost of research and development activities under the development plan through the completion of one or more Phase 2 clinical trials and will reimburse the Company for a specified portion of such costs it incurs. The costs of Phase 3 clinical trials for each product candidate will be allocated between the parties at a specified percentage of costs. The applicable percentage for each product candidate will be based upon whether certain events under the Servier Collaboration Agreement occur, including if the Company enters into a third-party agreement for the development and/or commercialization of a product in the United States at least 180 days before the initiation of the first Phase 3 clinical trial, or if the Company subsequently enters into a U.S. partner agreement, or if it does not enter into a U.S. partner agreement but files for approval in the United States using data from the Phase 3 clinical trial.

Under the Servier Collaboration Agreement, the Company also granted Servier a royalty-free, non-exclusive license to develop a companion diagnostic in its territory for any therapeutic product that may be developed by Servier under the Servier Collaboration Agreement. The Company also granted Servier an exclusive, royalty-free license to commercialize such a companion diagnostic in its territory for use in connection with the development and commercialization of such therapeutic product in its territory.

The Servier Collaboration Agreement will expire as to each underlying product candidate when Servier's royalty obligations as to such product candidate have expired. Servier may also terminate the Servier Collaboration Agreement for: (i) convenience upon a specified number of days' prior notice to the Company or (ii) upon determination of a safety issue relating to development under the agreement upon a specified number of days' prior notice to the Company. Either party may terminate the Servier Collaboration Agreement upon a material breach by the other party which is not cured within a specified number of days. The Company may also terminate the agreement if Servier challenges any of the patents licensed by the Company to Servier.

The Company determined that the elements within the Servier Collaboration Agreement should be treated as a single unit of accounting because the delivered elements, the licenses, did not have stand-alone value to Servier at the time the license was granted. As such, the Company recognized license fees earned under the Servier Collaboration Agreement as revenue on a proportional performance basis over the estimated period to complete the activities under the Research Collaboration. The total period of performance is equal to the estimated term of the Research Collaboration. The Company measured its progress under the proportional performance method based on actual and estimated full-time equivalents. The Company received a total of $12.4 million (€9.0 million) in non-refundable license fees under the Servier Collaboration Agreement. Based on earlier estimates of the term of the Research Collaboration, these license fees had been fully recognized as revenue during the period from October 2011 through December 2016. Accordingly, no amounts were recognized as revenue during the year ended December 31, 2017. During the year ended December 31, 2016, the Company recognized license revenue of $0.5 million, respectively.

In total, for the years ended December 31, 2017 and 2016, the Company recognized $3.1 million and $2.8 million, respectively, as revenue under the Servier Collaboration Agreement. Amounts incurred but not billed to Servier for research and related intellectual property activities totaled $1.1 million and $0.3 million as of December 31, 2017 and 2016, respectively. These amounts are included in prepaid expenses and other current assets in the Company's consolidated balance sheets. As of December 31, 2017, accounts receivable for Servier research and related intellectual property activities totaled $1.4 million. At December 31, 2016, the Company had no amounts billed to Servier included in accounts receivable.

4. REVERSE MERGER

On February 13, 2017, Private Miragen completed the Merger as discussed in Note 1. For accounting purposes, Private Miragen is considered to be acquiring Signal in the Merger. Private Miragen was determined to be the accounting acquirer based upon the terms of the Merger and other factors including: (i) the Private Miragen security holders owned approximately 95.2% of the combined company's outstanding common stock immediately following the closing of the Mergers; (ii) former Private Miragen directors held all of the board seats in the combined company immediately following the closing of the Mergers; and (iii) Private Miragen management holds key management positions of the combined company. The Merger has been accounted for as an asset acquisition rather than business combination because the assets acquired and liabilities assumed by Private Miragen do not meet the definition of a business as defined by U.S. GAAP. The net assets acquired in connection with this transaction were recorded at their estimated acquisition date fair values as of February 13, 2017, the date the Mergers were completed.

Immediately prior to the effective date of the Merger, all shares of preferred stock of Private Miragen converted into shares of common stock of Private Miragen on a one-for-one basis.

At the effective date of the Merger, the Company issued shares of its Common Stock to Private Miragen stockholders, at an exchange rate of approximately 0.7031 shares of Signal Common Stock in exchange for each share of Private Miragen common stock outstanding immediately prior to the Merger. The exchange rate was calculated by a formula that was determined through arms-length negotiations between the Company and Private Miragen. The combined company assumed all of the outstanding options, whether or not vested, under the 2008 Plan with such options representing the right to purchase a number of shares of Common Stock equal to approximately 0.7031 multiplied by the number of shares of Private Miragen common stock previously represented by such options.

Immediately after the Merger on February 13, 2017, there were 21,309,440 shares of Common Stock outstanding. In addition, immediately after the Merger, Private Miragen stockholders, warrant holders, and option holders owned approximately 95.9% of the aggregate number of shares of Common Stock, and the stockholders of the Company immediately prior to the Merger owned approximately 4.1% of the aggregate number of shares of Common Stock (each on a fully diluted basis).

On February 13, 2017, prior to the effectiveness of the Merger, Signal had 1,024,960 shares of Common Stock outstanding and a market capitalization of $12.6 million. The estimated fair value of the net assets of Signal on February 13, 2017, prior to the Merger, was $0.2 million. The fair value of Common Stock on the Merger closing date, prior to the Merger, was above the fair value of the Company's net assets. As the Company's net assets were predominantly comprised of cash offset by current liabilities, the fair value of the Company's net assets as of February 13, 2017, prior to the Merger, is considered to be the best indicator of the fair value and, therefore, the estimated preliminary purchase consideration.

The following table summarizes the net assets acquired based on their estimated fair values as of February 13, 2017, prior to the Merger (in thousands):

Cash and cash equivalents	$	1,280
Prepaid and other assets		248
Accrued liabilities		(1,324)
Net acquired tangible assets	$	204

5. PROPERTY AND EQUIPMENT

Property and equipment, net, consisted of the following:

	December 31,	
	2017	2016
	(in thousands)	
Lab equipment	$ 2,229	$ 2,163
Leasehold improvements	737	688
Computer hardware and software	355	281
Furniture and fixtures	77	51
Property and equipment, gross	3,398	3,183
Less: accumulated depreciation and amortization	(2,835)	(2,558)
Property and equipment, net	$ 563	$ 625

During each year ended December 31, 2017 and 2016, depreciation and amortization expense was $0.3 million. Depreciation and amortization expense is recorded primarily in research and development expense on the consolidated statements of operations.

6. ACCRUED LIABILITIES

Accrued liabilities consisted of the following:

	December 31,	
	2017	2016
	(in thousands)	
Accrued employee compensation and related taxes	$ 1,538	$ 928
Accrued outsourced clinical and preclinical studies	581	1,684
Accrued other professional service fees	232	124
Accrued equipment and lab materials	197	—
Accrued legal fees and expenses	185	759
Value of liability-classified stock purchase warrants	82	133
Deferred and accrued facility lease obligations	74	221
Other accrued liabilities	102	60
Total accrued liabilities	$ 2,991	$ 3,909

7. NOTES PAYABLE

2017 Silicon Valley Bank Loan Agreement

In November 2017, the Company entered into a loan and security agreement with Silicon Valley Bank (the "2017 SVB Loan Agreement"), which amended and restated the loan and security agreement Private Miragen entered into with Silicon Valley Bank in April 2015 (the "2015 SVB Loan Agreement").

Upon entry into the 2017 SVB Loan Agreement, the Company borrowed $10.0 million with a 30-month payment period following an 18-month interest-only payment period ending in November 2021. Amounts outstanding bear interest at the prime rate (4.50% at December 31, 2017), with a final payment fee equal to $0.9 million due upon maturity. The Company used a portion of the debt facility to repay amounts due under the 2015 SVB Loan Agreement, including $2.8 million for the outstanding principal and $0.3 million for the final interest payment. As of December 31, 2017, no additional amounts are available under the 2017 SVB Loan Agreement.

The Company may elect to prepay prior to maturity all or any portion of the outstanding principal amounts under the 2017 SVB Loan Agreement, subject to a prepayment charge, depending on the date of prepayment or upon the occurrence of an event of default in which the Company's obligations to repay the outstanding principal is accelerated.

The Company's obligations under the 2017 SVB Loan Agreement are secured by a first priority security interest, right, and title in all business assets, excluding the Company's intellectual property, which is subject to a negative pledge.

The 2017 SVB Loan Agreement includes customary representations, warranties, and covenants (affirmative and negative), including restrictive covenants that limit the Company's ability to: encumber or dispose of the collateral securing the loan; change the business of the Company; transfer a material portion of the Company's assets; acquire other businesses; and merge or consolidate with or into any other business organization; incur additional indebtedness; declare or pay any cash dividend or make a cash distribution on any class of stock or other equity interest; enter into specified material transactions with Company affiliates; make non-ordinary course payments or enter into any amendment regarding subordinated debt of the Company; or become an "investment company" under the Investment Company Act of 1940, as amended; in each case subject to specified exceptions.

The 2017 SVB Loan Agreement also includes standard events of default, including payment defaults, breaches of covenants following any applicable cure period, material breaches of representations or warranties, the occurrence of a material adverse change (as defined in the 2017 SVB Loan Agreement), events relating to bankruptcy or insolvency; breaches of material third-party agreements; the occurrence of an unsatisfied material judgment against the Company; specified governmental actions against the Company, including specified actions by the U.S. Food and Drug Administration. Upon the occurrence of an event of default, Silicon Valley Bank may declare all outstanding obligations immediately due and payable, including a prepayment charge, and take such other actions as are set forth in the 2017 SVB Loan Agreement. Upon the occurrence of an event of default, at the Silicon Valley Bank's discretion, interest on the 2017 SVB Loan Agreement will accrue at 5.0% above the rate

that is otherwise applicable thereto until the earlier of the repayment of the Company's obligations under the 2017 SVB Loan Agreement or the cure of such event of default.

2015 Silicon Valley Bank Loan Agreement

In April 2015, Private Miragen entered into the 2015 SVB Loan Agreement and $5.0 million was funded in May 2015, which had a 30-month payment period following an 18-month interest-only payment period that ended in November 2016. Interest accrued on amounts outstanding at the prime rate minus 0.25%, with a final payment fee equal to 5.50% of amounts borrowed. Upon the execution of the 2017 SVB Loan Agreement, the 2015 SVB Loan agreement was terminated in its entirety. As a result, the Company paid the remaining principal and final interest payment with proceeds from the 2017 SVB Loan Agreement. The Company accounted for the termination of the 2015 SVB Loan Agreement as an extinguishment and incurred a loss on debt extinguishment of $0.1 million, which was recorded within interest expense.

In connection with the 2015 SVB Loan Agreement entered into in April 2015, Private Miragen issued detachable warrants to purchase up to 11,718 shares of Private Miragen preferred stock at an adjusted exercise price of $8.53 per share. At issuance, the warrants were classified as a liability subject to remeasurement at each balance sheet date. Immediately prior to the Merger, these warrants became exercisable for Private Miragen common stock, which was immediately exchanged for the right to purchase the Company's Common Stock. The Company determined that although the warrants were no longer exercisable for redeemable preferred stock, the warrants continued to be classified as a liability after the Merger due to the right of the holder to require the Company to repurchase the warrants for $0.1 million under certain circumstances. As of December 31, 2017, the Company estimated the fair value of the warrants to be $0.1 million using a probability adjusted present value method with the following assumptions: term of two years, discount rate of 6.8%, and probability of 90.0%.

Amounts outstanding under the SVB loan agreements were as follows:

	December 31,	
	2017	2016
	(in thousands)	
Principal amount outstanding	$ 10,000	$ 4,667
Unamortized debt discount	(119)	(14)
Unamortized debt issuance costs	—	(31)
Accreted final payment fee	41	167
Total notes payable	9,922	4,789
Less: current maturities	—	(1,969)
Long-term notes payable, net of current portion	$ 9,922	$ 2,820

Future annual minimum principal payments under the 2017 SVB Loan Agreement December 31, 2017 are as follows (in thousands):

2018	$ —
2019	2,333
2020	4,000
2021	3,667
Total	$ 10,000

In connection with the 2017 SVB Loan Agreement, the Company issued detachable warrants to purchase up to 24,097 shares of the Company's Common Stock at an exercise price of $7.15 per share. At issuance, the warrants were classified as equity and recorded at fair value with no subsequent remeasurement. The Company estimated the fair value of the warrants at issuance to be $0.1 million using a probability adjusted present value method with the following assumptions: term of 7 years, discount rate of 2.26%, and volatility rate of 80.70%.

8. COMMITMENTS AND CONTINGENCIES

Indemnification Agreements

The Company has entered into indemnification agreements with each of its directors and officers whereby it has agreed to

indemnify such persons for certain events or occurrences while the individual is, or was, serving as a director, officer, employee, or other agent of the Company. The maximum potential amount of future payments the Company could be required to make under these indemnification agreements is unlimited.

Employment Agreements

The Company has entered into agreements with its executives that provide for base salary, severance, eligibility for bonuses, and other generally available benefits. The agreements provide that the Company may terminate the employment of its executives at any time, with or without cause.

If an executive is terminated without cause, as defined in the employment agreements, or an executive resigns for good reason, as defined in the employment agreements, then the executive is entitled to receive, upon the execution of a release agreement, a severance package consisting of: (i) the equivalent of 12 months of the executive's base salary in effect immediately prior to date of termination; (ii) acceleration of vesting of the equivalent of 12 months of vesting of the executive's outstanding unvested stock options or other equity awards that were outstanding as of the effective date of the executive's employment agreement; and (iii) 12 months of continued health coverage.

If an executive is terminated without cause or resigns for good reason within one month prior to or 12 months following a change of control, as defined in the employment agreements, the executive is entitled to receive, upon the execution of a release agreement, a severance package consisting of: (i) the equivalent of 12 months of the executive's base salary in effect immediately prior to date of termination; (ii) the vesting in full of the executive's then-outstanding stock options or other equity awards subject to time-based vesting; and (iii) 12 months of continued health coverage. Solely in the case of the Company's Chief Executive Officer, if such termination occurs one month before or 12 months following a change of control, then, upon the execution of a release agreement, the executive is entitled to: (i) the equivalent of 24 months of the executive's base salary in effect immediately prior to the date of termination; (ii) the vesting in full of the executive's outstanding stock options or other equity awards subject to time-based vesting; and (iii) 12 months of continued health coverage.

License Agreements with the University of Texas

As of December 31, 2017, the Company had five exclusive patent license agreements (the "UT License Agreements") with the Board of Regents of The University of Texas System (the "University of Texas"). Under each of the UT License Agreements, the University of Texas granted the Company exclusive and nonexclusive licenses to certain patent and technology rights. The University of Texas is a minority stockholder of the Company.

In consideration of rights granted by the University of Texas, the Company is required to: (i) pay a nonrefundable upfront license documentation fee in the amount of $10 thousand per license; (ii) pay an annual license maintenance fee in the amount of $10 thousand per license starting one year from the date of each agreement; (iii) reimburse the University of Texas for actual costs incurred in conjunction with the filing, prosecution, enforcement, and maintenance of patent rights prior to the effective date; and (iv) bear all future costs of and manage the filing, prosecution, enforcement, and maintenance of patent rights. During the years ended December 31, 2017 and 2016, the Company incurred immaterial upfront and maintenance fees, which were recorded as research and development expense. All costs related to the filing, prosecution, and maintenance of patent and technology rights are recorded as general and administrative expense when incurred.

Under the terms of the UT License Agreements, the Company may be obligated to make the following future milestone payments for each licensed product candidate: (i) up to approximately $0.6 million upon the initiation of defined clinical trials; (ii) $2.0 million upon regulatory approval in the United States; and (iii) $0.5 million per region upon regulatory approval in other specified regions. Additionally, if the Company or any of its sublicensees successfully commercializes any product candidate subject to the UT License Agreements, it is responsible for royalty payments in the low-single digits based upon net sales of such licensed products and payments at a percentage in the mid-teens of any sublicense income, subject to specified exceptions. The University of Texas's right to these royalty payments will expire as to each license agreement upon the expiration of the last patent claim subject to the applicable UT License Agreement.

The license term extends on a product-by-product and country-by-country basis until the expiration of the last to expire of the licensed patents that covers such product in such country. Upon expiration of the royalty payment obligation, the Company will have a fully paid license in such country. The Company may also terminate each UT License Agreement for convenience upon a specified number of days' prior notice to the University of Texas. The University of Texas also has the right to earlier terminate the UT License Agreements after a defined date under specified circumstances where the Company has effectively abandoned its research and development efforts or has no sales. The UT License Agreements will terminate under customary termination provisions including automatic termination upon the Company's bankruptcy or insolvency, upon notice of an

uncured material breach, and upon mutual written consent. All charges incurred under the UT License Agreements have been expensed to date due to the uncertainty as to future economic benefit from the acquired rights.

License Agreement with Roche Innovation Center Copenhagen A/S (formerly Santaris Pharma A/S)

In June 2010, Private Miragen entered into a license agreement with the Santaris Pharma A/S, which was subsequently acquired by F. Hoffmann-La Roche Ltd ("Roche") in 2014, and subsequently changed its name to Roche Innovation Center Copenhagen A/S ("RICC"). The agreement was amended in October 2011 and amended and restated in December 2012 (the "RICC License Agreement").

Under the RICC License Agreement, the Company has received exclusive and nonexclusive licenses from RICC to use specified technology of RICC (the "RICC Technology") for specified uses including research, development, and commercialization of pharmaceutical products using this technology worldwide. Under the RICC License Agreement, the Company has the right to develop and commercialize the RICC Technology directed to four specified targets and the option to obtain exclusive product licenses for up to six additional targets. The acquisition of Santaris Pharma A/S by Roche was considered a change-of-control under the RICC License Agreement, and as such, certain terms and conditions of the RICC License Agreement changed, as contemplated and in accordance with the RICC License Agreement. These changes primarily relate to milestone payments reflected in the disclosures below. As consideration for the grant of the license and option, Private Miragen previously paid RICC $2.3 million and issued RICC 856,806 shares of Private Miragen's Series A convertible preferred stock, which were subsequently transferred to Roche Finance Ltd, an affiliate of Roche, and, in 2017, were converted into 602,420 shares of Common Stock as a result of the Merger. If the Company exercises its option to obtain additional product licenses or to replace the target families, it will be required to make additional payments to RICC.

Under the terms of the RICC License Agreement, milestone payments were previously decreased by a specified percentage as a result of the change of control by RICC referenced above. The Company is obligated to make future milestone payments for each licensed product for up to $5.2 million, which is inclusive of a potential product license option fee. Certain of these milestones will be increased by a specified percentage if the Company undergoes a change in control during the term of the RICC License Agreement. If the Company grants a third party a sublicense to the RICC Technology, it is required to remit to Roche up to a specified percentage of the upfront and milestone and other specified payments it receives under its sublicense, and if such sublicense covers use of the RICC Technology in the United States or the entire European Union, the Company will not have any further obligation to pay the fixed milestone payments noted above.

If the Company or its sublicensee successfully commercializes any product candidate subject to the RICC License Agreements, then RICC is entitled to royalty payments in the mid-single digits on the net sales of such product, provided that if such net sales are made by a sublicensee under the RICC License Agreement, RICC is entitled to royalty payments equal to the lesser of a percentage in the mid-single digits on the net sales of such product or a specified percentage of the royalties paid to the Company by such sublicensee, subject to specified restrictions. The Company is obligated to make any such royalty payments until the later of: (i) a specified anniversary of the first commercial sale of the applicable product or (ii) the expiration of the last valid patent claim licensed by RICC under the RICC License Agreement underlying such product. Upon the occurrence of specified events, the royalty owed to RICC will be decreased by a specified percentage.

The RICC License Agreement will terminate upon the latest of the expiration of all of RICC's royalty rights, the termination of the last Miragen target, or the expiration of its right to obtain a product license for a new target under the RICC License Agreement. The Company may also terminate the RICC License Agreement for convenience upon a specified number of days' prior notice to RICC, subject to specified terms and conditions. Either party may terminate the RICC License Agreement upon an uncured material breach by the other party and RICC may terminate the RICC License Agreement upon the occurrence of other specified events immediately or after such event is not cured within a specified number of days, as applicable.

All charges incurred under the RICC License Agreement have been expensed to date due to the uncertainty as to future economic benefit from the acquired rights.

For the years ended December 31, 2017 and 2016, the Company paid $0.6 million and $0.2 million, respectively, to RICC for raw materials to be used in its drug manufacturing process.

Subcontract Agreement with Yale University

In October 2014, Private Miragen and Yale University ("Yale") entered into a subcontract agreement and into a subaward agreement in March 2015 (the "Yale Agreements"), which were subsequently amended. Under the Yale Agreements, the Company is providing specified services regarding the development of a proprietary compound that targets miR-29 in the

indication of idiopathic pulmonary fibrosis. Yale entered into the Yale Agreements in connection with a grant that Yale received from the National Institutes of Health ("NIH") for the development of a miR-29 mimic as a potential therapy for pulmonary fibrosis.

In consideration of the Company's services under the Yale Agreements, Yale has agreed to pay the Company up to $1.1 million over five years, subject to the availably of funds under the grant and continued eligibility. Under the terms of the Yale Agreements, the Company retains all rights to any and all intellectual property developed solely by the Company in connection with the Yale Agreements. Yale has also agreed to provide the Company with an exclusive option to negotiate in good faith for an exclusive, royalty-bearing license from Yale for any intellectual property developed by Yale or jointly by the parties under the Yale Agreements. Yale is responsible for filing, prosecuting, and maintaining foreign and domestic patent applications and patents on all inventions jointly developed by the parties under the Yale Agreements. Through December 31, 2017, the Company received $0.1 million under the Yale Agreements.

The Yale Agreements terminate automatically on the date that Yale delivers its final research report to the NIH under the terms of the grant underlying the Yale Agreements. Each party may also terminate the Yale Agreements upon a specified number of days' notice in the event that the NIH's grant funding is reduced or terminated or upon material breach by the other party.

License Agreements with the t2cure GmbH

In October 2010, Private Miragen entered into a license and collaboration agreement (the "t2cure Agreement") with t2cure GmbH ("t2cure"), which was subsequently amended. Under the t2cure Agreement, the Company received a worldwide, royalty-bearing, and exclusive license to specified patent and technology rights relating to miR-92.

In consideration of rights granted by t2cure, Private Miragen paid an upfront fee of $46 thousand and agreed to: (i) pay an annual license maintenance fee in the amount of €3 thousand ($3 thousand as of December 31, 2017); and (ii) reimburse t2cure for costs incurred in conjunction with the filing, prosecution, enforcement, and maintenance of patent rights.

Under the terms of the t2cure Agreement, the Company is obligated to make the following future milestone payments for each licensed product: (i) up to approximately $0.7 million upon the initiation of certain defined clinical trials; (ii) $2.5 million upon regulatory approval in the United States; and (iii) up to $1.5 million per region upon regulatory approval in the European Union or Japan. Additionally, if the Company or any of its sublicensees successfully commercialize any product candidate subject to the t2cure Agreement, it is responsible for royalty payments equal to percentages in the low-single digits upon net sales of licensed products and sublicense fees equal to a percentage in the low-twenties of sublicense income received by it. The Company is obligated to make any such royalty payment until the later of: (i) the tenth anniversary of the first commercial sale of the applicable product or (ii) the expiration of the last valid claim to a patent licensed by t2cure under the t2cure Agreement covering such product. If such patent claims expire prior to the end of the ten-year term, then the royalty owed to t2cure will be decreased by a specified percentage. The Company also has the right to decrease its royalty payments by a specified percentage for royalties paid to third parties for licenses to certain third-party intellectual property.

The license term extends on a country-by-country basis until the later of: (i) the tenth anniversary of the first commercial sale of a licensed product in a country and (ii) the expiration of the last to expire valid claim that claims such licensed product in such country. Upon expiration of the royalty payment obligation, the Company will have a fully paid license in such country. The Company has the right to terminate the t2cure Agreement at will, on a country-by-country basis, after 60 days' written notice. The t2cure Agreement will also automatically terminate upon the Company's bankruptcy or insolvency or upon notice of an uncured material breach.

The Company has expensed all charges incurred under the t2cure Agreement to date, due to the uncertainty as to future economic benefit from the acquired rights.

License Agreement with The Brigham and Women's Hospital

In May 2016, Private Miragen and The Brigham and Women's Hospital ("BWH") entered into an exclusive patent license agreement (the "BWH License Agreement"). Under the BWH License Agreement, the Company has an exclusive, worldwide license, including a right to sublicense, to specified patent rights and a nonexclusive, worldwide license, including a right to sublicense, to specified technology rights of BWH, each related to certain microRNAs believed to be involved in various neurodegenerative disorders. As consideration for these rights, the Company is obligated to pay a specified annual license fee. BWH is also entitled to milestone payments of up to approximately $2.6 million for each of the Company's product candidates developed based on the patent rights subject to the BWH License Agreement plus a one-time sales milestone payment of $0.3 million for all product candidates developed based on the patent rights subject to the BWH License Agreement. If the Company

were to successfully commercialize any product candidate subject to the BWH License Agreement, then BWH is entitled to royalty payments in the low-single digits on the net sales of such product. BWH's right to these royalty payments will expire on a product-by-product and country-by-country basis upon the expiration of the last patent claim in such country that is subject to the BWH License Agreement and covers the product, and the Company's license to such product in such country will become fully paid at such time. BWH is also entitled to a percentage in the low-double digits of any sublicense income from such product, subject to specified exceptions. The Company is also responsible for all costs associated with the preparation, filing, prosecution, and maintenance of the patent rights subject to the BWH License Agreement. Additionally, the Company is obligated to use commercially reasonable efforts to develop a product under the BWH License Agreement and to meet specified diligence milestones thereunder.

The BWH License Agreement will terminate upon the expiration of all issued patents and patent applications subject to the patent rights under the agreement. The Company may also terminate the BWH License Agreement for convenience upon a specified number of days' prior notice to BWH. BWH may terminate the BWH License Agreement upon a breach by the Company of its payment obligations and upon the occurrence of other specified events that are not cured within a specified number of days, provided that such termination is automatic upon the Company's bankruptcy or insolvency.

During the year ended December 31, 2017, the Company paid the first annual license fee, which was immaterial.

Facility Lease

In December 2010, Private Miragen entered into a multi-year lease agreement for its current office and lab space. The agreement was subsequently amended to extend the term through August 2020. This lease is noncancelable. Minimum base lease payments, including the impact of tenant improvement allowances, under the operating lease are recognized on a straight-line basis over the full term of the lease.

During both years ended December 31, 2017 and 2016, rent expense was $0.3 million. The Company is also required to pay for operating expenses related to the leased space, which was $0.3 million for both years ended December 31, 2017 and 2016.

Future annual minimum payments under the lease as of December 31, 2017 were as follows (in thousands):

2018	$	391
2019		404
2020		277
Total	$	1,072

9. CAPITAL STOCK

Common Stock

The Company is authorized to issue 105,000,000 shares of its stock, of which 100,000,000 shares have been designated as Common Stock and 5,000,000 shares have been designated as preferred stock with a par value of $0.01 per share. The number of authorized shares of Common Stock may be increased or decreased by the affirmative vote of the holders of a majority of the Company's stock who are entitled to vote. Each share of Common Stock is entitled to one vote. The holders of Common Stock are entitled to receive dividends when and as declared or paid by its board of directors. At the effective date of the Merger, each outstanding share of Private Miragen common stock was converted into the right to receive approximately 0.7031 shares of the Company's Common Stock.

On February 13, 2017, immediately prior to the Merger and in accordance with subscription agreements entered into with certain investors in October 2016, Private Miragen issued and sold an aggregate of 9,045,126 shares of Private Miragen's common stock at a price per share of $4.50, or 6,359,628 shares of Common Stock at a price per share of $6.40 as adjusted for the exchange ratio in the Merger, for aggregate consideration of $40.7 million, offset by associated financing fees of $1.5 million.

Series Preferred

In February 2017, in conjunction with the Merger, all of the outstanding redeemable convertible preferred stock of Private Miragen converted into Private Miragen common stock at a ratio of 1:1 and was immediately exchanged for the Company's Common Stock at an exchange ratio of 0.7031 as a result of the Merger. A summary of the conversion by class of preferred stock is summarized as follows (in thousands, except share data):

	Series A		Series B		Series C		Total	
	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount
Balance at December 31, 2016	7,149,176	$ 23,124	2,166,651	$ 12,975	9,268,563	$ 40,877	18,584,390	$ 76,976
Accretion of redeemable convertible preferred stock to redemption value	—	1	—	1	—	3	—	5
Conversion of preferred stock to common stock	(7,149,176)	(23,125)	(2,166,651)	(12,976)	(9,268,563)	(40,880)	(18,584,390)	(76,981)
Balance at February 13, 2017	—	$ —	—	$ —	—	$ —	—	$ —

As of December 31, 2017, the Company had no shares of preferred stock outstanding and had not designated the rights, preferences, or privileges of any class or series of preferred stock. Although the Company's board of directors has the authority to issue preferred stock at its discretion in one or more classes or series and to fix the designations, powers, preferences and rights, and the qualifications, limitations, or restrictions thereof, including dividend rights, conversion right, voting rights, terms of redemption, liquidation preferences, and the number of shares constituting any class or series of preferred stock, without further vote or action by the stockholders.

Common Stock Sales Agreement

On March 31, 2017, the Company entered into an at the market issuance Common Stock Sales Agreement (the "ATM Agreement") with Cowen and Company, LLC ("Cowen") under which the Company may offer and sell, from time to time at its sole discretion, shares of its Common Stock having an aggregate offering price of up to $50.0 million through Cowen as its sales agent.

Cowen may sell the Common Stock by any method permitted by law deemed to be an "at the market offering" as defined in Rule 415 of the Securities Act of 1933, as amended, including without limitation sales made by means of ordinary brokers' transactions on The Nasdaq Capital Market or otherwise at market prices prevailing at the time of sale, in block transactions, or as otherwise directed by the Company. Cowen will use commercially reasonable efforts to sell the Common Stock from time to time, based upon instructions from the Company (including any price, time or size limits or other customary parameters or conditions the Company may impose). The Company will pay Cowen a commission equal to 3.0% of the gross sales proceeds of any Common Stock sold through Cowen under the ATM Agreement, and also has provided Cowen with customary indemnification rights.

The Company is not obligated to make any sales of Common Stock under the ATM Agreement. The offering of shares of Common Stock pursuant to the ATM Agreement will terminate upon the earlier of: (i) the sale of all Common Stock subject to the ATM Agreement or (ii) termination of the ATM Agreement in accordance with its terms.

As of December 31, 2017, the Company sold, pursuant to the terms of the ATM Agreement, 840,534 shares of Common Stock, at a weighted average price of $9.35 per share, for aggregate gross proceeds of approximately $7.9 million. Net proceeds received during the year ended December 31, 2017 were approximately $7.5 million, including initial expenses for executing the "at the market offering" and commissions to Cowen as sales agent.

The Company incurred approximately $0.4 million in offering costs for the ATM Agreement, including costs for the related shelf filing, but excluding the commissions paid to Cowen as sales agent. The costs incurred are initially included in prepaid expenses and other current assets and are being amortized to a reduction of offering costs as shares are sold under the ATM Agreement. The costs reflected in the consolidated statements of cash flows include the 3.0% commission paid to Cowen on shares sold ($0.2 million through December 31, 2017) along with $23 thousand of amortized offering costs.

10. WARRANTS

Stock purchase warrant activity is as follows:

	Common Stock Warrants		Preferred Stock Warrants	
	Number	Weighted Average Exercise Price	Number	Weighted Average Exercise Price
Outstanding at December 31, 2015	7,031	$ 0.57	25,779	$ 6.21
Granted	—	$ —	—	$ —
Outstanding at December 31, 2016	7,031	$ 0.57	25,779	$ 6.21
Warrants acquired in Merger	13,534	$ 80.70	—	$ —
Preferred stock warrants converted into Common Stock warrants	25,779	$ 6.21	(25,779)	$ 6.21
Granted	24,097	$ 7.15	—	$ —
Exercised	(21,092)	$ 3.04	—	$ —
Outstanding at December 31, 2017	49,349	$ 27.65	—	$ —

A summary of outstanding Common Stock purchase warrants as of December 31, 2017 is as follows:

Number of Underlying Shares	Exercise Price	Expiration Date
13,534	$80.70	2019 & 2020
11,718	$8.53	2025
24,097	$7.15	2024
49,349		

In connection with the Merger, Private Miragen assumed 13,534 outstanding warrants to purchase shares of the Company's Common Stock at a weighted average exercise price of $80.70 per share. The assumed warrants expire on various dates in 2019 and 2020.

11. SHARE-BASED COMPENSATION

Equity Incentive Plans

In February 2017, the Company's 2014 Stock Incentive Plan (the "2014 Plan") was terminated as a result of the Merger. There are no awards outstanding under the 2014 Plan and no future awards will be issued under the 2014 Plan.

As of December 31, 2017, there were 1,922,261 options outstanding and no remaining equity awards available for future issuances under the 2008 Plan. All awards granted under the 2008 Plan that, after February 13, 2017, expire or terminate for any reason prior to exercise or settlement, are forfeited, or are reacquired, withheld, or not issued to satisfy a tax withholding obligation or to satisfy the exercise price of a stock award, will become available for grant under the 2016 Plan in accordance with its terms.

The 2016 Plan provides for the grant of incentive stock options, nonstatutory stock options, stock appreciation rights, restricted stock awards, restricted stock unit awards, other stock awards, and performance awards that may be settled in cash, stock, or other property. All employees and non-employee directors are eligible to participate in the 2016 Plan and may receive all types of awards other than incentive stock options. Incentive stock options may be granted under the 2016 Plan only to employees (including officers) and employees of the Company's affiliates.

The aggregate number of shares of Common Stock that may be issued under the 2016 Plan will not exceed 4,182,404 shares, which number is the sum of: (i) 1,681,294 shares, plus (ii) the number of shares subject to outstanding stock awards that were granted under the 2008 Plan, that, from and after the closing date of the Merger, expire or terminate for any reason prior to exercise or settlement, are forfeited because of the failure to meet a contingency or condition required to vest such shares, or are reacquired, withheld, or not issued to satisfy a tax withholding obligation in connection with an award or to satisfy the purchase price or exercise price of a stock award, if any, as such shares become available from time to time, plus (iii) 902,720 shares from previous automatic increases to the share reserve (as described in more detail below), including the automatic

increase of 902,720 shares effected on January 1, 2018. In addition, the share reserve will automatically increase on January 1 of each year, for a period of not more than ten years, commencing on January 1 of the year following the year in which the effective date of the 2016 Plan occurs, and ending on (and including) January 1, 2026, in an amount equal to 4% of the shares of Common Stock outstanding on December 31st of the preceding calendar year; however the board of directors or compensation committee may act prior to January 1 of a given year to provide that there will be no January 1 increase in the share reserve for such year or that the increase in the share reserve for such year will be a lesser number of shares of Common Stock than would otherwise occur pursuant to the automatic increase. As of December 31, 2017, there were 940,298 equity awards outstanding and 742,058 remaining equity awards available for future issuances under the 2016 Plan.

Options granted under the 2008 Plan and 2016 Plan have an exercise price equal to the market value of the Common Stock at the date of grant and expire ten years from the date of grant. Generally, options vest 25% on the first anniversary of the vesting commencement date and 75% ratably in equal monthly installments over the remaining 36 months. The Company has also granted options that vest in equal monthly or quarterly amounts over periods up to 48 months.

A summary of Common Stock option activity is as follows:

	Number of Options (in thousands)	Weighted Average Exercise Price	Weighted Average Remaining Contractual Term (years)	Aggregate Intrinsic Value (in thousands)
Outstanding at December 31, 2015	1,884	$ 0.95		
Granted	793	$ 2.45		
Exercised	(183)	$ (1.17)		
Forfeited	(173)	$ (1.04)		
Outstanding at December 31, 2016	2,321	$ 1.44		
Granted	989	$ 11.37		
Exercised	(412)	$ (0.74)		
Forfeited	(35)	$ (11.36)		
Outstanding at December 31, 2017	2,863	$ 4.85	6.64	$ 17,021
Vested or expected to vest at December 31, 2017	2,863	$ 4.85	6.64	$ 17,021
Exercisable as of December 31, 2017	1,616	$ 2.17	4.84	$ 13,495

The total intrinsic value of stock options exercised during the year ended December 31, 2017 and 2016 was $3.8 million and $0.8 million, respectively. Cash received from the exercise of stock options during the year ended December 31, 2017 and 2016 was $0.3 million and $0.2 million, respectively.

Fair Value Assumptions

The Company uses the Black-Scholes option pricing model to estimate the fair value of stock options granted. The Black-Scholes model requires inputs for risk-free interest rate, dividend yield, volatility, and expected lives of the options. Because the Company has a limited history of stock purchase and sale activity, expected volatility is based on historical data from public companies similar to the Company in size and nature of operations. The Company will continue to use similar entity volatility information until its historical volatility is relevant to measure expected volatility for option grants. The Company accounts for forfeitures as they occur. The risk-free rate for periods within the contractual life of each option is based on the U.S. Treasury yield curve in effect at the time of the grant for a period commensurate with the expected term of the grant. The expected term (without regard to forfeitures) for options granted represents the period of time that options granted are expected to be outstanding and is derived from the contractual terms of the options granted and expected option exercise behaviors. Prior to the Merger, Private Miragen estimated the fair value of underlying shares of common stock using a third-party valuation report that derived the fair value using the probability-weighted expected return method. After the Merger, the fair value of the underlying Common Stock is based on the closing price of the Common Stock on The Nasdaq Capital Market at the date of grant.

Stock Options Granted to Employees

The weighted-average fair value of options granted during the years ended December 31, 2017 and 2016 was $8.27 and $1.69, respectively. The fair value was determined by the Black-Scholes option pricing model using the following assumptions:

	Year Ended December 31,	
	2017	2016
Expected term, in years	6.43	5.00
Expected volatility	83.8%	85.8%
Risk-free interest rate	2.1%	1.3%
Expected dividend yield	—%	—%
Weighted-average grant date fair value of underlying Common Stock	$ 11.37	$ 2.45

Stock Options Granted to Non-Employees

The Company determines the value of Common Stock options issued to non-employees using the Black-Scholes option pricing model and adjusting the value of such awards to current fair value each reporting period until the awards are vested or a performance commitment has otherwise been reached. No Common Stock options were issued to non-employees during the years ended December 31, 2017 and 2016.

Employee Stock Purchase Plan

The 2016 Employee Stock Purchase Plan (“ESPP”) allows qualified employees to purchase shares of the Company's Common Stock at a price equal to 85% of the lower of: (i) the closing price at the beginning of the offering period or (ii) the closing price at the end of the offering period. The Company expects that a new 6-month offering period will begin each August 22 and February 22. As of December 31, 2017, the Company had 0.2 million shares available for issuance and 13 thousand shares had been issued under the ESPP.

Share-Based Compensation Expense

Share-based compensation related to all equity awards issued pursuant to the 2008 Plan and 2016 Plan and for estimated shares to be issued under the ESPP for the current purchase period is included in the consolidated statements of operations as follows:

	Year Ended December 31,	
	2017	2016
	(in thousands)	
Research and development	$ 917	$ 53
General and administrative	1,492	145
Total share-based compensation expense	$ 2,409	$ 198

As of December 31, 2017, the Company had $7.0 million of total unrecognized employee share-based compensation costs, which the Company expects to recognize over a weighted-average remaining period of 3.0 years. As of December 31, 2017, based on the current estimate of fair value, the Company estimates that the remaining unrecognized share-based compensation expense related to non-employees of $42 thousand will be recorded to expense over a weighted-average remaining period of 0.7 years.

12. INCOME TAXES

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 reverse. As a result of the reduction in the federal tax rate, the Company remeasured its ending net deferred tax assets and liabilities as of December 31, 2017. This remeasurement resulted in a $10.8 million revaluation to net deferred tax assets, which was equally offset by a reduction to the recorded valuation allowance.

Since its inception, the Company has incurred net taxable losses, and accordingly, no current provision for income taxes has been recorded. This amount differs from the amount computed by applying the U.S. federal income tax rate of 35.0% to pretax

loss due to the provision of a valuation allowance to the extent of the Company's net deferred tax asset, as well as to state income taxes and nondeductible expenses.

The effective income tax rate of the provision for income taxes differs from the federal statutory rate as follows:

	Year Ended December 31,	
	2017	2016
Federal statutory income tax rate	35.0 %	35.0 %
State income taxes, net of federal benefit	3.1	3.2
Federal and state tax credits	(4.8)	5.2
Transaction costs	(2.9)	—
Amortization of interest and related charges	—	(0.1)
Other permanent items	1.9	(0.4)
Change in valuation allowance	14.5	(43.0)
Change in tax rate	(40.7)	—
Net operating loss reduction	(6.7)	—
Other, net	0.6	0.1
Effective income tax rate	— %	— %

Temporary differences and carryforwards giving rise to deferred tax assets and liabilities were as follows:

	Year Ended December 31,	
	2017	2016
	(in thousands)	
Net operating loss carryforwards	$ 18,257	$ 20,961
Tax credits	2,287	2,785
Accruals and reserves	697	1,182
Start-up costs	829	1,414
Stock-based expense	439	—
Gross deferred tax assets	22,509	26,342
Valuation allowance	(22,509)	(26,342)
Net deferred tax assets	$ —	$ —

At December 31, 2017, the Company had approximately $73.2 million and $2.3 million of net operating loss and research and experimentation tax carryforwards, respectively, which will begin to expire in 2028. In addition, the realization of net operating losses to offset potential future taxable income and related income taxes that would otherwise be due is subject to annual limitations under the provisions of Internal Revenue Code Sections 382 and 383 and similar state provisions, which may result in the expiration of additional net operating losses before future utilization as a result of ownership changes. As a result of these ownership change provisions, the Company estimated an aggregate limitation on the utilization of net operating losses of $4.6 million. In addition to the limitation of net operating losses of $4.6 million, approximately $2.8 million of research and development tax credits were derecognized with the inability of the Company to ever realize a benefit from those credits in the future.

As of December 31, 2017 and 2016, the Company's net deferred tax assets before valuation allowance was $22.5 million and $26.3 million, respectively. In assessing the realizability of its deferred tax assets, the Company considers whether it is more likely than not that some portion or all of its 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. The Company considers the scheduled reversal of deferred tax liabilities, projected future taxable income, and tax planning strategies in making this assessment. As the Company does not have any historical taxable income or projections of future taxable income over the periods in which the deferred tax assets are deductible, and after consideration of its history of operating losses, the Company does not believe it is more likely than not that it will realize the benefits of its net deferred tax assets, and accordingly, has established a valuation allowance equal to 100% of its net deferred tax assets at December 31, 2017 and 2016. The change in valuation allowance was a decrease of $3.8 million in 2017 and an increase of

$7.4 million in 2016.

The Company has concluded that there were no significant uncertain tax positions relevant to the jurisdictions where it is required to file income tax returns requiring recognition in the consolidated financial statements for the years ended 2017 and 2016. As of December 31, 2017 and 2016, the Company had no accrued interest related to uncertain tax positions.

The Company's federal and state returns for 2013 through 2017 remain open to examination by tax authorities.

13. NET LOSS PER SHARE

Basic net loss per share is computed by dividing the net loss available to common stockholders by the weighted-average number of Common Stock outstanding. Diluted net loss per share is computed similarly to basic net loss per share except that the denominator is increased to include the number of additional shares of Common Stock that would have been outstanding if the potential shares of Common Stock had been issued and if the additional shares of Common Stock were dilutive. Diluted net loss per share is the same as basic net loss per share of Common Stock, since the effects of potentially dilutive securities are antidilutive.

Potentially dilutive securities include the following:

	December 31,	
	2017	2016
	(in thousands)	
Options to purchase Common Stock	2,863	2,321
Warrants to purchase Common Stock	49	7
Redeemable convertible preferred stock (1)	—	13,067
Warrants to purchase redeemable convertible preferred stock	—	26
Total	2,912	15,421

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(1) In February 2017, in conjunction with the Merger, all of the outstanding redeemable convertible preferred stock of Private Miragen converted into Private Miragen common stock at a ratio of 1:1 and was immediately exchanged for the Company's Common Stock at an exchange ratio of 0.7031 as a result of the Merger. Share amounts in the table above reflect this conversion.

14. SELECTED QUARTERLY FINANCIAL DATA (UNAUDITED)

The tables below summarize the Company's unaudited quarterly operating results for the year ended December 31, 2017:

	For the Quarters Ended			
	March	June	September	December
	(in thousands)			
Revenue	$ 462	$ 718	$ 1,631	$ 1,192
Research and development expenses	(4,120)	(5,487)	(5,018)	(4,998)
General and administrative expenses	(3,281)	(2,581)	(2,502)	(2,548)
Other income (expense), net	(41)	38	55	(32)
Net loss	$ (6,980)	$ (7,312)	$ (5,834)	$ (6,386)
Net loss available to common stockholders	$ (6,985)	$ (7,312)	$ (5,834)	$ (6,386)
Net loss per share, basic and diluted	$ (0.60)	$ (0.34)	$ (0.27)	$ (0.29)

The tables below summarize the Company's unaudited quarterly operating results for the year ended December 31, 2016:

	For the Quarters Ended			
	March	June	September	December
	(in thousands)			
Revenue	$ 917	$ 1,115	$ 936	$ 509
Research and development expenses	(3,466)	(3,355)	(2,965)	(3,906)
General and administrative expenses	(992)	(1,210)	(2,053)	(2,517)
Other expense, net	(82)	(74)	(71)	(60)
Net loss	$ (3,623)	$ (3,524)	$ (4,153)	$ (5,974)
Net loss available to common stockholders	$ (3,635)	$ (3,536)	$ (4,166)	$ (5,986)
Net loss per share, basic and diluted	$ (5.58)	$ (5.88)	$ (6.92)	$ (9.20)

15. SUBSEQUENT EVENTS

The Company has evaluated subsequent events and has determined there are no other subsequent events other than those presented in the notes above.

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Section 2: EX-4.2 (EXHIBIT 4.2)

Exhibit 4.2

THIS WARRANT AND THE SHARES ISSUABLE HEREUNDER HAVE NOT BEEN REGISTERED UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "**ACT**"), OR THE SECURITIES LAWS OF ANY STATE AND, EXCEPT AS SET FORTH IN SECTIONS 5.3 AND 5.4 BELOW, MAY NOT BE OFFERED, SOLD, PLEDGED OR OTHERWISE TRANSFERRED UNLESS AND UNTIL REGISTERED UNDER SAID ACT AND LAWS OR, IN THE OPINION OF LEGAL COUNSEL IN FORM AND SUBSTANCE SATISFACTORY TO THE ISSUER, SUCH OFFER, SALE, PLEDGE OR OTHER TRANSFER IS EXEMPT FROM SUCH REGISTRATION.

WARRANT TO PURCHASE STOCK

Company: Miragen Therapeutics, Inc., a Delaware corporation
Number of Shares: As set forth in Paragraph A below
Type/Series of Stock: As set forth in Paragraph A below
Warrant Price: As set forth in Paragraph A below
Issue Date: April 30, 2015
Expiration Date: April 30, 2025 **See also Section 5.1(b).**
Credit Facility: This Warrant to Purchase Stock ("**Warrant**") is issued in connection with that certain Loan and Security Agreement of even date herewith between Silicon Valley Bank and the Company (as amended and/or modified and in effect from time to time, the "**Loan Agreement**").

THIS WARRANT CERTIFIES THAT, for good and valuable consideration, SILICON VALLEY BANK (together with any successor or permitted assignee or transferee of this Warrant or of any shares issued upon exercise hereof, "**Holder**") is entitled to purchase up to such number of fully paid and non-assessable shares of the Class (as defined below) of the above-named company (the "**Company**") as determined pursuant to Paragraph A below, at the Warrant Price (as defined below), subject to the provisions and upon the terms and conditions set forth in this Warrant. Reference is made to Section 5.4 of this Warrant whereby

Silicon Valley Bank shall transfer this Warrant to its parent company, SVB Financial Group.

A. Number and Type/Series of Shares; Warrant Price.

(1) Certain Definitions. As used herein, the following definitions have the respective meanings set forth below:

"**Additional Shares**" has the meaning given in Paragraph A(4)(b) below.

"**Equity Financing**" means the sale or issuance by the Company after the Issue Date of this Warrant set forth above, in a single transaction or series of related transactions, of shares of its convertible preferred stock or other senior equity securities to one or more investors for cash for financing purposes.

"**Equity Financing Securities**" means, with respect to any Equity Financing, the type, class and series of convertible preferred stock or other senior equity security sold or issued by the Company in such Equity Financing.

"**Equity Financing Price**" means, with respect to any Equity Financing, the lowest price per share for which Equity Financing Securities are sold or issued by the Company in such Equity Financing.

"**Initial Shares**" has the meaning given in Paragraph A(4)(a) below.

"**Series B Price**" means $6.00, as adjusted from time to time upon the occurrence of events described in Section 2 hereof that occur on or after the Issue Date hereof.

"**Series B Stock**" shall mean the Company's Series B Preferred Stock, $0.001 par value per share, and any securities of the Company into or for which the outstanding shares of Series B Preferred Stock may be converted, reclassified, reorganized or exchanged.

(2) Type/Series of Stock.

(a) Initial Shares Class. The type, class and series of the Company's capital stock for which this Warrant shall be exercisable in respect of the Initial Shares (the "**Initial Shares Class**") shall be Series B Stock, subject to adjustment from time to time in accordance with the provisions of this Warrant.

(b) Additional Shares Class. The type, class and series of the Company's capital stock for which this Warrant shall be exercisable in respect of the Additional Shares, if any (the "**Additional Shares Class**") shall be Series B Stock, subject to adjustment from time to time in accordance with the provisions of this Warrant; provided, that if, on or prior to the date (if any) on which this Warrant becomes exercisable for the Additional Shares, there shall have occurred one or more Equity Financings, then "Additional Shares Class" shall mean the Equity Financing Securities sold and issued by the Company in the then-most recent such Equity Financing, subject to adjustment thereafter from time to time in accordance with the provisions of this Warrant.

(c) Class. As used in this Warrant, "**Class**" shall mean and refer to the Initial Shares Class in respect of the Initial Shares, and the Additional Shares Class in respect of the Additional Shares (if any).

(3) Warrant Price.

(a) Initial Shares Warrant Price. The purchase price per Initial Share hereunder (the "**Initial Shares Warrant Price**") shall be the Series B Price, subject to adjustment from time to time in accordance with the provisions of this Warrant.

(b) Additional Shares Warrant Price. The purchase price per Additional Share (if any) hereunder (the "**Additional Shares Warrant Price**") shall be the Series B Price, subject to adjustment from time to time in accordance with the provisions of this Warrant; provided, that if, on or prior to the date (if any) on any Funded Tranche B Loan (as defined below) is made, there shall have occurred one or more Equity Financings, then the "Additional Shares Warrant Price" with respect to the Additional Shares for which this Warrant becomes exercisable with respect to such Funded Tranche B Loan shall mean the Equity Financing Price of the then-most recent such Equity Financing, subject to adjustment thereafter from time to time in accordance with the provisions of this Warrant.

(c) Warrant Price. As used in this Warrant, "**Warrant Price**" shall mean the Initial Shares Warrant Price in respect of the Initial Shares, and the Additional Shares Warrant Price in respect of the Additional Shares (if any).

(4) Number of Shares. This Warrant shall be exercisable for the Initial Shares, plus the Additional Shares, if any (collectively, and as may be adjusted from time to time in accordance with the provisions hereof, the "**Shares**").

(a) Initial Shares. As used herein, "**Initial Shares**" means 16,667 shares of the Initial Shares Class, subject to adjustment from time to time in accordance with the provisions of this Warrant.

(b) Additional Shares. Upon the funding by Holder, if any, of each Term Loan in Tranche B (as such terms are defined in the Loan Agreement) to the Company in any amount (each, a "**Funded Tranche B Loan**") this Warrant automatically shall become exercisable for such number of additional shares of the Additional Shares Class as shall equal (i) two percent (2%) of the principal amount of such Funded Tranche B Loan, divided by (ii) the Additional Shares Warrant Price applicable to such Funded Tranche B Loan, subject to adjustment from time to time thereafter in accordance with the provisions of this Warrant. All shares (if any) for which this Warrant becomes exercisable in accordance with the provisions of this Paragraph A (4)(b) are referred to herein collectively as the "**Additional Shares").**

SECTION 1. EXERCISE.

1.1 Method of Exercise. Holder may at any time and from time to time through the Expiration Date exercise this Warrant, in whole or in part, by delivering to the Company the original of this Warrant together with a duly executed Notice of Exercise in substantially the form attached hereto as Appendix 1 and, unless Holder is exercising this Warrant pursuant to a cashless exercise set forth in Section 1.2, a check, wire transfer of same-day funds (to an account designated by the Company), or other form of payment acceptable to the Company for the aggregate Warrant Price for the Shares being purchased.

1.2 Cashless Exercise. On any exercise of this Warrant, in lieu of payment of the aggregate Warrant Price in the manner as specified in Section 1.1 above, but otherwise in accordance with the requirements of Section 1.1, Holder may elect to receive Shares equal to the value of this Warrant, or portion hereof as to which this Warrant is being exercised. Thereupon, the Company shall issue to the Holder such number of fully paid and non-assessable Shares as are computed using the following formula:

$$X = Y(A-B)/A$$

where:

X = the number of Shares to be issued to the Holder;

Y = the number of Shares with respect to which this Warrant is being exercised (inclusive of the Shares surrendered to the Company in payment of the aggregate Warrant Price);

A = the Fair Market Value (as determined pursuant to Section 1.3 below) of one Share; and

B = the Warrant Price.

1.3 Fair Market Value. If the Company's common stock is then traded or quoted on a nationally recognized securities exchange, inter-dealer quotation system or over-the-counter market (a "**Trading Market**") and the Class is common stock, the fair market value of a Share shall be the closing price or last sale price of a share of common stock reported for the Business Day immediately before the date on which Holder delivers the original of this Warrant together with its Notice of Exercise to the Company. If the Company's common stock is then traded in a Trading Market and the Class is a series of the Company's convertible preferred stock, the fair market value of a Share shall be the closing price or last sale price of a share of the Company's common stock reported for the Business Day immediately before the date on which Holder delivers the original of this Warrant together with its Notice of Exercise to the Company multiplied by the number of shares of the Company's common stock into which a Share is then convertible. If the Company's common stock is not traded in a Trading Market, the Board of Directors of the Company shall determine the fair market value of a Share in its reasonable good faith judgment.

1.4 Delivery of Certificate and New Warrant. Within a reasonable time after Holder exercises this Warrant in the manner set forth in Section 1.1 or 1.2 above, the Company shall deliver to Holder a certificate representing the Shares issued to Holder upon such exercise and, if this Warrant has not been fully exercised and has not expired, a new warrant of like tenor representing the Shares not so acquired.

1.5 Replacement of Warrant. On receipt of evidence reasonably satisfactory to the Company of the loss, theft, destruction or mutilation of this Warrant and, in the case of loss, theft or destruction, on delivery of an indemnity agreement reasonably satisfactory in form, substance and amount to the Company or, in the case of mutilation, on surrender of the original of this Warrant to the Company for cancellation, the Company shall, within a reasonable time, execute and deliver to Holder, in lieu of this Warrant, a new warrant of like tenor and amount.

1.6 Treatment of Warrant Upon Acquisition of Company.

(a) Acquisition. For the purpose of this Warrant, "**Acquisition**" means any transaction or series of related transactions involving: (i) the sale, lease, exclusive license, or other disposition of all or substantially all of the assets of the Company (ii) any merger or consolidation of the Company into or with another person or entity (other than a merger or consolidation effected exclusively to change the Company's domicile), or any other corporate reorganization, in which the stockholders of the Company in their capacity as such immediately prior to such merger, consolidation or reorganization, own less than a majority of the Company's (or the surviving or successor entity's) outstanding voting power immediately after such merger, consolidation or reorganization (or, if such Company stockholders beneficially own a majority of the outstanding voting power of the surviving or successor entity as of immediately after such merger, consolidation or reorganization, such surviving or successor entity is not the Company); or (iii) any sale or other transfer by the stockholders of the Company of shares representing at least a majority of the Company's then-total outstanding combined voting power; provided, that "Acquisition" shall not include the sale and issuance by the Company of shares of its capital stock to one or more investors for

cash and/or conversion of indebtedness in a transaction or series of related transactions the principal purpose of which is the bona fide equity financing of the Company.

(b) Treatment of Warrant at Acquisition. In the event of an Acquisition in which the consideration to be received by the Company's stockholders consists solely of cash, solely of Marketable Securities or a combination of cash and Marketable Securities (a "**Cash/Public Acquisition**"), and the fair market value of one Share as determined in accordance with Section 1.3 above would be greater than the Warrant Price in effect on such date immediately prior to such Cash/Public Acquisition, and Holder has not exercised this Warrant pursuant to Section 1.1 above as to all Shares, then this Warrant shall automatically be deemed to be cashless exercised pursuant to Section 1.2 above as to all Shares effective immediately prior to and contingent upon the consummation of a Cash/Public Acquisition. In connection with such cashless exercise pursuant to Section 1.2 above, Holder shall be deemed to have restated each of the representations and warranties in Section 4 of the Warrant as of the date thereof and the Company shall promptly notify the Holder of the number of Shares (or such other securities) issued upon cashless exercise. In the event of a Cash/Public Acquisition where the fair market value of one Share as determined in accordance with Section 1.3 above would be less than the Warrant Price in effect immediately prior to such Cash/Public Acquisition, then this Warrant will expire immediately prior to the consummation of such Cash/Public Acquisition.

(c) Upon the closing of any Acquisition other than a Cash/Public Acquisition, the acquiring, surviving or successor entity shall assume the obligations of this Warrant, and this Warrant shall thereafter be exercisable for the same securities and/or other property as would have been paid for the Shares issuable upon exercise of the unexercised portion of this Warrant as if such Shares were outstanding on and as of the closing of such Acquisition, subject to further adjustment from time to time in accordance with the provisions of this Warrant.

(d) As used in this Warrant, "**Marketable Securities**" means securities meeting all of the following requirements: (i) the issuer thereof is then subject to the reporting requirements of Section 13 or Section 15(d) of the Securities Exchange Act of 1934, as amended (the "**Exchange Act**"), and is then current in its filing of all required reports and other information under the Act and the Exchange Act; (ii) the class and series of shares or other security of the issuer that would be received by Holder in connection with the Acquisition were Holder to exercise this Warrant on or prior to the closing thereof is then traded in a Trading Market, and (iii) following the closing of such Acquisition, Holder would not be restricted from publicly re-selling all of the issuer's shares and/or other securities that would be received by Holder in such Acquisition were Holder to exercise this Warrant in full on or prior to the closing of such Acquisition, except to the extent that any such restriction (x) arises solely under federal or state securities laws, rules or regulations, and (y) does not extend beyond six (6) months from the closing of such Acquisition.

1.7 Holder Put Right. Notwithstanding the provisions of Section 1.6 above or any other provision of this Warrant to the contrary, in connection with (i) an Acquisition or IPO (as hereinafter defined), (ii) the liquidation, dissolution or winding up of the Company, or (iii) the expiration of this Warrant, in each case occurring prior to the exercise of this Warrant by Holder in whole or in part, Holder shall have the one-time right (but not the obligation), exercisable in its sole discretion upon written notice to the Company (the "**Put Notice**") given not less than:

(w) in the case of an Acquisition, ten (10) days following the Company's written notice to Holder specifying the final agreed determination of the total

consideration to be paid in respect of one share of the Class in connection therewith,

(x) in the case of the IPO, ten (10) days following the consummation thereof,

(y) in the case of a liquidation, dissolution or winding-up of the Company, ten (10) days following the Company's written notice to Holder of its final determination of the aggregate amounts (if any) to be distributed in respect of each share of the Class, or

(z) in the case of expiration, thirty (30) days prior to the Expiration Date,

to require the Company to repurchase from Holder all (but not less than all) of this Warrant (and the Company hereby agrees to repurchase this Warrant from Holder upon Holder's exercise of such right) for a total aggregate purchase price equal to the sum of (A) One Hundred Thousand Dollars ($100,000.00) and (B) two percent (2%) of the aggregate principal amount of the Term Loan (s) in Tranche B, if any, actually funded by Holder to the Company on or before the date of the Put Notice and regardless of whether any such Term Loan in Tranche B is then still outstanding (such sum, which in no event shall exceed $200,000, the "**Repurchase Price**"), such Repurchase Price to be paid by the Company to Holder in cash in a single installment of immediately available funds at the Put Closing (as defined below), against surrender by Holder to the Company thereat of the original of this Warrant, duly endorsed for transfer on the books of the Company or accompanied by duly executed stock powers and/or other instruments of assignment or transfer. As used in this Section 1.7, "**Put Closing**" means such date as shall be set forth in Holder's Put Notice on which the closing of the Company's repurchase of this Warrant shall occur, which date shall be

(A) in the event of a repurchase in connection with an Acquisition, the later of (i) the closing thereof, and (ii) ten (10) days following the date of Holder's Put Notice (or, if the same shall not be a Business Day (as hereinafter defined), then on the first Business Day following such tenth day),

(B) in the event of a repurchase in connection with the IPO, ten (10) days following the date of Holder's Put Notice (or, if the same shall not be a Business Day, then on the first Business Day following such tenth day),

(C) in the event of a repurchase in connection with the liquidation, dissolution or winding-up of the Company, the date of the first distribution made to holders of shares of the Class in connection therewith, or, if no such distribution is anticipated to be made, ten (10) days following the date of Holder's Put Notice (or, if the same shall not be a Business Day, then on the first Business Day following such tenth day), or

(D) in the event of a repurchase in connection with the expiration of this Warrant, the Expiration Date (or, if the same shall not be a Business Day, then on the first Business Day following such Expiration Date);

Notwithstanding anything in this Warrant to the contrary, (y) upon the delivery of the Put Notice, but subject to the consummation both of the event giving rise to Holder's delivery thereof and of the Put

Closing, this Warrant shall cease to be exercisable and (z) upon the consummation of both the event giving rise to Holder's delivery of the Put Notice and the Put Closing, this Warrant shall terminate and be of no further force or effect.

1.8 Certain Agreements. Upon any exercise of this Warrant and solely with respect to the Shares issued thereupon (and the shares of Common Stock, if any, issued upon conversion of such Shares), Holder shall, if the Company so requests in writing, become a party to, by execution and delivery to the Company of a counterpart signature page, joinder agreement, instrument of accession or similar instrument, the Company's Second Amended and Restated Voting Agreement, dated as of April 10, 2012, by and among the Company and certain of its stockholders, as such agreement may be amended from time to time (the "**Voting Agreement**"), and to be deemed an "Investor" under the Voting Agreement for purposes thereof, only if (i) all holders of outstanding shares of the Class are then parties thereto, and (ii) such agreement is then by its terms in force and effect. Provided that the conditions described in the foregoing clauses (i) and (ii) are met as to the Voting Agreement at the time of any exercise of this Warrant, Holder shall, effective upon such exercise, automatically become bound by, and the Shares issued upon such exercise (and the shares of Common Stock, if any, issuable upon conversion of such Shares), automatically become subject to, such Voting Agreement.

SECTION 2. ADJUSTMENTS TO THE SHARES AND WARRANT PRICE.

2.1 Stock Dividends, Splits, Etc. If the Company declares or pays a dividend or distribution on the outstanding shares of the Class payable in common stock or other securities or property (other than cash), then upon exercise of this Warrant, for each Share acquired, Holder shall receive, without additional cost to Holder, the total number and kind of securities and property which Holder would have received had Holder owned the Shares of record as of the date the dividend or distribution occurred. If the Company subdivides the outstanding shares of the Class by reclassification or otherwise into a greater number of shares, the number of Shares purchasable hereunder shall be proportionately increased and the Warrant Price shall be proportionately decreased. If the outstanding shares of the Class are combined or consolidated, by reclassification or otherwise, into a lesser number of shares, the Warrant Price shall be proportionately increased and the number of Shares shall be proportionately decreased.

2.2 Reclassification, Exchange, Combinations or Substitution. Upon any event whereby all of the outstanding shares of the Class are reclassified, exchanged, combined, substituted, or replaced for, into, with or by Company securities of a different class and/or series, then from and after the consummation of such event, this Warrant will be exercisable for the number, class and series of Company securities that Holder would have received had the Shares been outstanding on and as of the consummation of such event, and subject to further adjustment thereafter from time to time in accordance with the provisions of this Warrant. The provisions of this Section 2.2 shall similarly apply to successive reclassifications, exchanges, combinations, substitutions, replacements or other similar events.

2.3 Conversion of Preferred Stock. If the Class is a class and series of the Company's convertible preferred stock, in the event that all outstanding shares of the Class are converted, automatically or by action of the holders thereof, into common stock pursuant to the provisions of the Company's Certificate of Incorporation, including, without limitation, in connection with the Company's initial, underwritten public offering and sale of its common stock pursuant to an effective registration statement under the Act (the "**IPO**"), then from and after the date on which all outstanding shares of the Class have been so converted, this Warrant shall be exercisable for such number of shares of common stock into which

the Shares would have been converted had the Shares been outstanding on the date of such conversion, and the Warrant Price shall equal the Warrant Price in effect as of immediately prior to such conversion divided by the number of shares of common stock into which one Share would have been converted, all subject to further adjustment thereafter from time to time in accordance with the provisions of this Warrant.

2.4 Adjustments for Diluting Issuances. Without duplication of any adjustment otherwise provided for in this Section 2, the number of shares of common stock issuable upon conversion of the Shares shall be subject to anti-dilution adjustment from time to time in the manner set forth in the Company's Certificate of Incorporation as if the Shares were issued and outstanding on and as of the date of any such required adjustment.

2.5 No Fractional Share. No fractional Share shall be issuable upon exercise of this Warrant and the number of Shares to be issued shall be rounded down to the nearest whole Share. If a fractional Share interest arises upon any exercise of the Warrant, the Company shall eliminate such fractional Share interest by paying Holder in cash the amount computed by multiplying the fractional interest by (i) the fair market value (as determined in accordance with Section 1.3 above) of a full Share, less (ii) the then-effective Warrant Price.

2.6 Notice/Certificate as to Adjustments. Upon each adjustment of the Warrant Price, Class and/or number of Shares, the Company, at the Company's expense, shall notify Holder in writing within a reasonable time setting forth the adjustments to the Warrant Price, Class and/or number of Shares and facts upon which such adjustment is based. The Company shall, upon written request from Holder, furnish Holder with a certificate of its Chief Financial Officer, including computations of such adjustment and the Warrant Price, Class and number of Shares in effect upon the date of such adjustment.

SECTION 3. REPRESENTATIONS AND COVENANTS OF THE COMPANY.

3.1 Representations and Warranties. The Company represents and warrants to, and agrees with, the Holder as follows:

(a) The Series B Price first set forth above is not greater than the price per share at which shares of Series B Stock were last sold and issued prior to the Issue Date hereof in an arms-length transaction in which at least $500,000 of such shares were sold.

(b) All Shares which may be issued upon the exercise of this Warrant, and all securities, if any, issuable upon conversion of the Shares, shall, upon issuance, be duly authorized, validly issued, fully paid and non-assessable, and free of any liens and encumbrances except for restrictions on transfer provided for herein, under the Company's Bylaws, under the Voting Agreement (to the extent Holder is then subject thereto pursuant to Section 1.8 above), under the Investor Rights Agreement (as defined below) to the extent Holder is then a party thereto, or under applicable federal and state securities laws. The Company covenants that it shall at all times cause to be reserved and kept available out of its authorized and unissued capital stock such number of shares of the Class, common stock and other securities as will be sufficient to permit the exercise in full of this Warrant and the conversion of the Shares into common stock or such other securities.

(c) The Company's capitalization table attached hereto as Schedule 1 is true and complete, in all material respects, as of the Issue Date.

3.2 Notice of Certain Events. If the Company proposes at any time to:

(a) declare any dividend or distribution upon the outstanding shares of the Class or common stock, whether in cash, property, stock, or other securities and whether or not a regular cash dividend;

(b) offer for subscription or sale pro rata to the holders of the outstanding shares of the Class any additional shares of any class or series of the Company's stock (other than pursuant to contractual pre-emptive rights);

(c) effect any reclassification, exchange, combination, substitution, reorganization or recapitalization of the outstanding shares of the Class;

(d) effect an Acquisition or to liquidate, dissolve or wind up; or

(e) effect an IPO;

then, in connection with each such event, the Company shall give Holder:

(1) in the case of the matters referred to in (a) and (b) above, at least seven (7) Business Days prior written notice of the earlier to occur of the effective date thereof or the date on which a record will be taken for such dividend, distribution, or subscription rights (and specifying the date on which the holders of outstanding shares of the Class will be entitled thereto) or for determining rights to vote, if any;

(2) in the case of the matters referred to in (c) and (d) above, at least seven (7) Business Days prior written notice of the date when the same will take place (and specifying the date on which the holders of outstanding shares of the Class will be entitled to exchange their shares for the securities or other property deliverable upon the occurrence of such event and such reasonable information as Holder may reasonably require regarding the treatment of this Warrant in connection with such event giving rise to the notice); and

(3) with respect to the IPO, at least seven (7) Business Days prior written notice of the date on which the Company proposes to file its registration statement in connection therewith.

The Company will also provide information requested by Holder that is reasonably necessary to enable Holder to comply with Holder's accounting or reporting requirements.

SECTION 4. REPRESENTATIONS, WARRANTIES OF THE HOLDER.

The Holder represents and warrants to the Company as follows:

4.1 Purchase for Own Account. This Warrant and the securities to be acquired upon exercise of this Warrant by Holder are being acquired for investment for Holder's account, not as a nominee or agent, and not with a view to the public resale or distribution within the meaning of the Act. Holder also represents that it has not been formed for the specific purpose of acquiring this Warrant or the Shares.

4.2 Disclosure of Information. Holder is aware of the Company's business affairs and financial condition and has received or has had full access to all the information it considers necessary or appropriate to make an informed investment decision with respect to the acquisition of this Warrant and its underlying securities. Holder further has had an opportunity to ask questions and receive answers from the Company regarding the terms and conditions of the offering of this Warrant and its underlying securities and to obtain additional information (to the extent the Company possessed such information or could acquire it without unreasonable effort or expense) necessary to verify any information furnished to Holder or to which Holder has access.

4.3 Investment Experience. Holder understands that the purchase of this Warrant and its underlying securities involves substantial risk. Holder has experience as an investor in securities of companies in the development stage and acknowledges that Holder can bear the economic risk of such Holder's investment in this Warrant and its underlying securities and has such knowledge and experience in financial or business matters that Holder is capable of evaluating the merits and risks of its investment in this Warrant and its underlying securities and/or has a preexisting personal or business relationship with the Company and certain of its officers, directors or controlling persons of a nature and duration that enables Holder to be aware of the character, business acumen and financial circumstances of such persons.

4.4 Accredited Investor Status. Holder is an "accredited investor" within the meaning of Regulation D promulgated under the Act.

4.5 The Act. Holder understands that this Warrant and the Shares issuable upon exercise hereof have not been registered under the Act in reliance upon a specific exemption therefrom, which exemption depends upon, among other things, the bona fide nature of the Holder's investment intent as expressed herein. Holder understands that this Warrant and the Shares issued upon any exercise hereof must be held indefinitely unless subsequently registered under the Act and qualified under applicable state securities laws, or unless exemption from such registration and qualification are otherwise available. Holder is aware of the provisions of Rule 144 promulgated under the Act.

4.6 Market Stand-off Agreement. The Holder agrees that the Shares shall be subject to the Market Standoff provisions in Sections 2.11 and 2.12 of the Company's Second Amended and Restated Investor Rights Agreement, dated as of April 10, 2012, by and among the Company and certain of its stockholders, as amended and in effect from time to time (the "**Investor Rights Agreement**").

4.7 No Shareholder Rights. Without limitation of any provision of this Warrant, Holder agrees that as a Holder of this Warrant it will not have any rights as a shareholder of the Company (including, but not limited to, voting rights) in respect of the Shares issuable hereunder unless and until the exercise of this Warrant.

SECTION 5. MISCELLANEOUS.

5.1 Term; Automatic Cashless Exercise Upon Expiration.

(a) Term. Subject to the provisions of Sections 1.6 and 1.7 above, this Warrant is exercisable in whole or in part at any time and from time to time on or before 6:00 PM, Pacific time, on the Expiration Date and shall be void thereafter.

(b) Automatic Cashless Exercise upon Expiration. In the event that, upon the Expiration Date, the fair market value of one Share (or other security issuable upon the exercise hereof) as determined in accordance with Section 1.3 above is greater than the Warrant Price in effect on such date, then this Warrant, to the extent unexercised, shall automatically be deemed on and as of such date to be exercised pursuant to Section 1.2 above as to all Shares (or such other securities) for which it shall not previously have been exercised, and the Company shall, within a reasonable time, deliver a certificate representing the Shares (or such other securities) issued upon such exercise to Holder.

5.2 Legends. Each certificate evidencing Shares (and each certificate evidencing securities issued upon conversion of any Shares, if any) shall be imprinted with a legend in substantially the following form:

> THE SHARES EVIDENCED BY THIS CERTIFICATE HAVE NOT BEEN REGISTERED UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "**ACT**"), OR THE SECURITIES LAWS OF ANY STATE AND, EXCEPT AS SET FORTH IN THAT CERTAIN WARRANT TO PURCHASE STOCK ISSUED BY THE ISSUER TO SILICON VALLEY BANK DATED APRIL __, 2015, MAY NOT BE OFFERED, SOLD, PLEDGED OR OTHERWISE TRANSFERRED UNLESS AND UNTIL REGISTERED UNDER SAID ACT AND LAWS OR, IN THE OPINION OF LEGAL COUNSEL IN FORM AND SUBSTANCE SATISFACTORY TO THE ISSUER, SUCH OFFER, SALE, PLEDGE OR OTHER TRANSFER IS EXEMPT FROM SUCH REGISTRATION.

5.3 Compliance with Securities Laws on Transfer. This Warrant and the Shares issued upon exercise of this Warrant (and the securities issuable, directly or indirectly, upon conversion of the Shares, if any) may not be transferred or assigned in whole or in part except in compliance with applicable federal and state securities laws by the transferor and the transferee (including, without limitation, the delivery of investment representation letters and legal opinions reasonably satisfactory to the Company, as reasonably requested by the Company). The Company shall not require Holder to provide an opinion of counsel if the transfer is to SVB Financial Group (Silicon Valley Bank's parent company) or any other affiliate of Holder, provided that any such transferee is an "accredited investor" as defined in Regulation D promulgated under the Act. Additionally, the Company shall also not require an opinion of counsel if there is no material question as to the availability of Rule 144 promulgated under the Act.

5.4 Transfer Procedure. After receipt by Silicon Valley Bank of the executed Warrant, Silicon Valley Bank will transfer all of this Warrant to its parent company, SVB Financial Group. By its acceptance of this Warrant, SVB Financial Group hereby makes to the Company each of the representations and warranties set forth in Section 4 hereof and agrees to be bound by all of the terms and conditions of this Warrant as if the original Holder hereof. Subject to the provisions of Section 5.3 and upon providing the Company with written notice, SVB Financial Group and any subsequent Holder may transfer all or part of this Warrant or the Shares issued upon exercise of this Warrant (or the securities issued upon conversion of the Shares, if any) to any transferee, provided, however, in connection with any such transfer, SVB Financial Group or any subsequent Holder will give the Company notice of the portion of the Warrant and/or Shares (and/or securities issued upon conversion of the Shares, if any) being transferred with the name, address and taxpayer identification number of the transferee and Holder will surrender this Warrant to the Company for reissuance to the transferee(s) (and Holder if applicable); and provided further, that any subsequent transferee other than SVB Financial Group shall agree in writing with the Company to be bound

by all of the terms and conditions of this Warrant. Notwithstanding any contrary provision herein, at all times prior to the IPO, Holder may not, without the Company's prior written consent, transfer this Warrant or any portion hereof, or any Shares issued upon any exercise hereof, or any shares or other securities issued upon any conversion of any Shares issued upon any exercise hereof, to any person or entity who directly competes with the Company, except in connection with an Acquisition of the Company by such a direct competitor.

5.5 Notices. All notices and other communications hereunder from the Company to the Holder, or vice versa, shall be deemed delivered and effective (i) when given personally, (ii) on the third (3rd) Business Day after being mailed by first-class registered or certified mail, postage prepaid, (iii) upon actual receipt if given by facsimile or electronic mail and such receipt is confirmed in writing by the recipient, or (iv) on the first Business Day following delivery to a reliable overnight courier service, courier fee prepaid, in any case at such address as may have been furnished to the Company or Holder, as the case may be, in writing by the Company or such Holder from time to time in accordance with the provisions of this Section 5.5. All notices to Holder shall be addressed as follows until the Company receives notice of a change of address in connection with a transfer or otherwise:

SVB Financial Group
Attn: Treasury Department
3003 Tasman Drive, HC 215
Santa Clara, CA 95054
Telephone: (408) 654-7400
Facsimile: (408) 988-8317
Email address: derivatives@svb.com

Notice to the Company shall be addressed as follows until Holder receives notice of a change in address:

Miragen Therapeutics, Inc.
Attn: Chief Financial Officer
6200 Lookout Road #100
Boulder, CO 80301
Telephone: (720) 407-4600
Facsimile: (303) 531-5094
Email: jleverone@miragenrx.com

5.6 Waiver. This Warrant and any term hereof may be changed, waived, discharged or terminated (either generally or in a particular instance and either retroactively or prospectively) only by an instrument in writing signed by the party against which enforcement of such change, waiver, discharge or termination is sought.

5.7 Attorneys' Fees. In the event of any dispute between the parties concerning the terms and provisions of this Warrant, the party prevailing in such dispute shall be entitled to collect from the other party all costs incurred in such dispute, including reasonable attorneys' fees.

5.8 Counterparts; Facsimile/Electronic Signatures. This Warrant may be executed in counterparts, all of which together shall constitute one and the same agreement. Any signature page

delivered electronically or by facsimile shall be binding to the same extent as an original signature page with regards to any agreement subject to the terms hereof or any amendment thereto.

5.9 Governing Law. This Warrant shall be governed by and construed in accordance with the laws of the State of California, without giving effect to its principles regarding conflicts of law.

5.10 Headings. The headings in this Warrant are for purposes of reference only and shall not limit or otherwise affect the meaning of any provision of this Warrant.

5.11 Business Days. "**Business Day**" is any day that is not a Saturday, Sunday or a day on which Silicon Valley Bank is closed.

5.12 Confidentiality. Holder agrees that all Company information and notices provided to Holder hereunder shall be treated and held by it in confidence in accordance with the provisions of Section 12.8 of the Loan Agreement.

[Remainder of page left blank intentionally]
[Signature page follows]

IN WITNESS WHEREOF, the parties have caused this Warrant to Purchase Stock to be executed by their duly authorized representatives effective as of the Issue Date written above.

"COMPANY"

MIRAGEN THERAPEUTICS, INC.

By: /s/ Jason Leverone

Name: Jason Leverone

(Print)

Title: CFO

"HOLDER"

SILICON VALLEY BANK

By: /s/Benjaman Johnson

Name: Benjaman Johnson

(Print)

Title: Managing Director

APPENDIX 1

NOTICE OF EXERCISE

1. The undersigned Holder hereby exercises its right to purchase _____ shares of the Common/Series _____ Preferred [circle one] Stock of _____ (the "**Company**") in accordance with the attached Warrant To Purchase Stock, and tenders payment of the aggregate Warrant Price for such shares as follows:

[ ] check in the amount of $_____ payable to order of the Company enclosed herewith

[ ] Wire transfer of immediately available funds to the Company's account

[ ] Cashless Exercise pursuant to Section 1.2 of the Warrant

[ ] Other [Describe] _____

2. Please issue a certificate or certificates representing the Shares in the name specified below:

_____
Holder's Name

_____

_____
(Address)

3. By its execution below and for the benefit of the Company, Holder hereby restates each of the representations and warranties in Section 4 of the Warrant to Purchase Stock as of the date hereof.

HOLDER:

_____

By:_____

Name:_____

Title:_____

(Date):_____

SCHEDULE 1

Company Capitalization Table

See attached

1821443.4

Schedule 1

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Section 3: EX-21.1 (EXHIBIT 21.1)

Exhibit 21.1

Subsidiaries of the Registrant
(as of March 15, 2018)

Name of Subsidiary	Jurisdiction of Incorporation
Miragen Therapeutics Europe Limited	England and Wales

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Section 4: EX-23.1 (EXHIBIT 23.1)

Exhibit 23.1

Consent of Independent Registered Public Accounting Firm

The Board of Directors
Miragen Therapeutics, Inc.:

We consent to the incorporation by reference in the registration statements (No. 333-217084) on Form S-3 and (No. 333-216112) on Form S-8 of Miragen Therapeutics, Inc. of our report dated March 15, 2018 with respect to the consolidated balance sheets of Miragen Therapeutics, Inc. as of December 31, 2017 and 2016, and the related consolidated statements of operations, changed in preferred stock and stockholders' equity (deficit), and cash flows for the years then ended, and the related notes (collectively, the consolidated financial statements) which report appears in the December 31, 2017 annual report on Form 10-K of Miragen Therapeutics, Inc.

/s/ KPMG LLP
Denver, Colorado
March 15, 2018

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Section 5: EX-31.1 (EXHIBIT 31.1)

Exhibit 31.1

CERTIFICATION

I, William S. Marshall, Ph.D., certify that:

1. I have reviewed this Annual Report on Form 10-K, or this report, of Miragen Therapeutics, Inc., a Delaware corporation;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a–15(e) and 15d–15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or person performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 15, 2018

By: /s/ William S. Marshall

William S. Marshall, Ph.D.
Chief Executive Officer
(Principal Executive Officer)

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Section 6: EX-31.2 (EXHIBIT 31.2)

Exhibit 31.2

CERTIFICATION

I, Jason A. Leverone, certify that:

1. I have reviewed this Annual Report on Form 10-K, or this report, of Miragen Therapeutics, Inc., a Delaware corporation;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a–15(e) and 15d–15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or person performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 15, 2018

By: /s/ Jason A. Leverone

Jason A. Leverone
Chief Financial Officer
(Principal Financial Officer; Principal Accounting Officer)

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Section 7: EX-32.1 (EXHIBIT 32.1)

Exhibit 32.1

SECTION 1350 CERTIFICATION

Each of the undersigned, William S. Marshall, Chief Executive Officer of Miragen Therapeutics, Inc., a Delaware corporation (the "Company"), and Jason A. Leverone, Chief Financial Officer of the Company, do hereby certify, pursuant to 18 U.S.C. Section 1350 as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to the best of his knowledge (1) the Annual Report on Form 10-K of the Company for the annual period ended December 31, 2017, as filed with the Securities and Exchange Commission on the date hereof (the "Report"), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended, and (2) the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

/s/ William S. Marshall

William S. Marshall, Ph.D.
Chief Executive Officer
(Principal Executive Officer)
Date: March 15, 2018

/s/ Jason A. Leverone

Jason A. Leverone
Chief Financial Officer
(Principal Financial Officer; Principal Accounting Officer)
Date: March 15, 2018

This certification accompanies and is being "furnished" with this Report, shall not be deemed "filed" by the Company for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or otherwise subject to liability under that Section and shall not be deemed to be incorporated by reference into any filing of the Company under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended, whether made before or after the date of this Report, irrespective of any general incorporation language contained in such filing. A signed original of this written statement required by Section 906, or other document authenticating, acknowledging, or otherwise adopting the signature that appears in typed form within the electronic version of this written statement required by Section 906, has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.

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