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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, 2013

or

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

For the transition period from to .

Commission file number 001-36183

CELLADON CORPORATION
(Exact name of registrant as specified in its charter)

Delaware	**33-0971591**
(State or other jurisdiction of incorporation or organization)	**(I.R.S. Employer Identification No.)**
12760 High Bluff Drive, Suite 240, San Diego, CA	**92130**
(Address of principal executive offices)	**(Zip Code)**

(858) 366-4288
(Registrant's telephone number, including area code)

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

Title of each class	Name of each exchange on which registered
Common Stock, par value $0.0001 per share	**The NASDAQ Global Market**

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

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

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

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

Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Website, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§229.405 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, or a smaller reporting company. See the definitions of "large accelerated filer," "accelerated filer" and "smaller reporting 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	☒

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

The registrant did not have a public float on the last business day of its most recently completed second fiscal quarter because there was no public market for the registrant's common equity as of such date.

The number of outstanding shares of the registrant's common stock as of March 24, 2014 was 18,500,015.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's definitive Proxy Statement for the registrant's 2014 Annual Meeting of Stockholders to be filed with the Securities and Exchange Commission within 120 days after registrant's fiscal year ended December 31, 2013 are incorporated by reference into Part III of this report.

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CELLADON CORPORATION
Form 10-K
For the Fiscal Year Ended December 31, 2013

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PART I

Forward-Looking Statements

This Annual Report on Form 10-K, including the sections entitled “Business,” “Risk Factors” and “Management’s Discussion and Analysis of Financial Condition and Results of Operations,” may contain “forward-looking statements.” We may, in some cases, use words such as “anticipate,” “believe,” “could,” “estimate,” “expect,” “intend,” “may,” “plan,” “potential,” “predict,” “project,” “should,” “will,” “would” or the negative of those terms, and similar expressions that convey uncertainty of future events or outcomes, to identify these forward-looking statements. Any statements contained herein that are not statements of historical facts may be deemed to be forward-looking statements. Forward-looking statements in this Annual Report include, but are not limited to, statements about:

- the success, cost and timing of our product development activities and clinical trials;
- our ability to obtain and maintain regulatory approval for MYDICAR, our companion diagnostic, and any of our future product candidates, and any related restrictions, limitations, and/or warnings in the label of an approved product candidate;
- our ability to obtain funding for our operations, including funding necessary to complete all clinical trials that may potentially be required to file a biologics license application, or BLA, and a Marketing Authorization Application, or MAA, for MYDICAR for the treatment of systolic heart failure;
- the commercialization of our product candidates and companion diagnostic, if approved;
- our plans to research, develop and commercialize our product candidates and companion diagnostic;
- our ability to attract collaborators with development, regulatory and commercialization expertise;
- our plans and expectations with respect to future commercial scale-up activities, including our expectation regarding the building of a commercial manufacturing facility for the production of MYDICAR;
- future agreements with Lonza Houston, Inc., or Lonza, and other third parties in connection with the commercialization of MYDICAR, our companion diagnostic and any other approved product;
- the size and growth potential of the markets for our product candidates, and our ability to serve those markets;
- the rate and degree of market acceptance of our product candidates and companion diagnostic;
- regulatory developments in the United States and foreign countries;
- the performance of our third-party suppliers and manufacturers;
- the success of competing therapies that are or may become available;
- our ability to attract and retain key scientific or management personnel;
- the accuracy of our estimates regarding expenses, future revenues, capital requirements and needs for additional financing;
- our expectations regarding the period during which we qualify as an emerging growth company under the Jumpstart Our Business Startups Act of 2012, or the JOBS Act; and
- our expectations regarding our ability to obtain and maintain intellectual property protection for our product candidates.

These forward-looking statements reflect our management’s beliefs and views with respect to future events and are based on estimates and assumptions as of the filing date of this Annual Report and are subject to risks and uncertainties. We discuss many of these risks in greater detail under “Risk Factors.” 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. Given these uncertainties, you should not place undue reliance on these forward-looking statements. Except as required by law, we undertake no obligation to publicly update any forward-looking statements, whether as a result of new information, future events or otherwise.

ITEM 1. Business

Overview

We are a clinical-stage biotechnology company applying our leadership position in the field of calcium dysregulation by targeting SERCA enzymes to develop novel therapies for diseases with tremendous unmet medical needs. Sarco/endoplasmic reticulum Ca^{2+} -ATPase, or SERCA, enzymes are a family of enzymes that play an integral part in the regulation of intra-cellular calcium in all human cells. Calcium dysregulation is implicated in a number of important and complex medical conditions and diseases, such as heart failure, which is a clinical syndrome characterized by poor heart function, resulting in inadequate blood flow to meet the body's metabolic needs, as well as blood vessel health, diabetes and neurodegenerative diseases. Our therapeutic portfolio for diseases characterized by SERCA enzyme deficiency includes both gene therapies and small molecule compounds. MYDICAR, our most advanced product candidate, uses gene therapy to target SERCA2a, which is an enzyme that becomes deficient in patients with heart failure. SERCA2a was scientifically validated as a molecular target for heart failure in the 1990s and became a focus of internal discovery efforts for many large pharmaceutical companies. However, to date, no other company has been successful in targeting SERCA2a using traditional discovery methods. We believe that our gene therapy approach to modulating SERCA2a overcomes the issues encountered by previous efforts and has the potential to provide transformative disease-modifying effects with long-term benefits in patients with heart failure. In addition, we have identified a number of potential first-in-class compounds addressing novel targets in diabetes and neurodegenerative diseases with our small molecule platform of SERCA2b modulators.

We are the first company to enter clinical development with a product candidate, MYDICAR, that selectively targets SERCA2a. We refer to our Phase 1 trial and Phase 2a trial of MYDICAR together as our CUPID 1 trial. In Phase 2a of our CUPID 1 trial, 39 patients with systolic heart failure, which is caused by the inability of the heart to pump blood efficiently due to weakening and enlargement of the ventricles, were enrolled in a randomized, double-blind, placebo-controlled trial, where MYDICAR was found to be safe and well-tolerated, reduced heart failure-related hospitalizations, improved patients' symptoms, quality of life and serum biomarkers, and improved key markers of cardiac function predictive of survival, such as end systolic volume. Based on these results, as well as our previous preclinical studies and clinical trials, we advanced MYDICAR to a 250-patient randomized, double-blind, placebo-controlled international Phase 2b trial in patients with systolic heart failure, which we refer to as CUPID 2. We completed enrollment of CUPID 2 in February 2014 and expect to announce results in April 2015. If successful, these results, along with other studies, will form the basis for regulatory submissions for approval with the United States Food and Drug Administration, or FDA, and European Medicines Agency, or EMA. In 2012, we obtained a Special Protocol Assessment, or SPA, whereby the FDA agreed to use time-to-multiple heart failure-related hospitalizations as the primary endpoint for a MYDICAR Phase 3 pivotal trial. Our ongoing CUPID 2 trial uses a similar clinical protocol with identical endpoints as agreed to in the SPA. In May 1998, the FDA published "*Guidance for Industry—Providing Clinical Evidence of Effectiveness for Human Drug and Biological Products"* outlining the conditions in which a single trial might be sufficient to support a BLA submission. We believe that the FDA may not require us to complete additional trials of MYDICAR for the treatment of systolic heart failure if the results of our CUPID 2 trial meet the requirements for a single trial set forth in this guidance. In November 2013, the EMA indicated that if MYDICAR demonstrates a substantial and highly significant treatment effect in the advanced heart failure population, and no untoward effects attributable to MYDICAR are observed, a safety database of approximately 205-230 MYDICAR-treated subjects may be sufficient for a safety assessment to allow for acceptance of an MAA for MYDICAR for the treatment of systolic heart failure. We therefore believe that, if the above conditions are met, a Phase 3 trial may not be required for marketing approval in Europe.

MYDICAR utilizes a recombinant adeno-associated viral vector 1, or AAV1 serotype, which is a group of adeno-associated viruses, or AAVs, sharing specific antigens, to deliver the gene for the SERCA2a enzyme. We believe AAV1 serotype vectors are particularly well suited for administration to the heart muscle because AAV vectors are safe and are less immunogenic than other viral vectors commonly used in gene therapy. Most people are exposed to wild type AAV (serotype 2) during childhood, without experiencing any symptoms, because AAV causes no disease. In addition, local delivery of AAV1 to the heart requires extremely small quantities to achieve therapeutic effect, which has contributed to the low incidence of side effects in clinical trials to date. We have developed a companion diagnostic to identify the patients who are AAV1 neutralizing antibody, or NAb, negative and therefore eligible for MYDICAR treatment. We believe approximately 40% of patients in the United States are AAV1 NAb negative.

In 2013, the American Heart Association estimated that there are nearly six million patients currently diagnosed with heart failure in the United States. Despite optimal guideline-directed therapies employing a wide range of pharmacologic, device, and surgical options, many heart failure patients deteriorate over time. The long-term prognosis associated with heart failure is worse than that associated with the majority of cancers, with a mortality rate of approximately 50% at five years following initial diagnosis. There are one million primary heart failure-related hospitalizations and over 280,000 heart failure-related deaths annually in the United States. In 2010, the estimated direct and indirect cost of heart failure in the United States was $39 billion, half of which was related to repeated hospitalizations. The one- and six-month readmission rates after heart failure-related hospitalization are close to 25% and 50%, respectively, and there is growing pressure on hospitals to reduce readmissions for heart failure.

We are initially developing MYDICAR to treat patients with systolic heart failure. Heart failure caused by systolic dysfunction is characterized by a decreased contraction of the heart muscle. We also plan to develop MYDICAR for additional indications, such as arteriovenous fistula, or AVF, maturation failure, and for the treatment of patients with advanced heart failure who are on a left-ventricular assist device, or LVAD. Subject to raising additional capital, we also may initiate development programs in diastolic heart failure, which is caused by the inability of the heart to relax normally between contractions, and pulmonary arterial hypertension, or PAH, which is characterized by a SERCA2a deficiency in vascular smooth muscle cells. MYDICAR has demonstrated potential disease-modifying capability in preclinical models of these diseases.

We hold worldwide rights to MYDICAR in all indications and markets. We plan to commercialize MYDICAR for all approved heart failure indications using a targeted sales force in the United States focused on selected cardiologists and heart failure specialists who treat the majority of heart failure patients. We believe we can maximize the value of our company by retaining substantial commercialization rights to our product candidates and, where appropriate, entering into partnerships for specific therapeutic indications and/or geographic territories.

We are also investigating MYDICAR for enhancing the rate of AVF maturation. This program is currently in pre-clinical development. Over 500,000 Americans have end-stage renal disease requiring dialysis and approximately 100,000 fistulae are placed yearly. An AVF, which is a surgically created connection between an artery and a vein, is placed in the arm to provide access for hemodialysis. The access that is created is routinely used for hemodialysis two to five times per week. The AVF has proven to be the most durable, least complicated, and therefore preferred mode of vascular access for hemodialysis. The clinical problem that has resulted from this practice is that following surgery to create the fistula, approximately 50% of fistulae fail to mature to a usable state for hemodialysis. Furthermore, as many as 25% of hospital admissions in the dialysis population have been attributed to vascular access problems, including fistula malfunction and thrombosis. The biology of SERCA2a in both vascular smooth muscle cells, or VSMC, and endothelial cells provides a unique opportunity to potentially positively impact the pathological processes driving fistula failure. The majority of AVF maturation failures have been attributed to rapid proliferation of VSMC, resulting in vascular blockage or occlusion. In preclinical studies, SERCA2a enzyme deficiency has been associated with VSMC proliferation, and increasing SERCA2a activity has been shown to prevent VSMC proliferation and stenosis of injured blood

vessels. In addition to stenosis, maturation of AVF requires that the blood vessels dilate to support the increased blood flow during dialysis sessions. MYDICAR increases blood flow in treated vessels, and therefore these effects may aid AVF maturation.

In February 2014, we entered into a material transfer and exclusivity agreement with Les Laboratories Servier, or Servier, for the purpose of enabling Servier to conduct an evaluation of our small molecule compounds that modulate the SERCA2b enzyme. As part of this agreement, we granted Servier an option to enter into a license and research collaboration agreement for the joint collaboration, research and development of these compounds for the treatment of type II diabetes and other metabolic diseases, pursuant to which Servier may obtain an exclusive, royalty-bearing license to commercialize one or more of these compounds and any related products in the field of type II diabetes and other metabolic diseases outside of the United States.

Strategy

We are committed to apply our first-mover scientific leadership position in the field of SERCA2 enzymes to transform the lives of patients with debilitating, life-threatening diseases or conditions. Each of our ongoing and planned development projects addresses diseases or conditions with high unmet medical need that are characterized by an underlying SERCA2 enzyme deficiency. The core elements of our strategy include:

- ***Successfully develop MYDICAR as a novel, first-in-class therapy for patients with heart failure due to systolic dysfunction.*** Based on positive results from our CUPID 1 trial for MYDICAR, we are conducting our CUPID 2 trial to evaluate the safety and efficacy of MYDICAR to reduce heart failure-related hospitalizations in patients with systolic heart failure. We completed enrollment of this trial in February 2014 and expect to announce results in April 2015. In the United States alone, several hundreds of thousands of patients with heart failure due to systolic dysfunction currently have a poor prognosis and limited treatment options. We believe MYDICAR, if approved, will become a valuable treatment option for these patients.
- ***Advance MYDICAR through an expedited development and approval process.*** In 2012, we obtained an SPA in the context of a Phase 3 clinical trial protocol whereby the FDA agreed to the use of time-to-multiple heart failure-related hospitalizations as the primary endpoint for a potential pivotal trial of MYDICAR. Our ongoing CUPID 2 trial uses a similar clinical protocol with identical endpoints as agreed to in the SPA. Following the completion of our ongoing CUPID 2 trial, we anticipate that we will have meetings with the FDA and the EMA to discuss whether any remaining clinical trials will be required for approval of MYDICAR. If the FDA or the EMA allows us to pursue an expedited approval process, we anticipate that we will seek registration for MYDICAR upon completion of our CUPID 2 trial and would not conduct the Phase 3 trial outlined in the SPA.
- ***Maximize the value of our MYDICAR franchise by expanding into additional indications.*** The broad therapeutic potential of MYDICAR in multiple indications presents opportunities to maximize the value of our MYDICAR franchise. Beyond our lead proposed indication of systolic heart failure, we also plan to develop MYDICAR for additional indications such as treatment of AVF maturation failure and for the treatment of patients with advanced heart failure who are on an LVAD. Subject to raising additional capital, we also may initiate development programs in diastolic heart failure and PAH. Each of these diseases is characterized by a SERCA2a deficiency and MYDICAR has demonstrated disease-modifying results in preclinical models of these diseases. We may selectively form collaborative alliances to expand and accelerate our development capabilities and product offerings for indications that are poorly managed by existing treatment options.
- ***Commercialize MYDICAR using a highly-targeted cardiology-focused sales force in the United States.*** Heart failure patients are largely treated at leading hospitals and medical centers of excellence by a select group of high-prescribing cardiologists and heart failure specialists. We plan to commercialize MYDICAR for all potential heart failure indications using a targeted sales force focused on these treating physicians. We believe cardiologists, heart failure specialists and interventional

cardiologists are typically early adopters of innovative products, devices and technologies, in part because the rate of innovation in this sector has been sustained, and in part because of the large unmet need that their patients exhibit. We believe that MYDICAR would be adopted first by certain cardiologists and heart failure specialists at high-volume, key-opinion-leading hospitals and medical centers, and progressively by a broader segment of the market.

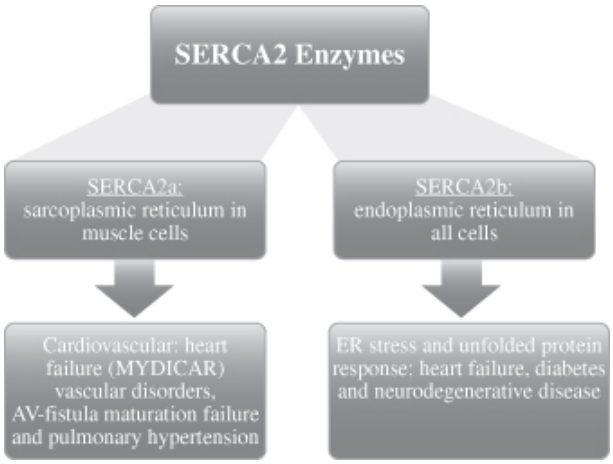
- ***Advance our small molecule platform targeting SERCA2 enzymes.*** We will leverage our leading position and proprietary scientific expertise in SERCA2 high throughput screening assays to identify SERCA2 small molecule product candidates. We have established early preclinical proof-of-concept results in the fields of heart failure, diabetes and neurodegenerative diseases. We plan to continue to advance these programs in certain diseases by ourselves or through a partnering strategy. In February 2014, we entered into a material transfer and exclusivity agreement with Servier for the purpose of enabling Servier to conduct an evaluation of our small molecule compounds that modulate the SERCA2b enzyme. This agreement may lead to a license and research collaboration agreement for the joint collaboration, research and development of these compounds for the treatment of type II diabetes and other metabolic diseases, pursuant to which Servier may obtain an exclusive, royalty-bearing license to commercialize one or more of these compounds and any related products in the field of type II diabetes and other metabolic diseases outside of the United States.
- ***Deploy capital strategically to develop our portfolio of product candidates and create stockholder value.*** We intend to deploy most of our capital resources to further support the manufacture and clinical development of our lead product candidate, MYDICAR. We strive to leverage new clinical design principles and regulatory approval paths to advance our product candidates towards key value inflection points in a capital efficient manner. We believe we can maximize the value of our company by retaining substantial commercial rights to our product candidates and, where appropriate, entering into partnerships for certain indications and/or geographic territories. We believe this combination of independent development and targeted commercialization, together with selective partnering activities, will allow us to capture substantial value of our product candidates while reducing our need for human and capital resources.

Our SERCA Platform

We target a specific class of proteins, or enzymes, that control calcium levels inside all cells. We believe that SERCA enzymes function as “master switches” that are critical to keeping cells of the body healthy through regulation of calcium levels. SERCA2 enzyme levels are deficient in many disease states, such as heart failure, AVF maturation failure, PAH, diabetes and neurodegenerative diseases. We are applying our leading expertise in the field of SERCA2 biology towards the development of gene therapies and small molecule compounds to correct SERCA2 deficiencies and the resulting calcium imbalances within diseased cells. We believe that the involvement of SERCA2 deficiencies in multiple diseases and conditions creates “franchise” opportunities for our first-in-class gene therapy and small molecule product candidates.

We have acquired leading AAV gene vector technology and developed proprietary delivery methods which form the basis of our MYDICAR platform. In addition, using our proprietary, patented SERCA2 screening assay, we have developed a broad platform of novel, first-in-class, small molecule modulators of the SERCA2b enzyme, creating development opportunities for product candidates targeting diseases associated with endoplasmic reticulum, or ER, stress-related pathways, such as diabetes and neurodegenerative diseases.

The following figure illustrates the opportunities and approach we are taking to target SERCA2 deficiency states:

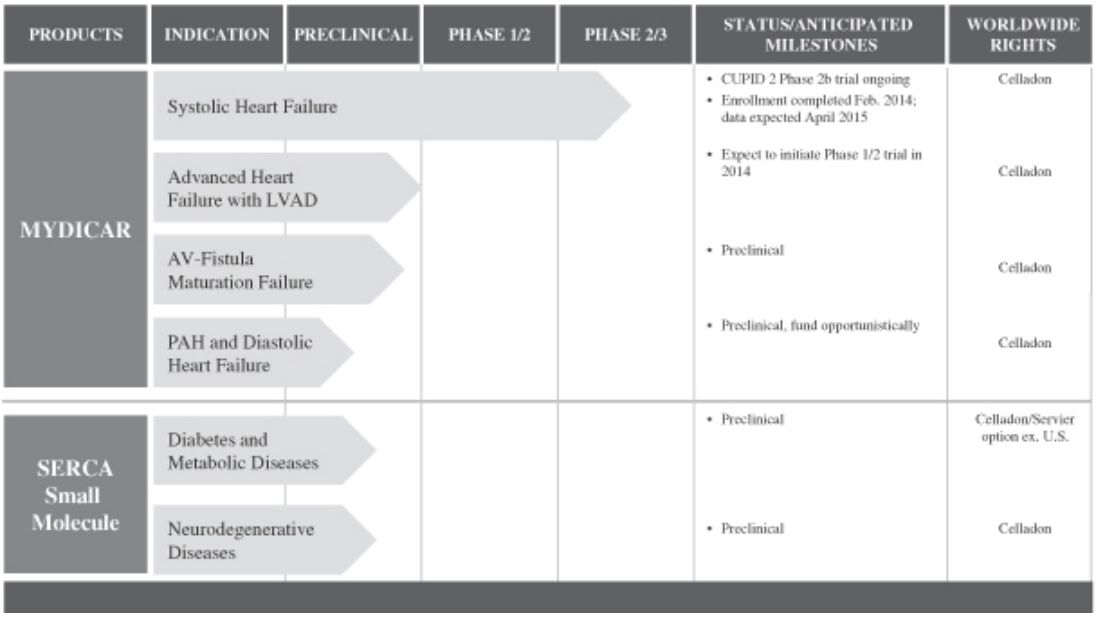


Our lead development program targets calcium dysregulation in the heart. Of the ions involved in the intricate workings of the heart, calcium is considered perhaps the most important. It enables the chambers of the heart to pump, or contract and relax, which causes blood to be propelled in and out of the heart. Calcium directly activates the myofilaments, which are threadlike structures in muscle fibers which cause contraction. Dysregulation of calcium is a central cause of heart failure due to both contractile (systolic) dysfunction, and relaxation (diastolic) dysfunction. One of the central causes of calcium dysregulation in heart failure is a deficiency in the level of SERCA2a enzymes in heart muscle cells. SERCA2a deficiencies are not limited to heart muscle cells, but are also present in blood vessel disorders such as AVF maturation failure and PAH.

Another focus of our research program relates to a different form of the SERCA2 enzyme, SERCA2b. Specifically, these enzymes control calcium movement in the ER in all human cells. SERCA2b enzyme levels become deficient when cells are stressed, and accumulate unfolded proteins in the ER, known as ER stress. There has been a proliferation of publications in scientific medical literature supporting the important role of ER stress in many diseases and conditions, including heart failure, diabetes and neurodegenerative diseases. We believe we are the industry leader in isolating small molecule modulators of the SERCA2b enzyme, which can correct underlying calcium dysregulation and ER stress. Our proprietary, novel, first-in-class, compounds have demonstrated activity in multiple preclinical models of diseases and conditions.

Our Product Pipeline

The following chart depicts key information regarding our development programs, their indications, and their current stage of development:



MYDICAR for Heart Failure

The Heart Failure Epidemic

Heart failure constitutes an important medical, social, and economic problem. Heart failure is a clinical condition in which the output of blood from the heart is insufficient to meet the metabolic demands of the body. In 2013, the American Heart Association estimated that there are nearly six million patients currently diagnosed with heart failure in the United States. The prevalence of heart failure is progressively increasing due to an aging population and increasing prevalence of major cardiovascular risk factors, including obesity and diabetes. Additional risk factors for heart failure include coronary heart disease, hypertension, alcoholism, drug abuse, exposure to toxins and infectious agents, pregnancy and congenital mutations. It is estimated that one in five adults at age 40 will develop heart failure during their remaining lifetime, and that approximately 250,000 to 500,000 patients in the United States are currently in the terminal phase of heart failure and have symptoms that cannot be effectively managed by existing optimized medical therapy. These patients suffer from disabling symptoms and often need hospitalization. The long-term prognosis associated with heart failure is worse than that associated with the majority of cancers, with approximate 50% mortality at five years following initial diagnosis. With over 280,000 heart failure-related deaths annually, we believe MYDICAR will provide a much needed therapeutic alternative for heart failure patients. We estimate that there are over 350,000 systolic heart failure patients in the United States alone who will be eligible for MYDICAR treatment upon launch.

Hospitalizations for heart failure are expensive and are particularly problematic, as the risk of death is increased with each recurrent heart failure-related hospitalization. There are one million primary heart failure-related hospitalizations annually in the United States alone. In 2010, the estimated direct and indirect cost of heart failure in the United States was $39 billion, half of which was related to repeated hospitalizations. By 2030, the total cost of heart failure in the United States is projected to increase to $70 billion. The one- and six-month

readmission rates after heart failure-related hospitalization are close to 25% and 50%, respectively. The Affordable Care Act recently established the "Hospital Readmissions Reduction Program," which requires Centers for Medicare & Medicaid Services to reduce payments to hospitals with excessive heart failure readmissions. As such, there is a growing pressure on hospitals to reduce readmissions for heart failure.

The pathologies resulting from heart failure are devastating. During heart failure progression, the heart steadily loses its ability to respond to increased metabolic demand, such as during intense physical activity. Patients suffer from increased shortness of breath in a progressive manner, and mild exercise soon exceeds the capacity of the heart to react to the increase in metabolic demand. Towards the end stage of the disease, the heart cannot pump enough blood to meet what the body needs even at rest. At this stage, fluids accumulate in the extremities or in the lungs, making the patient bedridden and unable to perform activities of daily living. In addition to constant shortness of breath, even minor deviation from a physical activity and diet restricted lifestyle can cause acute exacerbations, during which patients experience a drowning sensation and must be urgently hospitalized in intensive care or cardiac care units. Heart failure is classified in relation to the severity of the symptoms experienced by the patient. The most commonly used classification system, established by the New York Heart Association, or NYHA, is as follows:

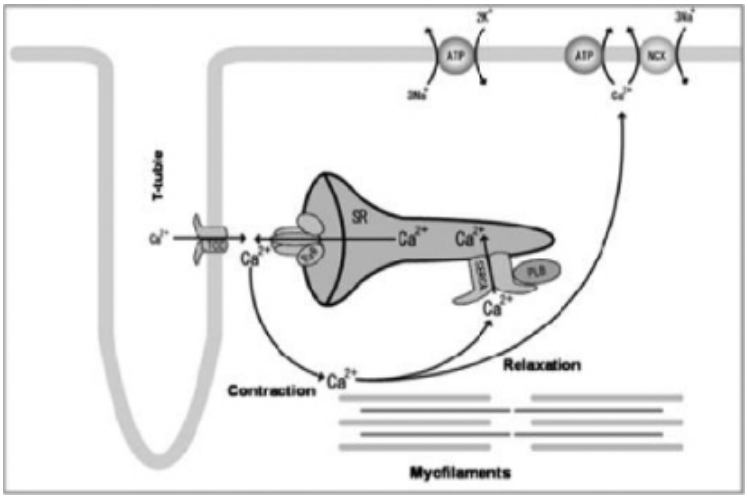
- Class I (mild): patients experience no or very mild symptoms with ordinary physical activity
- Class II (mild): patients experience fatigue and shortness of breath during moderate physical activity
- Class III (moderate): patients experience shortness of breath during even light physical activity
- Class IV (severe): patients are exhausted even at rest

The survival rate in each of these classes of heart failure is a function of the severity of the disease with the more advanced patients having poorer survival prognosis. Guideline-directed medical therapy for heart failure emphasizes angiotensin-converting enzyme, or ACE, inhibitors, angiotensin-2 receptor blockers if the patient is ACE intolerant, and beta blockers. There is recommendation for cardiac resynchronization therapy in certain patients. Implantable cardioverter-defibrillators, or ICDs, are used in patients at risk for sudden cardiac death. Despite these optimal guideline-directed therapies employing a wide range of pharmacologic, device, and surgical options, many patients deteriorate over time and develop advanced heart failure symptoms that cannot be effectively managed by existing optimized medical therapy. At the end stage of heart failure disease, current treatment options include heart transplant surgery or implantation of an LVAD. LVADs are battery operated mechanical circulatory devices used to partially or completely replace the function of the left ventricle of the heart for patients awaiting a heart transplant, or as a destination therapy for patients with NYHA Class IV heart failure who will never receive a heart transplant. Both of these end-stage treatment options require invasive open-chest surgery, include a host of complications such as lifetime immunosuppressive therapy in the case of transplant and risk of thrombosis and infection in the case of LVADs, and can cost in excess of $150,000. An estimated 1,500 patients per year in the United States have an LVAD implanted and an estimated 2,300 patients per year in the United States undergo heart transplant surgery.

Role of SERCA2a in Heart Failure

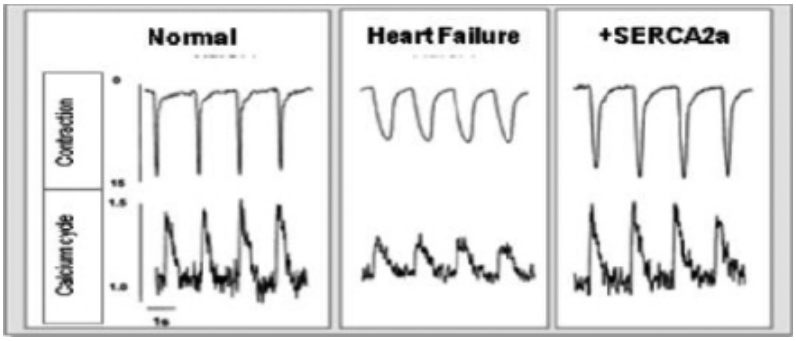
SERCA2a's role in heart failure was scientifically validated in the 1990s and immediately became a focus of pharmaceutical industry discovery efforts. However, due in part to ineffective screening technologies, SERCA2a proved to be an elusive target and to date no other company has been successful in targeting SERCA2a using traditional discovery methods.

Heart failure is characterized by abnormalities in the various steps of the heart muscle pumping process. Intracellular calcium movements in the heart are tightly regulated at various levels within the heart's cells. An organelle called the sarcoplasmic reticulum, or SR, plays an important role in orchestrating the movement of calcium during each contraction and relaxation. The cardiac cycle is illustrated in the figure below.



During contraction, calcium is released from the SR, activating the myofilaments leading to muscle contraction. During relaxation, the majority of calcium is sequestered back into the SR by the SERCA2a enzyme leading to muscle relaxation. It is modulated through normal physiology via a protein known as phospholamban (PLB in the figure above), increasing activity when we exercise and decreasing activity when we rest. In advanced heart failure, SERCA2a enzyme levels are abnormally low, so patients cannot effectively modulate SERCA2a activity and increase their cardiac output even upon mild physical activity, such as walking or climbing stairs.

The figure below depicts *in vitro* studies of the contraction and relaxation and calcium cycle in normal human heart cells, in cells from patients with heart failure, and after correction of the SERCA2a deficiency in heart failure cells.



Even in end-stage human heart failure cardiac cells, correction of the SERCA2a deficiency is able to restore normal contractility, relaxation, and calcium cycling. This demonstrates the central importance of SERCA2a deficiency in heart failure, and the ability to reverse the abnormality in contraction and relaxation driving the pathogenesis of this serious medical condition.

Heart failure can be caused by a problem with cardiac contraction, relaxation, or both. Ejection fraction, or EF, is the measurement used to describe the contractility of the heart. Approximately half of heart failure patients suffer from contractility abnormalities (systolic heart failure, EF less than 35%) and the other half suffer from relaxation abnormalities (diastolic heart failure, or heart failure with preserved EF). Both forms represent a significant unmet medical need and we are also developing MYDICAR to target the diastolic form of the disease. Diastolic heart failure is characterized by a "stiff" ventricle, which impairs relaxation of the heart between contractions. We believe MYDICAR can effectively treat diastolic heart failure by correcting the SERCA2a deficiency and improving the ability of the heart to relax between contractions. Based on the Framingham Heart Study conducted by the National Heart, Lung and Blood Institute and Boston University, the five-year mortality rate for patients with diastolic heart failure is 45–60%, which demonstrates the significant unmet need for effective treatments for this condition.

MYDICAR: Genetic Enzyme Replacement Therapy of SERCA2a Deficiency

Our lead product candidate, MYDICAR, uses genetic enzyme replacement therapy to correct the SERCA2a enzyme deficiency in heart failure patients that results in inadequate pumping of the heart. MYDICAR is delivered directly to the heart in a routine outpatient procedure, similar to an angiogram, in a cardiac catheterization laboratory. MYDICAR has the potential to provide transformative disease-modifying effects with long-term benefits in heart failure patients with a single administration. We filed an investigational new drug application, or IND, in December 2006 for MYDICAR for the treatment of heart failure.

Gene therapy alters a person's deficient genetic material (encoded by deoxyribonucleic acid, or DNA). The altered genes, in turn, through a process called gene expression, can then produce the correct proteins and/or enzymes that were otherwise being produced improperly, or in the case of SERCA2 deficiency, at abnormally low levels. Gene therapy is accomplished through a process known as gene transfer, whereby a functional gene is delivered and incorporated into a patient's cells through a delivery system called a vector, which are most commonly based on naturally-occurring viruses that have been modified to take advantage of the virus' natural ability to introduce genes into cells. However, unlike naturally-occurring viruses, which replicate following infection of a target cell and have the capacity to infect new cells, viral vectors are modified to be non-replicating by deleting that portion of the viral genome responsible for replication. We believe that the growing body of gene therapy-based clinical data and the establishment of regulatory guidelines to govern the development and approval of gene therapy products suggest that gene therapy is positioned to emerge as an important new therapeutic modality for patients with significant unmet medical need.

MYDICAR, or AAV1/SERCA2a, utilizes AAV1 to deliver the gene for the enzyme SERCA2a. AAV1/SERCA2a consists of an outer protein shell, called a capsid, and inner DNA genome that contains a gene for SERCA2a. In a treated patient, the capsid delivers the genome to the target cell, where the DNA will direct expression of the SERCA2a protein. Different strains of AAV, called serotypes, have slightly different capsids, which target the vector to different cell types. AAV vectors are particularly well suited for the treatment of heart failure because:

- AAV vectors are safe; most people are exposed to wild type AAV (serotype 2) during childhood, without developing any symptoms because AAV causes no disease. Regulatory authorities consider AAV vectors lower risk than other vectors commonly used in gene therapy, such as retroviruses or lentiviruses, because they present a low risk for inserting genetic material into the patient's chromosomes, which is known as insertional mutagenesis and may lead to cancer. This is because AAV DNA exists in the cell as a circle, or plasmid, outside the main chromosomal DNA.
- AAV vectors are less immunogenic than other viral vectors commonly used in gene therapy, which have caused inflammatory reactions in some patients.
- AAV1 results in a highly efficient delivery of genes into muscle cells so extremely small quantities can be administered directly to the heart to achieve a therapeutic effect; approximately 1/10,000 of a gram of AAV1 capsid protein is contained in a therapeutic dose. We have not observed any toxicities in our preclinical studies or clinical trials.

- AAV particles are small particles and pass freely through the blood vessel wall, bathing the heart muscle and providing broad distribution in the heart without the requirement for invasive or risky procedures. It is delivered directly to the heart over ten minutes in a simple outpatient procedure in a cardiac catheterization laboratory. Patients are awake under mild sedation, and outside of a small puncture in the groin or arm, feel no sensation as a catheter is advanced to the heart. Catheterization procedures like this are routine and are performed thousands of times a day around the globe for imaging the heart.
- Our AAV1 production and manufacturing technology has been developed with a focus on commercialization, and we believe we will be able to produce MYDICAR in large quantities to support our target markets.

After the AAV1/SERCA2a is infused in the arteries that feed the heart muscle, the AAV1 particle is taken up by the cells and results in expression of the normal SERCA2a human protein in the heart. This results in improved contractility, improved symptoms, and reductions in heart failure-related hospitalizations as demonstrated in our CUPID 1 trial.

Antibodies against AAV1 can block entry of MYDICAR into the target cells, and we have therefore developed a companion diagnostic to identify which patients do not have pre-existing NAbs against the AAV1 capsid proteins, and hence which patients are eligible for MYDICAR treatment. Even though the majority of the population has been exposed to wild type AAV (serotype 2), we believe approximately 40% of heart failure patients in the United States are AAV1 NAb negative and hence are eligible for MYDICAR treatment.

MYDICAR is initially being developed to treat patients with systolic heart failure. Heart failure caused by systolic dysfunction is characterized by a decreased contraction (EF less than 35%). We also plan to develop MYDICAR for additional indications, such as AVF maturation failure, and for the treatment of patients with advanced heart failure who are on an LVAD. Subject to raising additional capital, we also may initiate development programs in diastolic heart failure, which is caused by the inability of the heart to relax normally between contractions, and PAH, which is characterized by a SERCA2a deficiency in VSMC. MYDICAR has demonstrated potential disease-modifying capability in preclinical models of these diseases.

We estimate that there are over 350,000 systolic heart failure patients in the United States alone who will be eligible for MYDICAR therapy upon launch.

MYDICAR Previous Human Experience in Systolic Heart Failure

We are the first company to enter clinical development with agents that selectively target this well-validated, key enzyme deficiency. In Phase 2a of the CUPID 1 trial, 39 patients with systolic heart failure were enrolled in a randomized-double-blind, placebo-controlled trial in which MYDICAR compared to placebo was found to be safe, reduced heart failure-related hospitalizations, improved patients' symptoms, quality of life and serum biomarkers, and improved key markers of cardiac function predictive of survival, such as end systolic volume, or ESV. The CUPID 1 trial included a single dose of MYDICAR with an on-study observation period of 12 months, plus a two-year long-term follow-up. Details are provided below, but an overall summary is as follows:

- MYDICAR was associated with benefit in clinical outcomes such as worsening heart failure, heart failure-related hospitalizations, need for LVAD implantation or heart transplant, or death.
- Benefit in clinical outcomes was supported by improvement in patients' heart failure symptoms, exercise tolerance, serum biomarkers, and cardiac function.
- High-dose MYDICAR (1×10^{13} DNase resistant particles) met the primary endpoint versus placebo at six months, and all positive trends were confirmed at 12 months.

- Benefit in preventing clinical events such as hospitalizations was confirmed at three years as well as a trend in improved survival. We expect to present the full three-year follow-up data at an upcoming medical conference.
- MYDICAR demonstrated an excellent safety profile.

CUPID 1, Phase 1 (CELL-001)

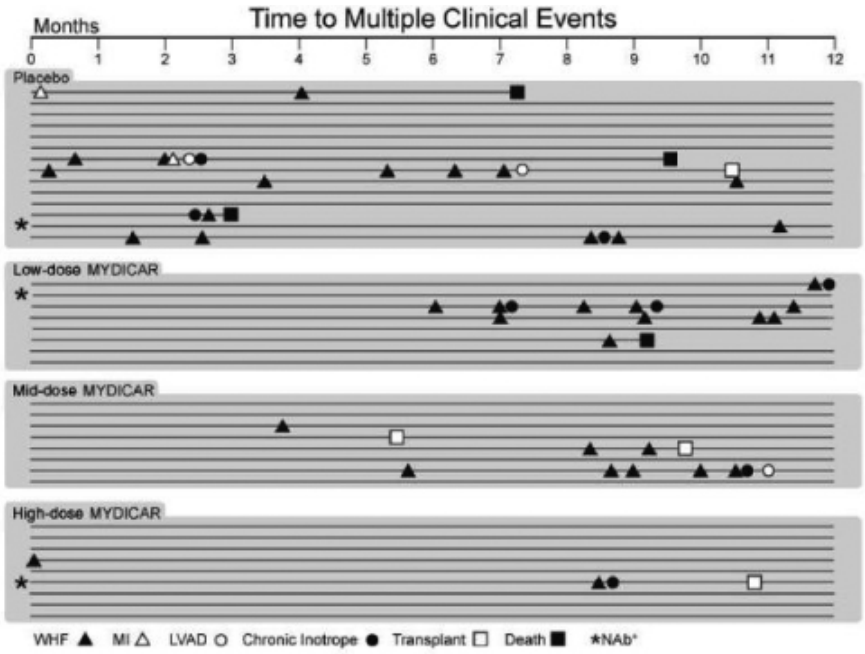
A total of 12 patients with heart failure (NYHA class III/IV) received a single intracoronary infusion of MYDICAR in an open-label dose-escalation trial in the United States. Administration of MYDICAR was on top of maximal optimized heart failure therapy. Doses administered ranged from 1.4 x 10^{11} to 1 x10^{13} DNase resistant particles, or DRP, per patient. The mode of administration was a ten-minute infusion into the coronary artery. MYDICAR demonstrated an excellent safety profile in this heart failure population, with no treatment related toxicities observed. Of the 12 patients who received MYDICAR, several demonstrated improvements from baseline to month six across a number of parameters important in heart failure, including symptomatic (NYHA and Minnesota Living with Heart Failure Questionnaire, five patients), functional (six-minute walk test and peak maximum oxygen consumption, five patients), biomarker (N-terminal prohormone brain natriuretic peptide, or NT-ProBNP, two patients), and left-ventricular, or LV, function/remodeling (EF and ESV, six patients). Quantitative evidence of biological activity across a number of parameters important for assessing heart failure status could be detected in several patients without pre-existing NAbs in this open-label trial.

CUPID 1, Phase 2a (CELL-001)

The Phase 2a design was a randomized, double-blind, placebo-controlled trial in 39 patients who received one of three different doses of MYDICAR or placebo. Twenty-five patients received MYDICAR and 14 received placebo. The mode of administration was a ten-minute infusion into the coronary arteries. All subjects had systolic heart failure (NYHA class III/IV). Treatment with either MYDICAR or placebo was on top of maximal optimized heart failure therapy. Seven efficacy parameters were assessed in four domains: symptoms (NYHA class and Minnesota Living With Heart Failure Questionnaire), functional status (six-minute walk test and peak maximum oxygen consumption), biomarker (NT-ProBNP), and LV function/remodeling (EF and ESV), plus clinical outcomes. The high-dose MYDICAR group versus placebo met the primary endpoint, which was demonstration of improvement across multiple domains without significant worsening in any domain. This combination of requirements resulted in a probability of success by chance alone (false-positive effect) of approximately 3%. The trial met the primary endpoint at six months (confirmed at 12 months) and demonstrated improvement or stabilization in the four efficacy domains.

The characteristics of recurrent clinical events and terminal events over the 12 months of the active observation period of the trial for Phase 2a portion of our CUPID 1 trial are illustrated in the figure below. Each line represents a single subject. Clinical events are depicted by symbols; a star at the beginning of a line represents subjects who were NAb positive at dosing. Patients who were AAV1 NAb positive at dosing had developed AAV1 NAbs during the period between their initial selection for participation in the trial and dosing, which in some cases, was as long as six months. We expect to use our companion diagnostic to screen out AAV1 NAb positive subjects going forward, as they are not expected to respond to MYDICAR therapy.

As can be seen from the figure below, despite maximal optimized background therapy, the clinical events (worsening heart failure, or WHF, myocardial infarction, or MI, LVAD implantation, use of chronic intravenous inotrope, heart transplant, or all-cause death) in the placebo group were substantial, underscoring the significant unmet need in this population, while in the high-dose MYDICAR group clinical events were limited. WHF was defined as signs and symptoms of heart failure requiring either hospitalization or treatment with intravenous diuretics, vasodilators or positive inotropes; mechanical fluid removal; or intra-aortic balloon pump.



Clinical Events in CELL-001 Phase 2a

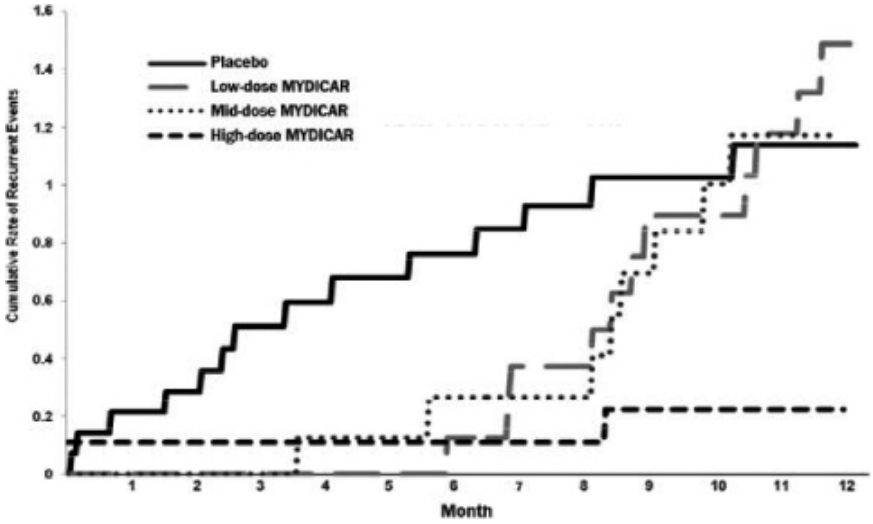
In the low-dose (6×10^{11} DNase resistant particles) and mid-dose (3×10^{12} DNase resistant particles) groups, there was a delay to the onset of clinical events, and in the high-dose group, a significant reduction: the relative risk reductions, or hazard ratios, at 12 months for the high-dose MYDICAR group versus placebo for recurrent adjudicated clinical events was 0.12, p=0.003 (where the p-value is the statistical probability of a result due to chance alone), representing a risk reduction of 88% for these important events with high-dose MYDICAR. At 36 months, the high-dose MYDICAR group versus placebo for recurrent adjudicated clinical events was 0.18, p=0.048, representing a risk reduction of 82% for these important events with high-dose MYDICAR. The hazard ratios for recurrent clinical events at 12 months are summarized by treatment group in the table below.

	Time to Multiple Clinical Events Analysis at 12 Months	
MYDICAR Dose vs. Placebo	**Hazard Ratio (CI) for Recurrent Clinical Events [1]**	**Risk Reduction**
Low-dose	0.40 (0.13, 1.21), p=0.11	60%
Mid-dose	0.44 (0.16, 1.24), p=0.12	54%
High-dose	0.12 (0.03, 0.49), p=0.003	88%

1 Recurrent clinical events include WHF and MI.

In the low- and mid-dose groups, there was a delay to the onset of clinical events, and in the high-dose group a significant reduction. In the low- and mid-dose groups, we believe the dose was not sufficient to insert the SERCA2a gene in enough cells of the myocardium to generate a long-lasting improvement in contractility. We have confirmed this in biopsy samples (see "CUPID 1 (CELL-001) Long-term Follow-up" below), since MYDICAR vector DNA was only detected at long time points in cardiac biopsies in the high-dose patients, but not in biopsies from any other group. MYDICAR increases the presence of an enzyme called nitric oxide synthase in endothelial cells and this enables blood vessels to relax, thereby resulting in short-term increased blood flow. Our hypothesis for why the low- and mid-dose groups demonstrate a delay of the onset of clinical events which is not durable relates to the short-term increase in blood flow to the heart after MYDICAR therapy; higher doses are required to insert the gene deep into the cardiac muscle cells.

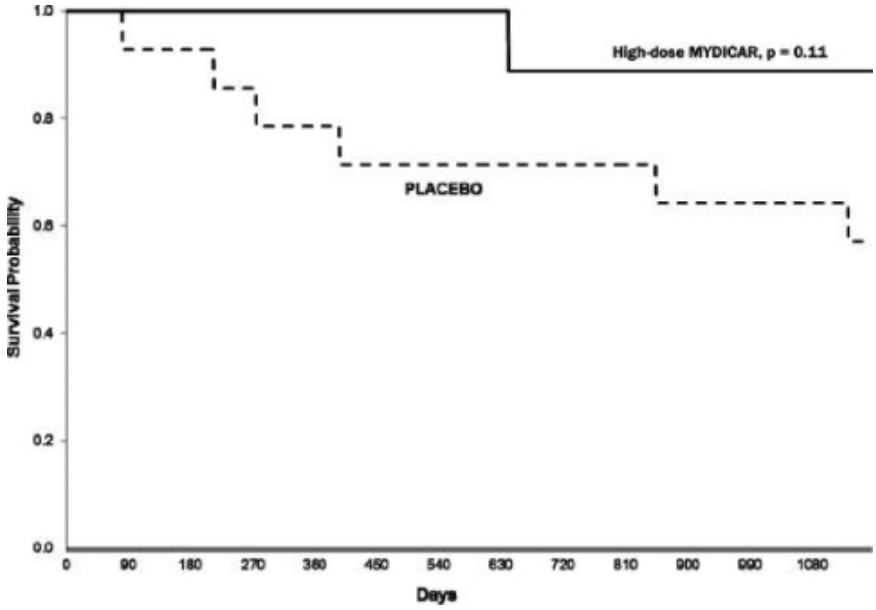
The frequency of cardiovascular-related events (WHF and MI), are shown in the figure below.



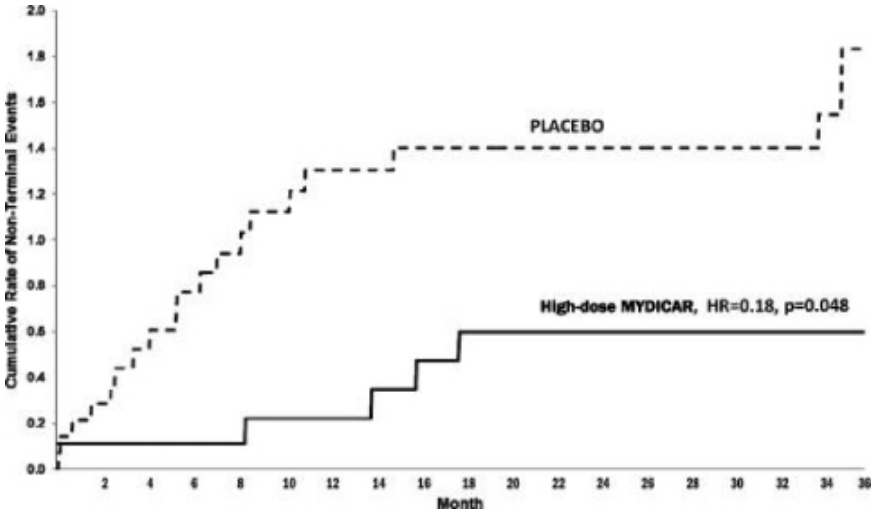
In addition to reducing the frequency of hospitalizations, the mean duration of heart failure-related hospitalizations over 12 months was substantially decreased (0.4 versus 4.5 days; p = 0.05) on high-dose treatment versus placebo. Finally, there were no adverse safety findings.

CUPID 1 (CELL-001) Long-term Follow-up

The patients in the Phase 1 and Phase 2a portions of the CUPID 1 trial were followed for a total of three years. The following clinical events were tracked in all groups: WHF, LVAD implantation, heart transplantation, MI and all-cause death. At three years post-administration, there were 13 deaths: six in the placebo group, three in the low-dose group, three in the mid-dose group and one in the high-dose group (see the figure below for high-dose MYDICAR versus placebo). We expect that data from this trial for the full three year follow-up will be presented at an upcoming conference.



Throughout the three years of follow-up, the number of clinical events was high in the placebo group and high but delayed in the low- and mid-dose groups. Few events occurred in the high-dose group where we found evidence of gene expression (the risk of pre-specified recurrent clinical events over three years of follow-up was reduced by 82% in the high-dose group compared to the placebo group, p=0.048). The figure below depicts cumulative clinical event rates over the three years of follow-up.



Finally, persistence of the AAV1/SERCA2a vector DNA in biopsy samples of the heart, in cases where heart tissue was made available, was demonstrated by a positive signal from quantitative polymerase chain reaction, or qPCR, testing in high-dose patients. We were only able to obtain heart tissue samples from patients who received an LVAD, cardiac transplant or who died in the hospital. The qPCR assay for AAV1/SERCA2a DNA has demonstrated persistence of the SERCA2a gene out to month 31 in the target tissue of one high-dose patient and to month 22 in another. A third high-dose patient demonstrated presence of vector DNA at month 23. All three patients with qPCR positive vector DNA results showing persistence of the AAV1/SERCA2a vector were in the high-dose group. The qPCR testing of available biopsy samples in patients from the placebo, low- and mid-dose groups did not demonstrate persistence of the AAV1/SERCA2a vector DNA.

Our CUPID 1 trial results demonstrated a favorable safety profile of MYDICAR. No increases in adverse events, disease-related events or laboratory abnormalities were observed in any of the MYDICAR-treated subjects compared to those receiving placebo over the three-year period. There was no indication of an increase in any new occurrences or exacerbation of pre-existing clinical conditions or prior disorders during long-term follow-up including malignancies, neurologic disorders, rheumatologic or other autoimmune disorders, hematologic disorders or other unexpected illnesses associated with MYDICAR administration.

Current and Future Clinical Development of MYDICAR for Systolic Heart Failure

The impact of high-dose MYDICAR on reduction of heart failure-related hospitalizations was an important finding from our CUPID 1 trial and current and future studies are designed to confirm these results and serve as the basis for potential regulatory approvals in the United States. Following completion of our CUPID 1 trial, we held an End-of-Phase 2 meeting with the FDA, as a result of which the FDA indicated that:

- data supported proceeding to a Phase 3 clinical trial with high-dose MYDICAR;
- our proposed safety database, which will include approximately 610 patients (one-half treated), may be acceptable if the safety profile is similar to CUPID 1;

- time-to-recurrent heart failure-related hospitalizations, in the presence of terminal events, is acceptable as the primary endpoint, pending details of the statistical analysis plan and further discussion with agency statisticians; and
- a single trial may be acceptable for a BLA submission assuming statistically significant primary outcome and strong concordance of primary and secondary endpoint analyses.

In November 2013, the EMA indicated that if MYDICAR demonstrates a substantial and highly significant treatment effect in the advanced heart failure population, and no untoward effects attributable to MYDICAR are observed, a safety database of approximately 205-230 MYDICAR-treated subjects may be sufficient for a safety assessment to allow for acceptance of an MAA for MYDICAR for the treatment of systolic heart failure. We therefore believe that, if the above conditions are met, a Phase 3 trial may not be required for marketing approval in Europe. We have also held a Type A SPA meeting with the FDA, as a result of which the FDA approved a 572-patient Phase 3 trial protocol under the SPA guidance and agreed that the design and planned analyses of this trial would be sufficient to provide data that, depending on outcome, could support a license application submission. Pursuant to the SPA, we also obtained an agreement from the FDA that the primary efficacy endpoint of time-to-recurrent heart failure-related hospitalizations in the presence of terminal events would be acceptable for a pivotal trial of MYDICAR. This endpoint counts multiple heart failure-related hospitalizations per patient, and "corrects" for the occurrence of terminal events. Other elements of the Phase 3 SPA protocol may be changed if agreed to in writing by both the FDA and us, including sample size. We are currently in discussions with the FDA regarding the use of the joint frailty statistical model as a method of analysis for the primary endpoint. Our extensive simulation studies have demonstrated that when recurrent heart failure-related hospitalizations and terminal events are correlated, the joint frailty model provides both high power to detect a treatment effect and strong control of false-positive rate. The FDA is currently performing additional simulations using our proprietary software to validate that the false-positive rate is acceptable for a pivotal trial using the joint frailty model.

The design of our CUPID 2 trial is substantially similar in design to the Phase 3 SPA protocol. Our CUPID 2 trial uses the identical primary efficacy endpoint, which is important as we have obtained an agreement on this endpoint with the FDA for use in a pivotal trial.

In 2012, we participated in European Scientific Advice Meetings with local authorities at the Paul Ehrlich Institute in Germany and the College ter Beoordeling van Geneesmiddelen, Medicines Evaluation Board in the Netherlands. Advice from these meetings was incorporated into the Clinical Trial Application for the CUPID 2 clinical trial. We plan to meet with the Scientific Advice Working Part of the EMA to obtain scientific advice regarding the overall development program and most expeditious approval route for MYDICAR.

MYDICAR for Systolic Heart Failure

CUPID 2 Trial (CELL-004)

The primary objective of our ongoing CUPID 2 trial is to determine the efficacy of a single intracoronary infusion of high-dose MYDICAR compared to placebo, in conjunction with maximal optimized heart failure therapy, in reducing the frequency of and/or delaying heart failure-related hospitalizations in patients with systolic heart failure (EF less than 35%) who are at increased risk of terminal events based on elevated levels of NT ProBNP or a recent heart failure-related hospitalization.

The population is adult patients, 18 to 80 years of age, with NYHA class III/IV symptoms of heart failure due to ischemic or non-ischemic cardiomyopathy, and who, despite maximal optimized heart failure therapy regimens, are at high risk of heart failure-related hospitalizations. A total of 250 patients (N= ~125 per treatment arm) were enrolled for the purpose of obtaining at least 186 adjudicated heart failure-related hospitalizations.

Patients are randomized in parallel to high-dose MYDICAR or placebo in a 1:1 ratio. The trial is being conducted at approximately 53 sites in the United States, Denmark, Sweden, Germany, Poland, Belgium, the Netherlands, the United Kingdom, Israel and Hungary, with randomization stratified by country.

Potential trial participants were prescreened for the presence of NAbs against AAV1 using our companion diagnostic. Those who tested negative for AAV1 NAbs underwent further screening tests and procedures to determine eligibility prior to randomization and enrollment into the trial. Those who tested positive for AAV1 NAbs were excluded from the trial. Data analyses will be performed when all patients have completed the full 12-month active observation period and at least 186 adjudicated heart failure-related hospitalizations have occurred.

In CUPID 2, we enrolled advanced heart failure patients, at high-risk for serious adverse events and death. An independent data monitoring committee, or DMC, responsible for monitoring safety of the trial, has met three times. In all three meetings the DMC recommended that CUPID 2 proceed with its trial protocol as planned. Because CUPID 2 is an event-driven trial, all clinical events are reviewed by both the unblinded DMC and by an independent blinded Clinical Endpoint Committee, or CEC. The primary endpoint will be assessed at one year and all patients will be followed for a total of five years.

In CUPID 2 the endpoints were chosen to capture disease burden fully and to gain efficiency by including all terminal events (e.g. all-cause death, heart transplants and LVAD implantation) in the analyses. There are many statistical methods for the analysis of recurrent events; however, the joint frailty model addresses the limitations of other approaches, as it accounts for the correlation between the recurrent event process and the terminal event process (informative censoring).

The primary efficacy endpoint is time-to-recurrent advanced heart failure-related hospitalizations in the presence of terminal events at the time of primary analysis data cutoff. In the primary endpoint analysis the treatment effect estimate (hazard ratio for recurrent heart failure-related hospitalizations for MYDICAR versus placebo adjusted for correlated terminal events), will be calculated using the joint frailty model. The secondary endpoint is time-to-first terminal event (all-cause death, heart transplant or LVAD implantation). Additional endpoints include Kansas City Cardiomyopathy Questionnaire (quality of life) and six-minute walk test (exercise capacity). NYHA class will be descriptively summarized by time point for each treatment group.

The sample size for our CUPID 2 trial is based on Monte Carlo simulations so that approximately 250 patients with an estimated total of 186 heart failure-related hospitalizations, should provide at least 83% power at the 0.05 two-sided significance level to detect at least a 45% risk reduction (hazard ratio of 0.55) based on time-to-recurrent heart failure-related hospitalizations in the presence of the terminal events. The assumed magnitude of treatment effect is based on the data from published studies in heart failure patients and a conservative estimate of the anticipated magnitude of effect of MYDICAR based on 12-month results from CUPID 1 that showed an 88% reduction in recurrent clinical events adjusted for correlated terminal events with high-dose MYDICAR compared to placebo. We completed enrollment of this trial in February 2014 and expect to announce results in April 2015.

Upon completion of our CUPID 2 trial, the results will be discussed with the FDA and the EMA with the possibility that MYDICAR could potentially qualify for approval if the trial outcome demonstrates substantial reduction in recurrent heart failure-related hospitalizations and concordant trends in reduction in and/or delay of terminal events overall, and death in particular. However, if the FDA requires a further trial, we have an SPA in place for an approximately 572-patient Phase 3 pivotal trial using the same endpoint as in our CUPID 2 trial. We believe the results of one or both of these trials could support submission of a BLA for MYDICAR for the treatment of systolic heart failure. In November 2013, the EMA indicated that if MYDICAR demonstrates a substantial and highly significant treatment effect in the advanced heart failure population, and no untoward

effects attributable to MYDICAR are observed, a safety database of approximately 205-230 MYDICAR- treated subjects may be sufficient for a safety assessment to allow for acceptance of an MAA for MYDICAR for the treatment of systolic heart failure. We therefore believe that, if the above conditions are met, a Phase 3 trial may not be required for marketing approval in Europe. However, there can be no assurance that regulatory agencies will not require one or more additional clinical trials prior to granting regulatory approval.

AGENT-HF Trial (AAV1-CMV-SERCA2a Gene Therapy Trial in Heart Failure)

This trial is an investigator initiated clinical trial which commenced screening in December 2013. The trial is partially funded by the French government and sponsored by Assistance Publique – Hôpitaux de Paris. We are providing investigational medicinal product and some financial support. This trial is not required by any regulatory authorities for systolic heart failure indications.

The primary objective of the AGENT-HF Trial is to determine whether treatment with MYDICAR leads to reverse remodeling of the heart. In patients with heart failure, the size, shape, structure and physiology of their heart changes over time, and these changes that lead to a progressive decline in left ventricular function are referred to as remodeling. In reverse remodeling, there would be changes back to the more normal, healthier state of the heart along with an improvement in the functioning of the heart. This trial is expected to enroll approximately 44 heart failure patients in France with half receiving MYDICAR and the other half placebo. The primary endpoint at six months will be change, compared to baseline, in left ventricular end systolic volume as measured by cardiac computed tomography.

CELL-005 AAV1 NAb Positive Trial

The primary objective of the AAV1 NAb positive trial is to determine the safety of a single intracoronary infusion of high-dose MYDICAR in patients who test positive for AAV1 NAbs. The FDA has required this safety study as a condition to the submission of a BLA, to cover the possibility that MYDICAR may be used off-label in AAV1 NAb positive patients. In addition, the trial would explore the potential level of activity of MYDICAR in AAV1 NAb positive patients, although the trial would not be of sufficient size to detect statistical differences in the response in patients who test positive for AAV1 NAbs versus those who test negative. The patient population would be similar to the target patient population in our CUPID 2 trial and would be approximately 60 patients. The study design would be a Phase 2, randomized, double-blinded, parallel study. Patients would be stratified by baseline AAV1 NAb titer – either negative/equivocal or positive (³1:2) – and randomized in parallel, in a 2:1 ratio, to either MYDICAR or placebo. The primary endpoint after all subjects had been followed for at least six months would be safety as measured by the incidence and severity of adverse events, including all-cause mortality and heart failure-related hospitalizations. The percentage of subjects experiencing an event would be calculated for survivors and for all patients enrolled. Frequency, type and duration of cardiovascular hospitalizations would also be analyzed. The CEC would classify all deaths and hospitalizations, distinguishing between the primary cause and immediate underlying cause of death or hospitalization. The following activity/efficacy variables would be summarized descriptively by treatment group as the trial is not powered to detect a statistical significance in any of the variables: left ventricular end systolic volume, distance walked during the six-minute walk test, NT-proBNP levels, NYHA classification, and quality of life assessed by the Kansas City Cardiomyopathy Questionnaire. We are currently evaluating the timeframe for initiating this trial in the context of our MYDICAR development plan.

CELL-006 Viral Shedding Trial

The viral shedding trial is required as part of the environmental risk assessment that must be included in a marketing application to regulatory authorities, both in the United States and in Europe. In this open-label trial, approximately 10 to 20 patients with heart failure (the same target patient population as our CUPID 2 trial and our AAV1 NAb positive trial) would be treated with high-dose MYDICAR and followed until they have two consecutive bodily fluid samples that are negative for presence of the SERCA2a gene, as assessed by qPCR. The patients would continue to be followed for safety for up to two years to add to the overall MYDICAR safety

database. With the information from this trial, the marketing application would have information on how long treated patients would be excreting MYDICAR into the environment, thereby potentially spreading the virus to family members, health care workers and the public. We are currently evaluating the timeframe for initiating this trial in the context of our MYDICAR development plan.

Preclinical Studies of MYDICAR in Systolic Heart Failure

Preclinical studies have shown that, after administration of an AAV vector, the plasmids containing the vector DNA are cleared from the blood and tissues via the mononuclear phagocyte system in liver, spleen and lymph nodes, and lungs. After intracoronary delivery, AAV particles which are not taken up in cardiac tissues are first passed through to the lung via the coronary sinus, making this the first pass organ. Stable, long-term presence of viral DNA, SERCA2a protein, and vector-derived SERCA2a mRNA have been demonstrated in cardiac tissue of normal rats for up to one year following a single administration of MYDICAR.

Gene transfer of SERCA2a is associated with improved cardiac function in various rodent models of heart failure. Improved heart function and enhanced expression of SERCA2 have also been demonstrated in an ovine (sheep) pacing-induced heart failure model with MYDICAR. SERCA2 gene transfer has also been associated with restoration of SERCA2a expression and improved heart function in both a dog-pacing heart failure model and in a chronic myocardial ischemia-induced heart failure model in mini-pigs. Beyond the effects on enhancing contractility, SERCA2a gene transfer has been shown in preclinical studies to restore the energetic state of the heart (both in terms of energy supply and utilization), to decrease arrhythmias, and enhance blood flow to the heart through expression in endothelial cells.

Several studies we have sponsored have established pharmacologic activity for MYDICAR gene transfer in animals with heart failure, with data demonstrating restored SERCA2a expression and stabilization/improvement in heart function. The pharmacology study was conducted in the porcine (pig) mitral regurgitation, or MR, heart failure model. MR induces reduced myocardial contractility, elevated B-type natriuretic peptide, or BNP, levels and other signs and markers which are virtually identical to those associated with the human disease, including a decrease in SERCA2a expression. MYDICAR-treated animals demonstrated significant improvements in the heart's ability to contract and relax and improved ventricular volumes. In these studies, there was an absolute increase of 16% in median EF in MYDICAR-treated animals as compared to control animals. ESV increased in the control group by a median of 16 milliliters, or a median relative increase of 35%, an indication of decreased contractility and cardiac enlargement, compared with the MYDICAR group, which showed a tendency to decrease LV ESV by a median of 9.9 milliliters (a median decrease of 14%). In humans, a reduction in ESV of 10% signifies clinically relevant reverse remodeling, which is a strong predictor of lower long-term mortality and heart failure clinical events. Treated animals also had lower BNP levels post-dosing.

We have also sponsored two safety toxicology and biodistribution studies, both in normal mini-pigs. Both were three-month studies simulating the clinical administration procedure for MYDICAR or placebo with 5, 30 and 90 day sacrifice time points. Doses of up to three times the human dose on a weight-adjusted basis were administered. No mortalities were observed in either study and treatment with MYDICAR was not associated with any signs of toxicity or effects on body weight, sperm motility, clinical pathology, gross pathology, clinical chemistry parameters, organ weights or histopathology. No significant effects were observed on cardiovascular parameters, including electrocardiographic intervals. There were no test article-related observations during the necropsies. Mild increases in troponin I were observed in eight out of a total of 36 MYDICAR-treated animals in the first study, barely above upper limits of normal for humans. These increases were not considered to be related to MYDICAR or biologically significant and were not observed in the second study. No treatment related changes in troponin I values were observed across the other large animal pharmacology studies.

MYDICAR in Additional Indications

Beyond our proposed lead indication of systolic heart failure, we also plan to develop MYDICAR for additional indications including treatment of AVF maturation failure and for the treatment of patients with

advanced heart failure who are on an LVAD. Subject to raising additional capital, we may also initiate development programs in diastolic heart failure and PAH. Each of these diseases is characterized by a SERCA2a deficiency, and MYDICAR has demonstrated disease-modifying capability in preclinical models of these diseases. The broad potential of MYDICAR in multiple indications presents opportunities to maximize the value of our development programs for indications that are poorly managed by existing treatment options.

MYDICAR in Arteriovenous Fistula Maturation Failure (SERCA2a-AVF)

Currently, over 500,000 Americans have end-stage renal disease requiring dialysis. An arteriovenous fistula, or AVF, which is a surgically created connection between an artery and a vein in the arm of the patient, has proven to be the most durable, least complicated, and therefore preferred mode of vascular access for hemodialysis. The access that is created is routinely used for hemodialysis two to five times per week. Approximately 100,000 fistulae are placed yearly in the United States. However, a clinical problem that has resulted from this practice is that, following surgery to create the fistula, approximately 50% of the fistulae fail to mature to a usable state, and as many as 25% of hospital admissions in the dialysis population have been attributed to vascular access problems, including fistula malfunction and thrombosis.

Role of SERCA2a in Arteriovenous Fistula Maturation Failure

We believe MYDICAR has the ability to provide patients with end-stage renal disease a reliable and durable vascular access site for hemodialysis. The role of SERCA2a in normal and diseased blood vessel biology has been extensively studied. Maturation failure of an AVF has been attributed to rapid proliferation of VSMC resulting in vascular occlusion. The histological lesion that appears to be associated with early AVF failure is referred to as neointimal hyperplasia, comprising VSMC, myofibroblasts and endothelial cells within microvessels. In the setting of early AVF failure, both aggressive neointimal hyperplasia and adverse vascular remodeling (vasoconstriction or an inability to dilate adequately) plays a role. In particular, the combination of early and aggressive neointimal hyperplasia together with adverse vascular remodeling results in aggressive early stenosis. The biology of SERCA2a in both VSMC and endothelial cells provides a unique opportunity to potentially positively impact these pathological processes:

- Proliferation of VSMC is associated in the rat, rabbit, and human with loss of SERCA2a expression and is thought to be the dominant cell type driving neointimal hyperplasia. SERCA2a gene transfer inhibits in vitro VSMC proliferation and prevents neointimal thickening in a rat carotid injury model and prevented in-stent restenosis using an ex vivo model of human left internal mammary artery intimal thickening.
- In endothelial cells, SERCA2a modulates endothelial nitric oxide synthase (eNOS) expression and activity. This enzyme produces nitric oxide (NO), which dilates blood vessels. In a swine model of heart failure, coronary artery blood flow was decreased significantly, and MYDICAR rescued blood flow to levels observed in normal animals. In human artery endothelial cells, SERCA2a overexpression increased eNOS expression, phosphorylation, promoter activity, and cellular Ca^{2+} storage capacity. Thus, SERCA2a gene transfer increases eNOS expression and activity by modulating calcium homeostasis, resulting in dilated blood vessels and improved blood flow.
- MYDICAR was tested in a pharmacology safety study in a swine model of vascular injury. MYDICAR-treated animals demonstrated reduced neointimal hyperplasia and less stenosis as compared to the control animals.

Prior to initiation of a SERCA2a AVF trial, additional preclinical studies may need to be completed and a separate IND may need to be filed. The purpose of the SERCA2a AVF trial is to determine if MYDICAR, when applied to a limited segment of blood vessel during surgery to create an AVF, is safe, dilates the blood vessel, helps keep vessels open, and improves the long-term function of the AVF.

MYDICAR—LVAD Trial Investigation of the Safety and Feasibility of AAV1/SERCA2a Gene Transfer in Patients with Heart Failure and an LVAD

This trial is partially funded by the British Heart Foundation, sponsored by Imperial College London, and is expected to start in the first half of 2014. We are providing investigational medicinal product and some financial support. It is not a required trial by any regulatory authorities; however, it could potentially serve as a proof-of-concept trial to support the use of MYDICAR to wean patients off of an LVAD. The use of these devices present a host of risk factors for the patient, such as increased risk of thrombosis and infections, and these devices do not last for long periods of time. Given that the circulatory system of a patient with an LVAD is dependent on these devices, device failure usually translates to a catastrophic event for the patient. The primary objectives of the SERCA2a-LVAD trial are to determine (1) the safety and feasibility of using MYDICAR to treat heart failure patients who have an LVAD, (2) how well MYDICAR delivers the gene for SERCA2a to heart cells and (3) what impact circulating NAbs to AAV1 have on the ability of MYDICAR to deliver the SERCA2a gene to heart muscle cells. This trial is expected to enroll approximately 24 patients in the United Kingdom with varying levels of circulating NAbs to AAV1, 16 of whom will be treated with MYDICAR and eight with placebo. Six months post-treatment, all patients will undergo a heart biopsy for collection of tissue to determine the presence of the SERCA2a gene. In addition, safety data and changes in LV function will be collected and analyzed.

MYDICAR—HF/pEF MYDICAR for Heart Failure with Preserved Ejection Fraction (Diastolic Heart Failure)

As in systolic heart failure, a consistent finding in diastolic heart failure is a decrease in the expression of SERCA2a—a change that is seen in most animal models of heart failure and in human hearts with diastolic dysfunction. In preclinical studies, overexpressing SERCA2a using gene therapy in streptozotocin-treated transgenic mice demonstrated that increasing SERCA2a could improve diastolic function. In human cardiomyocytes isolated from the left ventricle of patients with end-stage heart failure, SERCA2a levels were correlated with improved diastolic function. We have also evaluated MYDICAR in another preclinical study in a rat model for spontaneous non-insulin-dependent type II diabetes mellitus, which is characterized by diastolic dysfunction and associated with abnormal calcium levels and decrease in SERCA2a expression. In this study, SERCA2a gene transfer restored diastolic function to normal. These data showed that SERCA2a overexpression may be used as a therapeutic strategy for the treatment of this disease.

SERCA2a gene transfer has also been demonstrated to improve diastolic cardiac function in aged animals. In preclinical studies, cardiac SERCA2a protein and ATPase activity were significantly decreased in elderly rat hearts compared with adult rats and were restored to adult levels after SERCA2a gene transfer. Diastolic function parameters, which were adversely affected in elderly rat hearts, were restored by overexpression of SERCA2a, supporting the hypothesis that decreased SERCA2a contributes to the functional abnormalities observed in elderly hearts and demonstrating that targeting SERCA2a in the elderly heart may lead to improved diastolic cardiac function.

The MYDICAR- HF/pEF trial would be our pilot clinical trial for the treatment of diastolic heart failure, which comprises approximately half of all heart failure cases. Subject to raising additional capital, we anticipate that the existing data we have generated for our proposed systolic heart failure indication would allow us to launch directly into a Phase 1/2 trial in approximately 40 patients with diastolic heart failure with the objectives of assessing safety and preliminary efficacy of a single intracoronary infusion of high-dose MYDICAR compared to placebo. Patients would be randomized in a ratio of 1:1 (MYDICAR versus placebo) and safety would be assessed in a manner similar to the assessment method used in our CUPID 2 trial. Preliminary efficacy would be assessed by concordant clinically meaningful changes at six months versus baseline in diastolic function, NT-proBNP, NYHA, quality of life, distance walked in the six-minute walk test and recurrent heart failure-related hospitalizations in the presence of terminal events.

We expect that development work for this proposed indication would be funded opportunistically.

MYDICAR in Pulmonary Arterial Hypertension (SERCA2a-PAH)

PAH is an increase of blood pressure in the pulmonary artery, pulmonary vein, or pulmonary capillaries, together known as the lung vasculature, leading to shortness of breath, dizziness, fainting, leg swelling and other symptoms. PAH can be a severe disease with a markedly decreased exercise tolerance and an increased likelihood of heart failure.

PAH is characterized by dysregulated proliferation of pulmonary artery smooth muscle cells, or PASMC, leading to maladaptive vascular remodeling. In the systemic circulation, vascular injury is associated with downregulation of SERCA2a, and subsequent alterations in calcium homeostasis in PASMC stimulates proliferation of PASMC. SERCA2a expression is decreased significantly in remodeled pulmonary arteries from patients with PAH and the rat monocrotaline, or MCT, model of PAH. In preclinical studies, overexpression of SERCA2a in human coronary artery endothelial cells *in vitro* resulted in increased endothelial nitric oxide synthase expression and activation, which increased vascular relaxation. In MCT rats with established PAH, gene transfer of SERCA2a via intratracheal delivery of MYDICAR decreased pulmonary artery pressure, vascular remodeling, right ventricular hypertrophy and fibrosis compared to controls. Similarly, aerosolized MYDICAR delivered at the time of MCT administration limited adverse hemodynamic profiles and indices of pulmonary and cardiac remodeling compared with controls.

Prior to initiation of the SERCA2a-PAH trial, additional formulation and toxicology studies would have to be completed, and a separate IND would have to be filed. We expect that development work for this proposed indication would be funded opportunistically, or through a partnering strategy.

Sales and Marketing

We currently have full worldwide commercial rights to all of our development programs. We believe we can maximize the value of our company by retaining substantial commercialization rights to our product candidates and, where appropriate, entering into partnerships for specific therapeutic indications and/or geographic territories.

Our current strategy is to market MYDICAR for all potential heart failure indications using a dedicated direct sales model focused on selected cardiologists and heart failure specialists. These physicians are typically affiliated with leading hospitals and medical centers and we believe that they tend to have well-established referral networks with supporting interventional cardiologists and cardiac catheterization laboratories. We believe they represent a concentrated customer base suitable to a specialist care sales model. We believe that MYDICAR would be adopted first by high-volume key-opinion-leader hospitals and medical centers, and progressively by a broader segment of the market. We believe that therapy adoption generally occurs much faster in the United States compared to Europe or the rest of the world. Cardiologists, heart failure specialists, and interventional cardiologists, have a history of early adoption of innovative products and technologies, in part because the rate of innovation in this sector has been sustained, and in part because of the large unmet need that their patients exhibit.

We therefore believe that a commercial strategy involving a progressive build out of commercial infrastructure in the United States covering key prescribers and centers of excellence is one that we can realistically pursue. Our commercialization strategy for MYDICAR in different geographies and indications beyond heart failure will continue to be evaluated and may involve strategic partners.

Manufacturing of MYDICAR (AAV1/SERCA2a)

AAV has many characteristics that facilitate large scale manufacturing and distribution, when exploited effectively. We believe that our significant investment in AAV1/SERCA2a process development and analytical characterization has paid off in an inherently scalable, proprietary manufacturing process that is capable of supplying a global market as large as heart failure with a gene therapy product.

The technology includes a coordinated design of the AAV1/SERCA2a vector genome (the vector DNA) and the production system. AAV vectors are made “gutless,” meaning that they do not contain viral genes. Only the two small non-coding elements from the parent virus are needed for replicating and packaging the vector DNA during production, which can be provided separately. The genome was also designed to be very close to the size of the parent AAV genome, to optimally fit within the AAV capsid.

Our state of the art manufacturing process for AAV1/SERCA2a was developed based on proven industrial cell culture methodologies. Like many of the manufacturers of recombinant monoclonal antibodies or proteins, we use cell-suspension based culturing techniques and intend to use stirred tank bioreactors for large scale cell culture and production. Our envisioned commercial production scale is 2,000 liters, which is one-tenth the volume of the largest industrial production vessels, so our anticipated production scale is far from the limits of the technology. We selected stirred tank production bioreactor technology as our production system because it has been the workhorse for recombinant protein production for more than 20 years. For purification of AAV1/SERCA2a, we use industrial chromatography columns and resins, and filtration technology common to the biopharmaceutical industry. We believe these materials and equipment are common for good manufacturing practices, or GMP, manufacturing of FDA approved biological products.

Our Approach for Producing AAV1/SERCA2a

By specifically creating a cell line for the manufacture of AAV1/SERCA2a that has the necessary components stably integrated into the cell line, we have created a production process similar to other industrial processes used to treat large market disease indications.

We use standard cell culture techniques and standard equipment in production and purification found in industrial cell culture drug manufacturing. All media used for cell growth and production are free of animal-derived components. To induce production of AAV1/SERCA2a, the cells are infected with a highly characterized batch of adenovirus. AAV viruses in nature and AAV vectors are not capable of replicating on their own and require a helper virus, such as adenovirus, to initiate replication. The purification process was designed to yield a high purity AAV1/SERCA2a product. Special attention was placed on the inactivation and removal of adenovirus and its free components, clearance of DNA and protein impurities, and even intact host cells.

MYDICAR drug product is produced by an FDA registered contract manufacturer. The manufacturing process is relatively simple: drug product is diluted to a specified concentration, filter-sterilized, and vials are aseptically filled into single-use standard pharmaceutical grade vials and stoppered using an automated filling machine. The final drug product is stored frozen or refrigerated until use.

Our Plans for Scale-Up and Our Approach to Commercial Manufacturing

Our production process has already been successfully scaled up from lab scale to the 250-liter clinical scale. Of the limited number of batches produced at 250 liters, two batches were successfully produced under GMP manufacturing conditions at Targeted Genetics Corporation (now AmpliPhi Biosciences Corporation) in Seattle, Washington. We expect risk for scale-up to the 2,000-liter commercial scale to be minimal, based on our knowledge and experience, and the proven track record of the stirred tank bioreactor technology and industrial chromatography. We have selected a contract manufacturing organization, Lonza, a worldwide leader of biological product manufacturing with extensive experience in viral manufacturing, for transfer of the process and conducting the scale-up to the commercial scale of 2,000 liters, which is expected in 2014. Our experienced technical staff has worked closely with Lonza staff on the transfer of the process and is now actively involved in the planning and strategy for scale-up and commercial production.

Our plan for commercial manufacturing is to establish commercial supply agreements with Lonza for product launch and commercial supply. We plan for the AAV1/SERCA2a manufacturing process to be designed and operated using standard off-the-shelf equipment, including a 2,000-liter disposable bioreactor platform, within a simple modular cleanroom. The concept is to have a production train that can be replicated in

standardized fashion to ensure that from facility to facility the manufacturing process is operated exactly the same using identical equipment, material and supplies. We anticipate that one production train will meet our global product requirements for our expected first indication, systolic heart failure. However, if actual product demand is greater than anticipated or additional indications gain approval, we believe that the standardized approach will allow for an easy and quick start-up of additional production trains. Our approach is designed to minimize capital costs and provide nimbleness and expandability of the production process.

MYDICAR Clinical and Commercial Supply

We currently have enough MYDICAR clinical supplies (drug product) to complete the CUPID 2, MYDICAR-LVAD and AGENT-HF trials. One additional batch of clinical supply can be produced from the remaining batch of bulk drug substance produced to supply our AAV NAb positive trial, viral shedding trial, and MYDICAR-AVF maturation trial, if commenced. Another batch of drug substance and drug product would be required to conduct a Phase 3 clinical trial of MYDICAR, if required.

We have engaged Lonza for the manufacture of MYDICAR for use in our clinical trials, and we expect to enter into an agreement with Lonza for the commercial supply of MYDICAR. We expect that Lonza will build a commercial manufacturing facility with capability up to 2,000 liter bioreactor capacity, which we expect to be operational no earlier than 2015. If we are successful in entering into a commercial scale supply agreement with Lonza, and Lonza's construction and build-out proceeds as we expect, we anticipate that MYDICAR will be launched from Lonza's new commercial facility, and that production from the Lonza facility will be sufficient to meet our initial projected commercial demand for MYDICAR.

Companion Diagnostic

The presence of pre-existing NAbs against the proteins that encapsulate the AAV1 gene therapy agent can block entry of the gene therapy agents into their target cells. Preclinical and limited clinical results with AAV1 NAb positive animals or patients, as well as *in vitro* neutralization experiments, have demonstrated that the detection of AAV1 NAbs is important prior to treatment with MYDICAR. Our experience in our CUPID 1 and CUPID 2 trials indicates that approximately 40% of the heart failure patients in the United States are AAV1 NAb negative and hence eligible for MYDICAR therapy. In other countries, such as Poland, the prevalence of pre-existing AAV1 NAbs is significantly higher.

We have developed a companion diagnostic AAV1 NAb assay for use in combination with MYDICAR in order to qualify subjects for treatment in clinical trials and for commercial use. The AAV1 NAb assay is intended to measure the loss of infectivity of AAV1/GFP (green fluorescent protein), an AAV1 recombinant particle with a reporter gene, following treatment with subject's serum (i.e., neutralization). Diluted samples of a subject's serum are incubated with AAV1/GFP, and then the mixture is tested for vector activity/infectivity *in vitro* on a permissive cell line (testing the relative gene expression (fluorescence) as a measure of vector neutralization).

To date, our tests to measure a potential clinical trial participant's level of pre-existing NAbs have been performed for us by Laboratory Corporation of America Holdings. We expect that the commercial assay, if approved, would be automated and similarly run by a strategic partner in several locations worldwide. It is not expected that the assay will be provided to the laboratories as a stand-alone kit but that approved laboratories would purchase the cells, controls and critical reagent, AAV1/GFP, from qualified suppliers. We intend that Quality System regulation set forth in 21 CFR Part 820 would be followed for the manufacture of AAV1/GFP and for the performance of the assay.

Companion diagnostics are subject to regulation by the FDA, the EMA and other foreign regulatory authorities as medical devices and require separate regulatory clearance or approval prior to commercial use. We anticipate that our companion diagnostic will require approval under a pre-market approval application, or PMA, submitted to the FDA's Center for Devices and Radiological Health, or CDRH, prior to commercialization. We further anticipate that regulatory approval of our companion diagnostic will be a prerequisite to our ability to market MYDICAR. Representatives of CDRH have participated in our meetings with the Center for Biologics

Evaluation and Research, or CBER, regarding MYDICAR to discuss the potential use of our companion diagnostic, and we anticipate that future meetings will include representatives from both CBER and CDRH to ensure that the BLA submission (for MYDICAR) and PMA submission (for the companion diagnostic) are coordinated and subject to parallel review by these respective FDA centers. Accordingly, our objective is to align the development programs such that the companion diagnostic will be developed and approved contemporaneously with MYDICAR.

MYDICAR Administration Devices

MYDICAR is administered in an outpatient cardiac catheterization laboratory by a qualified interventional cardiologist as a single dose intracoronary infusion using a legally marketed syringe pump and off-the-shelf components typically used for minimally invasive interventional procedures, including a 60 mL syringe, tubing, stopcocks, and appropriate percutaneous catheter. MYDICAR and the syringe pump and catheters are regulated by the FDA as a biologic-device combination product. Cross-labeling may be required for MYDICAR and the administration devices at the time of a marketing approval of the combination product.

Research and Development Expenses

Our research and development expenses were $16.9 million and $13.3 million for the fiscal years ended December 31, 2013 and 2012, respectively.

Competition

The biotechnology and pharmaceutical industries in which we operate are subject to rapid change and are characterized by intense competition to develop new technologies and proprietary products. We face potential competition from many different sources, including larger and better-funded pharmaceutical companies. While we believe that MYDICAR's unique mechanism of action provides us with competitive advantages, particularly given that MYDICAR is designed to be administered in conjunction with other pharmacological agents and devices (except LVADs), we have identified several companies which are active in the advancement of gene therapy products in the heart failure arena as of the date of this report. Not only must we compete with other companies that are focused on gene therapy treatments, any products that we may commercialize will have to compete with existing therapies and new therapies that may become available in the future.

Some of the pharmaceutical and biotechnology companies we expect to potentially compete with include Renova Therapeutics, NanoCor Therapeutics, Juventas Therapeutics, VentriNova and Beat BioTherapeutics. Renova, Beat BioTherapeutics and Juventas are in the clinical stages of development with their gene therapy products targeting moderate to advanced heart failure. Renova is using adenovirus serotype 5 encoding human adenylyl cyclase type 6 in a Phase 1/2 trial, while Juventas is enrolling a Phase 2 trial with its product candidate JVS100, which is a non-viral plasmid that encodes for stromal cell-derived factor-1 (SDF-1). NanoCor (BNP delivery of I1), VentriNova (cyclin A2), and Beat BioTherapeutics (AAV/R1R2) are in the preclinical testing of their gene therapy product candidates for the treatment of heart failure. These companies also compete with us in recruiting human capital and securing licenses to complementary technologies that may be critical to the success of our business. They also compete with us for potential funding from the biotechnology and pharmaceutical industries. Our potential competitors also include academic institutions, government agencies and research institutions. In addition, as the presence of pre-existing NAbs against the proteins that encapsulate the AAV1 gene therapy agent can block entry of the AAV1 gene therapy agents into their target cells, previous patient exposure to other AAV1-based gene therapies, irrespective of the condition or disease they aim to treat, would render a patient ineligible for MYDICAR therapy and could therefore be considered competitive to MYDICAR.

We believe that the key competitive factors that will affect the development and commercial success of MYDICAR and any other product candidates that we develop are efficacy, safety and tolerability profile, convenience in dosing, product labeling, value, price and the availability of reimbursement from the government and other third-parties. Our commercial opportunity could be reduced or eliminated if our competitors have products which are better in one or more of these categories.

Intellectual Property

We strive to protect and enhance the proprietary technologies that we believe are important to our business, and seek to obtain and maintain patents for any patentable aspects of our products or product candidates, including our companion diagnostic, their methods of use and any other inventions that are important to the development of our business. Our success will depend significantly on our ability to obtain and maintain patent and other proprietary protection for commercially important technology, inventions and know-how related to our business, defend and enforce our patents, maintain our licenses to use intellectual property owned by third parties, preserve the confidentiality of our trade secrets and operate without infringing the valid and enforceable patents and other proprietary rights of third parties. We also rely on know-how, continuing technological innovation and in-licensing opportunities to develop, strengthen, and maintain our proprietary position in the fields targeted by our product candidates.

We are the owner or licensee of a portfolio of patents and patent applications and possess substantial know-how and trade secrets which protect various aspects of our business. The patent families comprising our patent portfolio are primarily focused on MYDICAR for the treatment of heart failure and are generally directed to certain genes, AAV vectors and methods of delivering such AAV vectors to cells, methods of delivery to myocardial cells and processes to manufacture our product candidates. We intend to leverage the intellectual property surrounding MYDICAR, together with the 12 years of available regulatory exclusivity that we expect to receive under the Biologics Price Competition and Innovation Act, as an important component of our business strategy.

Patent Protection for MYDICAR

Our portfolio of patents and patent applications related to MYDICAR generally relates to three aspects of MYDICAR: use of the SERCA2a gene for the treatment of heart failure; use and delivery of AAV vectors as a therapy; and manufacture of AAV vectors. The patent families which we believe are important for the protection of MYDICAR after its expected approval are summarized below. See also “Business—License Agreements.”

- *Delivery of AAV Vectors to the Heart as a Therapy*. We are the sole owner of two patent families related to a method of treating cardiovascular disease by infusion of a therapeutic nucleic acid, such as MYDICAR, into the coronary circulation over a specified period of time, either alone or optionally with a vasodilating substance such as nitroglycerine. One patent has issued from these families (U.S. Patent No. 8,221,738), which includes claims to the use of a vasodilator in conjunction with MYDICAR. This patent is expected to expire in March 2030. We are currently prosecuting other method of use applications, and we expect that additional patents will issue from this family. If issued, these patents would expire between 2027 and 2028, excluding any potential additional term that may be available as a result of patent term adjustments, or if we elect to seek patent term extensions, or PTEs, that may be available under the Hatch-Waxman Act. In addition to the United States, corresponding patents have issued in Europe (EP 2044199), and Israel (IL 196541), and applications are pending in Australia, Europe, Hong Kong, India, and Japan. These patents and any patents issuing from the pending applications are expected to expire in July 2027 or October 2028.
- *Composition of MYDICAR*. MYDICAR utilizes a hybrid AAV vector, where the various components of the AAV vectors (capsid proteins and/or genetic material) are from different AAV serotypes. We in-licensed two patent families containing patent applications related to recombinant hybrid AAV vectors, the first via a sublicense from the University of Pennsylvania, or UPenn, under our exclusive license agreement with AmpliPhi (formerly Targeted Genetics), and the second under our non-exclusive license agreement with AskBio LLC, or AskBio. We expect that these patent families (U.S. Patent Nos. 6,759,237, 7,186,552 and 7,172,893) will expire in November 2019 and February 2021, and we expect to pay a royalty to UPenn and AskBio upon commercialization of MYDICAR. Foreign patents corresponding to U.S. Patent Nos. 6,759,237 and 7,186,522 have issued in Australia (AU 768729 and AU 2004201463), Canada (CA 2,349,838), Europe (EP 1127150) and Japan (JP 2000/58122700), all of which are expected to expire in November 2019. Foreign patents corresponding to U.S. Patent

No. 7,172,893 include issued patents in Australia (AU 780231), Canada (CA 2348382) and Europe (EP 1135468), all of which are expected to expire in November 2019.

- *Manufacture of AAV Vectors.* The manufacture and purification of the AAV vector used in MYDICAR is complicated and requires technical know-how. Our manufacturing process technology is protected by patents, trade secrets and proprietary know-how. We have obtained an exclusive license from AmpliPhi for certain aspects of the AAV manufacturing technology related to MYDICAR. This includes licenses to several patent families covering products and methods of manufacturing AAV vectors, including patent families related to stably transfected host cells for production of AAV vectors, and methods for commercial scale manufacturing and purification of recombinant AAV vectors. Taken in conjunction with our proprietary know-how, these patents are expected to offer additional protection by restricting competitors' access to AAV manufacturing methods used to make MYDICAR or competing AAV-based products. In the United States, these patents (U.S. Patent Nos. 6,566,118, 6,989,264, 6,995,006 and 6,475,769) are expected to expire in September 2018. Corresponding foreign patents have issued in Australia (AU 758708, AU 772921, AU 2003204921), Canada (CA 2302992, CA 2342849), Europe (EP 1009808, EP 1109892), and Japan (JP 4472182), all of which are expected to expire in September of 2018 or 2019. Our exclusive license with AmpliPhi includes a patent family related to improved methods for purification of recombinant AAV vectors (WO 2010/148143) is pending in Brazil, Canada, China, Europe, Hong Kong, Israel, India, Japan, South Korea, Mexico, Russia, Singapore and the United States, and any resulting patents are expected to expire in June of 2030.
- *Use of SERCA2a for the Treatment of Heart Failure.* We are developing MYDICAR for the treatment or prevention of heart failure through the use of AAV vectors to deliver the SERCA2a gene to improve cardiac function. We have licensed certain patent rights from The Regents of the University of California (U.S. Patent Nos. 6,605,274 and 7,745,416) related to gene therapy for the purpose of increasing SERCA2a expression in the treatment of heart failure, which have been important in the development of our product candidates, but these patent rights are expected to expire in 2015 prior to our anticipated approval of MYDICAR. Corresponding patents have issued in Australia (AU 2004204815) and Israel (IL169663), with expected expiration in January 2024, and Canada (CA 2217967) and Europe (EP 0820310, EP 1977767) which are expected to expire in April 2016. An application is pending in Canada.

International Patent Protection for MYDICAR

We are the owner or licensee of numerous patents and patent applications in jurisdictions outside the United States. As noted above, most of the patent families discussed above have issued or are pending in foreign jurisdictions. Depending on the applicable national laws, these patents and patent applications (if applicable) covering MYDICAR may also benefit from extensions of patent term in individual countries.

Trade Secret Protection for MYDICAR

We exclusively in-license certain trade secret technology and know-how for manufacturing the AAV vector used in MYDICAR under our 2012 agreement with AmpliPhi. We believe that the expertise and materials licensed to us provide us with a commercial advantage over competitors attempting to utilize an AAV vector in their products.

U.S. Regulatory Protection for MYDICAR

In addition to patent and trade secret protection, we expect to receive a 12-year period of regulatory exclusivity from the FDA upon approval of MYDICAR pursuant to the Biologics Price Competition and Innovation Act. The exclusivity period, if granted, will run from the time of FDA approval. This exclusivity period, if granted, will supplement the intellectual property protection discussed above, providing an additional barrier to entry of any competitor seeking approval for a biosimilar version of MYDICAR.

In addition, it is possible to extend the patent term of one patent covering MYDICAR following FDA approval. This PTE is intended to compensate a patent owner for the loss of patent term during the FDA approval process. If eligible, we may use a PTE to extend the term of one of the patents discussed above beyond the expected expiration date, providing additional protection for MYDICAR.

Patent Protection of Pipeline Products

While the majority of our patent portfolio is related to MYDICAR and its use for treating heart failure, we are the owner or licensee of several additional patent families which relate to other technology which we are developing, including our small molecule program. This includes treatments for additional indications using SERCA enzymes and MYDICAR, and new drugs for treating other SERCA-related diseases.

- *Methods of Treating Stenosis* . We in-license a patent family from The General Hospital Corporation related to using SERCA2a genes, including delivery by AAV vectors, to reduce stenosis, which is the narrowing of a blood vessel, or restenosis, which is the repeated narrowing in blood vessels. We expect that these patents (U.S. Patent Nos. 7,291,604 and 8,133,878) will expire no earlier than September 2024.
- *Methods of Treating Pulmonary Arterial Hypertension* . We are the co-owner with the Mount Sinai School of Medicine of New York University, or Mount Sinai, of a patent family containing patent applications (U.S. Patent Pub. 2011/0256101) related to the use of genes, including SERCA, to treat pulmonary arterial hypertension, a type of high blood pressure that affects the arteries in the lungs and the right side of the heart. These applications are currently in prosecution, and we expect that any patents that may issue from this family of patent applications will expire no earlier than April 2031. We are the exclusive licensee of Mount Sinai's joint ownership interest in this patent family pursuant to a license agreement.
- *Methods of Treating Heart Arrhythmia* . We in-licensed a patent family containing patent applications (U.S. Patent Pub. 2009/0239940) assigned to the U.S. National Institutes of Health which disclose methods and materials for treating heart disease, including heart arrhythmia, using SERCA2a and AAV vectors. We expect that any patents which issue from this family of patent applications will expire no earlier than July 2018.
- *Activation of SERCA2a using Zinc Finger Technology* . We are the sole owner of a patent family containing a patent application (U.S. Patent Pub. 2011/0172144) related to the use of a class of proteins known as zinc finger proteins to augment the expression of SERCA2a in cardiac muscle. Filed in January of 2011, we expect that any patent which issues from this application will expire no earlier than January of 2031.
- *High-throughput Screening for SERCA Modulators and Their Use* . We are the co-owner, with The Regents of the University of Minnesota, or UMinn, of patent families (U.S. Patent No. 8,431,356, and WO 2010/088450) that relate to high-throughput screening methods used to identify small molecule compounds that modulate SERCA activity, as well as their use in treating SERCA-related disease. We are the exclusive licensee of UMinn's joint ownership interest in these patents pursuant to a license agreement and we are solely responsible for the prosecution of these patents. On January 10, 2013, we received a notice of allowance from the U.S. Patent and Trademark Office in connection with a patent application relating to certain SERCA screening methods. We plan to use this technology to help identify product candidates which can be used to increase SERCA activity in muscle tissue, including the heart, to build a pipeline of SERCA-related therapies. We expect patents that may issue from these patent families to expire no earlier than January 2030. The current issued patent will expire in January 2030.

Trademarks

We have registered the trademark "MYDICAR" in the United States for use in connection with a biological product, namely, a gene transfer product composed of a recombinant AAV vector for medical use. We intend to pursue additional registrations in markets outside the United States where we plan to sell MYDICAR.

Patent Term

The term of individual patents and patent applications listed in previous sections will depend upon the legal term of the patents in the countries in which they are obtained. In most countries, the patent term is 20 years from the date of filing of the patent application (or parent application, if applicable). For example, if an international Patent Cooperation Treaty, or PCT, application is filed, any patent issuing from the PCT application in a specific country expires 20 years from the filing date of the PCT application. In the United States, however, if a patent was in force on June 8, 1995, or issued on an application that was filed before June 8, 1995, that patent will have a term that is the greater of 20 years from the filing date, or 17 years from the date of issue.

Under the Hatch-Waxman Act, the term of a patent that covers an FDA-approved drug or biological product may also be eligible for PTE. PTE permits restoration of a portion of the patent term of a U.S. patent as compensation for the patent term lost during product development and the FDA regulatory review process if approval of the application for the product is the first permitted commercial marketing of a drug or biological product containing the active ingredient. The patent term restoration period is generally one-half the time between the effective date of an IND and the submission date of a BLA plus the time between the submission date of a BLA and the approval of that application. The Hatch-Waxman Act permits a PTE for only one patent applicable to an approved drug, and the maximum period of restoration is five years beyond the expiration of the patent. A PTE cannot extend the remaining term of a patent beyond a total of 14 years from the date of product approval, and a patent can only be extended once, and thus, even if a single patent is applicable to multiple products, it can only be extended based on one product. Similar provisions may be available in Europe and certain other foreign jurisdictions to extend the term of a patent that covers an approved drug. When possible, depending upon the length of clinical trials and other factors involved in the filing of a BLA, we expect to apply for PTEs for patents covering our product candidates and their methods of use.

For additional information on PTE, see “Business—Government Regulation.”

Proprietary Rights and Processes

We may rely, in some circumstances, on proprietary technology and processes (including trade secrets) to protect our technology. However, these can be difficult to protect. We seek to protect our proprietary technology and processes, in part, by entering into confidentiality agreements with those who have access to our confidential information, including our employees, consultants, scientific advisors and contractors. We also seek to preserve the integrity and confidentiality of our proprietary technology and processes by maintaining physical security of our premises and physical and electronic security of our information technology systems. 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 proprietary technology and processes may otherwise become known or be independently discovered by competitors. To the extent that our employees, consultants, scientific advisors, contractors, or any future collaborators use intellectual property owned by others in their work for us, disputes may arise as to the rights in related or resulting know-how and inventions. For this and more comprehensive risks related to our proprietary technology and processes, please see “Risk Factors—Risks related to our intellectual property.”

License Agreements

License Agreement with The Regents of the University of California

In February 2001, we entered into a license agreement with The Regents of the University of California, or UC, under which we obtained an exclusive, worldwide license to UC’s patent rights in certain inventions, or the UC Patent Rights, related to the use of gene therapy vectors to deliver the SERCA2a gene to improve cardiac function, including certain patents related to MYDICAR. The agreement was amended twice, once in March 2001 to modify certain financial terms and once in January 2005 to make further amendments to the financial terms, with the second amendment also adding additional patents. We paid to UC an amendment fee of $114,455 and reimbursed UC for approximately $86,000 of previously incurred patent costs relating to the UC Patent Rights in connection with the second amendment of the agreement in January 2005.

Under the agreement, we are permitted to research, develop, manufacture and commercialize products utilizing the UC Patent Rights for gene therapy for the treatment or prevention of heart failure by the delivery of a gene or a synthetic equivalent, including SERCA2a, and to sublicense such rights. UC retained the right, on behalf of itself and other non-profit institutions, to use the UC Patent Rights for educational and research purposes and to publish information about the inventions covered by the UC Patent Rights.

In consideration for the rights granted to us under the agreement, we issued an aggregate of 83 shares of our common stock to UC upon the achievement of certain developmental milestones. We are required to issue to UC an additional 55 shares of our common stock and pay to UC up to an aggregate of approximately $1.6 million upon the achievement of certain developmental and regulatory milestones. In addition, upon commercialization of any product utilizing the UC Patent Rights, we will be required to pay to UC a low single-digit royalty on net sales of such product sold by us or our affiliates subject to minimum annual royalty payments and other adjustments in certain circumstances. However, we do not expect to commercialize MYDICAR prior to the expiration of the UC Patent Rights applicable to MYDICAR, and our obligation to pay milestones and royalties to UC terminates upon the expiration of the applicable UC Patent Rights.

In the event we sublicense a UC Patent Right, we are obligated to pay to UC a fee based on a percentage of sublicense fees received by us, which percentage ranges from the low-teens to mid-twenties depending on the country of origin of such UC Patent Right and is subject to adjustment in certain circumstances. In addition, we will also be required to pay to UC a low single-digit percentage sublicense royalty on net sales of products sold by our sublicensees that utilize the sublicensed UC Patent Right, but in no event will we be required to pay more than 50% of the royalties we receive from such sublicensees.

The agreement requires that we diligently develop, manufacture and commercialize products that are covered by the UC Patent Rights, and we have agreed to meet certain developmental and commercial milestones. UC may, at its option, either terminate the agreement or change the license granted from an exclusive license to a non-exclusive license if we fail to meet such milestones. We are currently in compliance with these milestone requirements.

We may unilaterally terminate the agreement for any reason upon 90 days' written notice to UC. UC may terminate the agreement in the event of our nonperformance or breach of the agreement if such nonperformance or breach remains uncured for 60 days following our receipt of written notice of such nonperformance or breach. Absent early termination, the agreement will continue until the expiration date of the longest-lived patent right included in the UC Patent Rights, which is expected to occur in 2024.

Exclusive License Agreement with Dr. Martin J. Kaplitt

In June 2006, we entered into an exclusive license agreement with Dr. Martin J. Kaplitt pursuant to which Dr. Kaplitt granted to us an exclusive, worldwide license under Dr. Kaplitt's interest in certain patents related to the use of AAV vectors to deliver genes to cardiac muscles and delivery methods of AAV vectors to heart cells for the development, manufacture, use and sale of MYDICAR. The license granted to us under the agreement automatically became non-exclusive on the fourth anniversary of the effective date of the agreement. We have the right to grant sublicenses to third parties under the agreement.

In consideration for the rights granted to us under the agreement, we paid an upfront fee to Dr. Kaplitt of $25,000. We are also obligated to pay to Dr. Kaplitt an annual license maintenance fee of $6,000 during the term of the agreement. In addition, we are required to pay to Dr. Kaplitt a very low single-digit percentage royalty on net sales of products sold by us, our affiliates and our sublicensees that are covered by the licensed patents. Our royalty obligations continue on a product-by-product and country-by-country basis until the expiration of the last-to-expire valid claim in the licensed patents covering a licensed product in such country. Finally, we are obligated to pay to Dr. Kaplitt up to an aggregate of $200,000 upon the achievement of certain regulatory milestones.

We may unilaterally terminate the agreement upon 60 days' written notice to Dr. Kaplitt. Dr. Kaplitt may terminate the agreement in the event of our material breach of the agreement if such breach remains uncured for 60 days following our receipt of written notice of such breach. Absent early termination, the agreement will automatically terminate upon the expiration of the last-to-expire of the licensed patents containing a valid claim, which is expected to occur in 2015, prior to the projected launch of our product candidates.

Sublicense Agreement and Amended and Restated License Agreement with AmpliPhi

Sublicense Agreement

In June 2012, we entered into a sublicense agreement with AmpliPhi, or the AmpliPhi Sublicense, pursuant to which AmpliPhi sublicensed to us certain rights under a separate agreement, the UPenn Agreement, which AmpliPhi entered into in 2009 with the Trustees of UPenn. Under the terms of the agreement, we obtained an exclusive, worldwide sublicense from AmpliPhi under certain UPenn patents related to AAV1 vectors for the development, manufacture, use and sale of companion diagnostics to MYDICAR. We have the right to grant sublicenses to our affiliates and third-party collaborators under the agreement solely for research, development or other non-commercial purposes, or as reasonably necessary, to our manufacturers or distributors, provided that we remain primarily liable and such downstream sublicenses are consistent with the terms of our agreement with AmpliPhi and prohibit further sublicensing. In addition, we are required to use commercially reasonable efforts to meet certain developmental, regulatory and commercial milestones with respect to companion diagnostics under the agreement. We are currently in compliance with these milestone requirements. While we have sole control over the development and commercialization of companion diagnostics under the agreement, AmpliPhi has the first right to prosecute and maintain the licensed patents, subject to our right to consult with AmpliPhi with regard to such prosecution and maintenance upon our reasonable request.

In consideration for the sublicense granted to us under the agreement, we paid to AmpliPhi a sublicense initiation fee of $310,000, and we are obligated to pay to AmpliPhi an annual sublicense maintenance fee of $310,000. We are also required to pay to AmpliPhi a low single-digit percentage royalty based on net sales of any companion diagnostic covered by a licensed patent sold by us, our affiliates or our sublicensees. Our royalty obligations continue on a companion diagnostic-by-companion diagnostic and country-by-country basis until the expiration of the last-to-expire valid claim in a licensed patent covering the applicable companion diagnostic in such country. Finally, we are obligated to pay to AmpliPhi all royalty and milestone payments that become due and payable by AmpliPhi to UPenn under the UPenn Agreement as a result of our exercise of the sublicense granted under our agreement with AmpliPhi, including a low single-digit tiered percentage royalty on net sales of any companion diagnostic sold by us, our affiliates or our sublicensees, which royalty is separate from and in addition to the royalty payable to AmpliPhi described above, and up to an aggregate of $850,000 in potential milestone payments per product covered by the licensed patents.

We may unilaterally terminate the agreement upon 30 days' written notice to AmpliPhi. Absent early termination, the agreement will automatically terminate upon the expiration of the last-to-expire licensed patent, which is expected to occur in 2019.

Amended and Restated License Agreement

We entered into an amended and restated license agreement with AmpliPhi concurrently with the AmpliPhi Sublicense that both amended the terms of the license agreement which we entered into with AmpliPhi in 2009 and terminated our manufacturing agreement with AmpliPhi which we entered into in 2009. Under the agreement, we obtained an exclusive, worldwide license under certain patents and know-how related to AmpliPhi's AAV vector and manufacturing technology for the development, manufacture, use and sale of MYDICAR. We have the right to grant sublicenses to our affiliates and third-party collaborators under the agreement for research, development or other non-commercial purposes, or as reasonably necessary, to our manufacturers or distributors, provided that we remain primarily liable and such sublicenses comply with the terms of our agreement with AmpliPhi and prohibit further sublicensing. In addition, we have agreed to use

commercially reasonable efforts to meet certain diligence milestones with respect to the development and commercialization of at least one product covered by the UPenn patent rights licensed to AmpliPhi by UPenn under the UPenn Agreement. We are currently in compliance with these milestone requirements. While we have sole control over development and commercialization of products covered by the licensed patents, AmpliPhi has the first right to prosecute and maintain the licensed patents, subject to our right to consult with AmpliPhi with regard to such prosecution and maintenance upon our reasonable request.

During the term of the agreement, we are obligated to pay to AmpliPhi all royalty and milestone payments that become due and payable by AmpliPhi to UPenn under the UPenn Agreement as a result of our exercise of the sublicense granted under our agreement with AmpliPhi. This includes a low single-digit tiered percentage royalty on net sales of MYDICAR and any other product covered by the licensed patents sold by us, our affiliates or our sublicensees, and up to $850,000 in milestone payments upon the achievement of certain developmental and regulatory milestones related to MYDICAR and any other product covered by the licensed patents.

The agreement does not provide either party with termination rights and does not have a provision for expiration or automatic termination.

License Agreement with AdVec

In February 2009, we entered into a license agreement with AdVec, Inc., or AdVec, under which we obtained a non-exclusive, worldwide license to use and acquire from AdVec's distributor certain human embryo kidney cells transformed by Adenovirus 5 DNA, or 293 Cells, and certain AdVec know-how related to 293 Cells for use in testing of MYDICAR for lot release. In consideration for the rights granted to us under the agreement, we are obligated to pay to AdVec an annual license maintenance fee of $5,000.

Either party may terminate the agreement upon written notice of the other party's insolvency or bankruptcy or upon the other party's breach of the agreement if such breach remains uncured after 60 days of receipt of written notice of such breach. Absent early termination, the agreement will remain in effect until the tenth anniversary of the effective date. Thereafter, the agreement will automatically renew for successive five-year terms unless either party notifies the other party in writing at least 90 days prior to the end of any such five-year term of its election not to renew the agreement.

Non-Exclusive License Agreement with Virovek

In November 2010, we entered into a non-exclusive license agreement with Virovek Incorporation, or Virovek, under which we obtained a non-exclusive, worldwide license under certain patent rights and trade secrets related to Virovek's AAV baculovirus technology to develop, manufacture, use and sell AAV1/GFP vector reagents as part of a companion diagnostic. Under the terms of the agreement, we have the right to grant sublicenses to third parties, and we are required to use commercially reasonable efforts to develop and commercialize a companion diagnostic to MYDICAR. We are currently in compliance with this requirement.

In consideration for the rights granted to us under the agreement, we paid to Virovek an up-front license fee of $15,000, and we are obligated to pay to Virovek an annual maintenance fee of $20,000, which fee is creditable against royalties due under the agreement. We are also required to pay to Virovek a percentage royalty in the mid-teen range based on upfront, annual, milestone, royalty and other payments received by us as a result of the performance of companion diagnostics by us, our affiliates and our sublicensees, subject to adjustment in certain circumstances. Our royalty obligations continue on a companion diagnostic-by-companion diagnostic and country-by-country basis until the expiration of the last-to-expire valid claim in a licensed patent covering the companion diagnostic in such country, which is expected to occur in 2027, or 10 years from the date of first commercial sale in such country if the companion diagnostic is covered only by licensed trade secrets.

We may unilaterally terminate the agreement upon 60 days' notice to Virovek. Either party may terminate the agreement for the other party's material breach of the agreement if such breach remains uncured after 90 days of receiving written notice of such breach. Absent early termination, the agreement will automatically terminate upon the expiration of our royalty payment obligations.

Non-Exclusive License Agreement with AskBio

In January 2008, we entered into a non-exclusive license agreement with AskBio, a wholly owned subsidiary of Asklepios Biopharmaceutical Inc., under which we obtained a non-exclusive, worldwide license under certain patents related to recombinant AAV vectors to develop, manufacture, use and sell MYDICAR. We have the right to grant sublicenses to third parties under the agreement provided that such sublicenses are entered into pursuant to a written sublicense agreement containing terms consistent with our agreement with AskBio.

Under the terms of the agreement, we granted to AskBio an option to obtain a non-exclusive, worldwide license under certain of our patent rights related to infusion of AAV in the arteries of the heart to develop, manufacture, use and sell products for the treatment of cardiac diseases. This option includes our currently pending patent application related to a method of treating cardiovascular disease by infusion of a therapeutic nucleic acid into the coronary circulation over a specified period of time. It does not include our issued patent in this family, which includes claims to the concurrent use of a vasodilating substance such as nitroglycerine. If AskBio timely exercises its option to obtain the license under the agreement on or before the earlier of January 15, 2015 and within 60 days following notice that a patent has issued from the patent applications included within the patent rights subject to the option, we will enter into a separate license agreement with AskBio with respect to such license with previously agreed upon payment terms. Although the scope of the license granted to AskBio upon exercise of the option would enable AskBio to develop and commercialize a competing product with respect to the patent rights to which the option applies, we believe that the exclusion of our issued patent from that license, and the scope of our anticipated regulatory approvals, will prevent AskBio from being able to launch any product that is able to compete directly with MYDICAR.

In consideration for the rights granted to us under the agreement, we paid to AskBio license fee payments of $150,000 in the aggregate. In addition, we are obligated to pay to AskBio an annual maintenance fee of $100,000. Upon commercialization of any product utilizing the licensed patents, we will also be required to pay to AskBio a low single-digit percentage royalty on net sales of such products, including MYDICAR. Our royalty obligations continue on a product-by-product and country-by-country basis until the expiration of the last-to-expire valid claim in a licensed patent covering the applicable product in such country, which is expected to be in 2021. We are also obligated to reimburse AskBio for up to an aggregate of $355,000 per licensed product upon the achievement of certain clinical, regulatory and sales milestones that may become due and payable by AskBio under a separate agreement between AskBio and the University of North Carolina at Chapel Hill from 2003.

We may unilaterally terminate the agreement upon 180 days' written notice to AskBio. Either party may terminate the agreement for the other party's material breach of the agreement if such breach is not cured after 30 days of receiving written notice of such breach. Absent early termination, the agreement will continue in effect until the expiration of our royalty payment obligations under the agreement.

Exclusive Patent License with the Regents of the University of Minnesota

We are joint owners with UMinn of the rights in a certain patent related to screening technology for isolation of small molecule modulators of SERCA enzymes (fluorescence resonance energy transfer, or FRET, assays). In May 2009, we entered into an exclusive patent license agreement with UMinn under which we obtained an exclusive license to UMinn's joint ownership interest in the patent application that led to the current issued patent. We have the right to grant sublicenses to third parties under the agreement, and UMinn retained the right to use the licensed technology for non-commercial research and educational purposes.

We have agreed to meet certain performance milestones under the agreement, the deadline for which may be extended at our request provided that we have used commercially reasonable efforts to achieve such milestones by the applicable deadlines. We are currently in compliance with these milestone requirements. We have the first right to prosecute and maintain the applicable patent family.

In consideration for the rights granted to us under the agreement, we made an upfront payment to UMinn of $120,000. In addition, we are obligated to pay to UMinn an annual license fee of $120,000. The annual license fee will increase to $325,000 if we (1) undergo a change of control, (2) assign the agreement, any of our rights or obligations under the agreement or our joint ownership interest in the licensed technology, (3) receive a certain amount in license and sublicense revenues under the agreement, (4) file an IND, new drug application, or NDA, BLA or orphan drug application (or a foreign equivalent of any such application) for a product covered by the licensed technology, or (5) enter into any agreement with a third party to market or use the licensed technology, subject to certain exceptions.

We may unilaterally terminate the agreement upon 90 days' written notice to UMinn. UMinn may terminate the agreement upon 10 days' written notice to us upon our insolvency or for our breach of the agreement if such breach remains uncured for 90 days after we receive notice of such breach, or 30 days in the case of a non-payment breach. Absent early termination, the agreement will automatically terminate upon the expiration of all active claims in any licensed patent or patent application, which is expected to occur no earlier than January 2030.

Material Transfer and Exclusivity Agreement with Les Laboratoires Servier

In February 2014, we and Servier entered into a material transfer and exclusivity agreement, pursuant to which we agreed to transfer to Servier samples of certain proprietary compounds from our small molecule SERCA2b modulator program and granted to Servier a non-exclusive, non-sublicensable, royalty-free license to conduct certain studies of the samples for the purpose of evaluating Servier's interest in negotiating a potential license and research collaboration agreement with us relating to small molecule SERCA2b modulators, or Compounds, for the treatment of type 2 diabetes and other metabolic diseases.

Subject to earlier termination of the agreement as described below, the term of Servier's license to conduct the evaluation, or the evaluation period, will expire six months after Servier's initial receipt from us of the samples, provided that Servier may extend the evaluation period for up to an additional two months.

Under the terms of the agreement, we also granted to Servier the exclusive right to negotiate for an exclusive, royalty-bearing license to develop and commercialize Compounds, and products containing Compounds, in the field of type 2 diabetes and other metabolic diseases, or the field, solely outside of the United States and its territories and possessions, or ex-U.S. territory, on the terms and conditions set forth in the agreement and other commercially reasonable terms to be negotiated in good faith by the parties and set forth in a definitive license and research collaboration agreement.

Manufacturing

Manufacturing Services Agreement with Lonza

In August 2012, we entered into a manufacturing services agreement with Lonza, which we subsequently amended and restated in August 2013. Under the terms of the agreement, Lonza provides manufacturing services to produce MYDICAR at a scale sufficient for our clinical trials to date. We pay for manufacturing services performed by Lonza under the agreement pursuant to statements of work entered into from time to time.

We may unilaterally terminate the agreement upon six months' written notice to Lonza. Lonza may terminate the agreement upon written notice to us, provided that such termination by Lonza will not be effective until the earlier of one year after the date we receive such written notice or our qualification of an alternative

supplier and completion of certain technology transfer assistance services to establish manufacturing capabilities at the alternative supplier's facilities. Either party may terminate the agreement in the event of the other party's insolvency or for the other party's material breach of the agreement if such breach remains uncured after 30 days of receiving written notice of such breach or after 180 days of receiving written notice of such breach if such breach is not a non-payment related breach, is not capable of being cured within 30 days and the breaching party is making diligent efforts to cure such breach. In addition, either party may terminate the agreement, by providing two months' written notice to the other party if it receives notice that the production of MYDICAR under the agreement or clinical trials for which MYDICAR is being produced has been or will be suspended or terminated by the FDA or EMA due to product failure. Absent early termination, the agreement will continue until the fifth anniversary of the effective date of the original agreement.

We have also entered into a non-binding letter of intent with Lonza, pursuant to which both parties have agreed to work in good faith to negotiate a definitive agreement for the commercial manufacture of MYDICAR in the event we desire to commence commercial scale manufacture of MYDICAR.

Government Regulation

Biological products, including gene therapy products, are subject to regulation under the Federal Food, Drug, and Cosmetic Act, or FD&C Act, and the Public Health Service Act, or PHS Act, and other federal, state, local and foreign statutes and regulations. Both the FD&C Act and the PHS Act and their corresponding regulations govern, among other things, the testing, manufacturing, safety, purity, potency, efficacy, labeling, packaging, storage, record keeping, distribution, reporting, advertising and other promotional practices involving biological products. FDA approval must be obtained before clinical testing of a biological product begins, and each clinical trial protocol for a gene therapy product is reviewed by the FDA and, in some instances, the U.S. National Institutes of Health, or NIH, through its Recombinant DNA Advisory Committee, or RAC. FDA approval also must be obtained before marketing of biological products. The process of obtaining regulatory approvals and the subsequent compliance with appropriate federal, state, local and foreign statutes and regulations require the expenditure of substantial time and financial resources and we may not be able to obtain the required regulatory approvals. To date, the FDA has never approved a gene therapy product for commercial sale. Within the FDA, the Center for Biologics Evaluation and Research, or CBER, regulates gene therapy products, the Center for Devices and Radiological Health Center, or CDRH, regulates companion diagnostics, and the Office of Combination Products regulates combination products.

CBER works closely with the NIH and its RAC, which makes recommendations to the NIH on gene therapy issues and engages in a public discussion of scientific, safety, ethical and societal issues related to proposed and ongoing gene therapy protocols. The FDA and the NIH have published guidance documents with respect to the development and submission of gene therapy protocols. The FDA also has published guidance documents related to, among other things, gene therapy products in general, their preclinical assessment, observing subjects involved in gene therapy studies for delayed adverse events, potency testing and chemistry, manufacturing and control information in gene therapy INDs.

Ethical, social and legal concerns about gene therapy, genetic testing and genetic research could result in additional regulations restricting or prohibiting the processes we may use. Federal and state agencies, congressional committees and foreign governments have expressed interest in further regulating biotechnology. More restrictive regulations or claims that our products are unsafe or pose a hazard could prevent us from commercializing any products. New government requirements may be established that could delay or prevent regulatory approval of our product candidates under development. It is impossible to predict whether legislative changes will be enacted, regulations, policies or guidance changed, or interpretations by agencies or courts changed, or what the impact of such changes, if any, may be.

U.S. Biological Products Development Process

The process required by the FDA before a biological product may be marketed in the United States generally involves the following:

- completion of nonclinical laboratory tests and animal studies according to good laboratory practices, or GLPs, and applicable requirements for the humane use of laboratory animals or other applicable regulations;
- submission to the FDA of an IND application, which must become effective before human clinical trials may begin;
- performance of adequate and well-controlled human clinical trials according to the FDA's regulations, commonly referred to as good clinical practices, or GCPs, and any additional requirements for the protection of human research subjects and their health information, to establish the safety and efficacy of the proposed biological product for its intended use;
- submission to the FDA of a BLA for marketing approval that includes substantive evidence of safety, purity and potency from results of nonclinical testing and clinical trials;
- satisfactory completion of an FDA inspection of the manufacturing facility or facilities where the biological product is produced to assess compliance with GMP, to assure that the facilities, methods and controls are adequate to preserve the biological product's identity, strength, quality and purity and, if applicable, the FDA's current good tissue practices, or GTPs, for the use of human cellular and tissue products;
- potential FDA audit of the nonclinical study and clinical trial sites that generated the data in support of the BLA; and
- FDA review and approval, or licensure, of the BLA.

Before testing any biological product candidate, including a gene therapy product, in humans, the product candidate enters the preclinical testing stage. Preclinical tests, also referred to as nonclinical studies, include laboratory evaluations of product chemistry, toxicity and formulation, as well as animal studies to assess the potential safety and activity of the product candidate. The conduct of the preclinical tests must comply with federal regulations and requirements including GLPs.

Where a gene therapy trial is conducted at, or sponsored by, institutions receiving NIH funding for recombinant DNA research, prior to the submission of an IND to the FDA, a protocol and related documentation is submitted to and the trial is registered with the NIH Office of Biotechnology Activities, or OBA, pursuant to the NIH Guidelines for Research Involving Recombinant DNA Molecules, or NIH Guidelines. Compliance with the NIH Guidelines is mandatory for investigators at institutions receiving NIH funds for research involving recombinant DNA, however many companies and other institutions not otherwise subject to the NIH Guidelines voluntarily follow them. The NIH is responsible for convening the RAC, a federal advisory committee, which discusses protocols that raise novel or particularly important scientific, safety or ethical considerations at one of its quarterly public meetings. The OBA will notify the FDA of the RAC's decision regarding the necessity for full public review of a gene therapy protocol. RAC proceedings and reports are posted to the OBA website and may be accessed by the public.

The clinical trial sponsor must submit the results of the preclinical tests, together with manufacturing information, analytical data, any available clinical data or literature and a proposed clinical protocol, to the FDA as part of the IND. Some preclinical testing may continue even after the IND is submitted. The IND automatically becomes effective 30 days after receipt by the FDA, unless the FDA places the trial on a clinical hold within that 30-day time period. In such a case, the IND sponsor and the FDA must resolve any outstanding concerns before the clinical trial can begin. With gene therapy protocols, if the FDA allows the IND to proceed, but the RAC decides that full public review of the protocol is warranted, the FDA will request at the completion

of its IND review that sponsors delay initiation of the protocol until after completion of the RAC review process. The FDA may also impose clinical holds on a biological product candidate at any time before or during clinical trials due to safety concerns or non-compliance. If the FDA imposes a clinical hold, trials may not recommence without FDA authorization and then only under terms authorized by the FDA. Accordingly, we cannot be sure that submission of an IND will result in the FDA allowing clinical trials to begin, or that, once begun, issues will not arise that suspend or terminate such trials.

Clinical trials involve the administration of the biological product candidate to healthy volunteers or patients under the supervision of qualified investigators, generally physicians not employed by or under the trial sponsor's control. Clinical trials are conducted under protocols detailing, among other things, the objectives of the clinical trial, dosing procedures, subject selection and exclusion criteria, and the parameters to be used to monitor subject safety, including stopping rules that assure a clinical trial will be stopped if certain adverse events should occur. Each protocol and any amendments to the protocol must be submitted to the FDA as part of the IND. Clinical trials must be conducted and monitored in accordance with the FDA's regulations comprising the GCP requirements, including the requirement that all research subjects provide informed consent. Further, each clinical trial must be reviewed and approved by an independent institutional review board, or IRB, at or servicing each institution at which the clinical trial will be conducted. An IRB is charged with protecting the welfare and rights of trial participants and considers such items as whether the risks to individuals participating in the clinical trials are minimized and are reasonable in relation to anticipated benefits. The IRB also approves the form and content of the informed consent that must be signed by each clinical trial subject or his or her legal representative and must monitor the clinical trial until completed. Clinical trials also must be reviewed by an institutional biosafety committee, or IBC, a local institutional committee that reviews and oversees basic and clinical research conducted at that institution. The IBC assesses the safety of the research and identifies any potential risk to public health or the environment.

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

- *Phase 1*. The biological product is initially introduced into healthy human subjects and tested for safety. In the case of some products for severe or life-threatening diseases, especially when the product may be too inherently toxic to ethically administer to healthy volunteers, the initial human testing is often conducted in patients.
- *Phase 2*. The biological product is evaluated in a limited patient population to identify possible adverse effects and safety risks, to preliminarily evaluate the efficacy of the product for specific targeted diseases and to determine dosage tolerance, optimal dosage and dosing schedule.
- *Phase 3*. Clinical trials are undertaken to further evaluate dosage, clinical efficacy, potency, and safety in an expanded patient population at geographically dispersed clinical trial sites. These clinical trials are intended to establish the overall risk/benefit ratio of the product and provide an adequate basis for product labeling.

Post-approval clinical trials, sometimes referred to as Phase 4 clinical trials, may be conducted after initial marketing approval. These clinical trials are used to gain additional experience from the treatment of patients in the intended therapeutic indication, particularly for long-term safety follow-up. The FDA recommends that sponsors observe subjects for potential gene therapy-related delayed adverse events for a 15-year period, including a minimum of five years of annual examinations followed by ten years of annual queries, either in person or by questionnaire, of trial subjects.

During all phases of clinical development, regulatory agencies require extensive monitoring and auditing of all clinical activities, clinical data, and clinical trial investigators. Annual progress reports detailing the results of the clinical trials must be submitted to the FDA. Written IND safety reports must be promptly submitted to the FDA, the NIH and the investigators for serious and unexpected adverse events, any findings from other studies, tests in laboratory animals or *in vitro* testing that suggest a significant risk for human subjects, or any clinically

important increase in the rate of a serious suspected adverse reaction over that listed in the protocol or investigator brochure. The sponsor must submit an IND safety report within 15 calendar days after the sponsor determines that the information qualifies for reporting. The sponsor also must notify the FDA of any unexpected fatal or life-threatening suspected adverse reaction within seven calendar days after the sponsor's initial receipt of the information. Phase 1, Phase 2 and Phase 3 clinical trials may not be completed successfully within any specified period, if at all. The FDA or the sponsor or its data safety monitoring board may suspend a clinical trial at any time on various grounds, including a finding that the research subjects or patients are being exposed to an unacceptable health risk, including risks inferred from other unrelated gene therapy trials. Similarly, an IRB can suspend or terminate approval of a clinical trial at its institution if the clinical trial is not being conducted in accordance with the IRB's requirements or if the biological product has been associated with unexpected serious harm to patients.

Human gene therapy products are a new category of therapeutics. Because this is a relatively new and expanding area of novel therapeutic interventions, there can be no assurance as to the length of the trial period, the number of patients the FDA will require to be enrolled in the trials in order to establish the safety, efficacy, purity and potency of human gene therapy products, or that the data generated in these trials will be acceptable to the FDA to support marketing approval. The NIH and the FDA have a publicly accessible database, the Genetic Modification Clinical Research Information System which includes information on gene transfer studies and serves as an electronic tool to facilitate the reporting and analysis of adverse events on these studies.

Concurrently with clinical trials, companies usually complete additional animal studies and must also develop additional information about the physical characteristics of the biological product as well as finalize a process for manufacturing the product in commercial quantities in accordance with GMP requirements. To help reduce the risk of the introduction of adventitious agents with use of biological products, the PHS Act emphasizes the importance of manufacturing control for products whose attributes cannot be precisely defined. The manufacturing process must be capable of consistently producing quality batches of the product candidate and, among other things, the sponsor must develop methods for testing the identity, strength, quality, potency and purity of the final biological product. Additionally, appropriate packaging must be selected and tested and stability studies must be conducted to demonstrate that the biological product candidate does not undergo unacceptable deterioration over its shelf life.

U.S. Review and Approval Processes

After the completion of clinical trials of a biological product, FDA approval of a BLA must be obtained before commercial marketing of the biological product. The BLA must include results of product development, laboratory and animal studies, human trials, information on the manufacture and composition of the product, proposed labeling and other relevant information. The FDA may grant deferrals for submission of data or full or partial waivers. The testing and approval processes require substantial time and effort and there can be no assurance that the FDA will accept the BLA for filing and, even if filed, that any approval will be granted on a timely basis, if at all.

Under the Prescription Drug User Fee Act, or PDUFA, as amended, each BLA must be accompanied by a significant user fee. The FDA adjusts the PDUFA user fees on an annual basis. PDUFA also imposes an annual product fee for biological products and an annual establishment fee on facilities used to manufacture prescription biological products. Fee waivers or reductions are available in certain circumstances, including a waiver of the application fee for the first application filed by a small business. Additionally, no user fees are assessed on BLAs for products designated as orphan drugs, unless the product also includes a non-orphan indication.

Within 60 days following submission of the application, the FDA reviews a BLA submitted to determine if it is substantially complete before the agency accepts it for filing. The FDA may refuse to file any BLA that it deems incomplete or not properly reviewable at the time of submission and may request additional information. In this event, the BLA must be resubmitted with the additional information. The resubmitted application also is

subject to review before the FDA accepts it for filing. Once the submission is accepted for filing, the FDA begins an in-depth substantive review of the BLA. The FDA reviews the BLA to determine, among other things, whether the proposed product is safe and potent, or effective, for its intended use, and has an acceptable purity profile, and whether the product is being manufactured in accordance with GMP to assure and preserve the product's identity, safety, strength, quality, potency and purity. The FDA may refer applications for novel biological products or biological products that present difficult questions of safety or efficacy to an advisory committee, typically a panel that includes clinicians and other experts, for review, evaluation and a recommendation as to whether the application should be approved and under what conditions. The FDA is not bound by the recommendations of an advisory committee, but it considers such recommendations carefully when making decisions. During the biological product approval process, the FDA also will determine whether a Risk Evaluation and Mitigation Strategy, or REMS, is necessary to assure the safe use of the biological product. If the FDA concludes a REMS is needed, the sponsor of the BLA must submit a proposed REMS. The FDA will not approve a BLA without a REMS, if required.

Before approving a BLA, the FDA may inspect the facilities at which the product is manufactured. The FDA will not approve the product unless it determines that the manufacturing processes and facilities are in compliance with GMP requirements and adequate to assure consistent production of the product within required specifications. Additionally, before approving a BLA, the FDA will typically inspect one or more clinical sites to assure that the clinical trials were conducted in compliance with IND trial requirements and GCP requirements. To assure GMP and GCP compliance, an applicant must incur significant expenditure of time, money and effort in the areas of training, record keeping, production, and quality control.

Notwithstanding the submission of relevant data and information, the FDA may ultimately decide that the BLA does not satisfy its regulatory criteria for approval and deny approval. Data obtained from clinical trials are not always conclusive and the FDA may interpret data differently than we interpret the same data. If the agency decides not to approve the BLA in its present form, the FDA will issue a complete response letter that describes all of the specific deficiencies in the BLA identified by the FDA. The deficiencies identified may be minor, for example, requiring labeling changes, or major, for example, requiring additional clinical trials. Additionally, the complete response letter may include recommended actions that the applicant might take to place the application in a condition for approval. If a complete response letter is issued, the applicant may either resubmit the BLA, addressing all of the deficiencies identified in the letter, or withdraw the application.

If a product receives regulatory approval, the approval may be significantly limited to specific diseases and dosages or the indications for use may otherwise be limited, which could restrict the commercial value of the product. Further, the FDA may require that certain contraindications, warnings or precautions be included in the product labeling. The FDA may impose restrictions and conditions on product distribution, prescribing, or dispensing in the form of a risk management plan, or otherwise limit the scope of any approval. In addition, the FDA may require post marketing clinical trials, sometimes referred to as Phase 4 clinical trials, designed to further assess a biological product's safety and effectiveness, and testing and surveillance programs to monitor the safety of approved products that have been commercialized.

The FDA has agreed to certain review goals under PDUFA, and aims to complete its review of 90% of standard BLAs within ten months from filing and 90% of priority BLAs within six months from filing. The FDA does not always meet its PDUFA goal dates for standard and priority BLAs and its review goals are subject to

change from time to time. The review process and the PDUFA goal date may be extended by three months if the FDA requests, or the BLA sponsor otherwise provides, additional information or clarification regarding information already provided in the submission within the last three months before the PDUFA goal date.

Fast Track Designation, Accelerated Approval, Priority Review and Breakthrough Therapy Programs

The FDA has a Fast Track program that is intended to expedite or facilitate the process for reviewing new drugs and biological products that meet certain criteria. Specifically, new drugs and biological products are eligible for Fast Track designation if they are intended to treat a serious or life-threatening condition and demonstrate the potential to address unmet medical needs for the 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 or biological product may request the FDA to designate the drug or biological product as a Fast Track product at any time during the clinical development of the product. Unique to a Fast Track 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.

Other types of FDA programs intended to expedite development and review, such as priority review, accelerated approval and Breakthrough Therapy designation, also exist. A 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 or biological product designated for priority review in an effort to facilitate the review. Additionally, a product may be eligible for accelerated approval. Drug or biological products studied for their safety and effectiveness in treating serious or life-threatening illnesses and that provide meaningful therapeutic benefit over existing treatments may receive accelerated approval, 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. As a condition of approval, the FDA may require that a sponsor of a drug or biological product receiving 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.

A product may also be eligible for receipt of a Breakthrough Therapy designation. The Breakthrough Therapy designation is intended to expedite the FDA's review of a potential new drug for serious or life-threatening diseases 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 of a drug as a Breakthrough Therapy provides the same benefits as are available under the Fast Track program, as well as intensive FDA guidance on the product's development program. 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.

Combination Products

Combination products include products where two or more separate products are packaged together (e.g., drug and device products); or a product packaged separately but intended for use only with an approved, individually specified product, where both are required to achieve the intended use, indication, or effect and where upon approval of the proposed product, the labeling of the individually specified product would need to be changed, e.g., to reflect a change in intended use.

Regulation of Companion Diagnostics

In the United States, the FD&C Act and its implementing regulations, and other federal and state statutes and regulations govern, among other things, medical device design and development, preclinical and clinical testing, premarket clearance or approval, registration and listing, manufacturing, labeling, storage, advertising and promotion, sales and distribution, export and import, and post-market surveillance. Companion diagnostic tests are classified as medical devices under the FD&C Act. Unless an exemption applies, diagnostic tests require marketing clearance or approval from the FDA prior to commercial distribution. The two primary types of FDA marketing authorization applicable to a medical device are premarket notification, also called 510(k) clearance, and PMA approval. We anticipate that the companion diagnostic tests we are developing will be subject to the PMA approval process.

PMA applications must be supported by valid scientific evidence, which typically requires extensive data, including technical, preclinical, clinical and manufacturing data, to demonstrate to the FDA's satisfaction the safety and effectiveness of the device. For diagnostic tests, a PMA application typically includes data regarding analytical and clinical validation studies. As part of its review of the PMA, the FDA will conduct a pre-approval inspection of the manufacturing facility or facilities to ensure compliance with the Quality System Regulation, or QSR, which requires manufacturers to follow design, testing, control, documentation and other quality assurance procedures. FDA review of an initial PMA application is required by statute to take between six to ten months, although the process typically takes longer, and may require several years to complete. If the FDA evaluations of both the PMA application and the manufacturing facilities are favorable, the FDA will either issue an approval letter or an approvable letter, which usually contains a number of conditions that must be met in order to secure the final approval of the PMA. If the FDA's evaluation of the PMA or manufacturing facilities is not favorable, the FDA will deny approval of the PMA or issue a not approvable letter. A not approvable letter will outline the deficiencies in the application and, where practical, will identify what is necessary to make the PMA approvable. The FDA may also determine that additional clinical trials are necessary, in which case the PMA approval may be delayed for several months or years while the trials are conducted and then the data submitted in an amendment to the PMA. Once granted, PMA approval may be withdrawn by the FDA if compliance with post approval requirements, conditions of approval or other regulatory standards is not maintained or problems are identified following initial marketing.

We and our third-party collaborators who may develop our companion diagnostics will work cooperatively to generate the data required for submission with the PMA application, and will remain in close contact with the Center for Devices and Radiological Health, or CDRH, at the FDA to ensure that any changes in requirements are incorporated into the development plans. We anticipate that, as was the case in our meetings to date, future meetings with the FDA with regard to MYDICAR and its companion diagnostic product candidate will include representatives from both the CBER and the CDRH to ensure that the BLA and PMA submissions are coordinated to enable the FDA to conduct a parallel review of both submissions. On July 14, 2011, the FDA issued for comment a draft guidance document addressing the development and approval process for "In Vitro Companion Diagnostic Devices." According to the draft guidance, for novel products such as MYDICAR, the PMA for a companion diagnostic device should be developed and approved contemporaneously with the biological product. While this draft guidance is not yet finalized, we believe our programs for the development of our companion diagnostics are consistent with the draft guidance as proposed.

Post-approval Requirements

Maintaining substantial compliance with applicable federal, state and local statutes and regulations requires the expenditure of substantial time and financial resources. Rigorous and extensive FDA regulation of biological products continues after approval, particularly with respect to GMP. We will rely, and expect to continue to rely, on third parties for the production of clinical and commercial quantities of any products that we may commercialize. Manufacturers of our products are required to comply with applicable requirements in the GMP regulations, including quality control and quality assurance and maintenance of records and documentation. Other post-approval requirements applicable to biological products include reporting of GMP deviations that

may affect the identity, potency, purity and overall safety of a distributed product, record-keeping requirements, reporting of adverse effects, reporting updated safety and efficacy information, and complying with electronic record and signature requirements. After a BLA is approved, the product also may be subject to official lot release. As part of the manufacturing process, the manufacturer is required to perform certain tests on each lot of the product before it is released for distribution. If the product is subject to official release by the FDA, the manufacturer submits samples of each lot of product to the FDA together with a release protocol showing a summary of the history of manufacture of the lot and the results of all of the manufacturer's tests performed on the lot. In addition, the FDA conducts laboratory research related to the regulatory standards on the safety, purity, potency and effectiveness of biological products.

We also must comply with the FDA's advertising and promotion requirements, such as those related to direct-to-consumer advertising, the prohibition on promoting products for uses or in patient populations that are not described in the product's approved labeling (known as "off-label use"), industry-sponsored scientific and educational activities, and promotional activities involving the internet. Discovery of previously unknown problems or the failure to comply with the applicable regulatory requirements may result in restrictions on the marketing of a product or withdrawal of the product from the market as well as possible civil or criminal sanctions. Failure to comply with the applicable U.S. requirements at any time during the product development process, approval process or after approval may subject an applicant or manufacturer to administrative or judicial civil or criminal sanctions and adverse publicity. FDA sanctions could include refusal to approve pending applications, withdrawal of an approval, clinical hold, warning or untitled letters, product recalls, product seizures, total or partial suspension of production or distribution, injunctions, fines, refusals of government contracts, mandated corrective advertising or communications with doctors, debarment, restitution, disgorgement of profits, or civil or criminal penalties. Any agency or judicial enforcement action could have a material adverse effect on us.

Biological product manufacturers and other entities involved in the manufacture and distribution of approved biological products are required to register their establishments with the FDA and certain state agencies, and are subject to periodic unannounced inspections by the FDA and certain state agencies for compliance with GMPs and other laws. Accordingly, manufacturers must continue to expend time, money and effort in the area of production and quality control to maintain GMP compliance. Discovery of problems with a product after approval may result in restrictions on a product, manufacturer or holder of an approved BLA, including withdrawal of the product from the market. In addition, changes to the manufacturing process or facility generally require prior FDA approval before being implemented and other types of changes to the approved product, such as adding new indications and additional labeling claims, are also subject to further FDA review and approval.

Coverage and Reimbursement

Sales of our products will depend, in part, on the extent to which our products will be covered by third-party payors, such as government healthcare programs, commercial insurance and managed healthcare organizations. These third-party payors are increasingly reducing reimbursements for medical products and services. In addition, the U.S. government, state legislatures and foreign governments have continued implementing cost containment programs, including price controls, 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 further limit our net revenue and results. Decreases in third-party reimbursement for our product candidates or a decision by a third-party payor to not cover our product candidates could reduce physician usage of our products once approved and have a material adverse effect on our sales, results of operations and financial condition.

Fraud and Abuse Laws

Although we currently do not have any products on the market, if MYDICAR, our companion diagnostic, or our other product candidates are approved and we begin commercialization, we 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, false claims, privacy and security and physician sunshine laws and regulations. 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 civil and criminal penalties, damages, fines, the curtailment or restructuring of our operations, the exclusion from participation in federal and state healthcare programs and imprisonment, any of which could adversely affect our ability to operate our business and our financial results.

Additional Regulation

In addition to the foregoing, state and federal laws regarding environmental protection and hazardous substances, including the Occupational Safety and Health Act, the Resource Conservancy and Recovery Act and the Toxic Substances Control Act, affect our business. These and other laws govern our use, handling and disposal of various biological, chemical and radioactive substances used in, and wastes generated by, our operations. If our operations result in contamination of the environment or expose individuals to hazardous substances, we could be liable for damages and governmental fines. We believe that we are in material compliance with applicable environmental laws and that continued compliance therewith will not have a material adverse effect on our business. We cannot predict, however, how changes in these laws may affect our future operations.

U.S. Foreign Corrupt Practices Act

The U.S. Foreign Corrupt Practices Act, to which we are subject, prohibits corporations and individuals from engaging in certain activities to obtain or retain business or to influence a person working in an official capacity. It is illegal to pay, offer to pay or authorize the payment of anything of value to any foreign government official, government staff member, political party or political candidate in an attempt to obtain or retain business or to otherwise influence a person working in an official capacity.

Government Regulation Outside of the United States

In addition to regulations in the United States, we will be subject to a variety of regulations in other jurisdictions governing, among other things, clinical trials and any commercial sales and distribution of our products. Because biologically sourced raw materials are subject to unique contamination risks, their use may be restricted in some countries.

Whether or not we obtain FDA approval for a product, we must obtain the requisite approvals from regulatory authorities in foreign countries prior to the commencement of clinical trials or marketing of the product in those countries. Certain countries outside of the United States have a similar process that requires the submission of a clinical trial application much like the IND prior to the commencement of human clinical trials. In the European Union, for example, a CTA must be submitted to each country’s national health authority and an independent ethics committee, much like the FDA and the IRB, respectively. Once the CTA is approved in accordance with a country’s requirements, clinical trial development may proceed.

The requirements and process governing the conduct of clinical trials, product licensing, pricing and reimbursement vary from country to country. In all cases, the clinical trials are conducted in accordance with GCP and the applicable regulatory requirements and the ethical principles that have their origin in the Declaration of Helsinki.

To obtain regulatory approval of an investigational biological product under European Union regulatory systems, we must submit a marketing authorization application. The application used to file the BLA in the United States is similar to that required in the European Union, with the exception of, among other things, country-specific document requirements. The European Union also provides opportunities for market exclusivity.

For example, in the European Union, upon receiving marketing authorization, new chemical entities generally receive eight years of data exclusivity and an additional two years of market exclusivity. If granted, data exclusivity prevents regulatory authorities in the European Union from referencing the innovator's data to assess a generic application. During the additional two-year period of market exclusivity, a generic marketing authorization can be submitted, and the innovator's data may be referenced, but no generic product can be marketed until the expiration of the market exclusivity. However, there is no guarantee that a product will be considered by the European Union's regulatory authorities to be a new chemical entity, and products may not qualify for data exclusivity.

The ten-year market exclusivity may be reduced to six years if, at the end of the fifth year, it is established that the product no longer meets the criteria for orphan designation, for example, if the product is sufficiently profitable not to justify maintenance of market exclusivity. Additionally, marketing authorization may be granted to a similar product for the same indication at any time if:

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

For other countries outside of the European Union, such as countries in Eastern Europe, Latin America or Asia, the requirements governing the conduct of clinical trials, product licensing, pricing and reimbursement vary from country to country. In all cases, again, the clinical trials are conducted in accordance with GCP and the applicable regulatory requirements and the ethical principles that have their origin in the Declaration of Helsinki.

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

Employees

As of March 24, 2014, we had 16 full-time employees, consisting of research, process development, manufacturing, finance, administration and business development personnel. We also regularly use independent contractors across the organization to augment our regular staff. None of our employees are covered by collective bargaining agreements and we consider relations with our employees to be good. We believe that our future success will depend in part on our continued ability to attract, hire and retain qualified personnel.

Corporate Information

We were originally incorporated in California in December 2000. In April 2012, we reincorporated in Delaware. Our principal executive offices are located at 12760 High Bluff Drive, Suite 240, San Diego, California 92130, and our telephone number is (858) 366-4288. Our corporate website address is www.celladon.net. Our Annual Report 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 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.

We have obtained a registered trademark for MYDICAR® in the United States. This Annual Report on Form 10-K 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 on Form 10-K, 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 February 2014, (b) in which we have total annual gross revenue of at least $1.0 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 on Form 10-K as the "JOBS Act," and references to "emerging growth company" have the meaning associated with it in the JOBS Act.

Unless the context requires otherwise, references to "Celladon," "we," "us" and "our" refer to Celladon Corporation.

ITEM 1A. Risk Factors

You should carefully consider the following risk factors, as well as the other information in this report, and in our other public filings. The occurrence of any of the following risks could harm our business, financial condition, results of operations and/or growth prospects or cause our actual results to differ materially from those contained in forward-looking statements we have made in this report and those we may make from time to time. You should consider all of the risk factors described when evaluating our business.

Risks Related to our Financial Condition and Capital Requirements

We have incurred significant losses since our inception and anticipate that we will continue to incur significant losses for the foreseeable future.

We are a clinical-stage biotechnology company and we have not yet generated any revenues. We have incurred net losses in each year since our inception, including consolidated net losses of $20.1 million and $15.9 million, respectively, for the years ended December 31, 2013 and 2012. As of December 31, 2013, we had an accumulated deficit of approximately $112.6 million. Our prior losses, combined with expected future losses, have had and may continue to have an adverse effect on our stockholders' equity and working capital.

We have devoted most of our financial resources to research and development, including developing our manufacturing capabilities and preclinical and clinical development activities. To date, we have financed our operations primarily through the sale of equity securities and convertible debt. 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 or strategic collaborations. We have not completed pivotal clinical trials for any product candidate and it will be several years, if ever, before we have a product candidate ready for commercialization. Even if we obtain regulatory approval to market a product candidate (and, if necessary, any related companion diagnostic), our future revenues will depend upon the size of any markets in which our product candidates have received approval, and our ability to achieve sufficient market acceptance, reimbursement from third-party payors and adequate market share for our product candidates and companion diagnostic in those markets.

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

- expand or accelerate our clinical development activities, particularly with respect to our clinical trials of MYDICAR for systolic heart failure, including our CUPID 2 trial of MYDICAR, our AAV1 NAb

positive trial and our viral shedding trial, as well as our preclinical studies and clinical trials of MYDICAR for AVF, diastolic heart failure and other indications;

- further develop the manufacturing process for our vectors or our product candidates including commercial scale-up, validation and automation of our companion diagnostic;
- seek regulatory and marketing approvals for MYDICAR and any other product candidate that successfully completes clinical trials;
- seek regulatory and marketing approvals for our companion diagnostic;
- establish a sales, marketing and distribution infrastructure in the United States to commercialize any products for which we obtain marketing approval;
- initiate additional preclinical, clinical or other studies for our product candidates;
- expand and accelerate development of our small molecule programs in the fields of diabetes and neurodegenerative diseases;
- acquire rights to other product candidates and technologies;
- change or add additional manufacturers or suppliers;
- maintain, expand and protect our intellectual property portfolio;
- continue our research and preclinical development of our product candidates and seek to identify and validate additional product candidates;
- make milestone or other payments under any in-license or collaboration agreement;
- attract and retain skilled personnel;
- create additional infrastructure to support our operations as a public company and our product development and planned future commercialization efforts; and
- experience any delays or encounter issues with any of the above.

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. In any particular quarter or quarters, our operating results could be below the expectations of securities analysts or investors, which could cause our stock price to decline.

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

Our ability to generate meaningful revenue and achieve profitability depends on our ability, and the ability of any third party with which we may partner, to successfully complete the development of, and obtain the regulatory approvals necessary to, commercialize our product candidates and any related companion diagnostics. We do not anticipate generating revenues from product sales for the foreseeable future, if ever. If any of our product candidates fail in clinical trials or if any of our product candidates or any related companion diagnostics do not gain regulatory approval, or if any of our product candidates and any related companion diagnostics, if approved, fail to achieve market acceptance, we may never become profitable. Even if we achieve profitability in the future, we may not be able to sustain profitability in subsequent periods. Our ability to generate future revenues from product sales depends heavily on our success in:

- completing research and preclinical and clinical development of our product candidates;
- seeking and obtaining regulatory and marketing approvals for product candidates for which we complete clinical trials;

- developing a sustainable, scalable, reproducible, and transferable manufacturing process for our vectors and product candidates;
- automating, validating and seeking and obtaining regulatory approvals for our companion diagnostic on a timely basis;
- establishing and maintaining supply and manufacturing relationships with third parties that can provide adequate (in amount and quality) products and services to support clinical development and, if approved, the market demand for our product candidates;
- launching and commercializing product candidates for which we obtain regulatory and marketing approval, either by establishing a sales force, marketing and distribution infrastructure, or by collaborating with a partner;
- obtaining market acceptance of any approved products and gene therapy as a viable treatment option;
- addressing any competing technological and market developments;
- implementing additional internal systems and infrastructure, as needed;
- identifying and validating new product candidates;
- negotiating favorable terms in any collaboration, licensing or other arrangements into which we may enter;
- maintaining, protecting and expanding our portfolio of intellectual property rights, including patents, trade secrets and know-how; 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. Our expenses could increase beyond expectations if we are required by the FDA, the EMA, or other foreign regulatory authorities to perform clinical trials and other studies in addition to those that we currently anticipate. Even if we are able to generate revenues from the sale of any approved products, we may not become profitable and may need to obtain additional funding to continue operations.

We will need to raise additional funding, which may not be available on acceptable terms, or at all. Failure to obtain this necessary capital when needed may force us to delay, limit or terminate our product development efforts or other operations.

We are currently advancing our lead product candidate, MYDICAR for the treatment of systolic heart failure, through clinical development and other product candidates through preclinical development. Developing products is expensive, and we expect our research and development expenses to increase substantially in connection with our ongoing activities, particularly as we advance our product candidates in clinical trials.

Our operations have consumed substantial amounts of cash since inception. As of December 31, 2013, our cash, cash equivalents and investments were $18.4 million. Our research and development expenses were $16.9 million and $13.3 million for the years ended December 31, 2013 and 2012, respectively. In 2014, we plan to develop MYDICAR for additional indications including treatment of AVF maturation failure and for the treatment of patients with advanced heart failure who are on an LVAD. We believe that our existing cash, cash equivalents and investments will be sufficient to fund our current operations through our expected receipt of data from our CUPID 2 trial in April 2015. This period could be shortened if there are any significant increases beyond our expectations in spending on development programs or more rapid progress of development programs than anticipated. We do not expect our existing capital resources to be sufficient to enable us to begin a Phase 3 trial of MYDICAR for systolic heart failure, if required. Furthermore, our operating plan may change as a result of many factors currently unknown to us, and we may need to seek additional funds sooner than planned, through public or private equity or debt financings, government or other third-party funding, marketing and distribution arrangements

and other collaborations, strategic alliances and licensing arrangements, or a combination of these approaches. In any event, we will require additional capital to obtain regulatory approval for, and to commercialize, our product candidates and companion diagnostic, as well as to further develop MYDICAR for additional indications, such as AVF maturation failure, the treatment of patients with advanced heart failure who are on an LVAD, and to potentially develop MYDICAR for PAH and/or diastolic heart failure. Even if we believe we have sufficient funds for our current or future operating plans, we may seek additional capital if market conditions are favorable or if we have specific strategic considerations.

Any additional fundraising efforts may divert our management from their day-to-day activities, which may adversely affect our ability to develop and commercialize our product candidates and companion diagnostic. In addition, we cannot guarantee that future financing will be available in sufficient amounts or on terms acceptable to us, if at all. We could also be required to seek funds through arrangements with collaborative partners or otherwise at an earlier stage than would otherwise be ideal and we may be required to relinquish rights to some of our technologies, product candidates or our companion diagnostic, or otherwise agree to terms unfavorable to us, any of which may have a material adverse effect on our business, operating results and prospects.

If we are unable to obtain funding on a timely basis, we may be required to significantly curtail, delay or discontinue one or more of our research or development programs or the commercialization of any approved products or be unable to expand our operations or otherwise capitalize on our business opportunities, as desired, which could materially adversely affect our business, financial condition and results of operations.

Raising additional funds through debt or equity financing could be dilutive and may cause the market price of our common stock to decline.

To the extent that additional capital is raised through the sale of equity or convertible debt securities, the issuance of those securities could result in substantial dilution for our current stockholders and the terms may include liquidation or other preferences that adversely affect the rights of our current stockholders. Furthermore, the issuance of additional securities, whether equity or debt, by us, or the possibility of such issuance, may cause the market price of our common stock to decline and existing stockholders may not agree with our financing plans or the terms of such financings. Moreover, the incurrence of debt financing could result in a substantial portion of our operating cash flow being dedicated to the payment of principal and interest on such indebtedness and could impose restrictions on our operations, such as limitations on our ability to incur additional debt, limitations on our ability to acquire, sell or license intellectual property rights and other operating restrictions that could adversely impact our ability to conduct our business. Additional funding may not be available to us on acceptable terms, or at all.

Risks Related to the Discovery and Development of our Product Candidates and Companion Diagnostic

We are highly dependent on the success of MYDICAR and we may not be able to successfully obtain regulatory or marketing approval for, or successfully commercialize, this product candidate.

To date, we have expended significant time, resources and effort on the development of MYDICAR for the treatment of systolic heart failure, including conducting preclinical studies and clinical trials. Although we are in preclinical development of MYDICAR for the treatment of diastolic heart failure and our small molecule product candidates are in preclinical development for the treatment of diabetes and neurodegenerative diseases, our ability to generate product revenues and to achieve commercial success in the near term will initially depend almost entirely on our ability to successfully develop, obtain regulatory approval for and then successfully commercialize MYDICAR for the treatment of systolic heart failure in the United States and the European Economic Area, or EEA. Before we can market and sell MYDICAR in the United States or foreign jurisdictions, we will need to commence and complete additional clinical trials, manage clinical and manufacturing activities, obtain necessary regulatory approvals from the FDA in the United States, from the EMA in the EEA, and from other foreign regulatory authorities in other jurisdictions for both MYDICAR and its companion diagnostic, obtain manufacturing supply, build a commercial organization or enter into a marketing collaboration with a third

party, and in some jurisdictions, obtain reimbursement authorization, among other things. We cannot assure you that we will be able to successfully complete the necessary clinical trials and/or obtain regulatory approvals and sufficient commercial manufacturing supply for MYDICAR or its companion diagnostic. To date, no gene therapy product has ever been approved in the United States. If we do not receive regulatory approvals, our business, prospects, financial condition and results of operations will be adversely affected. Even if we obtain regulatory approvals, we may never generate significant revenues from any commercial sales of MYDICAR. If we fail to successfully commercialize MYDICAR, we may be unable to generate sufficient revenues to sustain and grow our business and our business, prospects, financial condition and results of operations will be adversely affected.

MYDICAR is based on a novel technology, which makes it difficult to predict the time and cost of product candidate development and subsequently obtaining regulatory approval. At the moment, no gene therapy product has been approved in the United States and only one gene therapy product has been approved in Europe.

We have primarily concentrated our research and development efforts on our lead product candidate, MYDICAR for the treatment of systolic heart failure, and our future success is highly dependent on the successful development of this product candidate. There can be no assurance that any development problems we experience in the future related to our product candidates will not cause significant delays or unanticipated costs, or that such development problems can be solved. In addition, our product development program is dependent on the development and commercialization of a required companion diagnostic by us or by third party collaborators. Companion diagnostics are subject to regulation as medical devices and those diagnostic tools must independently be cleared or approved by the FDA, the EMA or other foreign regulatory authorities before we may commercialize our product candidates. We may also experience delays in developing a sustainable, reproducible and scalable manufacturing process or transferring that process to commercial partners, which may prevent us from completing our clinical trials or commercializing our products on a timely or profitable basis, if at all.

In addition, the clinical trial requirements of the FDA, the EMA and other foreign regulatory authorities, and the criteria these regulators use to determine the safety and efficacy of a product candidate vary substantially according to the type, complexity, novelty and intended use and market of the potential products. The regulatory approval process for novel product candidates such as ours can be more expensive and take longer than for other, better known or extensively studied pharmaceutical or other product candidates. For example, the FDA has required us to conduct a safety and efficacy trial of patients with pre-existing NAbs to the AAV-based vectors used by MYDICAR as well as a viral shedding trial to determine the dissemination of our MYDICAR vector particles into the environment. At the moment, no gene therapy product has been approved in the United States and only one gene therapy product, UniQure's Glybera, which received marketing authorization from the EMA in 2012, has been approved in Europe but has not yet been launched for commercial sale, which makes it 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 Europe. Approvals by the EMA may not be indicative of what the FDA may require for approval.

Regulatory requirements governing gene therapy products have changed frequently and may continue to change in the future. For example, the FDA has established the Office of Cellular, Tissue and Gene Therapies within its Center for Biologics Evaluation and Research, or CBER, to consolidate the review of gene therapy and related products, and the Cellular, Tissue and Gene Therapies Advisory Committee to advise CBER on its review. Gene therapy clinical trials conducted at institutions that receive funding for recombinant DNA research from the U.S. National Institutes of Health, or the NIH, are also subject to review by the NIH Office of Biotechnology Activities' Recombinant DNA Advisory Committee, or the RAC. Although the FDA decides whether individual gene therapy protocols may proceed, the RAC review process can impede the initiation of a clinical trial, even if the FDA has reviewed the trial and approved its initiation. Conversely, the FDA can put an investigational new drug application, or IND, on clinical hold even if the RAC has provided a favorable review. For example, our IND for MYDICAR, which we filed with the FDA in December 2006, was placed on clinical

hold by the FDA in May 2012 until detailed, updated manufacturing information was submitted and the clinical hold was removed by the FDA in July 2012. Also, before a clinical trial can begin at an NIH-funded institution, that institution's institutional review board, or IRB, and its Institutional Biosafety Committee will have to review the proposed clinical trial to assess the safety of the trial. In addition, adverse developments in clinical trials of gene therapy products conducted by others may cause the FDA, the EMA or other foreign regulatory authorities to change the requirements for approval of any of our gene therapy-based product candidates.

These regulatory review committees and advisory groups, and the new guidelines they promulgate, may lengthen the regulatory review process, require us to perform additional studies, increase our development costs, lead to changes in regulatory positions and interpretations, delay or prevent approval and commercialization of these product candidates or lead to significant post-approval limitations or restrictions. As we advance the development of our gene therapy product candidates, we will be required to consult with these regulatory and advisory groups and comply with applicable guidelines. If we fail to do so, we may be required to delay or discontinue development of our product candidates. Delay or failure to obtain, or unexpected costs in obtaining, the regulatory approvals necessary to bring a potential product to market could decrease our ability to generate sufficient product revenue to maintain our business.

Failure to successfully validate, commercialize and obtain regulatory approval for our companion diagnostic could delay or prevent commercialization of MYDICAR. Devices used in the administration of MYDICAR may also require labeling changes and result in delays for the commercialization of MYDICAR.

A key element of our strategy is to screen out patients with certain amounts of pre-existing NAbs to the AAV1 viral vector used by MYDICAR. We have developed a companion diagnostic that will be used in combination with MYDICAR to help us better identify those patients that may benefit from treatment with MYDICAR. Accordingly, we will be dependent on such companion diagnostic, both during our clinical trials and in connection with any future commercialization of MYDICAR for systolic heart failure or for other indications. We expect that we will enter into a strategic alliance with a third party for the automation and commercialization of our companion diagnostic. We and any of our future collaborators may encounter difficulties in developing the companion diagnostic for commercial application, including issues in relation to automation, selectivity/specificity, analytical validation, reproducibility, or clinical validation of such companion diagnostic. Companion diagnostics are subject to regulation by the FDA, the EMA and other foreign regulatory authorities as medical devices and require separate regulatory clearance or approval prior to commercialization. In the case of MYDICAR, we anticipate that the FDA will require approval of the companion diagnostic under a medical device pre-market approval, or PMA, application prior to approval and commercialization of MYDICAR, which could delay our ability to commercialize both products. If we or any of our future collaborators fail to obtain regulatory approval of the companion diagnostic or are delayed in receiving such approval, our ability to commercialize MYDICAR would be delayed until such time as regulatory approval is obtained. In addition, our future collaborators may encounter production difficulties that could constrain the supply of the companion diagnostic, and both they and we may have difficulties gaining acceptance of the use of the companion diagnostic in the clinical community. MYDICAR and certain of the off-the-shelf administration components used in the cardiac catheterization laboratory are regulated as combination products. These include products where two or more separate products are packaged together (e.g., drug and device products); or a product packaged separately but intended for use only with an approved, individually specified product where both are required to achieve the intended use of the proposed product. MYDICAR will include labelling that specifies certain administration products, and the labeling of some of the administration products may need to be changed, e.g., to reflect a change in intended use, which revisions could delay our ability to commercialize MYDICAR.

We may find it difficult to enroll patients in our clinical trials, which could delay or prevent development of our product candidates.

Identifying and qualifying patients to participate in clinical trials of our product candidates is critical to our success. The timing of our clinical trials depends on the speed at which we can recruit patients to participate in testing our product candidates as well as completion of required follow-up periods. If patients are unwilling to

participate in our gene therapy trials because of negative publicity from adverse events in the biotechnology or gene therapy industries or for other reasons, including competitive clinical trials for similar patient populations, the timeline for recruiting patients, conducting trials and obtaining regulatory approval of potential products may be delayed. If there are delays in accumulating the required number of clinical events in trials where clinical events are a primary endpoint, such as our CUPID 2 trial, there may be delays in completing the trial. These delays could result in increased costs, delays in advancing our product development, delays in testing the effectiveness of our technology or termination of the clinical trials altogether.

Patient enrollment and completion of clinical trials are affected by factors including:

- severity of the disease under investigation;
- design of the trial protocol;
- size of the patient population;
- eligibility criteria for the trial in question;
- perceived risks and benefits of the product candidate under trial;
- proximity and availability of clinical trial sites for prospective patients;
- availability of competing therapies and clinical trials;
- efforts to facilitate timely enrollment in clinical trials;
- patient referral practices of physicians;
- ability to monitor patients adequately during and after treatment; and
- the degree of treatment effect in event-driven trials.

We may not be able to identify, recruit and enroll a sufficient number of patients, or those with required or desired characteristics or to complete our clinical trials in a timely manner. Although we did not experience difficulties enrolling patients in our 250-patient CUPID 2 trial, we may experience difficulties enrolling the requisite number of patients for subsequent clinical trials, including additional trials that may be required by the FDA for the approval of MYDICAR. For example, one significant obstacle to the timely recruitment and enrollment of a sufficient number of eligible patients in a Phase 3 trial of MYDICAR, if required, is the high prevalence of certain pre-existing NAbs to the viral vector used by MYDICAR, with, we believe, approximately 60% of potential patients in the United States exhibiting these antibodies. In other countries, such as Poland, the prevalence of pre-existing AAV1 NAbs is significantly higher. These antibodies neutralize the effectiveness of AAV-based vectors, such as MYDICAR, and although we are able to prescreen for the presence of these antibodies, the high prevalence of these antibodies in humans reduces the pool of available trial participants. In addition, because therapy with AAV vectors can cause the body to produce NAbs after as little as one treatment, the pool of available trial participants may also be reduced if AAV vectors are increasingly used to treat heart failure or other conditions.

We plan to seek initial marketing approval for our product candidates in the United States, the EEA, Hungary and Israel. We may not be able to initiate or continue clinical trials if we cannot enroll a sufficient number of eligible patients to participate in the clinical trials required by the FDA, the EMA or other foreign regulatory authorities. Our ability to successfully initiate, enroll and complete a clinical trial in any foreign country is subject to numerous risks unique to conducting business in foreign countries, including:

- difficulty in establishing or managing relationships with contract research organizations, or CROs, and physicians;
- different standards for conducting clinical trials;
- our inability to locate qualified local consultants, physicians and partners; and
- the potential burden of complying with a variety of foreign laws, medical standards and regulatory requirements, including the regulation of pharmaceutical and biotechnology products and treatments.

If we have difficulty enrolling a sufficient number of patients to conduct our clinical trials as planned, we may need to delay, limit or terminate ongoing or planned clinical trials, any of which would have an adverse effect on our business.

We may encounter substantial delays in our clinical trials or we may fail to demonstrate safety and efficacy to the satisfaction of applicable regulatory authorities.

Before obtaining marketing approval from regulatory authorities for the sale of our product candidates, we must conduct extensive clinical trials to demonstrate the safety and efficacy of the product candidates in humans. Clinical testing is expensive, time-consuming and uncertain as to outcome. 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 testing. Events that may prevent successful or timely completion of clinical development include:

- delays in raising, or inability to raise, sufficient capital to fund the planned clinical trials;
- delays in reaching a consensus with regulatory agencies on trial design;
- identifying, recruiting and training suitable clinical investigators;
- delays in reaching agreement on acceptable terms with prospective CROs and clinical trial sites;
- delays in obtaining required IRB approval at each clinical trial site;
- delays in recruiting suitable patients to participate in our clinical trials;
- delays due to changing standard of care for the diseases we are studying;
- delays in dosing or other delays in our clinical trial plans or planned clinical trials as a result of direction from one or more independent monitoring committees;
- adding new clinical trial sites;
- imposition of a clinical hold by regulatory agencies, after an inspection of our clinical trial operations or trial sites;
- failure by our CROs, other third parties or us to adhere to clinical trial requirements;
- catastrophic loss of product due to shipping delays or delays in customs in connection with delivery to foreign countries for use in clinical trials;
- failure to perform in accordance with the FDA's good clinical practices, or GCPs, or applicable regulatory guidelines in other countries;
- delays in the testing, validation, manufacturing and delivery of our product candidates to the clinical sites;
- delays in the approval or commercial scale-up, validation and automation of critical companion diagnostics;
- delays in the manufacture of critical reagents used in any companion diagnostic;
- delays in having patients complete participation in a trial or return for post-treatment follow-up;
- clinical trial sites or patients dropping out of a trial;
- occurrence of serious adverse events associated with the product candidate that are viewed to outweigh its potential benefits; or
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols.

Any inability to successfully complete preclinical and clinical development could result in additional costs to us or impair our ability to generate revenues from product sales, regulatory and commercialization milestones and royalties. Even though we received Fast Track designation from the FDA in December 2011 for MYDICAR for the treatment of systolic heart failure in NYHA Class III/IV heart failure patients, that designation may not result in faster review or approval, if at all. In addition, if we make manufacturing or formulation changes to our

product candidates, we may need to conduct additional studies to bridge our modified product candidates to earlier versions. Clinical trial delays could also shorten any periods during which we may have the exclusive right to commercialize our product candidates or allow our competitors to 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.

If the results of our clinical trials are inconclusive or if there are safety concerns or adverse events associated with our product candidates, we may:

- be delayed in obtaining marketing approval for our product candidates or critical companion diagnostics, if at all;
- obtain approval for indications or patient populations that are not as broad as intended or desired;
- obtain approval with labeling that includes significant use or distribution restrictions or safety warnings;
- be subject to changes in the way the product is administered;
- be required to perform additional clinical trials to support approval or be subject to additional post-marketing testing requirements;
- have regulatory authorities withdraw their approval of the product or impose restrictions on its distribution in the form of a modified risk evaluation and mitigation strategy;
- be subject to the addition of labeling statements, such as warnings or contraindications;
- be sued; or
- experience damage to our reputation.

Our product candidates could potentially cause other adverse events that have not yet been predicted. As described above, any of these events could prevent us from achieving or maintaining market acceptance of our product candidates and impair our ability to commercialize our products.

Success in early clinical trials may not be indicative of results obtained in later trials.

Trial designs and results from previous trials, including the results from our CUPID 1 and CUPID 2 trial, are not necessarily predictive of our future clinical trial designs or results. In addition, our CUPID 1 and CUPID 2 trials had a combined enrollment of 301 patients, which is significantly smaller than the approximately 572 patients we may need to enroll in a Phase 3 trial for MYDICAR, if such trial is required by the FDA. Our product candidates may also fail to show the desired safety and efficacy in later stages of clinical development despite having successfully advanced through initial clinical trials.

There is a high failure rate for drugs and biological products proceeding through clinical trials. A number of companies in the pharmaceutical and biotechnology industries have suffered significant setbacks in later stage clinical trials even after achieving promising results in earlier stage clinical trials. Data obtained from preclinical and clinical activities are subject to varying interpretations, which may delay, limit or prevent regulatory approval. In addition, regulatory delays or rejections may be encountered as a result of many factors, including changes in regulatory policy during the period of product development.

The results from our CUPID 2 trial may not be sufficiently robust to support the submission of marketing approval for MYDICAR for the treatment of systolic heart failure. Before we submit MYDICAR for marketing approval, the FDA and the EMA may require us to conduct additional clinical trials, or evaluate subjects for an additional follow-up period.

Our CUPID 2 trial, which is a 250-patient, double-blind, placebo-controlled, randomized Phase 2b clinical trial to evaluate the safety and efficacy of MYDICAR to reduce the frequency of and/or delay heart failure-related hospitalizations in persons with systolic heart failure, may not be deemed to be a pivotal trial or may not

provide sufficient support for a BLA submission. Although our CUPID 1 trial met its primary safety and efficacy endpoints at six months for high-dose MYDICAR versus placebo and the safety profile from this trial was very favorable, it is still possible that, even if we achieve favorable results in the CUPID 2 trial, the FDA may require us to conduct one or more additional clinical trials, possibly involving a larger sample size or a different clinical trial design, particularly if the FDA does not find the results from the CUPID 2 trial to be sufficiently persuasive to support a BLA submission. For example, the FDA advised us in October 2013 that the number of subjects in our proposed safety database may be an issue to be considered in review of our BLA submission. The FDA may also require that we conduct a longer follow-up period of subjects treated with our MYDICAR product candidate prior to accepting our BLA submission.

In May 1998, the FDA published " *Guidance for Industry—Providing Clinical Evidence of Effectiveness for Human Drug and Biological Products"* outlining the conditions in which a single trial might be sufficient to support a BLA submission. We believe that the FDA may not require us to complete additional trials of MYDICAR for the treatment of systolic heart failure if the results of our CUPID 2 trial meet the requirements for a single trial set forth in this guidance. In addition, in November 2013, the EMA indicated that if MYDICAR demonstrates a substantial and highly significant treatment effect in the advanced heart failure population, and no untoward effects attributable to MYDICAR are observed, a safety database of approximately 205-230 MYDICAR-treated subjects may be sufficient for a safety assessment to allow for acceptance of a Marketing Authorization Application, or MAA, for MYDICAR for the treatment of systolic heart failure. We therefore believe that, if the above conditions are met, a Phase 3 trial will not be required for marketing approval in Europe. It is possible, however, that the FDA or the EMA may not consider the results of our CUPID 2 trial to be sufficient for approval of MYDICAR for the treatment of systolic heart failure. If the FDA or the EMA requires additional studies, including Phase 3 trials, we would incur increased costs and delays in the marketing approval process, which would require us to expend more resources than we have available. In addition, it is possible that the FDA and the EMA may have divergent opinions on the elements necessary for a successful BLA and MAA, respectively, which may cause us to alter our development, regulatory and/or commercialization strategies.

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

As with many pharmaceutical and biological products, treatment with MYDICAR may produce undesirable side effects or adverse reactions or events. Although extensive preclinical safety and biodistribution testing conducted on MYDICAR and other AAV vectors, including the CUPID 1 trial of MYDICAR for systolic heart failure and data from previous clinical trials of other AAV vectors, suggests that MYDICAR will be well tolerated, known adverse side effects that could present with treatment with AAV vectors include an immunologic reaction to the capsid protein or gene at early timepoints after administration. In previous clinical trials involving AAV viral vectors for gene therapy, some subjects experienced serious adverse events, including the development of T-cell response due to immune response against the vector capsid proteins. If our vectors demonstrate a similar effect, or other adverse events, we may be required to halt or delay further clinical development of our product candidates. In addition, theoretical adverse side effects of AAV vectors include replication and spread of the virus to other parts of the body and insertional oncogenesis, which is the process whereby the insertion of a corrected gene near a gene that is important in cell growth or division results in uncontrolled cell division, also known as cancer, which could potentially enhance the risk of malignant transformation. Potential procedure-related events are similar to those associated with standard coronary intervention procedures, and may include vascular injury (e.g., damage to the femoral, radial, or brachial arteries at the site of vascular access, or damage to the coronary arteries) or myocardial injury. If any such adverse events occur, our clinical trials could be suspended or terminated and the FDA, the EMA or other foreign regulatory authorities could order us to cease further development of or deny approval of our product candidates for any or all targeted indications. The product-related side effects could affect patient recruitment or the ability of enrolled patients to complete the trial or result in potential product liability claims. Any of these occurrences may harm our business, financial condition and prospects significantly.

Even if we complete the necessary preclinical studies and clinical trials, we cannot predict when or if we will obtain regulatory approval to commercialize a product candidate or the approval may be for a more narrow indication than we expect.

We cannot commercialize a product until the appropriate regulatory authorities have reviewed and approved the product candidate and, if applicable, its companion diagnostic, as is the case with MYDICAR. Even if our product candidates demonstrate safety and efficacy in clinical trials, the regulatory agencies may not complete their review processes in a timely manner, or we may not be able to obtain regulatory approval. Additional delays may result if an FDA advisory committee or other regulatory authority recommends non-approval or restrictions on approval. In addition, we may experience delays or rejections based upon additional government regulation from future legislation or administrative action, or changes in regulatory agency policy during the period of product development, clinical trials and the review process. Regulatory agencies also may approve a treatment candidate for fewer or more limited indications than requested or may grant approval subject to the performance of post-marketing studies. In addition, regulatory agencies may not approve the labeling claims that are necessary or desirable for the successful commercialization of our treatment candidates.

Even if we obtain regulatory approval for a product candidate, our products will remain subject to regulatory scrutiny.

Even if we obtain regulatory approval in a jurisdiction, regulatory authorities may still impose significant restrictions on the indicated uses or marketing of our product candidates, or impose ongoing requirements for potentially costly post-approval studies or post-market surveillance. For example, the holder of an approved BLA is obligated to monitor and report adverse events and any failure of a product to meet the specifications in the BLA. The holder of an approved BLA must also submit new or supplemental applications and obtain FDA approval for certain changes to the approved product, product labeling or manufacturing process. Advertising and promotional materials must comply with FDA rules and are subject to FDA review, in addition to other potentially applicable federal and state laws.

In addition, product manufacturers and their facilities are subject to payment of user fees and continual review and periodic inspections by the FDA and other regulatory authorities for compliance with good manufacturing practices, or GMP, and adherence to commitments made in the BLA. If we or 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, a regulatory agency may impose restrictions relative to that product or the manufacturing facility, including requiring recall or withdrawal of the product from the market or suspension of manufacturing.

If we fail to comply with applicable regulatory requirements following approval of any of our product candidates, a regulatory agency may:

- issue a warning letter asserting that we are in violation of the law;
- seek an injunction or impose civil or criminal penalties or monetary fines;
- suspend or withdraw regulatory approval;
- suspend any ongoing clinical trials;
- refuse to approve a pending BLA or supplements to a BLA submitted by us;
- seize product; or
- refuse to allow us to enter into supply contracts, including government contracts.

Any government investigation of alleged violations of law could require us to expend significant time and resources in response and could generate negative publicity. The occurrence of any event or penalty described above may inhibit our ability to commercialize our product candidates and generate revenues.

Public opinion and increased regulatory scrutiny of gene therapy and genetic research may impact public perception of our product candidates or adversely affect our ability to conduct our business or obtain regulatory approvals for our product candidates.

Gene therapy remains a novel technology, with no gene therapy product approved to date in the United States and only one gene therapy product approved to date in Europe. Public perception may be influenced by claims that gene therapy is unsafe, and gene therapy may not gain the acceptance of the public or the medical community. In particular, our success will depend upon physicians specializing in the treatment of those diseases that our product candidates target prescribing treatments that involve the use of our product candidates in lieu of, or in addition to, existing treatments they are already familiar with and for which greater clinical data may be available. More restrictive government regulations or negative public opinion could have an adverse effect on our business or financial condition and may delay or impair the development and commercialization of our product candidates or demand for any products we may develop. Adverse events in our clinical trials, even if not ultimately attributable to our product candidates, and the resulting publicity could result in increased governmental regulation, unfavorable public perception, potential regulatory delays in the testing or approval of our potential product candidates, stricter labeling requirements for those product candidates that are approved and a decrease in demand for any such product candidates.

Even if we obtain and maintain approval for MYDICAR from the FDA, we may never obtain approval for MYDICAR outside of the United States, which would limit our market opportunities and adversely affect our business.

Approval in the United States by the FDA does not ensure approval by regulatory authorities in other countries or jurisdictions, and approval by one regulatory authority does not ensure approval by regulatory authorities in other foreign countries or by the FDA. Sales of MYDICAR outside of the United States will be subject to foreign regulatory requirements governing clinical trials and marketing approval. Even if the FDA grants marketing approval for a product candidate, comparable regulatory authorities of foreign countries must also approve the manufacturing and marketing of the product candidates in those countries and, if applicable, any required companion diagnostic. Approval procedures vary among jurisdictions and can involve requirements and administrative review periods different from, and greater than, those in the United States, including additional preclinical studies or clinical trials. In many countries outside the United States, a product candidate must be approved for reimbursement before it can be approved for sale in that country. In some cases, the price that we intend to charge for our products, if approved, is also subject to approval. While we may decide to submit an MAA to the EMA for approval in the EEA, obtaining such approval is a lengthy and expensive process and the EMA has its own procedures for approval of product candidates. Even if a product is approved, the FDA or the EMA, as the case may be, may limit the indications for which the product may be marketed, require extensive warnings on the product labeling or require expensive and time-consuming clinical trials or reporting as conditions of approval. Regulatory authorities in countries outside of the United States and the EEA also have requirements for approval of drug candidates with which we must comply prior to marketing in those countries. Obtaining foreign regulatory approvals and compliance with foreign regulatory requirements could result in significant delays, difficulties and costs for us and could delay or prevent the introduction of our products in certain countries. Further, clinical trials conducted in one country may not be accepted by regulatory authorities in other countries and regulatory approval in one country does not ensure approval in any other country, while a failure or delay in obtaining regulatory approval in one country may have a negative effect on the regulatory approval process in others. Also, regulatory approval for any of our product candidates may be withdrawn. If we fail to comply with the regulatory requirements in international markets and/or receive applicable marketing approvals, our target market will be reduced and our ability to realize the full market potential of MYDICAR will be harmed and our business will be adversely affected.

If approved, MYDICAR or any future products may cause or contribute to adverse medical events that we are required to report to regulatory agencies and if we fail to do so, we could be subject to sanctions that would materially harm our business.

Some participants in our clinical trials have reported adverse effects after being treated with MYDICAR. If we are successful in commercializing MYDICAR or any other products, FDA and foreign regulatory agency regulations require that we report certain information about adverse medical events if those products may have caused or contributed to those adverse events. The timing of our obligation to report would be triggered by the date we become aware of the adverse event as well as the nature of the event. We may fail to report adverse events we become aware of within the prescribed timeframe. We may also fail to appreciate that we have become aware of a reportable adverse event, especially if it is not reported to us as an adverse event or if it is an adverse event that is unexpected or removed in time from the use of our products. If we fail to comply with our reporting obligations, the FDA, the EMA or other foreign regulatory authorities could take action including criminal prosecution, the imposition of civil monetary penalties, seizure of our products, or delay in approval or clearance of future products.

Although we have obtained an SPA for a potential Phase 3 pivotal clinical trial of MYDICAR for the treatment of systolic heart failure, this agreement does not guarantee any particular outcome from regulatory review.

In May 2012, we obtained an SPA from the FDA for a potential Phase 3 pivotal clinical trial of MYDICAR. The FDA's SPA process creates a written agreement between the sponsoring company and the FDA regarding clinical trial design and other clinical trial issues, such as the trial endpoints, that can be used to support approval of a product candidate. The SPA is intended to provide assurance that if the agreed upon clinical trial protocols are followed and the clinical trial endpoints are achieved, the data may serve as the primary basis for an efficacy claim in support of a BLA. However, an SPA is not a guarantee of an approval of a product candidate or any permissible claims about the product candidate. In particular, an SPA agreement is not binding on the FDA if previously unrecognized public health concerns arise during the performance of the clinical trial, if other new scientific concerns regarding product candidate safety or efficacy arise or if the sponsoring company fails to comply with the agreed upon clinical trial protocols. Moreover, an SPA does not address all of the variables and details that may go into planning for or conducting a clinical trial, and any change in the protocol for a clinical trial can invalidate an SPA or require the sponsor to submit an amendment. Although our SPA with the FDA provides that the primary efficacy endpoint of time-to-recurrent heart failure-related hospitalizations in the presence of terminal events (all-cause death, heart transplant and LVAD implantation) is acceptable for a potential Phase 3 pivotal trial of MYDICAR, the SPA specifically provides that the FDA's agreement to this point assumes certain elements, including the acceptance of certain simulation models by the FDA and the validation by the FDA of the software used to implement the statistical model. In June 2013, the FDA advised us that it had concerns regarding the simulation results that we had submitted in favor of the trial model. Later in June 2013, we responded to the FDA and provided it with software for data simulations and analysis supporting our proposed statistical model, however, the FDA may not agree with the sufficiency of our simulation models and software used to implement such models and may request that we use an alternative statistical model.

Notably, CUPID 2 is substantially similar in design to the SPA Phase 3 protocol and uses the same primary efficacy endpoint. However, while we believe that the FDA's agreement in the SPA regarding the trial endpoints will support approval if the CUPID 2 trial is deemed a pivotal trial for purposes of BLA submission, the SPA does not directly apply to the CUPID 2 trial. There can also be no assurance that the FDA will ultimately consider our SPA to be binding, particularly on the CUPID 2 trial that we are conducting. The FDA could assert that additional data, including data obtained through one or more additional clinical trials, may be required to support a regulatory submission. In addition, while an SPA addresses the requirements for submission of a BLA, the results of the related clinical trial may not support FDA approval.

Risks Related to our Reliance on Third Parties

We rely on third parties to conduct some or all aspects of our vector production, product manufacturing, combination product commercial supply, companion diagnostic testing, reagent manufacturing, protocol development, research, and preclinical and clinical testing, and these third parties may not perform satisfactorily.

We do not currently, and do not expect to in the future, independently conduct all aspects of our vector production, product manufacturing, combination product component supply, companion diagnostic testing, reagent manufacturing, protocol development, research and monitoring and management of our ongoing preclinical and clinical programs. We currently rely, and expect to continue to rely, on third parties with respect to these items, and control only certain aspects of their activities.

Any of these third parties may terminate their engagements with us at any time. If we need to enter into alternative arrangements, our product candidate or companion diagnostic development activities may be delayed. Our reliance on these third parties for research and development activities, including the conduct of any IND-enabling studies, reduces our control over these activities but does not relieve us of our responsibility to ensure compliance with all required legal, regulatory and scientific standards and any applicable trial protocols. For example, for product candidates that we develop and commercialize on our own, we will remain responsible for ensuring that each of our IND-enabling studies and clinical trials are conducted in accordance with the trial plan and protocols.

If these third parties do not successfully carry out their contractual duties, meet expected deadlines or conduct our studies in accordance with regulatory requirements or our stated study plans and protocols, we may be delayed in completing, or unable to complete, the preclinical studies and clinical trials required to support future IND submissions and approval of our product candidates.

We rely on our manufacturers to purchase from third-party suppliers the materials necessary to produce our product candidates and our companion diagnostic for our clinical trials. There are a small number of suppliers for certain capital equipment and raw materials that we use to manufacture our product candidates and our companion diagnostic. Such suppliers may not sell these raw materials to our manufacturers at the times we need them or on commercially reasonable terms. We do not have any control over the process or timing of the acquisition of these raw materials by our manufacturers. Moreover, we currently do not have any agreements for the commercial production of these raw materials. Although we generally do not begin a clinical trial unless we believe we have a sufficient supply of a product candidate or the reagent for our companion diagnostic to complete the clinical trial, any significant delay in the supply of a product candidate, a diagnostic reagent, or the raw material components thereof for an ongoing clinical trial due to the need to replace a third-party manufacturer could considerably delay completion of our clinical trials, product testing and potential regulatory approval of our product candidates or companion diagnostic. If our manufacturers or we are unable to purchase these raw materials after regulatory approval has been obtained for our product candidates or companion diagnostic, our ability to commercially launch and/or generate revenues from the sale of any of our approved products or companion diagnostic would be impaired. Reliance on third-party manufacturers entails exposure to risks to which we would not be subject if we manufactured the product candidates or companion diagnostic ourselves, including:

- we may be unable to negotiate manufacturing agreements with third parties under commercially reasonable terms;
- reduced control over the manufacturing process for our product candidates and companion diagnostic as a result of using third-party manufacturers for all aspects of manufacturing activities;
- termination or nonrenewal of manufacturing agreements with third parties in a manner or at a time that may be costly or damaging to us or result in delays in the development or commercialization of our product candidates or companion diagnostic; and
- disruptions to the operations of our third-party manufacturers or suppliers caused by conditions unrelated to our business or operations, including the bankruptcy of the manufacturer or supplier.

Any of these events could lead to delays in the development of our product candidates or companion diagnostic, including delays in our clinical trials, or failure to obtain regulatory approval for our product candidates or companion diagnostic, or it could impact our ability to successfully commercialize our current product candidates, companion diagnostic or any future products. Some of these events could be the basis for FDA or other regulatory action, including injunction, recall, seizure or total or partial suspension of production.

We and our contract manufacturers are subject to significant regulation with respect to manufacturing our viral vectors, product candidates and companion diagnostic. The manufacturing facilities on which we rely may not continue to meet regulatory requirements and have limited capacity.

We currently have a relationship with only one supplier, Lonza, for the manufacturing of our viral vectors and product candidates for clinical testing purposes, and intend to continue to utilize Lonza as our sole or primary supplier in the future. We also expect to rely upon third parties to produce materials required for the commercial production of our product candidates and companion diagnostic if we succeed in obtaining the necessary regulatory approvals. Because certain of our license agreements place restrictions on our ability to transfer or sublicense our intellectual property rights obtained under such agreements in connection with manufacturing activities, if any supplier we use requires a sublicense of our intellectual property rights for commercial manufacture of our viral vectors, product candidates or companion diagnostic, we may be unable to transfer or sublicense the requisite intellectual property rights, which may negatively impact our supply of our viral vectors, product candidates or companion diagnostic.

All entities involved in the preparation of therapeutic product for clinical trials or commercial sale, including our existing contract manufacturers, are subject to extensive regulation. Components of a finished therapeutic product approved for commercial sale or used in late-stage clinical trials must be manufactured in accordance with GMP and equivalent foreign standards. These regulations govern manufacturing processes and procedures (including record keeping) and the implementation and operation of quality systems to control and assure the quality of investigational products and products approved for sale. Poor control of production processes can lead to the introduction of adventitious agents or other contaminants, or to inadvertent changes in the properties or stability of our product candidates that may not be detectable in final product testing. We or our contract manufacturers must supply all necessary documentation in support of a BLA on a timely basis and must adhere to the FDA's good laboratory practices, or GLPs, and GMP regulations enforced by the FDA through its facilities inspection program. Any failure by our third-party manufacturers to comply with GMP or failure to scale-up manufacturing processes, including any failure to deliver sufficient quantities of product candidates in a timely manner, could lead to a delay in, or failure to obtain, regulatory approval of any of our product candidates or companion diagnostic. Our facilities and quality systems and the facilities and quality systems of some or all of our third-party contractors must also pass a pre-approval inspection for compliance with the applicable regulations as a condition of regulatory approval of our product candidates or companion diagnostic. In addition, the regulatory authorities may, at any time, audit or inspect a manufacturing facility involved with the preparation of our product candidates, companion diagnostic or the associated quality systems for compliance with the regulations applicable to the activities being conducted. If these facilities and quality systems do not pass a pre-approval plant inspection, FDA approval of our product candidates, or the equivalent approvals in other jurisdictions, will not be granted.

Regulatory authorities also may, at any time following approval of a product for sale, audit our manufacturing facilities or those of our third-party contractors. If any such inspection or audit identifies a failure to comply with applicable regulations or if a violation of our product specifications or applicable regulations occurs independent of such an inspection or audit, we or the relevant regulatory authority may require remedial measures that may be costly and/or time-consuming for us or a third party to implement and that may include the temporary or permanent suspension of a clinical trial or commercial sales or the temporary or permanent closure of a facility. Any such remedial measures imposed upon us or third parties with whom we contract could materially harm our business.

If we or any of our third-party manufacturers fail to maintain regulatory compliance, the FDA can impose regulatory sanctions including, among other things, refusal to approve a pending application for a new drug product or biological product, or revocation of a pre-existing approval. If any such event occurs, our business, financial condition and results of operations may be materially harmed.

Additionally, if supply from one approved manufacturer is interrupted, there could be a significant disruption in commercial supply. An alternative manufacturer would need to be qualified through a BLA supplement which could result in further delay. The regulatory agencies may also require additional studies if a new manufacturer is relied upon for commercial production. Switching manufacturers may involve substantial costs and would likely result in a delay in our desired clinical and commercial timelines.

These factors could cause the delay of clinical trials, regulatory submissions, required approvals or commercialization of our product candidates, cause us to incur higher costs and prevent us from commercializing our products successfully. Furthermore, if our suppliers fail to meet contractual requirements, and we are unable to secure one or more replacement suppliers capable of production at a substantially equivalent cost, our clinical trials may be delayed or we could lose potential revenue.

We rely on third parties to conduct, supervise and monitor our clinical trials. If these third parties do not successfully carry out their contractual duties or meet expected deadlines, we may not be able to obtain regulatory approval for or commercialize our product candidates and our business could be substantially harmed.

We rely on CROs and clinical trial sites to ensure our clinical trials are conducted properly and on time. While we will have agreements governing their activities, we will have limited influence over their actual performance. We will control only certain aspects of our CROs' activities. Nevertheless, we will be responsible for ensuring that each of our clinical 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 are required to comply with the FDA's GCPs for conducting, recording and reporting the results of clinical trials to assure that the data and reported results are credible and accurate and that the rights, integrity and confidentiality of clinical trial participants are protected. The FDA, the Competent Authorities of the Member States of the EEA, and comparable foreign regulatory authorities, enforce these GCPs through periodic inspections of trial sponsors, principal investigators and clinical trial sites. If we or our CROs fail to comply with applicable GCPs, the clinical data generated in our future clinical trials may be deemed unreliable and the FDA, the EMA, or other foreign regulatory authorities may require us to perform additional clinical trials before approving any marketing applications. Upon inspection, the FDA may determine that our clinical trials did not comply with GCPs. In addition, our future clinical trials will require a sufficient number of test subjects to evaluate the safety and effectiveness of our product candidates. Accordingly, if our CROs fail to comply with these regulations or fail to recruit a sufficient number of patients, we may be required to repeat such clinical trials, which would delay the regulatory approval process.

Our CROs are not our employees, and we are therefore unable to directly monitor whether or not they devote sufficient time and resources to our clinical and nonclinical programs. These CROs may also have relationships with other commercial entities, including our competitors, for whom they may also be conducting clinical trials or other product development activities that could harm our competitive position. If our CROs do not successfully carry out their contractual duties or obligations, fail to meet expected deadlines, or if the quality or accuracy of the clinical data they obtain is compromised due to the failure to adhere to our clinical protocols or regulatory requirements, or for any other reasons, our clinical trials may be extended, delayed or terminated, and we may not be able to obtain regulatory approval for, or successfully commercialize, our product candidates. If any such event were to occur, our financial results and the commercial prospects for our product candidates would be harmed, our costs could increase, and our ability to generate revenues could be delayed.

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

We also rely on other third parties to store and distribute our vectors and products for the clinical trials that we conduct. Any performance failure on the part of our distributors could delay clinical development or marketing approval of our product candidates or commercialization of our products, if approved, producing additional losses and depriving us of potential product revenue.

We may seek to form strategic alliances in the future with respect to our product candidates or companion diagnostic, and we may not realize the benefits of such alliances.

We may form strategic alliances, create joint ventures or collaborations or enter into licensing arrangements with third parties for the development and commercialization of our product candidates and companion diagnostic. We face significant competition in seeking appropriate strategic partners and the negotiation process is time-consuming and complex. Any delays in entering into new strategic partnership agreements related to our product candidates or companion diagnostic could delay the development and commercialization of our product candidates and reduce their competitiveness even if they reach the market. Moreover, we may not be successful in our efforts to establish a strategic partnership or other collaborative arrangement for any future product candidates or companion diagnostic because the potential partner may consider that our research and development pipeline is insufficiently developed to justify a collaborative effort, or that our product candidates and programs do not have the requisite potential to demonstrate safety and efficacy in the target population. Even if we are successful in establishing such a strategic partnership or collaboration, we cannot be certain that, following such a strategic transaction or license, we will be able to progress the development and commercialization of the applicable product candidates as envisaged, or that we will achieve the revenues that would justify such transaction.

Risks Related to Commercialization of our Product Candidates and Companion Diagnostic

We intend to rely on third parties to produce our viral vectors, product candidates and other key materials and for our companion diagnostic testing, but we have not entered into binding agreements with any such manufacturers to support commercialization. Additionally, these manufacturers do not have experience producing our vectors, product candidates or companion diagnostic materials at commercial levels and may not achieve the necessary regulatory approvals or produce our vectors, products or companion diagnostic materials at the quality, quantities, locations and timing needed to support commercialization.

We have not yet secured manufacturing capabilities for commercial quantities of our small molecule compounds or viral vectors to support commercialization of our product candidates, if approved. Although we intend to rely on third parties for commercialization and expect that Lonza will build a commercial manufacturing facility with capability up to 2,000 liter bioreactor capacity, which we expect to be operational no earlier than 2015, to date we have only entered into a single clinical-scale binding manufacturing agreement with Lonza to support our clinical trials. We may be unable to negotiate a binding agreement with Lonza or with any other suitably qualified third-party manufacturer to support our commercialization activities at commercially reasonable terms.

We are currently developing a scalable manufacturing process for MYDICAR, which we are in the process of transferring to Lonza. There is no guarantee that the scale-up process will be able to be completed without complications or delay. Although we have entered into an agreement for the manufacture of our MYDICAR

vector with Lonza for our clinical trials, Lonza may not perform as agreed, may be unable to comply with GMP requirements and with FDA, state and foreign regulatory requirements or may terminate its agreement with us. If Lonza is unable to manufacture our MYDICAR vector in a timely manner, encounters manufacturing difficulties, or otherwise fails to comply with its contractual obligations and we are required to switch to a new manufacturer, we expect that our clinical development timeline would be delayed by at least one year. Moreover, we have not entered into a commercial-scale supply agreement with Lonza and Lonza has not yet manufactured our MYDICAR vector on a commercial scale. Because of the complex nature of our product candidates, Lonza, or any other manufacturer with whom we may enter into an agreement, may not be able to manufacture our product candidates at a cost or in quantities or on timelines necessary for the successful commercialization of our product candidates. If we successfully commercialize any of our product candidates, we may be required to establish large-scale commercial manufacturing capabilities, either independently or with one or more third parties, and there is no guarantee that any such third parties will be able to do this in a timely manner, or at all. In addition, in the event that our product development pipeline increases and matures, we will have a greater need for clinical trial and commercial manufacturing capacity. We have no experience manufacturing pharmaceutical or biological products on a commercial scale and some of our suppliers, including Lonza, would need to increase their scale of production to meet our projected needs for commercial manufacturing of our product candidates, the satisfaction of which may not be met on a timely basis.

Even if we develop a manufacturing process in a timely fashion and successfully transfer it to Lonza or any other third-party vector and product manufacturers, if such third-party manufacturers are unable to produce our viral vectors or product candidates in the necessary quantities, or in compliance with GMP, or in compliance with pertinent regulatory requirements, and within our planned time frame and cost parameters, the development and sales of our products, if approved, may be materially harmed.

We similarly intend to enter into an agreement with a third-party partner for the commercial scale-up, automation and administration of our companion diagnostic. However, we may be unable to enter into such an agreement on favorable terms, or at all.

We may run into technical or scientific issues related to manufacturing or development that we may be unable to resolve in a timely manner or with available funds. In addition, we have not completed the characterization and validation activities necessary for commercial and regulatory approvals. If Lonza or any of our other manufacturing partners does not obtain such regulatory approvals, our commercialization efforts will be harmed. For more information regarding our manufacturing services agreement with Lonza, see “Business—Manufacturing—Manufacturing Services Agreement with Lonza.”

In addition, any significant disruption in our supplier relationships could harm our business. We source key materials from third parties, either directly through agreements with suppliers or indirectly through our manufacturers who have agreements with suppliers. There are a small number of suppliers for certain key materials that are used to manufacture our product candidates and companion diagnostic. Such suppliers may not sell these key materials to our manufacturers at the times we need them or on commercially reasonable terms. We do not have any control over the process or timing of the acquisition of these key materials by our manufacturers. Moreover, we currently do not have any agreements for the commercial production of these key materials.

If we are unable to establish sales and marketing capabilities or enter into agreements with third parties to market and sell our product candidates or companion diagnostic, if approved, we may be unable to generate any revenues.

We currently do not have an organization for the sales, marketing and distribution of products and the cost of establishing and maintaining such an organization may exceed the cost-effectiveness of doing so. In order to market any products that may be approved, including MYDICAR, we must build our sales, distribution, marketing, managerial and other non-technical capabilities or make arrangements with third parties to perform

these services. We have no prior experience in the marketing, sale or distribution of pharmaceutical or diagnostic products and there are significant risks involved in building and managing a sales organization, including our ability to hire, retain, and incentivize qualified individuals, generate sufficient sales leads, provide adequate training to sales and marketing personnel, and effectively manage a geographically dispersed sales and marketing team. Any failure or delay in the development of our internal sales, marketing and distribution capabilities would adversely impact the commercialization of these products. We may enter into strategic partnerships with third parties to commercialize our product candidates or companion diagnostic outside of the United States, including for MYDICAR. We intend to build an internal sales force for the commercialization of MYDICAR in the United States. However, we will also consider the option to enter into strategic partnerships for our product candidates and companion diagnostic in the United States and other geographies where we obtain marketing approval.

Our strategy for MYDICAR is to develop a hospital-directed sales force and/or collaborate with third parties to promote the product to selected cardiologists, heart failure specialists and third-party payors, which number in the thousands in the United States. Some pharmaceutical companies employ groups of sales representatives of much larger scale than we intend to utilize to target their cardiovascular products for the general physician community and third-party payors. We may in the future, choose to align ourselves with collaborators as part of our commercialization strategy, particularly outside of the United States, and our future collaboration partners, if any, may not dedicate sufficient resources to the commercialization of our product candidates or companion diagnostic or may otherwise fail in their commercialization due to factors beyond our control. If we are unable to establish effective collaborations to enable the sale of our product candidates and companion diagnostic to healthcare professionals and in geographical regions, including the United States, that will not be covered by our own marketing and sales force, or if our potential future collaboration partners do not successfully commercialize our product candidates or companion diagnostic, our ability to generate revenues from product sales, including sales of MYDICAR, will be adversely affected.

Building an internal sales force involves many challenges, including:

- recruiting and retaining talented people;
- training employees that we recruit;
- setting the appropriate system of incentives;
- managing additional headcount; and
- integrating a new business unit into an existing corporate architecture.

If we are unable to build our own sales force or negotiate a strategic partnership for the commercialization of MYDICAR or our companion diagnostic in the United States, we may be forced to delay the potential commercialization of MYDICAR, reduce the scope of our sales or marketing activities for MYDICAR or undertake the commercialization activities for MYDICAR at our own expense. If we elect to increase our expenditures to fund commercialization activities ourselves, we will need to obtain additional capital, which may not be available to us on acceptable terms, or at all. If we do not have sufficient funds, we will not be able to bring MYDICAR to market or generate product revenue. We could enter into arrangements with collaborative partners or otherwise at an earlier stage than otherwise would be ideal and we may be required to relinquish rights to some of our technologies, product candidates or our companion diagnostic or otherwise agree to terms unfavorable to us, any of which may have a material adverse effect on our business, operating results and prospects.

If we are unable to establish adequate sales, marketing and distribution capabilities, whether independently or with third parties, we may not be able to generate sufficient product revenue and may not become profitable. We will be competing with many companies that currently have extensive and well-funded marketing and sales operations. Without an internal team or the support of a third party to perform marketing and sales functions, we may be unable to compete successfully against these more established companies.

In addition, there are risks involved with both establishing our own sales and marketing capabilities and entering into arrangements with third parties to perform these services. For example, recruiting and training a sales force is expensive and time-consuming and could delay any product launch. If the commercial launch of a product candidate for which we recruit a sales force and establish marketing capabilities is delayed or does not occur for any reason, we would have prematurely or unnecessarily incurred these commercialization expenses. This may be costly, and our investment would be lost if we cannot retain or reposition our sales and marketing personnel.

If the market size for MYDICAR is considerably smaller than we anticipate, it could significantly and negatively impact our business, financial condition and results of operations.

It is very difficult to estimate the future commercial potential of MYDICAR due to factors such as safety and efficacy compared to other available treatments, changing standards of care, third-party payor reimbursement standards, patient and physician preferences, and the availability of competitive alternatives that may emerge. We believe that approximately 60% of such potential patients in the United States will be ineligible for treatment with MYDICAR due to the presence of pre-existing AAV1 NAbs which will neutralize the effectiveness of AAV-based vectors such as MYDICAR. In other countries, such as Poland, the prevalence of pre-existing AAV-resistant antibodies is significantly higher. In addition, just one exposure to an AAV-based treatment such as MYDICAR may cause a patient to produce NAbs. Furthermore, other pharmaceutical companies could develop and receive approval for new AAV-based treatments which could increase the number of patients that exhibit NAbs. We estimate that there are over 350,000 heart failure patients in the United States alone that will be eligible for MYDICAR therapy; however, if the potential eligible patient population is lower than we anticipate, or if considerably more than 60% of potential patients exhibit NAbs, it could significantly and negatively impact our business, financial condition and results of operations.

We face intense competition and rapid technological change and the possibility that our competitors may develop therapies that are more advanced or effective than ours, which may adversely affect our financial condition and our ability to successfully commercialize our product candidates.

We face competition both in the United States and internationally, including from major multinational pharmaceutical companies, biotechnology companies and universities and other research institutions. Some of the pharmaceutical and biotechnology companies we know are developing gene therapies for heart failure that could potentially be competitive with or hinder the uptake of MYDICAR and change the standard of care for heart failure patients. These include Renova Therapeutics, NanoCor Therapeutics, Juventas Therapeutics, VentriNova and Beat BioTherapeutics. In addition, many universities and private and public research institutes are active in our target disease areas.

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. Competition may increase further as a result of advances in the commercial applicability of technologies and greater availability of capital for investment in these industries. Our competitors may succeed in developing, acquiring or licensing on an exclusive basis, products that are more effective or less costly than any product candidate that we may develop, or achieve earlier patent protection, regulatory approval, product commercialization and market penetration than we do. Additionally, technologies developed by our competitors may render our potential product candidates uneconomical or obsolete, and we may not be successful in marketing our product candidates against competitors.

Under the terms of our license agreement with AskBio LLC, or AskBio, we granted AskBio an option to obtain a non-exclusive, worldwide license under certain of our patent rights related to infusion of AAV in the arteries of the heart to develop, manufacture, use and sell products for the treatment of cardiac diseases. This option includes our currently pending patent application related to a method of treating a cardiovascular disease by infusion of a therapeutic nucleic acid into the coronary circulation over a specified period of time. It does not

include our issued patent in this family, which includes claims to the concurrent use of a vasodilating substance such as nitroglycerin. Although the scope of the license granted to AskBio excludes our issued patent and the scope of our anticipated regulatory approvals, there can be no guarantee AskBio will not seek to develop and commercialize a product that is able to compete with MYDICAR.

Even if we are successful in achieving regulatory approval to commercialize a product candidate faster than our competitors, we may face competition from "biosimilars" due to the changing regulatory environment. In the United States, the Biologics Price Competition and Innovation Act of 2009 created an abbreviated approval pathway for biological products that are demonstrated to be "highly similar," or "biosimilar," to or "interchangeable" with an FDA-approved biological product. This new pathway could allow competitors to reference data from biological products already approved after 12 years from the time of approval. In addition, companies may be developing biosimilars in other countries that could compete with our products. If competitors are able to obtain marketing approval for biosimilars referencing our products, our products may become subject to competition from such biosimilars, with the attendant competitive pressure and consequences. Expiration or successful challenge of our applicable patent rights could also trigger competition from other products, assuming any relevant exclusivity period has expired.

Finally, as a result of the expiration or successful challenge of our patent rights, we could face litigation with respect to the validity and/or scope of patents relating to our competitors' products. The availability of our competitors' products could limit the demand, and the price we are able to charge, for any products that we may develop and commercialize.

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

Ethical, social and legal concerns about gene therapy and genetic research could result in additional regulations restricting or prohibiting the products and processes we may use. Even with the requisite approvals, the commercial success of our gene therapy product candidates will depend in part on the medical community, patients, and third-party payors accepting gene therapy products in general, and our product candidates in particular, as medically useful, cost-effective, and safe. Any product that we bring to the market may not gain market acceptance by physicians, patients, third-party payors and others in the medical community. If these products do not achieve an adequate level of acceptance, we may not generate significant product revenue and may not become profitable. The degree of market acceptance of these product candidates, if approved for commercial sale, will depend on a number of factors, including:

- the potential efficacy and potential advantages over alternative treatments;
- the clinical indications for which the product candidate is approved;
- with respect to MYDICAR, the approval, availability and market acceptance, coverage and reimbursement for the companion diagnostic;
- the prevalence and severity of any side effects, including any limitations or warnings contained in a product's approved labeling;
- relative convenience and ease of administration;
- the willingness of the target patient population to try new therapies and of physicians to prescribe these therapies;
- acceptance by physicians and patients of the product as a safe and effective treatment;
- the potential and perceived advantages of such product candidate over alternative treatments, especially with respect to patient subsets that we are targeting with such product candidate;

- the existence of other gene therapy products utilizing an AAV vector, which potential patients may elect to take for other indications, thereby causing them to develop NAbs and making them ineligible to take MYDICAR;
- the safety of such product candidate seen in a broader patient group, including its use outside the approved indications;
- the cost of treatment in relation to alternative treatments;
- relative convenience and ease of administration;
- the strength of marketing and distribution support and timing of market introduction of competitive products;
- the effectiveness of our sales and marketing efforts;
- publicity concerning our products or competing products and treatments; and
- sufficient third-party insurance coverage or reimbursement.

Even if a potential product displays a favorable efficacy and safety profile in preclinical studies and clinical trials, market acceptance of the product will not be known until after it is launched. Our efforts to educate the medical community and third-party payors on the benefits of the product candidates may require significant resources and may never be successful. Such efforts to educate the marketplace may require more resources than are required by the conventional technologies marketed by our competitors.

If we are unable to achieve and maintain adequate levels of coverage and reimbursement for MYDICAR, our companion diagnostic or any other product candidates, if approved, on reasonable pricing terms, their commercial success may be severely hindered.

Successful sales of any approved product candidates depend on the availability of adequate coverage and reimbursement from third-party payors. 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. Sales of our product candidates will therefore depend substantially, both domestically and abroad, on the extent to which the costs of our product candidates will be paid by health maintenance, managed care, pharmacy benefit and similar healthcare management organizations, or reimbursed by government health administration authorities, such as Medicare and Medicaid, private health coverage insurers and other third-party payors. In addition, the market for MYDICAR and any of our other product candidates will depend significantly on access to third-party payors' formularies, or lists of treatments for which third-party payors provide coverage and reimbursement.

Third-party payors, whether foreign or domestic, or governmental or commercial, are developing increasingly sophisticated methods of controlling healthcare costs. In the United States, no uniform policy of coverage and reimbursement for therapeutic products exists among third-party payors. Therefore, coverage and reimbursement for therapeutic products can differ significantly from payor to payor. 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, with no assurance that adequate coverage and reimbursement will be obtained. In many foreign countries, a product candidate must be approved for reimbursement before it can be approved for sale in that country, and we may fail to obtain such reimbursement approvals.

In the United States, decisions about Medicare coverage and reimbursement for new medicines are made by the Centers for Medicare & Medicaid Services, or CMS, the agency within the U.S. Department of Health and Human Services responsible for administering the Medicare program. Private payors and other government payors often follow CMS's policies to a substantial degree, making the Medicare determinations particularly

significant. It remains uncertain what CMS will decide with respect to reimbursement for fundamentally novel products such as ours, as there is no body of established practices and precedents for these new products. Similarly, outside the United States, we may not succeed in obtaining reimbursement approval from the relevant regulatory authorities.

In addition, coverage decisions may depend upon clinical and economic standards that disfavor new products when more established or lower cost alternatives are already available or subsequently become available. Assuming we obtain coverage for a given product, the resulting reimbursement payment rates might not be adequate or may require co-payments that patients find unacceptably high. Moreover, payment methodologies may be subject to changes in healthcare legislation and regulatory initiatives. For example, the Middle Class Tax Relief and Job Creation Act of 2012 required CMS to reduce the Medicare clinical laboratory fee schedule by 2% in 2013, which in turn serves as a base for 2014 and subsequent years. CMS also released final regulations whereby it will systematically re-examine and adjust payment amounts for tests reimbursed under the Medicare clinical laboratory fee schedule due to changes in technology. The examination would seek to identify codes that had undergone technological changes affecting the price of the test. CMS will begin this process in 2014 with the first set of payment adjustments to be effective on January 1, 2015. In addition, CMS announced that it will bundle the Medicare payments for certain laboratory tests ordered while a patient received services in a hospital outpatient setting beginning on January 1, 2014. Levels of reimbursement may be impacted by these initiatives and other current and future legislation, regulation or reimbursement policies of third-party payors in a manner that may harm the demand and reimbursement available for our products, including our companion diagnostic, which in turn, could harm our product pricing and sales.

Outside the United States, international operations are generally subject to extensive governmental price controls and other market 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 our product candidates. In many countries, the prices of medical products are subject to varying price control mechanisms as part of national health systems. In general, the prices of medicines under such systems are substantially lower than in the United States. Other countries allow companies to fix their own prices for medicines, but monitor and control company profits. Additional foreign price controls or other changes in pricing regulation could restrict the amount that we are able to charge for our product candidates. Accordingly, in markets outside the United States, the reimbursement for our products may be reduced compared with the United States and may be insufficient to generate commercially reasonable revenues and profits.

Third-party coverage and reimbursement for MYDICAR or any of our other product candidates for which we may receive regulatory approval may not be available or adequate in either the United States or international markets and may vary substantially from our current assumptions, which could have a material adverse effect on our business, results of operations, financial condition and prospects.

Healthcare reform measures may have a material adverse effect on our business and results of operations.

In the United States, the legislative landscape continues to evolve. In March 2010, the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act, or the Affordable Care Act, was passed, which has the potential to substantially change health care financing by both governmental and private insurers, and significantly impact the U.S. pharmaceutical industry. The Affordable Care Act, among other things, subjects biological products to potential competition by lower-cost biosimilars, revised the methodology by which rebates owed by manufacturers for covered outpatient drugs under the Medicaid Drug Rebate Program are calculated, increased the minimum Medicaid rebates owed by most manufacturers under the Medicaid Drug Rebate Program, extended the Medicaid Drug Rebate Program to utilization of prescriptions of individuals enrolled in Medicaid managed care organizations, subjected manufacturers to new annual fees and taxes for certain branded prescription drugs, and provided incentives to programs that increase the federal government’s comparative effectiveness research.

In addition, other legislative changes have been proposed and adopted in the United States since the Affordable Care Act was enacted. On August 2, 2011, the Budget Control Act of 2011 among other things, created measures for spending reductions by Congress. A Joint Select Committee on Deficit Reduction, tasked with recommending a targeted deficit reduction of at least $1.2 trillion for the years 2013 through 2021, was unable to reach required goals, thereby triggering the legislation's automatic reduction to several government programs. This includes aggregate reductions of Medicare payments to providers of up to 2% per fiscal year. On January 2, 2013, President Obama signed into law the American Taxpayer Relief Act of 2012, or the ATRA, which, among other things, delayed for another two months the budget cuts mandated by these sequestration provisions of the Budget Control Act of 2011. On March 1, 2013, the President signed an executive order implementing sequestration, and on April 1, 2013, the 2% Medicare payment reductions went into effect. The ATRA also reduced Medicare payments to certain providers, including physicians, hospitals, imaging centers and cancer treatment centers, and increased the statute of limitations period for the government to recover overpayments to providers from three to five years. 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 for our product candidates or additional pricing pressures.

If we obtain approval to commercialize our product candidates outside of the United States, a variety of risks associated with international operations could materially adversely affect our business.

If any of our product candidates are approved for commercialization, we may enter into agreements with third parties to market them on a worldwide basis or in more limited geographical regions. We expect that we will be subject to additional risks related to entering into international business relationships, including:

- different regulatory requirements for approval of drugs and biological products in foreign countries;
- reduced protection for intellectual property rights;
- unexpected changes in tariffs, trade barriers and regulatory requirements;
- regulations under the U.S. Foreign Corrupt Practices Act and similar foreign anti-corruption laws;
- economic weakness, including inflation, or political instability in particular foreign economies and markets;
- compliance with tax, employment, immigration and labor laws for employees living or traveling abroad;
- foreign currency fluctuations, which could result in increased operating expenses and reduced revenues, and other obligations incident to doing business in another country;
- workforce uncertainty in countries where labor unrest is more common than in the United States;
- production shortages resulting from any events affecting raw material supply or manufacturing capabilities abroad; and
- business interruptions resulting from geopolitical actions, including war and terrorism, or natural disasters including earthquakes, typhoons, floods and fires.

Risks Related to our Business Operations

Our future success depends on our ability to retain key employees, consultants and advisors and to attract, retain and motivate qualified personnel.

We are highly dependent on the members of our executive team, the loss of whose services may adversely impact the achievement of our objectives. While we have entered into offer letters with each of our executive officers, any of them could leave our employment at any time, as all of our employees are "at will" employees. Recruiting and retaining other qualified employees, consultants and advisors for our business, including scientific and technical personnel, will also be critical to our success.

Although we have not historically experienced unique difficulties attracting and retaining qualified employees, we could experience such problems in the future. For example, competition for qualified personnel in the biotechnology and pharmaceuticals field is intense due to the limited number of individuals who possess the skills and experience required by our industry. There is currently a shortage of skilled executives in our industry, which is likely to continue. As a result, competition for skilled personnel is intense and the turnover rate can be high. We will need to hire additional personnel as we expand our clinical development and commercial activities. We may not be able to attract and retain personnel on acceptable terms, or at all, given the competition among numerous pharmaceutical and biotechnology companies for individuals with similar skill sets. In addition, failure to succeed in preclinical studies or clinical trials may make it more challenging to recruit and retain qualified personnel. The inability to recruit or loss of the services of any executive, key employee, consultant or advisor may impede the progress of our research, development and commercialization objectives. Furthermore, to the extent we hire personnel from competitors, we may be subject to allegations that they have been improperly solicited or that they have divulged proprietary or other confidential information, or that their former employers own their research output.

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

As of March 24, 2014, we had 16 full-time employees. As we mature and expand our research and development and other pre-commercialization activities, we expect to expand our full-time employee base and to hire more consultants and contractors. In addition, we currently plan to commercialize MYDICAR, if approved, using an internal sales force to selected cardiologists, heart failure specialists and third-party payors in the United States. Our management may need to divert a disproportionate amount of its 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 revenues 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.

Our employees, principal investigators, consultants and commercial partners may engage in misconduct or other improper activities, including non-compliance with regulatory standards and requirements and insider trading.

We are exposed to the risk of fraudulent conduct or other illegal activity by our employees, independent contractors, principal investigators, consultants, commercial partners and vendors. Misconduct by these parties could include intentional, reckless and/or negligent conduct that fails to: comply with the regulations of the FDA and non-U.S. regulators, provide accurate information to the FDA and non-U.S. regulators, comply with healthcare fraud and abuse laws in the United States and abroad, report financial information or data accurately or disclose unauthorized activities to us. In particular, promotion, sales, marketing and certain business arrangements in the healthcare industry are subject to extensive laws intended to prevent fraud, misconduct, kickbacks, self-dealing and other abusive practices. These laws may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, sales commission, customer incentive programs and other business arrangements. Such misconduct could also involve the improper use of information obtained in the course of patient recruitment or clinical trials, which could result in regulatory sanctions and cause serious harm to our reputation. We have adopted a code of business conduct and ethics applicable to all of our employees, but it is not always possible to identify and deter employee misconduct, and the precautions we take to detect and prevent this activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations or other actions or lawsuits stemming from a failure to comply with these laws or

regulations. If any such actions are instituted against us, and we are not successful in defending ourselves or asserting our rights, those actions could have a significant impact on our business, including the imposition of significant fines or other sanctions.

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 directly, or indirectly through our prescribers, customers and purchasers, subject to various federal and state fraud and abuse laws, including, without limitation, the federal Health Care Program Anti-Kickback Statute and the federal civil and criminal False Claims Acts. These laws may impact, among other things, our proposed promotional, sales, marketing and educational programs. In addition, we may be subject to patient privacy laws by both the federal government and the states in which we conduct our business. The laws that may affect our ability to operate include, but are not limited to:

- the federal Health Care Program Anti-Kickback Statute, which prohibits, among other things, persons or entities from knowingly and willfully soliciting, receiving, offering or paying any remuneration (including any kickback, bribe, or rebate), directly or indirectly, overtly or covertly, in cash or in kind in return for, the purchase, recommendation, leasing or furnishing of an item or service reimbursable under a federal healthcare program, such as the Medicare and Medicaid programs;
- federal civil and criminal false claims laws and civil monetary penalty laws, which prohibit, among other things, individuals or entities from knowingly presenting, or causing to be presented, claims for payment or approval from Medicare, Medicaid, or other government payers that are false or fraudulent;
- the federal Health Insurance Portability and Accountability Act of 1996, or HIPAA, which created new federal criminal statutes that prohibit a person from knowingly and willfully executing a scheme or from making false or fraudulent statements to defraud any healthcare benefit program, regardless of the payor (e.g., public or private);
- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act, or HITECH, and its implementing regulations, and as amended again by the final HIPAA omnibus rule, Modifications to the HIPAA Privacy, Security, Enforcement, and Breach Notification Rules Under HITECH and the Genetic Information Nondiscrimination Act; Other Modifications to HIPAA, published in January 2013, which imposes certain requirements relating to the privacy, security and transmission of individually identifiable health information without appropriate authorization by entities subject to the rule, such as health plans, health care clearinghouses and health care providers;
- the federal Food, Drug and Cosmetic Act, or FDCA, which prohibits, among other things, the adulteration or misbranding of drugs and devices;
- federal transparency laws, including the federal Physician Payment Sunshine Act that requires disclosure of payments and other transfers of value provided to physicians and teaching hospitals;
- the Affordable Care Act, and its implementing regulations, which may impact, among other things, reimbursement rates by federal health care programs and commercial insurers; and
- state law equivalents of each of the above federal laws, such as anti-kickback and false claims laws which may apply to items or services reimbursed by any third-party payor, including commercial insurers, and state laws governing the privacy and security of health information in certain circumstances, many of which differ from each other in significant ways and may not have the same effect, thus complicating compliance efforts in certain circumstances, such as specific disease states.

Further, the Affordable Care Act, among other things, amends the intent requirements of the federal Anti-Kickback Statute and the criminal statute governing healthcare fraud. A person or entity can now be found guilty of violating the Anti-Kickback Statute and the federal criminal healthcare fraud statute without actual knowledge

of the statute or specific intent to violate it. In addition, 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 federal False Claims Act.

In addition, there has been a recent trend of increased federal and state regulation of payments and other items of value provided to health care professionals and health care entities. Some states, such as California, Connecticut, Massachusetts and Nevada, mandate implementation of commercial compliance programs. Other states, such as Massachusetts, Minnesota and Vermont, impose restrictions on drug manufacturer marketing practices. Further, some states, such as Massachusetts, Vermont and West Virginia, as well as the District of Columbia, require tracking and reporting of gifts, compensation, other remuneration and items of value provided to health care professionals and health care entities.

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

We 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 product candidates harms patients, or is perceived to harm patients even when such harm is unrelated to our product candidates, our regulatory approvals could be revoked or otherwise negatively impacted and we could be subject to costly and damaging product liability claims.

The use or misuse of our product candidates in clinical trials and the sale of any products for which we obtain marketing approval exposes us to the risk of 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 products. 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. In addition, regardless of merit or eventual outcome, product liability claims may result in:

- impairment of our business reputation;
- initiation of investigations by regulators;
- withdrawal of clinical trial participants;
- costs due to related litigation;
- distraction of management’s attention from our primary business;
- substantial monetary awards to patients or other claimants;
- the inability to commercialize our product candidates;
- product recalls, withdrawals or labeling, marketing or promotional restrictions; and
- decreased demand for our product candidates, if approved for commercial sale.

We carry product liability insurance of $10.0 million per occurrence and a $10.0 million aggregate limit. We believe our product liability insurance coverage is appropriate in light of our current clinical programs; however, we may not be able to maintain insurance coverage at a reasonable cost or in sufficient amounts to protect us against losses due to liability. If and when we obtain marketing approval for product candidates, we intend to expand our insurance coverage to include the sale of commercial products; however, we may be unable to obtain product liability insurance on commercially reasonable terms or in adequate amounts. On occasion, large judgments have been awarded in class action lawsuits based on drugs or medical treatments that had unanticipated adverse effects. A successful product liability claim or series of claims brought against us could cause our stock price to decline and, if judgments exceed our insurance coverage, could adversely affect our results of operations and business.

Patients with the diseases targeted by our product candidates are often already in severe and advanced stages of disease and have both known and unknown significant pre-existing and potentially life-threatening health risks. During the course of treatment, patients may suffer adverse events, including death, for reasons that may be related to our product candidates. Such events could subject us to costly litigation, require us to pay substantial amounts of money to injured patients, delay, negatively impact or end our opportunity to receive or maintain regulatory approval to market our products, or require us to suspend or abandon our commercialization efforts. Even in a circumstance in which we do not believe that an adverse event is related to our products, the investigation into the circumstance may be time-consuming or inconclusive. These investigations may interrupt our sales efforts, delay our regulatory approval process in other countries, 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.

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

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

Although we maintain workers' compensation insurance to cover us for costs and expenses we may incur due to injuries to our employees resulting from the use of hazardous materials or other work-related injuries, this insurance may not provide adequate coverage against potential liabilities.

We may not be successful in our efforts to identify or discover additional product candidates.

The success of our business depends primarily upon our ability to identify, develop and commercialize products based on our gene therapy and small molecule platforms. Although our MYDICAR product candidates are currently in clinical or preclinical development and our small molecule product candidates are in preclinical development, our research programs may fail to identify other potential product candidates for clinical development for a number of reasons. For example, our research methodology may be unsuccessful in identifying potential product candidates or 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.

If any of these events occur, we may be forced to abandon our development efforts for a program or programs, which would have a material adverse effect on our business and could potentially cause us to cease operations. 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.

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 resources, we may forego or delay pursuit of opportunities with certain programs or product candidates or for 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 profitable market opportunities. Our spending on current and future research and development programs for product candidates may not yield any commercially viable products. 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 collaboration, 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 will incur significant increased costs as a result of operating as a public company, and our management will be required to devote substantial time to new compliance initiatives.

As a public company, we will incur significant legal, accounting and other expenses that we did not incur as a private company. In addition, the Sarbanes-Oxley Act of 2002, or the Sarbanes-Oxley Act, as well as rules subsequently implemented by the Securities and Exchange Commission, or SEC, and the NASDAQ Global Market have imposed various requirements on public companies. In July 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act, or the Dodd-Frank Act, was enacted. There are significant corporate governance and executive compensation related provisions in the Dodd-Frank Act that require the SEC to adopt additional rules and regulations in these areas such as “say on pay” and proxy access. Recent legislation permits smaller “emerging growth companies” to implement many of these requirements over a longer period and up to five years from the pricing of their initial public offering. We intend to take advantage of this new legislation but cannot guarantee that we will not be required to implement these requirements sooner than budgeted or planned and thereby incur unexpected expenses. Stockholder activism, the current political environment and the current high level of government intervention and regulatory reform may lead to substantial new regulations and disclosure obligations, which may lead to additional compliance costs and impact (in ways we cannot currently anticipate) the manner in which we operate our business. Our management and other personnel will need to devote a substantial amount of time to these compliance initiatives. Moreover, these rules and regulations will increase our legal and financial compliance costs and will make some activities more time-consuming and costly. For example, we expect these rules and regulations to make it more difficult and more expensive for us to obtain director and officer liability insurance and we may be required to incur substantial costs to maintain our current levels of such coverage.

Unfavorable global economic conditions could adversely affect our business, financial condition or results of operations.

Our results of operations could be adversely affected by general conditions in the global economy and in the global financial markets. The recent global financial crisis caused extreme volatility and disruptions in the capital and credit markets. A severe or prolonged economic downturn, such as the recent global financial crisis, could result in a variety of risks to our business, including, weakened demand for our product candidates and a decreased ability to raise additional capital when needed on acceptable terms, if at all. This is particularly true in Europe, which is undergoing a continued severe economic crisis. A weak or declining economy could also strain

our suppliers, possibly resulting in supply disruption, or cause our customers to delay making payments for our services. Any of the foregoing could harm our business and we cannot anticipate all of the ways in which the current economic climate and financial market conditions could adversely impact our business.

Our business and operations would suffer in the event of system failures.

Despite the implementation of security measures, our internal computer systems and those of our current and any future CROs and other contractors, consultants and potential collaborators are vulnerable to damage from computer viruses, unauthorized access, natural disasters, terrorism, war and telecommunication and electrical failures. While we have not experienced any such material system failure, accident or security breach to date, if such an event were to occur and cause interruptions in our operations, it could result in a material disruption of our development programs and our business operations. For example, the loss of clinical trial data from completed or future clinical trials could result in delays in our regulatory approval efforts and significantly increase our costs to recover or reproduce the data. Likewise, we rely on third parties to manufacture our vectors, our product candidates and our companion diagnostic and conduct clinical trials, and similar events relating to their computer systems could also have a material adverse effect on our business. To the extent that any disruption or security breach were to result in a loss of, or damage to, our data or applications, or inappropriate disclosure of confidential or proprietary information, we could incur liability and the further development and commercialization of our product candidates and any related companion diagnostics could be delayed.

Interruptions in the supply of product or inventory loss may adversely affect our operating results and financial condition.

Our product candidates and companion diagnostic are manufactured and distributed using technically complex processes requiring specialized facilities, highly specific raw materials and other production constraints. The complexity of these processes, as well as strict company and government standards for the manufacture and storage of our products, subjects us to production risks. While product batches released for use in clinical trials or for commercialization undergo sample testing, some defects may only be identified following product release. In addition, process deviations or unanticipated effects of approved process changes may result in these intermediate products not complying with stability requirements or specifications. Most of our product candidates must be stored and transported at temperatures within a certain range. If these environmental conditions deviate, our product candidates' remaining shelf-lives could be impaired or their efficacy and safety could become adversely affected, making them no longer suitable for use. The occurrence or suspected occurrence of production and distribution difficulties can lead to lost inventories, and in some cases product recalls, with consequential reputational damage and the risk of product liability. The investigation and remediation of any identified problems can cause production delays, substantial expense, lost sales and delays of new product launches. Any interruption in the supply of finished products or the loss thereof could hinder our ability to timely distribute our products and satisfy customer demand. Any unforeseen failure in the storage of the product or loss in supply could delay our clinical trials and, if our product candidates are approved, result in a loss of our market share and negatively affect our revenues and operations.

We or the third parties upon whom we depend may be adversely affected by earthquakes or other natural disasters and our business continuity and disaster recovery plans may not adequately protect us from a serious disaster.

Earthquakes or other natural disasters could severely disrupt our operations, and have a material adverse effect on our business, results of operations, financial condition and prospects. A majority of our management operates in our principal executive offices located in San Diego, California. If our San Diego offices were affected by a natural or man-made disaster, particularly those that are characteristic of the region, such as wildfires and earthquakes, or other business interruption, our ability to manage our domestic and foreign operations could be impaired, which could materially and adversely affect our results of operations and financial condition. If a natural disaster, power outage or other event occurred that prevented us from using all or a significant portion of our headquarters, that damaged critical infrastructure, such as the manufacturing facilities

of our third-party contract manufacturers, or that otherwise disrupted operations, it may be difficult or, in certain cases, impossible for us to continue our business for a substantial period of time. The disaster recovery and business continuity plans we have in place currently are limited and are unlikely to prove adequate in the event of a serious disaster or similar event. We may incur substantial expenses as a result of the limited nature of our disaster recovery and business continuity plans, which, particularly when taken together with our lack of earthquake insurance, could have a material adverse effect on our business. We currently rely, and intend to rely in the future, on our third-party manufacturer, Lonza, to produce our supply of MYDICAR. Our ability to obtain supply of MYDICAR could be disrupted, and our results of operations and financial condition could be materially and adversely affected if the operations of Lonza were affected by a man-made or natural disaster or other business interruption. The ultimate impact of any such events on us, our significant suppliers and our general infrastructure is unknown. For more information regarding our manufacturing services agreement and our non-binding letter of intent with Lonza, see "Business—Manufacturing—Manufacturing Services Agreement with Lonza."

Risks Related to our Intellectual Property

If we are unable to obtain or protect intellectual property rights related to our product candidates and companion diagnostic, we may not be able to compete effectively in our markets.

We rely upon a combination of patents, trade secret protection and confidentiality agreements to protect the intellectual property related to our product candidates and companion diagnostic. The strength of patents in the biotechnology and pharmaceutical field involves complex legal and scientific questions and can be uncertain. The patent applications that we own or in-license may fail to result in issued patents with claims that cover our product candidates and companion diagnostic in the United States or in other foreign countries. There is no assurance that all of the 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 or companion diagnostic, third parties may challenge their validity, enforceability or scope, which may result in such patents being narrowed 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 companion diagnostic 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.

If the patent applications we hold or have in-licensed with respect to our programs, product candidates and companion diagnostic fail to issue, if their breadth or strength of protection is threatened, or if they fail to provide meaningful exclusivity for our product candidates or companion diagnostic, it could dissuade companies from collaborating with us to develop product candidates, and threaten our ability to commercialize, future products. Several patent applications covering our product candidates and companion diagnostic have been filed recently. 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 could deprive us of rights necessary for the successful commercialization of any product candidates or companion diagnostic that we may develop. Further, if we encounter delays in regulatory approvals, the period of time during which we could market a product candidate and companion diagnostic under patent protection could be reduced. Since patent applications in the United States and most other countries are confidential for a period of time after filing, and some remain so until issued, we cannot be certain that we were the first to file any patent application related to a product candidate or companion diagnostic. Furthermore, if third parties have filed such patent applications, an interference proceeding in the United States can be initiated by a third party to determine who was the first to invent any of the subject matter covered by the patent claims of our applications. In addition, patents have a limited lifespan. In the United States, the natural expiration of a patent is generally 20 years after it is filed. Various extensions may be available; however the life of a patent, and the protection it affords, is limited. Even if patents covering our product candidates and companion diagnostic are obtained, once the patent life has expired for a product, we may be open to competition from generic medications.

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 candidates and companion diagnostic 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 those who have access to our confidential information, including 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. 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. In addition, others may independently discover our trade secrets and proprietary information. For example, the FDA, as part of its Transparency Initiative, is currently considering whether to make additional information publicly available on a routine basis, including information that we may consider to be trade secrets or other proprietary information, and it is not clear at the present time how the FDA's disclosure policies may change in the future, if at all.

Further, the laws of some foreign countries do not protect proprietary rights to the same extent or in the same manner as the laws of the United States. As a result, we may encounter significant problems in protecting and defending our intellectual property both in the United States and abroad. If we are unable to prevent material disclosure of the non-patented intellectual property related to our technologies to third parties, and there is no guarantee that we will have any such enforceable trade secret protection, we may not be able to establish or maintain a competitive advantage in our market, which could materially adversely affect our business, results of operations and financial condition.

If we fail to comply with our obligations in the agreements under which we license intellectual property 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 license agreements under which we are granted rights to intellectual property that are important to our business and we expect that we may need to enter into additional license agreements in the future. Our existing license agreements impose, and we expect that future license agreements will impose on us, various development, regulatory and/or commercial diligence obligations, payment of milestones and/or royalties and other obligations. If we fail to comply with our obligations under these agreements, or we are subject to a bankruptcy, the licensor may have the right to terminate the license, in which event we would not be able to market products covered by the license. Additionally, several of our existing license agreements are sublicenses from a third party who is not the original licensor of the intellectual property at issue. Under these agreements, we must rely on our licensor to comply with their obligations under the primary license agreements under which such third party obtained rights in the applicable intellectual property, where we may have no relationship with the original licensor of such rights. If our licensors fail to comply with their obligations under these upstream license agreements, the original third-party licensor may have the right to terminate the original license, which may terminate our sublicense. If this were to occur, we would no longer have rights to the

applicable intellectual property unless we are able to secure our own direct license with the owner of the relevant rights, which we may not be able to do at a reasonable cost or on reasonable terms, which may impact our ability to continue to develop and commercialize our product candidates and companion diagnostic incorporating the relevant intellectual property. See "Business—License Agreements" for a description of our license agreements, which includes a description of the termination provisions of these agreements.

As we have done previously, we may need to obtain licenses from third parties to advance our research or allow commercialization of our product candidates or companion diagnostic, and we cannot provide any assurances that third-party patents do not exist which might be enforced against our current product candidates or companion diagnostic or future products in the absence of such a license. We may fail to obtain any of these licenses on commercially reasonable terms, if at all. Even if we are able to obtain a license, it may be non-exclusive, thereby giving our competitors access to the same technologies licensed to us. In that event, we may be required to expend significant time and resources to develop or license replacement technology. If we are unable to do so, we may be unable to develop or commercialize the affected product candidates or companion diagnostic, which could materially harm our business and the third parties owning such intellectual property rights could seek either an injunction prohibiting our sales, or, with respect to our sales, an obligation on our part to pay royalties and/or other forms of compensation.

Licensing of intellectual property is of critical importance to our business and involves complex legal, business and scientific issues. Disputes may arise between us and our licensors regarding intellectual property subject to a license agreement, including:

- the scope of rights granted under the license agreement and other interpretation-related issues;
- whether and the extent to which our technology and processes infringe on intellectual property of the licensor that is not subject to the licensing agreement;
- our right to sublicense patent and other rights to third parties under collaborative development relationships;
- our diligence obligations with respect to the use of the licensed technology in relation to our development and commercialization of our product candidates or the companion diagnostic, and what activities satisfy those diligence obligations; and
- the ownership of inventions and know-how resulting from the joint creation or use of intellectual property by our licensors and us and our partners.

If disputes over intellectual property that we have licensed prevent or impair our ability to maintain our current licensing arrangements on acceptable terms, we may be unable to successfully develop and commercialize the affected product candidates or any related companion diagnostics.

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

Our commercial success depends in part on our avoiding infringement of the patents and proprietary rights of third parties. There is a substantial amount of litigation, both within and outside the United States, involving patent and other intellectual property rights in the biotechnology and pharmaceutical industries, including patent infringement lawsuits, interferences, oppositions and *inter partes* review proceedings before the U.S. Patent and Trademark Office, or U.S. PTO, 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 pursuing development candidates and our companion diagnostic. As the biotechnology and pharmaceutical industries expand and more patents are issued, the risk increases that our product candidates and companion diagnostic may be subject to claims of infringement of the patent rights of third parties.

Third parties may assert that we are employing their proprietary technology without authorization. There may be third-party patents or patent applications with claims to materials, formulations, methods of manufacture or methods for treatment related to the use or manufacture of our product candidates and companion diagnostic. Because patent applications can take many years to issue, third parties may have currently pending patent applications which may later result in issued patents that our product candidates or companion diagnostic may infringe, or which such third parties claim are infringed by the use of our technologies. If any third-party patents are held by a court of competent jurisdiction to cover any aspect of the manufacturing process for any of our product candidates or companion diagnostic, any molecules formed during the manufacturing process, or any final product candidate or companion diagnostic, including the formulation or method of use of such product candidate or companion diagnostic, the holders of any such patents may be able to block our ability to commercialize such product candidate or companion diagnostic unless we obtained a license under the applicable patents, or until such patents expire. In any such case, such a license may not be available on commercially reasonable terms or at all.

Parties making claims against us for infringement of their intellectual property rights 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 or any related companion diagnostics. 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 could be required to redesign our infringing products or obtain a license from such third party to continue developing and commercializing our products and technology. However, we may not be able to obtain any required license on commercially reasonable terms, or at all. Even if we are able to obtain a license, it may be non-exclusive, thereby giving our competitors access to the same technologies licensed to us. It may be impossible to redesign our products and technology, or it may require substantial time and monetary expenditure, which could force us to cease commercialization of one or more of our product candidates or the companion diagnostic, or some of our business operations, which could materially harm our business. In addition, in any such proceeding, we may be required to pay substantial damages, including treble damages and attorneys' fees in the event we are found liable for willful infringement.

We may not be successful in obtaining or maintaining necessary rights to product components 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 that we own, to develop our product candidates and companion diagnostic. Because our programs may involve additional product candidates or companion diagnostics that 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 acquire, in-license or use these proprietary rights. In addition, our product candidates and companion diagnostic 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 companies, which may be more established, or have greater resources than we do, may also be pursuing strategies to license or acquire third-party intellectual property rights that we may consider necessary or attractive in order to commercialize our product candidates and companion diagnostic. More 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 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 us with 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 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 our program.

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

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

Competitors may infringe our patents or the patents of our licensors. To counter infringement or unauthorized use, we may be required to file infringement claims, which can be expensive and time-consuming. In addition, in an infringement proceeding, a court may decide that a patent of ours or our licensors is not valid, is unenforceable and/or is not infringed, or may refuse to stop the other party from using the technology at issue on the grounds that our patents do not cover the technology in question. A third-party defendant may also request post grant review or *inter partes* review by the U.S. PTO of any patent we assert. An adverse result in any litigation or defense proceedings could put one or more of our patents at risk of being invalidated or interpreted narrowly and could put our patent applications at risk of not issuing.

Interference proceedings provoked by third parties or brought by us 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 it 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. We may not be able to prevent, alone or with our licensors, misappropriation of our intellectual property rights, particularly in countries where the laws may not protect those rights as fully as in the United States.

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.

The patent protection and patent prosecution for some of our product candidates and companion diagnostic may be dependent on third parties.

While we normally seek to obtain the right to control the prosecution and maintenance of the patents relating to our product candidates and companion diagnostic, there may be times when the filing and prosecution activities for platform technology patents that relate to our product candidates and companion diagnostic are controlled by our licensors. For example, we do not have the right to prosecute and maintain the patent rights licensed to us under agreements with each of The Regents of the University of California, AmpliPhi Biosciences Corporation (including the patent rights sublicensed to us from the University of Pennsylvania, or UPenn), Virovek Incorporation, AskBio and Dr. Martin J. Kaplitt, and our ability to have input into such filing and prosecution activities is limited. If these licensors or any of our future licensors fail to appropriately prosecute and maintain patent protection for patents covering any of our product candidates or companion diagnostic, our ability to develop and commercialize those product candidates and companion diagnostic may be adversely affected and we may not be able to prevent competitors from making, using and selling competing products.

Our reliance on third parties requires us to share our trade secrets, which increases the possibility that a competitor will discover them or that our trade secrets will be misappropriated or disclosed.

Because we rely on third parties to manufacture our vectors, product candidates and companion diagnostic, and because we collaborate with various organizations and academic institutions on the advancement of our gene

therapy and small molecule platforms and companion diagnostic, we must, at times, share trade secrets with them. We seek to protect our proprietary technology in part by entering into confidentiality agreements and, if applicable, material transfer agreements, consulting agreements or other similar agreements with our advisors, employees, third-party contractors and consultants prior to beginning research or disclosing proprietary information. These agreements typically limit the rights of the third parties to use or disclose our confidential information, including our trade secrets. Despite the contractual provisions employed when working with third parties, the need to share trade secrets and other confidential information increases the risk that such trade secrets become known by our competitors, are inadvertently incorporated into the technology of others, or are disclosed or used in violation of these agreements. Given that our proprietary position is based, in part, on our know-how and trade secrets, a competitor's discovery of our trade secrets or other unauthorized use or disclosure would impair our competitive position and may have a material adverse effect on our business.

In addition, these agreements typically restrict the ability of our advisors, employees, third-party contractors and consultants to publish data potentially relating to our trade secrets, although our agreements may contain certain limited publication rights. For example, any academic institution that we may collaborate with in the future will usually expect to be granted rights to publish data arising out of such collaboration, provided that we are notified in advance and given the opportunity to delay publication for a limited time period in order for us to secure patent protection of intellectual property rights arising from the collaboration, in addition to the opportunity to remove confidential or trade secret information from any such publication. In the future we may also conduct joint research and development programs that may require us to share trade secrets under the terms of our research and development partnerships or similar agreements. Despite our efforts to protect our trade secrets, our competitors may discover our trade secrets, either through breach of our agreements with third parties, independent development or publication of information by any of our third-party collaborators. A competitor's discovery of our trade secrets would impair our competitive position and have an adverse impact on our business.

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.

In September 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, including provisions that affect the way patent applications will be prosecuted and may also affect patent litigation. The U.S. PTO is currently developing regulations and 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, were enacted in March 2013. It is not clear what, if any, impact the Leahy-Smith Act will have on the operation of our business. Moreover, 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 and financial condition.

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.

Although we seek to protect our ownership of intellectual property rights by ensuring that our agreements with our employees, collaborators and other third parties with whom we do business include provisions requiring such parties to assign rights in inventions to us, we may also be subject to claims that former employees, collaborators or other third parties have an ownership interest in our patents or other intellectual property. We may be subject to ownership disputes in the future arising, for example, from conflicting obligations of consultants or others who are involved in developing our product candidates and companion diagnostic. Litigation may be necessary to defend against these and other claims challenging inventorship or ownership. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights, such as exclusive ownership of, or right to use, valuable intellectual property. Such an outcome

could have a material adverse effect on our business. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management and other employees.

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

We may also be subject to claims that former employees, collaborators or other third parties have an ownership interest in our patents or other intellectual property. We may be subject to ownership disputes in the future arising, for example, from conflicting obligations of consultants or others who are involved in developing our product candidates and companion diagnostic. Litigation may be necessary to defend against these and other claims challenging inventorship or ownership. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights, such as exclusive ownership of, or right to use, valuable intellectual property. Such an outcome could have a material adverse effect on our business. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management and other employees.

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

Periodic maintenance fees, renewal fees, annuity fees and various other governmental fees on patents and/or applications will be due to be paid to the U.S. PTO and various governmental patent agencies outside of the United States in several stages over the lifetime of the patents and/or applications. We have systems in place to remind us to pay these fees, and we employ an outside firm and rely on our outside counsel to pay these fees due to non-U.S. patent agencies. The U.S. PTO and various non-U.S. governmental patent agencies require compliance with a number of procedural, documentary, fee payment and other similar provisions during the patent application process. We employ reputable law firms and other professionals to help us comply, and in many cases, an inadvertent lapse can be cured by payment of a late fee or by other means in accordance with the applicable rules. However, there are situations in which non-compliance can result in abandonment or lapse of the patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, our competitors might be able to enter the market and this circumstance would have a material adverse effect on our business.

Issued patents covering our product candidates and companion diagnostic could be found invalid or unenforceable if challenged in court or the U.S. PTO.

If we or one of our licensing partners initiated legal proceedings against a third party to enforce a patent covering one of our product candidates or companion diagnostic, the defendant could counterclaim that the patent covering our product candidate or companion diagnostic, as applicable, is invalid and/or unenforceable. In patent litigation in the United States, defendant counterclaims alleging invalidity and/or unenforceability are commonplace, and there are numerous ground upon which a third party can assert invalidity or unenforceability of a patent Third parties may also raise similar claims before administrative bodies in the United States or abroad, even outside the context of litigation. Such mechanisms include re-examination, post grant review, and equivalent proceedings in foreign jurisdictions (e.g., opposition proceedings). Such proceedings could result in revocation or amendment to our patents in such a way that they no longer cover our product candidates or related companion diagnostics. The outcome following legal assertions of invalidity and unenforceability is unpredictable. With respect to the validity question, for example, we cannot be certain that there is no invalidating prior art, of which we, our patent counsel and the patent examiner were unaware during prosecution. If a defendant were to prevail on a legal assertion of invalidity and/or unenforceability, we would lose at least part, and perhaps all, of the patent protection on our product candidates and companion diagnostic. Such a loss of patent protection could have a material adverse impact on our business.

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

As is the case with other biotechnology companies, our success is heavily dependent on intellectual property, particularly 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 certain circumstances and weakened the rights of patent owners in certain situations. In addition to increasing uncertainty with regard to our ability to obtain patents in the future, this combination of events has created uncertainty with respect to the value of patents, once obtained. Depending on decisions by the U.S. Congress, the federal courts, and the U.S. PTO, 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. For example, in the recent case, *Assoc. for Molecular Pathology v. Myriad Genetics, Inc.*, the U.S. Supreme Court held that certain claims to DNA molecules are not patentable. While we do not believe that any of the patents owned or licensed by us will be found invalid based on this decision, we cannot predict how future decisions by the courts, the U.S. Congress or the U.S. PTO may impact the value of our patents.

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. Consequently, we may not be able to prevent third parties from practicing our inventions in all countries outside the United States, or from selling or importing products made using our inventions in and into the United States or other jurisdictions. Competitors may use our technologies in jurisdictions where we have not obtained patent protection to develop their own products and further, may export otherwise infringing products to territories where we have patent protection, but enforcement is not as strong as that in the United States. These products may compete with our products and our patents or other intellectual property rights may not be effective or sufficient to prevent them from competing.

Many companies have encountered significant problems in protecting and defending intellectual property rights in foreign jurisdictions. The legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents, trade secrets and other intellectual property protection, particularly those relating to biotechnology products, which could make it difficult for us to stop the infringement of our patents or marketing of competing products in violation of our proprietary rights generally. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business, could put our patents at risk of being invalidated or interpreted narrowly 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.

Intellectual property rights do not necessarily address all potential threats to our competitive advantage.

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

- others may be able to make gene therapies or small molecule compounds that are similar to our product candidates but that are not covered by the claims of the patents that we own or have exclusively licensed;

- we or our licensors or future collaborators might not have been the first to make the inventions covered by the issued patent or pending patent application that we own or have exclusively licensed;
- we or our licensors or future collaborators might not have been the first to file patent applications covering certain of our inventions;
- others may independently develop similar or alternative technologies or duplicate any of our technologies without infringing our intellectual property rights;
- it is possible that our pending patent applications will not lead to issued patents;
- issued patents that we own or have exclusively licensed may be held invalid or unenforceable, as a result of legal challenges by our competitors;
- our competitors might conduct research and development activities in countries where we do not have patent rights and then use the information learned from such activities to develop competitive products for sale in our major commercial markets;
- we may not develop additional proprietary technologies that are patentable; and
- the patents of others may have an adverse effect on our business.

Should any of these events occur, they could significantly harm our business, results of operations and prospects.

Risks Related to Ownership of our Common Stock

The market price of our common stock may be highly volatile, and you may not be able to resell some or all of your shares at a desired market price.

Prior to our recently completed initial public offering, there was no public market for our common stock. We cannot assure you that an active, liquid trading market for our shares will develop or persist. You may not be able to sell your shares quickly or at a recently reported market price if trading in our common stock is not active.

The market price of our common stock is likely to be volatile. Our stock price could be subject to wide fluctuations in response to a variety of factors, including the following:

- adverse results or delays in preclinical studies or clinical trials;
- our decision to initiate a clinical trial, not to initiate a clinical trial or to terminate an existing clinical trial;
- unanticipated serious safety concerns related to the use of any of our product candidates;
- reports of adverse events in other gene therapy products or clinical trials of such products;
- inability to obtain additional funding;
- any delay in filing an IND or BLA for any of our product candidates and any adverse development or perceived adverse development with respect to the FDA's review of that IND or BLA;
- failure to obtain regulatory and marketing approvals;
- failure to successfully develop and commercialize our product candidates or companion diagnostic;
- failure to enter into collaborations;
- failure by us or our licensors to prosecute, maintain or enforce our intellectual property rights;
- our dependence on third parties, including CROs as well as our partners that provide us with our companion diagnostic product;
- changes in laws or regulations applicable to future products;

- inability to obtain adequate product supply for our product candidates or companion diagnostic or the inability to do so at acceptable prices;
- adverse regulatory decisions;
- introduction of new products, services or technologies by our competitors;
- failure to meet or exceed financial projections we may provide to the public;
- failure to meet or exceed the financial 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 partnerships, 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 scientific or management personnel;
- significant lawsuits, including patent or stockholder litigation;
- changes in the market valuations of similar companies;
- overall performance of the equity markets and other factors that may be unrelated to our operating performance or the operating performance of our competitors, including changes in market valuations of similar companies;
- sales of our common stock by us or our stockholders in the future; and
- trading volume of our common stock.

In addition, companies trading in the stock market in general, and the NASDAQ Global Market in particular, have experienced extreme price and volume fluctuations that have often been unrelated or disproportionate to the operating performance of these companies. Broad market and industry factors may negatively affect the market price of our common stock, regardless of our actual operating performance.

If securities or industry analysts issue an adverse or misleading opinion regarding our stock, our stock price and trading volume could decline.

The trading market for our common stock will be influenced by the research and reports that industry or securities analysts publish about us or our business. If any of the analysts who cover us issue an adverse or misleading opinion regarding us, our business model, our intellectual property or our stock performance, or if our clinical trials and operating results fail to meet the expectations of analysts, our stock price would likely decline. If one or more of these analysts cease coverage of us or fail to publish reports on us regularly, we could lose visibility in the financial markets, which in turn could cause our stock price or trading volume to decline.

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

As of the closing of our initial public offering on February 4, 2014, our executive officers, directors, 5% stockholders and their affiliates beneficially owned approximately 76.9% of our outstanding voting stock. Therefore, these stockholders will have the ability to influence us through this ownership position. These stockholders may be able to determine all matters requiring stockholder approval. For example, these stockholders, acting together, may be able to control elections of directors, amendments of our organizational documents, or approval of any merger, sale of assets, or other major corporate transaction. This may prevent or discourage unsolicited acquisition proposals or offers for our common stock that you may believe are in your best interest as one of our stockholders.

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

We are an "emerging growth company," as defined in the JOBS Act. For as long as we continue to be an emerging growth company, we may take advantage of exemptions from various reporting requirements that are applicable to other public companies that are not "emerging growth companies," including exemption from compliance with the auditor attestation requirements of Section 404 of the Sarbanes-Oxley Act of 2002 (Sarbanes-Oxley Act), reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements, and exemptions from the requirements of holding a nonbinding advisory vote on executive compensation. 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, (b) in which we have total annual gross revenue of at least $1.0 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.

Even after we no longer qualify as an emerging growth company, we may still qualify as a "smaller reporting company" which would allow us to take advantage of many of the same exemptions from disclosure requirements including exemption from compliance with the auditor attestation requirements of Section 404 of the Sarbanes-Oxley Act and reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements. We cannot predict if investors will find our common stock less attractive because we may rely on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock and our stock price may be more volatile.

Under the JOBS Act, emerging growth companies can also delay adopting new or revised accounting standards until such time as those standards apply to private companies. We have irrevocably elected not to avail ourselves of this exemption from new or revised accounting standards and, therefore, will be subject to the same new or revised accounting standards as other public companies that are not emerging growth companies.

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

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

- variations in the level of expenses related to our product candidates, companion diagnostic or future development programs;
- if any of our product candidates receives regulatory approval, the level of underlying demand for these product candidates and wholesalers' buying patterns;
- addition or termination of clinical trials or funding support;
- our execution of any collaborative, licensing or similar arrangements, and the timing of payments we may make or receive under these arrangements.
- any intellectual property infringement lawsuit in which we may become involved; and
- regulatory developments affecting our product candidates or companion diagnostic or those of our competitors.

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

If we fail to maintain an effective system of internal control over financial reporting, we may not be able to accurately report our financial results or prevent fraud. As a result, stockholders could lose confidence in our financial and other public reporting, which would harm our business and the trading price of our common stock.

Effective internal controls over financial reporting are necessary for us to provide reliable financial reports and, together with adequate disclosure controls and procedures, are designed to prevent fraud. Any failure to implement required new or improved controls, or difficulties encountered in their implementation could cause us to fail to meet our reporting obligations. In addition, any testing by us conducted in connection with Section 404 of the Sarbanes-Oxley Act, or the subsequent testing by our independent registered public accounting firm, may reveal deficiencies in our internal controls over financial reporting that are deemed to be material weaknesses or that may require prospective or retroactive changes to our consolidated financial statements or identify other areas for further attention or improvement. Inferior internal controls could also cause investors to lose confidence in our reported financial information, which could have a negative effect on the trading price of our common stock.

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

Sales of a substantial number of shares of our common stock in the public market or the perception that these sales might occur, could depress the market price of our common stock and could impair our ability to raise capital through the sale of additional equity securities. We are unable to predict the effect that sales may have on the prevailing market price of our common stock.

Substantially all of our existing stockholders are subject to lock-up agreements with the underwriters of our initial public offering that restrict the stockholders' ability to transfer shares of our common stock for 180 days from the date of the final prospectus for our initial public offering, subject to certain exceptions. The lock-up agreements limit the number of shares of common stock that may be sold prior to the expiration of the lock-up agreements; however, the underwriters may, in their discretion, permit our officers, directors and other stockholders who are subject to these lock-up agreements to sell shares prior to the expiration of the lock-up agreements. Subject to certain limitations, including sales volume limitations with respect to shares held by our affiliates, substantially all of our outstanding shares prior to our initial public offering on January 29, 2014 will become eligible for sale upon expiration of the lock-up period. In addition, shares issued or issuable upon exercise of options and warrants vested as of the expiration of the lock-up period will be eligible for sale at that time. Sales of stock by these stockholders could have a material adverse effect on the trading price of our common stock.

Certain holders of our securities are entitled to rights with respect to the registration of their shares under the Securities Act of 1933, as amended, or the Securities Act, subject to the 180-day lock-up arrangement described above. Registration of these shares under the Securities Act would result in the shares becoming freely tradable without restriction under the Securities Act. Any sales of securities by these stockholders could have a material adverse effect on the trading price of our common stock.

Future sales and issuances of our common stock or rights to purchase common stock, including pursuant to our equity incentive plans, could result in additional dilution of the percentage ownership of our stockholders and could cause our stock price to fall.

We expect that significant additional capital will be needed in the future to continue our planned operations. To the extent we raise additional capital by issuing equity securities, our stockholders may experience substantial dilution. We may sell common stock, convertible securities or other equity securities in one or more transactions at prices and in a manner we determine from time to time. If we sell common stock, convertible securities or other equity securities in more than one transaction, investors may be materially diluted by subsequent sales. These sales may also result in material dilution to our existing stockholders, and new investors could gain rights superior to our existing stockholders.

Pursuant to our 2013 equity incentive plan, or the 2013 plan, our management is authorized to grant stock options and other equity-based awards to our employees, directors and consultants. The number of shares available for future grant under the 2013 plan will automatically increase on January 1 of each year by 5% of the total number of shares of our common stock outstanding on December 31 of the preceding calendar year, subject to the ability of our board of directors to take action to reduce the size of the increase in any given year. In addition, we may grant or provide for the grant of rights to purchase shares of our common stock pursuant to our 2013 employee stock purchase plan, or ESPP. The number of shares of our common stock reserved for issuance under the ESPP will automatically increase on January 1 of each calendar year by the lesser of 1% of the total number of shares of our common stock outstanding on December 31 of the preceding calendar year and 384,307 shares, subject to the ability of our board of directors to take action to reduce the size of the increase in any given year. Currently, we plan to register the increased number of shares available for issuance under the 2013 plan and ESPP each year. Increases in the number of shares available for future grant or purchase may result in additional dilution, which could cause our stock price to decline.

We are at risk of securities class action litigation.

In the past, securities class action litigation has often been brought against a company following a decline in the market price of its securities. This risk is especially relevant for us because biotechnology companies have experienced significant stock price volatility in recent years. If we face such litigation, it could result in substantial costs and a diversion of management's attention and resources, which could harm our business.

Our ability to use our net operating loss carryforwards and certain other tax attributes may be limited.

Under Section 382 of the Internal Revenue Code of 1986, as amended, or the Code, if a corporation undergoes an "ownership change," 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 (such as research tax credits) to offset its post-change income may be limited. We completed a study to assess whether an ownership change, as defined by Section 382 of the Code, had occurred since our formation through December 31, 2013. Based upon the results of this study, we determined that several ownership changes had occurred and that federal and California net operating loss carryforwards of $48.2 million and $49.6 million, respectively, are available and federal and California research and development tax credit carryforwards of $662,000 and $1.2 million, respectively, are available. We may also experience ownership changes in the future as a result of subsequent shifts in our stock ownership. As a result, if we earn net taxable income, our ability to use our pre-change net operating loss carryforwards to offset U.S. federal taxable income may be subject to limitations, which could potentially result in increased future tax liability to us.

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

We have never declared or paid any cash dividends on our common stock. We currently anticipate that we will retain future earnings for the development, operation and expansion of our business and do not anticipate declaring or paying any cash dividends for the foreseeable future. Any return to stockholders will therefore be limited to the appreciation of their stock.

Provisions in our amended and restated certificate of incorporation and bylaws, as well as provisions of Delaware law, could make it more difficult for a third party to acquire us or increase the cost of acquiring us, even if doing so would benefit our stockholders or remove our current management.

Some provisions of our charter documents and Delaware law may have anti-takeover effects that could discourage an acquisition of us by others, even if an acquisition would be beneficial to our stockholders and may prevent attempts by our stockholders to replace or remove our current management. These provisions include:

- authorizing the issuance of "blank check" preferred stock, the terms of which may be established and shares of which may be issued without stockholder approval;

- limiting the removal of directors by the stockholders;
- creating a staggered board of directors;
- prohibiting stockholder action by written consent, thereby requiring all stockholder actions to be taken at a meeting of our stockholders;
- eliminating the ability of stockholders to call a special meeting of stockholders; and
- establishing advance notice requirements for nominations for election to the board of directors or for proposing matters that can be acted upon at stockholder meetings.

These provisions may frustrate or prevent any attempts by our stockholders to replace or remove our current management by making it more difficult for stockholders to replace members of our board of directors, which is responsible for appointing the members of our management. In addition, we are subject to Section 203 of the Delaware General Corporation Law, which generally prohibits a Delaware corporation from engaging in any of a broad range of business combinations with an interested stockholder for a period of three years following the date on which the stockholder became an interested stockholder, unless such transactions are approved by our board of directors. This provision could have the effect of delaying or preventing a change of control, whether or not it is desired by or beneficial to our stockholders. Further, other provisions of Delaware law may also discourage, delay or prevent someone from acquiring us or merging with us.

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

Our executive officers are parties to employment agreements that contain change of control and severance provisions providing for severance and other benefits and acceleration of vesting of stock options in the event of a termination of employment under specified circumstances, including in connection with a change of control of us. See “Executive and Director Compensation.” The accelerated vesting of options could result in dilution to our existing stockholders and harm the market price of our common stock. The payment of these severance benefits could harm our financial condition and results. In addition, these potential severance payments may discourage or prevent third parties from seeking a business combination with us.

ITEM 1B. Unresolved Staff Comments

Not applicable.

ITEM 2. Properties

Our corporate headquarters are located at 12760 High Bluff Drive, Suite 240, San Diego, California 92130 in a facility we lease encompassing approximately 2,270 square feet of office space. The lease for this facility expires in November 2017. We also plan to obtain additional office space to accommodate our reasonably foreseeable expected growth in the near to medium term.

ITEM 3. Legal Proceedings

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

ITEM 4. Mine Safety Disclosures

Not applicable.

PART II

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

Market Information

Our common stock began trading on The NASDAQ Global Market on January 30, 2014 and trades under the symbol "CLDN". Prior to January 30, 2014, there was no public market for our common stock. As a result we have not set forth quarterly information with respect to the high and low prices for our common stock for the two most recent fiscal years or provided a performance graph. On March 24, 2014, the last reported sale price of our common stock was $11.68.

Holders of Record

As of March 24, 2014, there were approximately 36 stockholders of record of our common stock. Certain shares are held in "street" name and accordingly, the number of beneficial owners of such shares is not known or included in the foregoing number.

Dividend Policy

We have never declared or paid any dividends on our common stock. We currently intend to retain all available funds and any future earnings, if any, to fund the development and expansion of our business and we do not anticipate paying any cash dividends in the foreseeable future. Any future determination to pay dividends will be made at the discretion of our board of directors.

Recent Sales of Unregistered Securities

During the year ended December 31, 2013, we issued and sold the following unregistered securities:

From January 1, 2013 through April 25, 2013, we granted stock options under our 2012 Equity Incentive Plan to purchase up to an aggregate of 69,653 shares of our common stock at an exercise price of $1.12 per share. From April 26, 2013 through December 31, 2013, we granted stock options under our 2012 Equity Incentive Plan to purchase up to an aggregate of 210,197 shares of our common stock at an exercise price of $9.37 per share. The foregoing share numbers and per share exercise prices reflect the effect of the 1-for-12.49 reverse stock split of our common stock effected on October 25, 2013. The offers, sales and issuances of these options were deemed to be exempt from registration under the Securities Act in reliance on Rule 701 in that the transactions were under compensatory benefit plans and contracts relating to compensation as provided under Rule 701. The recipients of such securities were our employees, directors or bona fide consultants. Appropriate legends were affixed to the securities issued in these transactions. Each of the recipients of securities in these transactions had adequate access, through employment, business or other relationships, to information about us.

In October 2013, we issued and sold to investors convertible promissory notes in the aggregate principal amount of $1,097,017 and warrants exercisable for an aggregate of 2,895,570 shares of our Series A-1 preferred stock at an exercise price of $0.449 per share. The aggregate consideration paid to us for these convertible notes and warrants was $1,097,307. In connection with the closing of our initial public offering in February 2014, the principal amount of the convertible notes and accrued interest thereon automatically converted into 139,644 shares of our common stock. In addition, upon the closing of our initial public offering, the warrants became exercisable for an aggregate of 231,821 shares of our common stock at an exercise price of $5.61 per share. The foregoing share numbers and per share exercise prices reflect the effect of the 1-for-12.49 reverse stock split of our common stock effected on October 25, 2013. The offers, sales and issuances of the foregoing securities were deemed to be exempt from registration under the Securities Act in reliance on Section 4(a)(2) of the Securities Act and Rule 506 of Regulation D promulgated thereunder as transactions by an issuer not involving a public offering. The recipients of these securities acquired the securities for investment only and not with a view to or

for sale in connection with any distribution thereof and appropriate legends were affixed to the securities issued in these transactions. Each of the recipients of securities in these transactions was an accredited investor within the meaning of Rule 501 of Regulation D under the Securities Act and had adequate access, through employment, business or other relationships, to information about us. No underwriters were involved in these transactions.

Use of Proceeds

On January 29, 2014, the SEC declared effective the registration statement on Form S-1 (File Nos. 333-191688 and 333-193647) for our initial public offering of our common stock. Pursuant to the registration statement, we registered the offer and sale of 6,325,000 shares of our common stock. On February 4, 2014, we sold 5,500,000 shares of our common stock at a public offering price of $8.00 per share and on February 27, 2014, we sold 825,000 shares of our common stock at a public offering price of $8.00 per share pursuant to the full exercise of the underwriters' option to purchase additional shares. The offering has terminated. The sole book-running managing underwriter for the offering was Barclays Capital Inc. After deducting underwriting discounts, commissions and offering costs paid by us of $6.3 million, the net proceeds from the offering were approximately $44.3 million. No offering expenses were paid or are payable, directly or indirectly, to our directors or officers, to persons owning 10% or more of any class of our equity securities, or to any of our affiliates.

The net proceeds from our initial public offering have been invested in highly-liquid money market funds. There has been no material change in the expected use of the net proceeds from our initial public offering as described in our final prospectus filed with the SEC pursuant to Rule 424(b), except we may decide to dedicate all or a portion of the net proceeds received by us from the full exercise of the underwriters' option to purchase additional shares to a trial of MYDICAR for the treatment of AVF maturation failure.

ITEM 6. Selected Financial Data

The following selected financial data should be read in conjunction with our audited financial statements located elsewhere in this Annual Report on Form 10-K and "Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations". Amounts are in thousands, except share and per share data.

	Years Ended December 31,		Six Months Ended December 31,	Year Ended June 30,	Period from December 21, 2000 (inception) to December 31,
	2013	2012	2011	2011	2013
Consolidated Statements of Operations Data:					
Operating expenses:					
Research and development	$ 16,927	$ 13,314	$ 1,252	$ 4,193	$ 92,044
General and administrative	3,037	2,631	920	1,832	19,522
Total operating expenses	19,964	15,945	2,172	6,025	111,566
Loss from operations	(19,964)	(15,945)	(2,172)	(6,025)	(111,566)
Other income (expense)	(127)	74	(689)	(965)	(1,270)
Consolidated net loss	(20,091)	(15,871)	(2,861)	(6,990)	(112,836)
Net loss attributable to non-controlling interest	96	154	—	—	250
Net loss attributable to Celladon Corporation	(19,995)	(15,717)	(2,861)	(6,990)	(112,586)
Accretion to redemption value of redeemable convertible preferred stock	—	(343)	—	—	(343)
Change in fair value of non-controlling interest	(3,105)	(154)	—	—	(3,259)
Deemed dividend	(856)	—	—	—	(856)
Net loss attributable to common stockholders	$ (23,956)	$ (16,214)	$ (2,861)	$ (6,990)	$ (117,044)
Net loss per share attributable to common stockholders, basic and diluted[1]	$ (27.09)	$ (19.74)	$ (1,022.52)	$ (2,729.66)	
Weighted-average shares outstanding, basic and diluted	884,179	821,568	2,798	2,561	

	As of December 31,		
	2013	2012	2011
Consolidated Balance Sheet Data:			
Cash, cash equivalents and investments	$ 18,370	$ 35,511	$ 468
Working capital (deficit)	11,990	31,159	(14,835)
Total assets	21,154	35,929	636
Redeemable non-controlling interest	—	4,814	—
Redeemable convertible preferred stock	60,098	52,274	—
Convertible preferred stock	5,450	5,450	56,282
Deficit accumulated during the development stage	(112,586)	(92,591)	(76,874)
Total stockholders' deficit	(50,991)	(28,416)	(70,979)

(1) See Note 1 to our consolidated financial statements appearing elsewhere in this Report for an explanation of the method used to calculate basic and diluted net loss per share attributable to common stockholders and the number of shares used in the computation of the per share amounts.

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

You should read the following discussion and analysis together with "Item 6. Selected Financial Data" and our financial statements and related notes included elsewhere in this Annual Report. The following discussion contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those expressed or implied in any forward-looking statements as a result of various factors, including those set forth under the caption "Item 1A. Risk Factors."

Overview

We are a clinical-stage biotechnology company applying our leadership position in the field of calcium dysregulation by targeting SERCA enzymes to develop novel therapies for diseases with tremendous unmet medical needs. Our therapeutic portfolio for diseases characterized by SERCA enzyme deficiency includes both gene therapies and small molecule compounds. We are evaluating our lead product candidate, MYDICAR, in a 250-patient randomized, double-blind, placebo-controlled international Phase 2b trial in patients with systolic heart failure, which we refer to as CUPID 2. We completed enrollment of CUPID 2 in February 2014 and expect to announce results in April 2015. If successful, these results, along with other studies, will form the basis for regulatory submissions for approval with the FDA and the EMA. We also plan to develop MYDICAR for additional indications, such as AVF maturation failure, and for the treatment of patients with advanced heart failure who are on an LVAD. Subject to raising additional capital, we also may initiate development programs in diastolic heart failure, which is caused by the inability of the heart to relax normally between contractions, and PAH, which is characterized by a SERCA2a deficiency in VSMC. MYDICAR has demonstrated potential disease-modifying capability in preclinical models of these diseases. We currently hold worldwide rights to MYDICAR and plan to commercialize MYDICAR for all approved heart failure indications using a targeted sales force in the United States focused on selected cardiologists and heart failure specialists who treat the majority of heart failure patients.

In February 2014, we and Servier entered into a material transfer and exclusivity agreement, pursuant to which we agreed to transfer to Servier samples of certain proprietary compounds from our small molecule SERCA2b modulator program and granted to Servier a non-exclusive, non-sublicensable, royalty-free license to conduct certain studies of the samples for the purpose of evaluating Servier's interest in negotiating a potential license and research collaboration agreement with us relating to small molecule SERCA2b modulators, or Compounds, for the treatment of type 2 diabetes and other metabolic diseases. Subject to earlier termination of the agreement as described below, the term of Servier's license to conduct the evaluation, or the evaluation period, will expire six months after Servier's initial receipt from us of the samples, provided that Servier may extend the evaluation period for up to an additional two months. Under the terms of the agreement, we also granted to Servier the exclusive right to negotiate for an exclusive, royalty-bearing license to develop and commercialize Compounds, and products containing Compounds, in the field of type 2 diabetes and other metabolic diseases, or the field, solely outside of the United States and its territories and possessions, or ex-U.S. territory, on the terms and conditions set forth in the agreement and other commercially reasonable terms to be negotiated in good faith by the parties and set forth in a definitive license and research collaboration agreement.

We are a development-stage company. To date, we have devoted substantially all of our resources to research and development efforts relating to our product candidates, including conducting clinical trials and developing manufacturing capabilities, in-licensing related intellectual property, providing general and administrative support for these operations and protecting our intellectual property. We do not have any products approved for sale and have not generated any revenue from product sales or other sources. From our inception through December 31, 2013, we have funded our operations primarily through the sales of equity and convertible debt securities totaling approximately $122.9 million.

We have incurred net losses in each year since our inception. Our consolidated net losses were approximately $20.1 million and $15.9 million for the years ended December 31, 2013 and 2012, respectively.

As of December 31, 2013, we had a deficit accumulated during the development stage of approximately $112.6 million. Substantially all our net losses have resulted from costs incurred in connection with our research and development programs and from general and administrative costs associated with our operations.

We anticipate that our expenses will increase substantially if and as we:

- expand or accelerate our preclinical and clinical development activities, particularly with respect to clinical trials of MYDICAR for systolic heart failure, including our ongoing CUPID 2 trial, preclinical and clinical activities to evaluate MYDICAR for the treatment of AVF maturation failure, an LVAD trial, an AAV1 NAb positive trial and a viral shedding trial, and our preclinical studies and clinical trials of MYDICAR for the treatment of diastolic heart failure and other indications;
- develop of our small molecule modulators of SERCA2 enzymes;
- further develop the manufacturing process for our viral vectors and product candidates, including commercial scale-up, validation and automation of our companion diagnostic;
- seek regulatory and marketing approvals for MYDICAR and any other product candidate that successfully completes clinical trials;
- seek regulatory and marketing approvals for our companion diagnostic;
- establish a sales, marketing and distribution infrastructure in the United States to commercialize any products for which we obtain marketing approval;
- expand and accelerate development of our small molecule program in the fields of diabetes and neurodegenerative diseases;
- acquire rights to other product candidates and technologies;
- change or add additional manufacturers or suppliers;
- maintain, expand and protect our intellectual property portfolio;
- continue our research and preclinical development of our product candidates and seek to identify and validate additional product candidates;
- make milestone or other payments under any in-license or collaboration agreement;
- attract and retain skilled personnel;
- create additional infrastructure to support our operations as a public company and our product development and planned future commercialization efforts; and
- experience any delays or encounter issues with any of the above.

We expect to continue to incur significant expenses and increasing losses for at least the next several years. Accordingly, we anticipate that we will need to raise additional capital prior to the commercialization of MYDICAR, our companion diagnostic, our small molecule program, or any of our other product candidates. Until such time that we can generate meaningful revenue from product sales, if ever, we expect to finance our operating activities through public or private equity or debt financings, government or other third-party funding, marketing and distribution arrangements and other collaborations, strategic alliances and licensing arrangements or a combination of these approaches. In any event, we will require additional capital to obtain regulatory approval for, and to commercialize, our product candidates and companion diagnostic. If we are unable to obtain funding on a timely basis, we may be required to significantly curtail, delay or discontinue one or more of our research or development programs or the commercialization of any approved products or be unable to expand our operations or otherwise capitalize on our business opportunities, as desired, which could materially adversely affect our business, financial condition and results of operations.

Initial Public Offering and Related Transactions

In February 2014, we completed our initial public offering in which we sold 6,325,000 shares of common stock at a public offering price of $8.00 per share. Estimated net proceeds from our initial public offering were determined as follows (in thousands):

Gross proceeds (including over-allotment)	$50,600
Underwriting discounts and commissions	(3,542)
Estimated total offering costs (including costs paid as of December 31, 2013)	(2,800)
Offering costs paid as of December 31, 2013	1,693
Estimated net proceeds to be received subsequent to December 31, 2013	$45,951

In addition, each of the following occurred on February 4, 2014 in connection with our initial public offering:

- the conversion of all outstanding shares of convertible preferred stock into 11,151,192 shares of our common stock;
- the conversion of $1.1 million of outstanding principal and accrued interest on convertible notes into 139,644 shares of our common stock and the write-off of $0.1 million of unamortized debt discount related to the convertible notes;
- the conversion of warrants to purchase 2,895,570 shares of Series A-1 preferred stock into warrants to purchase 234,821 shares of our common stock and the resultant reclassification of the warrant liability to additional paid-in capital; and
- the amendment and restatement of our certificate of incorporation, authorizing 200,000,000 shares of common stock and 10,000,000 shares of undesignated preferred stock.

Financial Overview

Research and Development Expenses

To date, we have devoted substantially all of our resources to research and development efforts relating to our product candidates, including conducting clinical trials, developing manufacturing capabilities, in-licensing related intellectual property, providing general and administrative support for these operations and protecting our intellectual property. We recognize research and development expenses as they are incurred. Our research and development expenses consist primarily of:

- salaries and related overhead expenses, which include stock-based compensation and benefits for personnel in research and development functions;
- fees paid to consultants and contract research organizations, or CROs, including in connection with our preclinical studies and clinical trials and other related clinical trial fees, such as for investigator grants, patient screening, laboratory work, clinical trial material management and statistical compilation and analysis;
- costs related to acquiring and manufacturing clinical trial materials, including continued testing such as process validation and stability of drug product;
- costs related to compliance with regulatory requirements; and
- payments related to licensed products and technologies.

From our inception through December 31, 2013, we have incurred approximately $92.0 million in research and development expenses, of which we estimate $86.5 million relates to our development of MYDICAR. We plan to increase our research and development expenses for the foreseeable future as we continue to develop

MYDICAR for the treatment of systolic heart failure and our companion diagnostic, as well as, subject to the availability of additional funding, further advance the development of our other product candidates and MYDICAR for additional indications. Our direct research and development expenses consist principally of external costs, such as fees paid to investigators, consultants, central laboratories and CROs, in connection with our clinical trials, and costs related to acquiring and manufacturing clinical trial materials. We typically use our employee and infrastructure resources across multiple research and development programs.

The successful development of our clinical and preclinical product candidates and companion diagnostic is highly uncertain. At this time, we cannot reasonably estimate the nature, timing or costs of the efforts that will be necessary to complete the remainder of the development of any of our clinical or preclinical product candidates or companion diagnostic or the period, if any, in which material net cash inflows from these product candidates may commence. This is due to the numerous risks and uncertainties associated with the development of our product candidates and companion diagnostic, including:

- the uncertainty of the scope, rate of progress and expense of our ongoing, as well as additional, clinical trials and other research and development activities;
- the potential benefits of our product candidates over other therapies;
- our ability to market, commercialize and achieve market acceptance for any product candidate or companion diagnostic that we are developing or may develop in the future;
- ongoing and future clinical trial results;
- the timing and receipt of any regulatory approvals of MYDICAR for systolic heart failure, and approval to initiate a clinical trial to evaluate MYDICAR for the treatment of AVF maturation failure, an AAV1 NAb positive trial and a viral shedding trial; and
- the filing, prosecuting, defending and enforcing of patent claims and other intellectual property rights, and the expense of doing so.

A change in the outcome of any of these variables with respect to the development of a product candidate or companion diagnostic could mean a significant change in the costs and timing associated with the development of that product candidate or companion diagnostic. For example, if the FDA, the EMA or other foreign regulatory authorities were to require us to conduct clinical trials beyond those that we currently anticipate will be required for the completion of clinical development of a product candidate or companion diagnostic, or if we experience significant delays in enrollment in any of our clinical trials, we could be required to expend significant additional financial resources and time with respect to the development of that product candidate or companion diagnostic.

MYDICAR

The majority of our research and development resources are currently focused on our ongoing CUPID 2 trial, commercialization and manufacturing preparations, clinical trials and other work needed to submit MYDICAR for regulatory approval in the United States and Europe. We have incurred and expect to continue to incur significant expense in connection with these efforts, including expenses related to:

- the development of manufacturing capabilities for the commercial production of MYDICAR;
- conduct of our CUPID 2 trial of MYDICAR and the enrollment and conduct of an AVF trial, AAV NAb positive trial and viral shedding trial for patients with systolic heart failure; and
- commercial scale-up, validation and automation activities related to our companion diagnostic.

Small Molecules

Our research and development expenses for our small molecule program relate primarily to identification and testing of small molecule SERCA2 enzyme modulators.

General and Administrative Expenses

General and administrative expenses consist primarily of salaries and related costs for employees in executive, finance and administration, corporate development and administrative support functions, including stock-based compensation expenses and benefits. Other significant general and administrative expenses include accounting and legal services, expenses associated with obtaining and maintaining patents, the cost of various consultants, occupancy costs and information systems costs.

Other Income (Expense)

Other expense consists primarily of the amortization of debt discount and interest charges we incur in periods when we had convertible debt outstanding and the change in the fair value of our outstanding warrant liability prior to its reclassification to stockholders' equity in February 2014 in connection with the closing of our initial public offering. Other income consists primarily of interest income earned on our cash, cash equivalents and investments.

Critical Accounting Policies and Estimates

Our management's discussion and analysis of our financial condition and results of operations is based on our consolidated financial statements, which we have prepared in accordance with generally accepted accounting principles in the United States, or GAAP. The preparation of our consolidated financial statements requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of our consolidated financial statements, as well as the reported expenses during the reported periods. We evaluate these estimates and judgments on an ongoing basis. We base our estimates on historical experience and on various other factors that we believe are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying value of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions.

While our significant accounting policies are more fully described in Note 1 to our consolidated financial statements appearing elsewhere in this Annual Report, we believe that the following accounting policies related to clinical trial expenses, valuation of stock-based compensation and valuation of our convertible debt and warrant liability are the most critical for fully understanding and evaluating our financial condition and results of operations.

Clinical Trial Accruals

As part of the process of preparing our consolidated financial statements, we are required to estimate our expenses resulting from our obligations under contracts with vendors and consultants and clinical site agreements in connection with conducting clinical trials. The financial terms of these contracts are subject to negotiations which vary from contract to contract and may result in payment flows that do not match the periods over which materials or services are provided to us under such contracts. Our clinical trial accrual is dependent upon the timely and accurate reporting of CROs and other third-party vendors.

Our objective is to reflect the appropriate clinical trial expenses in our consolidated financial statements by matching those expenses with the period in which services and efforts are expended. We account for these expenses according to the progress of the trial as measured by patient progression and the timing of various aspects of the trial. We determine accrual estimates through discussion with applicable personnel and outside service providers as to the progress or state of completion of clinical trials, or the services completed. During the course of a clinical trial, we adjust the rate of clinical trial expense recognition if actual results differ from the estimates. We make estimates of our accrued expenses as of each balance sheet date in our financial statements based on facts and circumstances known at that time. Although we do not expect that our estimates will be materially different from amounts actually incurred, our understanding of status and timing of services performed

relative to the actual status and timing of services performed may vary and may result in our reporting amounts that are too high or too low for any particular period. Through December 31, 2013, there had been no material adjustments to our prior period estimates of accrued expenses for clinical trials. However, due to the nature of estimates, we cannot assure you that we will not make changes to our estimates in the future as we become aware of additional information about the status or conduct of our clinical trials.

Stock-Based Compensation

Stock-based compensation expense represents the grant date fair value of employee stock option grants recognized over the requisite service period of the awards (usually the vesting period) on a straight-line basis, net of estimated forfeitures. For stock option grants with performance-based milestones, the expense is recorded over the remaining service period after the point when the achievement of the milestone is probable or the performance condition has been achieved.

We account for stock options granted to non-employees using the fair-value approach. These options are subject to periodic revaluation over their vesting terms.

We estimate the fair value of our stock options granted to employees and non-employees using the Black-Scholes option pricing model, which requires the input of highly subjective assumptions, including (a) the risk-free interest rate, (b) the expected volatility of our stock, (c) the expected term of the award and (d) the expected dividend yield. Until our recently completed initial public offering, there was no public market for the trading of our common stock. Due to this fact and a lack of company specific historical and implied volatility data, we have based our estimate of expected volatility on the historical volatility of a group of similar companies that are publicly traded. For these analyses, we have selected companies with comparable characteristics to ours, including enterprise value, risk profiles, position within the industry and with historical share price information sufficient to meet the expected life of the stock-based awards. We compute the historical volatility data using the daily closing prices for the selected companies' shares during the equivalent period of the calculated expected term of our stock-based awards. We will continue to apply this process until a sufficient amount of historical information regarding the volatility of our own stock price becomes available. We have estimated the expected life of our employee stock options using the "simplified" method, whereby, the expected life equals the average of the vesting term and the original contractual term of the option. The risk-free interest rate is based on U.S. Treasury zero-coupon bonds with maturities similar to those of the expected term of the award being valued.

The weighted-average assumptions used in the Black-Scholes option pricing model to determine the fair value of employee stock option grants were as follows:

	Years Ended December 31,	
	2013	2012
Risk-free interest rate	1.62%	2.29%
Expected volatility	79%	84%
Expected option term (in years)	5.6	5.9
Expected dividend yield	0.0%	0.0%

Total employee stock-based compensation expense related to unvested stock option grants not yet recognized as of December 31, 2013 was approximately $2.7 million and the weighted-average period over which these grants are expected to vest is 2.7 years.

Determination of the Fair Value of Common Stock

Prior to our IPO, the fair value of the common stock underlying our stock-based awards was determined on each grant date by our board of directors, with input from management. All options to purchase shares of our common stock were intended to be granted with an exercise price per share no less than the fair value per share

of our common stock underlying those options on the date of grant, determined in good faith and based on the information known to us on the date of grant. In the absence of a public trading market for our common stock, on each grant date, our board of directors determined the fair value of our common stock by considering various objective and subjective factors, along with input from management, including:

- the prices of our convertible preferred stock sold to investors in arm's length transactions, and the rights, preferences and privileges of our convertible preferred stock as compared to those of our common stock, including the liquidation preferences of our convertible preferred stock;
- our results of operations, financial position and the status of research and development efforts and achievement of enterprise milestones;
- the composition of, and changes to, our management team and board of directors;
- the lack of liquidity of our common stock as a private company;
- our stage of development and business strategy, and the material risks related to our business and industry;
- external market conditions affecting the life sciences and biotechnology industry sectors; and
- the likelihood of achieving a liquidity event for the holders of our common stock, such as an IPO or a sale of our company, given prevailing market conditions.

In addition to the above factors, as part of its assessment of the fair value of our common stock for purposes of making stock option grants, our board of directors considered appraisals of the value of our common stock as of January 31, 2012 and September 30, 2013 that were prepared by an independent third-party valuation specialist using methodologies, approaches and assumptions consistent with the American Institute of Certified Public Accountants, or AICPA, Audit and Accounting Practice Aid Series: *Valuation of Privately Held Company Equity Securities Issued as Compensation* , or the Practice Aid. As part of its reassessment of the fair value of our common stock as part of the preparation of the financial statements necessary for inclusion in the registration statement related to our IPO, our board of directors also considered an appraisal of the value of our common stock as of June 30, 2013 that was prepared by an independent third-party valuation specialist using methodologies, approaches and assumptions consistent with the Practice Aid.

Convertible Debt and Warrant Liability

In October 2013, we entered into a note and warrant purchase agreement with certain existing investors for the sale of up to an aggregate of $1,097,017 of convertible promissory notes, or the 2013 Notes, and warrants exercisable to purchase shares of Series A-1 Preferred Stock, or the 2013 Warrants. Prior to their conversion concurrently with the closing our initial public offering, the 2013 Notes accrued interest at a rate of 6% per annum. Upon the completion of our initial public offering in February 2014, the principal amount of the 2013 Notes and accrued interest thereon converted into 139,644 shares of our common stock and the 2013 Warrants became exercisable for an aggregate of 231,821 shares of our common stock at an exercise price of $5.61 per share. The 2013 Warrants will expire in October 2018.

The conversion of the 2013 Notes in the event of a qualified initial public offering or private placement of equity was deemed to be the predominant settlement mechanism. As this predominant settlement mechanism provided for the settlement of a fixed monetary amount in a variable number of equity instruments, we concluded that it was appropriate to recognize the 2013 Notes at fair value. We valued the 2013 Notes utilizing an estimated cost of debt for comparable venture backed and mezzanine financings. We concluded that a 20% discount rate was appropriate, resulting in an initial fair value for the 2013 Notes of approximately $1.0 million. The resulting debt discount of $0.1 million was amortized to interest expense on a straight-line basis through the earliest maturity date of March 31, 2014.

The 2013 Warrants were initially accounted for as liabilities with subsequent changes in fair value recognized within the consolidated statement of operations. We determined that the initial fair value of the 2013 Warrants was $1.0 million. The fair value of the 2013 Warrants was derived from the probability weighted expected return model we used to value our common stock. Upon completion of our initial public offering in February 2014, the warrants no longer require liability accounting and the then fair value of the warrant liability was reclassified into equity.

Other Information

Net Operating Loss Carryforwards

As of December 31, 2013, we had federal and California tax net operating loss carryforwards of approximately $48.2 million and $49.6 million, respectively, which will begin to expire in 2027 and 2014, respectively, unless previously utilized. As of December 31, 2013, we had federal and California research and development tax credit carryforwards of approximately $662,000 and $1.2 million, respectively. The federal research and development tax credit carryforwards will begin to expire in 2032, unless previously utilized. The California research and development tax credit carryforwards are available indefinitely until utilized.

The future utilization of net operating loss and tax credit carryforwards may be limited due to changes in ownership. In general, if we experience a greater than 50% aggregate change in ownership of certain significant stockholders or groups over a three-year period, or a Section 382 ownership change, utilization of our pre-change net operating loss carryforwards would be subject to an annual limitation under Section 382 of the Internal Revenue Code of 1986, as amended, or the Code, and similar state laws. The annual limitation is generally determined by multiplying the value of our stock at the time of such ownership change (subject to certain adjustments) by the applicable long-term tax-exempt rate. Such limitations may result in expiration of a portion of the pre-change net operating loss carryforwards before utilization and may be substantial. We completed a study to assess whether an ownership change, as defined by Section 382 of the Code, had occurred since our formation through December 31, 2013. Based upon the results of this study, we determined that several ownership changes had occurred and we reduced our deferred tax asset with a corresponding adjustment to the valuation allowance accordingly. We have recorded a valuation allowance for the full amount of the remaining portion of the deferred tax asset related to our net operating loss and research and development tax credit carryforwards. We may also experience ownership changes in the future as a result of subsequent shifts in our stock ownership. As a result, if we earn net taxable income, our ability to use our pre-change net operating loss carryforwards to offset U.S. federal taxable income may be subject to limitations, which could potentially result in increased future tax liability to us.

JOBS Act

On April 5, 2012, the JOBS Act was enacted. Section 107 of the JOBS Act provides that an “emerging growth company” can take advantage of the extended transition period provided in Section 7(a)(2)(B) of the Securities Act for complying with new or revised accounting standards. In other words, an “emerging growth company” can delay the adoption of certain accounting standards until those standards would otherwise apply to private companies. We have irrevocably elected not to avail ourselves of this extended transition period and, as a result, we will adopt new or revised accounting standards on the relevant dates on which adoption of such standards is required for other public companies.

Subject to certain conditions set forth in the JOBS Act, as an “emerging growth company,” we intend to rely on certain of these exemptions, including without limitation, (1) providing an auditor’s attestation report on our system of internal controls over financial reporting pursuant to Section 404(b) of the Sarbanes-Oxley Act and (2) complying with any requirement that may be adopted by the Public Company Accounting Oversight Board regarding mandatory audit firm rotation or a supplement to the auditor’s report providing additional information

about the audit and the consolidated financial statements, known as the auditor discussion and analysis. We will remain an "emerging growth company" until the earliest of (a) the last day of the fiscal year in which we have total annual gross revenues of $1 billion or more, (b) the last day of our fiscal year following the fifth anniversary of the date of the completion of our initial public offering, (c) the date on which we have issued more than $1 billion in non-convertible debt during the previous three years or (d) the date on which we are deemed to be a large accelerated filer under the rules of the SEC.

Results of Operations

Comparison of the Years Ended December 31, 2013 and 2012

The following table summarizes our results of operations for the years ended December 31, 2013 and 2012 (in thousands):

	Years Ended December 31,		Increase / (Decrease)
	2013	2012	
Research and development	$16,927	$13,314	$ 3,613
General and administrative	3,037	2,631	406
Total other income (expense)	(127)	74	(201)

Research and Development Expenses. Research and development expenses were $16.9 million and $13.3 million for the years ended December 31, 2013 and 2012, respectively. The increase of approximately $3.6 million was due primarily to an increase of $4.5 million in expenses during 2013 associated with the increase in enrollment of patients in our CUPID 2 clinical trial, $0.8 million associated with the transfer of our manufacturing process to Lonza and $1.5 million in compensation related to an increase in headcount and stock-based compensation, offset by a charge of $3.2 million which occurred during the year ended December 31, 2012 related to the purchase of intangible assets from AmpliPhi Biosciences Corporation, or AmpliPhi, relating to the development of MYDICAR. We expect that our overall research and development expenses will increase in 2014 as we initiate additional clinical trials and begin to scale-up for commercial manufacturing.

General and Administrative Expenses. General and administrative expenses were $3.0 million and $2.6 million for the years ended December 31, 2013 and 2012, respectively. The increase of approximately $0.4 million was due primarily to an increase in compensation expense related to an increase in headcount and professional fees associated with transitioning our company into a public company, offset by a reduction in outside legal services due to the completion of the establishment of our European subsidiary, Celladon Europe, and legal costs associated with licensing activities in 2012. We expect that our general and administrative expenses will increase as we operate as a public company. We believe that these increases will likely include increased costs for director and officer liability insurance, costs related to the hiring of additional personnel to support product commercialization efforts and increased fees for outside consultants, attorneys and accountants. We also expect to incur increased costs to comply with corporate governance, internal controls, investor relations and disclosures, and similar requirements applicable to public companies.

Other Income (Expense). Other income (expense) was $(0.1) million and $74,000 for the years ended December 31, 2013 and 2012, respectively. The other expense for the year ended December 31, 2013 consisted primarily of $0.2 million of other expense related to an increase in the fair value of our outstanding warrant liability and $45,000 of interest expense related to the amortization of debt discount on our outstanding convertible debt, offset by $0.1 million of interest income on our investments. The other income for the year ended December 31, 2012 consisted primarily of interest income on our investments offset by interest expense on outstanding convertible debt. We expect our interest income to increase in 2014 as we invest the proceeds from our initial public offering pending their use in our operations.

Comparison of the Year Ended December 31, 2012 and the Six Months Ended December 31, 2011

We changed our fiscal year end from June 30 to December 31, effective for the fiscal period ended December 31, 2011. Consequently, the transitional period ended December 31, 2011 comprises six months only as compared to 12 months during the year ended December 31, 2012.

The following table summarizes our results of operations for the year ended December 31, 2012 and the six months ended December 31, 2011 (in thousands):

	Year Ended December 31, 2012	Six Months Ended December 31, 2011	Increase / (Decrease)
Research and development	$ 13,314	$ 1,252	$ 12,062
General and administrative	2,631	920	1,711
Other income (expense)	74	(689)	763

Research and Development Expenses. Research and development expenses were $13.3 million for the year ended December 31, 2012 and $1.3 million for the six months ended December 31, 2011. On a comparative annualized basis, the increase in research and development expenses during this period was due primarily to start-up activities and the initiation of enrollment of our CUPID 2 clinical trial, an increase in personnel primarily for additional manufacturing and clinical support and related costs, and the purchase of intangible assets from AmpliPhi.

General and Administrative Expenses. General and administrative expenses were $2.6 million for the year ended December 31, 2012 and $0.9 million for the six months ended December 31, 2011. On a comparative annualized basis, the increase in general and administrative expenses during 2012 was primarily due to the increased use of outside services, including legal and accounting fees associated with the establishment of Celladon Europe and clinical trial agreements.

Other Income (Expense). Other income (expense) was $0.1 million for the year ended December 31, 2012 and $(0.7) million for the six months ended December 31, 2011. The other expense for the six months ended December 31, 2011 consisted primarily of interest expense related to convertible debt that was converted into shares of our capital stock in January 2012.

Comparison of the Six Months Ended December 31, 2011 and the Year Ended June 30, 2011

We changed our fiscal year end from June 30 to December 31, effective for the six months ended December 31, 2011. Consequently, the transitional period ended December 31, 2011 comprises six months only as compared to 12 months during the fiscal year ended June 30, 2011.

The following table summarizes our results of operations for the six months ended December 31, 2011 and the fiscal year ended June 30, 2011 (in thousands):

	Six Months Ended December 31, 2011	Year Ended June 30, 2011	Increase / Decrease
Research and development	$ 1,252	$ 4,193	$ (2,941)
General and administrative	920	1,832	(912)
Other income (expense)	(689)	(965)	276

Research and Development Expenses. Research and development expenses were $1.3 million for the six months ended December 31, 2011 and $4.2 million for the fiscal year ended June 30, 2011. On a comparative

annualized basis, the decrease in research and development expenses during this period was primarily due to a decrease in clinical trial costs, as we completed data collection for our CUPID 1 clinical trial in August 2010.

General and Administrative Expenses. General and administrative expenses were $0.9 million for the six months ended December 31, 2011 and $1.8 million for the fiscal year ended June 30, 2011. On a comparative annualized basis, general and administrative expenses were consistent.

Other Income (Expense). Other income (expense) was $(0.7) million for the six months ended December 31, 2011 and $(1.0) million for the fiscal year ended June 30, 2011. On a comparative annualized basis, the difference consisted primarily of $0.2 million in funding from the qualifying therapeutic discovery project tax credit in the fiscal year ended June 30, 2011, partially offset by a $0.1 million loss on disposal of equipment in this period.

Liquidity and Capital Resources

We have incurred net losses each year since our inception and as of December 31, 2013, we had an accumulated deficit of approximately $112.6 million. We anticipate that we will continue to incur net losses for at least the next several years. We expect that our research and development and general and administrative expenses will continue to increase and, as a result, we will need additional capital to fund our operations, which we may obtain through one or more public or private equity offerings, debt financings, government or other third-party funding, strategic alliances and licensing or collaboration arrangements.

Since our inception through December 31, 2013, we have funded our operations primarily from the sale of our equity and debt securities. As of December 31, 2013, we had cash, cash equivalents and investments of approximately $18.4 million. Cash in excess of immediate requirements is invested in accordance with our investment policy, primarily with a view to liquidity and capital preservation. As discussed above, our initial public offering resulted in net proceeds to us of $46.0 million subsequent to December 31, 2013.

The following table shows a summary of our cash flows for the periods indicated (in thousands):

	Years Ended December 31,		Six Months Ended December 31,	Year Ended June 30,
	2013	2012	2011	2011
Net cash provided by (used in):				
Operating activities	$(16,196)	$(14,637)	$ (1,582)	$ (5,611)
Investing activities	10,854	(21,833)	—	35
Financing activities	(596)	49,843	1,450	4,472
Net (decrease) increase in cash and cash equivalents	$ (5,938)	$ 13,373	$ (132)	$ (1,104)

Operating activities. Net cash used in operating activities of $16.2 million during the year ended December 31, 2013 was primarily a result of our net loss of $20.1 million. The primary difference between our net loss and our cash used in operating activities was $1.9 million of changes in our operating assets and liabilities, $1.4 million of stock-based compensation, $0.2 million related to the change in fair value of our outstanding warrant liability, $0.3 million of interest income related to the amortization of discounts and premiums paid on investment securities and $0.1 million of noncash interest related to the amortization of debt discount on our convertible debt.

Net cash used in operating activities of $14.6 million during the year ended December 31, 2012 was primarily a result of our net loss of $15.9 million. The primary difference between our net loss and our cash used in operating activities was $0.6 million of changes in our operating assets and liabilities and $0.3 million of stock-based compensation.

Net cash used in operating activities of $1.6 million during the six months ended December 31, 2011 was primarily a result of our net loss of $2.9 million. The primary difference between our net loss and our cash used in operating activities was $0.7 million of interest accrued on our outstanding convertible debt.

Net cash used in operating activities of $5.6 million during the fiscal year ended June 30, 2011 was primarily a result of our net loss of $7.0 million. The primary difference between our net loss and our cash used in operating activities was $1.1 million of interest accrued on our outstanding convertible debt.

Investing Activities. Net cash provided by investing activities of $10.9 million during the year ended December 31, 2013 was primarily a result of the net maturities of investments used to fund our operating activities.

Net cash used in investing activities was $21.8 million during the year ended December 31, 2012 and consisted primarily of the investment of proceeds received from our Series A-1 preferred stock financing.

We had no significant investing activities during the year ended June 30, 2011 or the six months ended December 31, 2011.

Financing Activities. Net cash used in financing activities during the year ended December 31, 2013 consisted of $1.7 million of costs we paid in connection with our IPO, offset by $1.1 million of proceeds from our issuance of convertible debt.

Net cash provided by financing activities of $49.8 million during the year ended December 31, 2012 was primarily a result of proceeds received from our Series A-1 preferred stock financing and related issuance of exchangeable shares.

Net cash provided by financing activities of $4.5 million during the year ended June 30, 2011 and $1.5 million during the six months ended December 31, 2011, was primarily a result of proceeds received from the issuance of convertible notes that converted into capital stock in connection with our Series A-1 preferred stock financing.

Future Funding Requirements

To date, we have not generated any revenue from product sales. We do not know when, or if, we will generate any revenue from product sales. We do not expect to generate any revenue from product sales unless and until we obtain regulatory approval of MYDICAR and our companion diagnostic and commercialize MYDICAR or any of our other product candidates. At the same time, we expect our expenses to increase in connection with our ongoing development activities, particularly as we continue the research, development and clinical trials of, and seek regulatory approval for, our product candidates and companion diagnostic. We expect to incur additional costs associated with operating as a public company. In addition, subject to obtaining regulatory approval of any of our product candidates and companion diagnostic, we expect to incur significant commercialization expenses for product sales, marketing, manufacturing and distribution. We anticipate that we will need additional funding in connection with our continuing operations.

Based upon our current operating plan, we believe that our existing cash, cash equivalents and short-term investments, will enable us to fund our operations through 2015. We intend to use our existing cash, cash equivalents and short-term investments to fund development activities, including commercial manufacturing capabilities, related to MYDICAR for the treatment of systolic heart failure, including patients with existing LVADs, AVF maturation failure, internal salaries and external costs related to completion of our CUPID 2 trial and the remainder to fund working capital, including general operating expenses. We have based our estimates on assumptions that may prove to be wrong, and we may use our available capital resources sooner than we

currently expect. Because of the numerous risks and uncertainties associated with the development and commercialization of our product candidates, we are unable to estimate the amounts of increased capital outlays and operating expenditures necessary to complete the development of our product candidates.

Our future capital requirements will depend on many factors, including:

- the progress, costs, results and timing of our CUPID 2 trial, and the clinical development of MYDICAR for other potential indications;
- the willingness of the FDA to accept CUPID 2, as well as our other completed and planned preclinical studies and clinical trials and other work, as the basis for review and regulatory approval of MYDICAR for the treatment of systolic heart failure and for other potential indications;
- the outcome, costs and timing of seeking and obtaining FDA and any other regulatory approvals;
- the costs associated with securing, establishing and maintaining commercialization and manufacturing capabilities;
- the number and characteristics of product candidates that we pursue, including our product candidates in preclinical development;
- the ability of our product candidates to progress through clinical development successfully;
- our need to expand our research and development activities;
- the costs of acquiring, licensing or investing in businesses, products, product candidates and technologies;
- our ability to maintain, expand and defend the scope of our intellectual property portfolio, including the amount and timing of any payments we may be required to make, or that we may receive, in connection with the licensing, filing, prosecution, defense and enforcement of any patents or other intellectual property rights;
- our need and ability to hire additional management and scientific, medical and sales personnel;
- the effect of competing technological and market developments; and
- our need to implement additional internal systems and infrastructure, including financial and reporting systems.

Until such time that we can generate meaningful revenue from product sales, if ever, we expect to finance our operating activities through public or private equity or debt financings, government or other third-party funding, marketing and distribution arrangements, and other collaborations, strategic alliances and licensing arrangements or a combination of these approaches. To the extent that we raise additional capital through the sale of equity or convertible debt securities, the ownership interests of our common stockholders will be diluted, and the terms of these securities may include liquidation or other preferences that adversely affect the rights of our common stockholders. Debt financing, if available, may involve agreements that include covenants limiting or restricting our ability to take specific actions, such as incurring additional debt, making capital expenditures or declaring dividends. If we raise additional funds through government or other third-party funding, marketing and distribution arrangements or other collaborations, or strategic alliances or licensing arrangements with third parties, we may have to relinquish valuable rights to our technologies, future revenue streams, research programs or product candidates or to grant licenses on terms that may not be favorable to us.

Contractual Obligations and Commitments

The following table summarizes our contractual obligations at December 31, 2013 (in thousands):

	Payments due by period				
	Total	Less than 1 year	1 – 3 Years	3 – 5 Years	More than 5 years
Operating lease obligation relating to facility (1)	$367	$ 92	$192	$ 83	$ —

(1) Consists of our corporate headquarters lease encompassing 2,270 square feet of office space that expires in November 2017.

Additionally, we have entered into a non-cancellable agreement with Lonza for the manufacture of our viral vectors and product candidates for clinical testing purposes. The agreement requires us to pay Lonza an aggregate amount of $4.5 million before the end of 2015. The timing of the payment obligation is indeterminable and therefore is not included in the table above. We have entered and will continue to enter into other contracts in the normal course of business with CROs for clinical trials and with vendors for preclinical research studies and other services and products for operating purposes. These agreements generally provide for termination or cancellation within 180 days or less of notice, and therefore are not included in the table above.

Each of our license agreements under which we may be required to pay an annual fee to maintain the license is generally cancelable by us, given appropriate prior written notice and, as such, is excluded from the table above. The annual amounts payable by us to maintain our existing licenses is approximately $0.6 million. In addition, we have payment obligations under license agreements that are contingent upon future events such as our achievement of specified development, regulatory and commercial milestones and are required to make development milestone payments and royalty payments in connection with the sale of products developed under these agreements. As of December 31, 2013, we were unable to estimate the timing or likelihood of achieving the milestones or making future product sales and, therefore, any related payments are not included in the table above. We have potential milestone payment obligations of approximately $5.0 million, assuming only one product is developed or commercialized under each of our existing license agreements.

We also have employment agreements with our President and Chief Executive Officer, our Vice President, Finance and Administration, our Vice President, Clinical Operations, our Vice President, Manufacturing and our Vice President, Corporate Development and Investor Relations that require the funding of specific payments, if certain events occur, such as a change of control or the termination of employment without cause. These potential payment obligations are not included in the table above.

In October 2013, we entered into a note and warrant purchase agreement with certain existing investors for the sale of up to an aggregate of $1,097,017 of convertible promissory notes, or the 2013 Notes, and warrants exercisable to purchase shares of Series A-1 Preferred Stock, or the 2013 Warrants. Prior to their conversion concurrently with the closing our initial public offering, the 2013 Notes accrued interest at a rate of 6% per annum. Upon the completion of our initial public offering in February 2014, the principal amount of the 2013 Notes and accrued interest thereon converted into 139,644 shares of our common stock and the 2013 Warrants became exercisable for an aggregate of 231,821 shares of our common stock at an exercise price of $5.61 per share.

Off-Balance Sheet Arrangements

During the periods presented we did not have, nor do we currently have, any off-balance sheet arrangements as defined under the rules of the Securities and Exchange Commission.

Recent Accounting Pronouncements

In February 2013, the Financial Accounting Standards Board, or FASB, issued guidance to provide information about the amounts reclassified out of accumulated other comprehensive income, or AOCI, by component. An entity is required to present, either on the face of the consolidated financial statements or in the notes, significant amounts reclassified out of AOCI by the respective line items of net income, but only if the amount reclassified is required to be reclassified in its entirety in the same reporting period. For amounts that are not required to be reclassified in their entirety to net income, an entity is required to cross-reference to other disclosures that provide additional details about those amounts. On January 1, 2013, we adopted this standard, which had no impact on our financial position or results of operations.

In July 2013, the FASB issued Accounting Standards Update, or ASU, No. 2013-11, *Presentation of an Unrecognized Tax Benefit When a Net Operating Loss Carryforward, a Similar Tax Loss, or a Tax Credit Carryforward Exists*. ASU 2013-11 provides explicit guidance on the financial statement presentation of an unrecognized tax benefit when a net operating loss carryforward, a similar tax loss, or a tax credit carryforward exists. The guidance is effective prospectively for fiscal years, and interim periods within those years, beginning after December 15, 2013, with an option for early adoption. We intend to adopt this guidance at the beginning of our first quarter of fiscal year 2014 and do not believe the adoption of this standard will have a material impact on our financial position, results of operations or related financial statement disclosures.

ITEM 7A. Quantitative and Qualitative Disclosures About Market Risk

Our primary exposure to market risk is interest income sensitivity, which is affected by changes in the general level of U.S. interest rates. Due to the short-term duration of our investment portfolio and the low-risk profile of our investments, we would not expect our operating results or cash flows to be affected to any significant degree by the effect of a sudden change in market interest rates on our investment portfolio. A 10% change in interest rates on December 31, 2013 would not have had a material effect on the fair market value of our portfolio.

We do not believe that our cash, cash equivalents and investments have significant risk of default or illiquidity. While we believe our cash and cash equivalents do not contain excessive risk, we cannot provide absolute assurance that in the future our investments will not be subject to adverse changes in market value. In addition, we maintain significant amounts of cash and cash equivalents at one or more financial institutions that are in excess of federally insured limits.

Our balance sheet as of December 31, 2013 includes cash and cash equivalents of $0.6 million denominated in euros through Celladon Europe. The majority of payments made by Celladon Europe are denominated in euros. Such payments have not been material in any period since our inception. We do not participate in any foreign currency hedging activities and we do not have any other derivative financial instruments. We did not recognize any significant exchange rate losses during the year ended December 31, 2013. A 10% change in the euro-to-dollar exchange rate on December 31, 2013 would not have had a material effect on our results of operations or financial condition.

Inflation generally affects us by increasing our cost of labor and clinical trial costs. We do not believe that inflation has had a material effect on our results of operations during the periods presented.

ITEM 8. Financial Statements and Supplementary Data

Report of Independent Registered Public Accounting Firm

The Board of Directors and Stockholders of
Celladon Corporation

We have audited the accompanying consolidated balance sheets of Celladon Corporation, as of December 31, 2013 and 2012, and the related consolidated statements of operations and comprehensive loss, preferred stock and stockholders' deficit, and cash flows for the years ended December 31, 2013 and 2012, the six-month period ended December 31, 2011, the fiscal year ended June 30, 2011, and the period from December 21, 2000 (inception) to December 31, 2013. These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with the standards of the Public Company Accounting Oversight Board (United States). Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. We were not engaged to perform an audit of the Company's internal control over financial reporting. Our audits included consideration of internal control over financial reporting as a basis for designing audit procedures that are appropriate in the circumstances, 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. An audit also includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the consolidated financial position of Celladon Corporation at December 31, 2013 and 2012, and the consolidated results of its operations and its cash flows for the years ended December 31, 2013 and 2012, the six-month period ended December 31, 2011, the fiscal year ended June 30, 2011, and the period from December 21, 2000 (inception) to December 31, 2013, in conformity with U.S. generally accepted accounting principles.

/s/ Ernst & Young LLP

San Diego, California
March 31, 2014

Celladon Corporation
(A Development Stage Company)

Consolidated Balance Sheets
(in thousands, except share and per share data)

	December 31, 2013	December 31, 2012
Assets		
Current assets:		
Cash and cash equivalents	$ 7,903	$ 13,841
Short-term investments	10,467	18,808
Prepaid expenses and other assets	180	288
Total current assets	18,550	32,937
Long-term investments	—	2,862
Property and equipment, net	308	122
Other assets	2,296	8
Total assets	$ 21,154	$ 35,929
Liabilities, preferred stock and stockholders' deficit		
Current liabilities:		
Accounts payable and accrued expenses	$ 2,908	$ 1,134
Accrued clinical expenses	1,478	644
Accrued interest	14	—
Convertible notes, net of discount	1,044	—
Warrant liability	1,116	—
Total current liabilities	6,560	1,778
Deferred rent	37	28
Redeemable non-controlling interest	—	4,814
Commitments and contingencies (Note 5)		
Preferred stock, $0.0001 par value:		
Authorized shares—147,964,577 and 143,732,952 at December 31, 2013 and 2012, respectively		
Series A-1 redeemable convertible preferred stock:		
Authorized shares—135,826,497 and 131,594,871 at December 31, 2013 and 2012, respectively; issued and outstanding shares—127,140,530 and 116,424,125 at December 31, 2013 and 2012, respectively; liquidation preference—$114,172 and $104,549 at December 31, 2013 and 2012, respectively	60,098	52,274
Convertible preferred stock:		
Authorized shares—12,138,080 at December 31, 2013 and 2012; issued and outstanding shares—12,138,080 at December 31, 2013 and 2012; liquidation preference—$5,450 at December 31, 2013 and 2012	5,450	5,450
Special voting preferred:		
Authorized, issued and outstanding shares – none and one at December 31, 2013 and 2012, respectively	—	1
Stockholders' deficit:		
Common stock, $0.0001 par value; authorized shares—180,000,000 and 172,249,444 at December 31, 2013 and 2012, respectively; issued and outstanding—884,179 at December 31, 2013 and 2012	—	—
Additional paid-in capital	61,593	64,166
Accumulated other comprehensive income	2	9
Deficit accumulated during the development stage	(112,586)	(92,591)
Total stockholders' deficit	(50,991)	(28,416)
Total liabilities, preferred stock and stockholders' deficit	$ 21,154	$ 35,929

See accompanying notes.

Celladon Corporation
(A Development Stage Company)

Consolidated Statements of Operations and Comprehensive Loss
(in thousands, except share and per share data)

	Years Ended December 31,		Six Months Ended December 31,	Year Ended June 30,	Period from December 21, 2000 (inception) to December 31,
	2013	2012	2011	2011	2013
Operating expenses:					
Research and development	$ 16,927	$ 13,314	$ 1,252	$ 4,193	$ 92,044
General and administrative	3,037	2,631	920	1,832	19,522
Total operating expenses	19,964	15,945	2,172	6,025	111,566
Loss from operations	(19,964)	(15,945)	(2,172)	(6,025)	(111,566)
Other income (expense):					
Interest income	69	35	—	7	675
Interest expense	(59)	(108)	(689)	(1,124)	(2,357)
Other income	25	147	—	152	574
Change in fair value of warrant liability	(162)	—	—	—	(162)
Consolidated net loss	(20,091)	(15,871)	(2,861)	(6,990)	(112,836)
Net loss attributable to non-controlling interest	96	154	—	—	250
Net loss attributable to Celladon Corporation	(19,995)	(15,717)	(2,861)	(6,990)	(112,586)
Accretion to redemption value of redeemable convertible preferred stock	—	(343)	—	—	(343)
Change in fair value of non-controlling interest	(3,105)	(154)	—	—	(3,259)
Deemed dividend	(856)	—	—	—	(856)
Net loss attributable to common stockholders	$ (23,956)	$ (16,214)	$ (2,861)	$ (6,990)	$ (117,044)
Other comprehensive loss:					
Unrealized gain (loss) on investments	(7)	9	—	—	2
Comprehensive loss	$ (20,098)	$ (15,862)	$ (2,861)	$ (6,990)	$ (112,834)
Net loss per share attributable to common stockholders, basic and diluted	$ (27.09)	$ (19.74)	$ (1,022.52)	$ (2,729.66)	
Weighted-average shares outstanding, basic and diluted	884,179	821,568	2,798	2,561	

See accompanying notes.

Celladon Corporation
(A Development Stage Company)

Consolidated Statements of Preferred Stock and Stockholders' Deficit
(in thousands, except share data)

	Series A-1 Redeemable Convertible Preferred Stock		Convertible Preferred Stock		Special Voting Stock		Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Income (Loss)	Deficit Accumulated During the Development Stage	Total Stockholders' Equity (Deficit)
	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount				
Balance at December 21, 2000	—	$ —	—	$ —	—	$ —	—	$ —	$ —	$ —	$ —	$ —
Issuance of common stock to founders	—	—	—	—	—	—	596	16	—	—	—	16
Net income through June 30, 2003	—	—	—	—	—	—	—	—	—	—	27	27
Balance at June 30, 2003	—	—	—	—	—	—	596	16	—	—	27	43
Issuance of common stock to founders	—	—	—	—	—	—	9	145	—	—	—	145
Net loss	—	—	—	—	—	—	—	—	—	—	(658)	(658)
Balance at June 30, 2004	—	—	—	—	—	—	605	161	—	—	(631)	(470)
Issuance of common stock to founders	—	—	—	—	—	—	1,307	151	—	—	—	151
Issuance of Series A convertible preferred stock at $1.00 per share, net of $104 of offering costs	—	—	4,000,000	3,896	—	—	—	—	—	—	—	—
Stock-based compensation	—	—	—	—	—	—	—	1	—	—	—	1
Net loss	—	—	—	—	—	—	—	—	—	—	(2,576)	(2,576)
Balance at June 30, 2005	—	—	4,000,000	3,896	—	—	1,912	313	—	—	(3,207)	(2,894)
Issuance of common stock to founders	—	—	—	—	—	—	9	1	—	—	—	1
Issuance of Series A convertible preferred stock at $1.00 per share	—	—	500,000	—	—	—	—	—	—	—	—	—
Issuance of Series B convertible preferred stock at $1.10 per share, net of $76 of offering costs	—	—	6,909,093	—	—	—	—	—	—	—	—	—
Conversion of Series B convertible preferred stock to common stock	—	—	(4,000,068)	(4,400)	—	—	320	4,400	—	—	—	4,400
Stock-based compensation	—	—	—	—	—	—	—	4	—	—	—	4
Net loss	—	—	—	—	—	—	—	—	—	—	(9,745)	(9,745)
Balance at June 30, 2006	—	$ —	7,409,025	$ 7,520	—	$ —	2,241	$ 4,718	$ —	$ —	$ (12,952)	$ (8,234)

See accompanying notes.

Celladon Corporation
(A Development Stage Company)

Consolidated Statements of Preferred Stock and Stockholders' Deficit
(in thousands, except share data)

	Series A-1 Redeemable Convertible Preferred Stock		Convertible Preferred Stock		Special Voting Stock		Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Income (Loss)	Deficit Accumulated During the Development Stage	Total Stockholders' Equity (Deficit)
	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount				
Balance at June 30, 2006	—	$ —	7,409,025	$ 7,520	—	$ —	2,241	$ 4,718	$ —	$ —	$ (12,952)	$ (8,234)
Issuance of Series B convertible preferred stock at $1.10 per share, net of $27 of offering costs	—	—	10,000,000	10,973	—	—	—	—	—	—	—	—
Issuance of Series B-1 convertible preferred stock at $1.80 per share, net of $57 of offering costs	—	—	2,222,223	3,943	—	—	—	—	—	—	—	—
Stock-based compensation	—	—	—	—	—	—	—	102	—	—	—	102
Net loss	—	—	—	—	—	—	—	—	—	—	(14,200)	(14,200)
Balance at June 30, 2007	—	—	19,631,248	22,436	—	—	2,241	4,820	—	—	(27,152)	(22,332)
Issuance of Series B-1 convertible preferred stock at $1.80 per share, net of $5 of offering costs	—	—	6,666,669	11,996	—	—	—	—	—	—	—	—
Issuance of Series B-1 convertible preferred stock	—	—	39,568	75	—	—	—	—	—	—	—	—
Issuance of Series C convertible preferred stock at $1.80 per share, net of $44 of offering costs	—	—	5,555,556	9,956	—	—	—	—	—	—	—	—
Issuance of common stock for services	—	—	—	—	—	—	27	—	—	—	—	—
Stock-based compensation	—	—	—	—	—	—	—	166	—	—	—	166
Net loss	—	—	—	—	—	—	—	—	—	—	(12,381)	(12,381)
Balance at June 30, 2008	—	—	31,893,041	44,463	—	—	2,268	4,986	—	—	(39,533)	(34,547)
Issuance of Series B-1 convertible preferred stock at $1.90 per share	—	—	36,034	68	—	—	—	—	—	—	—	—
Cancellation of Series B-1 convertible preferred stock	—	—	(75,602)	(56)	—	—	—	—	—	—	—	—
Issuance of Series C convertible preferred stock at $1.80 per share	—	—	5,000,000	8,999	—	—	—	—	—	—	—	—
Stock-based compensation	—	—	—	—	—	—	—	221	—	—	—	221
Net loss	—	—	—	—	—	—	—	—	—	—	(17,752)	(17,752)
Balance at June 30, 2009	—	$ —	36,853,473	$ 53,474	—	$ —	2,268	$ 5,207	$ —	$ —	$ (57,285)	$ (52,078)

See accompanying notes.

Celladon Corporation
(A Development Stage Company)

Consolidated Statements of Preferred Stock and Stockholders' Deficit
(in thousands, except share data)

	Series A-1 Redeemable Convertible Preferred Stock		Convertible Preferred Stock		Special Voting Stock		Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Income (Loss)	Deficit Accumulated During the Development Stage	Total Stockholders' Equity (Deficit)
	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount				
Balance at June 30, 2009	—	$ —	36,853,473	$ 53,474	—	$ —	2,268	$ 5,207	$ —	$ —	$ (57,285)	$ (52,078)
Issuance of common stock	—	—	—	—	—	—	40	9	—	—	—	9
Issuance of Series C convertible preferred stock at $1.80 per share	—	—	1,555,556	2,800	—	—	—	—	—	—	—	—
Issuance of Series C convertible preferred stock at $0.01 per share upon the exercise of warrants	—	—	777,778	8	—	—	—	—	—	—	—	—
Stock-based compensation	—	—	—	—	—	—	—	290	—	—	—	290
Net loss	—	—	—	—	—	—	—	—	—	—	(9,738)	(9,738)
Balance at June 30, 2010	—	—	39,186,807	56,282	—	—	2,308	5,506	—	—	(67,023)	(61,517)
Issuance of common stock	—	—	—	—	—	—	490	90	—	—	—	90
Stock-based compensation	—	—	—	—	—	—	—	217	—	—	—	217
Net loss	—	—	—	—	—	—	—	—	—	—	(6,990)	(6,990)
Balance at June 30, 2011	—	—	39,186,807	56,282	—	—	2,798	5,813	—	—	(74,013)	(68,200)
Stock-based compensation	—	—	—	—	—	—	—	82	—	—	—	82
Net loss	—	—	—	—	—	—	—	—	—	—	(2,861)	(2,861)
Balance at December 31, 2011	—	$ —	39,186,807	$ 56,282	—	$ —	2,798	$ 5,895	$ —	$ —	$ (76,874)	$ (70,979)

See accompanying notes.

Celladon Corporation
(A Development Stage Company)

Consolidated Statements of Preferred Stock and Stockholders' Deficit
(in thousands, except share data)

	Series A-1 Redeemable Convertible Preferred Stock		Convertible Preferred Stock		Special Voting Stock		Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Income (Loss)	Deficit Accumulated During the Development Stage	Total Stockholders' Equity (Deficit)
	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount				
Balance at December 31, 2011	—	$ —	39,186,807	$ 56,282	—	$ —	2,798	$ 5,895	$ —	$ —	$ (76,874)	$ (70,979)
Issuance of common stock	—	—	—	—	—	—	55	—	—	—	—	—
Conversion of Series A, B, B-1 and C preferred stock to common stock	—	—	(39,186,807)	(56,282)	—	—	31,374	56,282	—	—	—	56,282
Issuance of preferred stock and common stock in connection with conversion of debt and accrued interest	15,160,301	6,807	12,138,080	5,450	—	—	849,952	2,188	—	—	—	2,188
Delaware reincorporation	—	—	—	—	—	—	—	(64,168)	64,168	—	—	—
Issuance of special voting stock	—	—	—	—	1	1	—	—	—	—	—	—
Issuance of Series A-1 preferred stock, net of $343 of offering costs	101,263,824	45,124	—	—	—	—	—	—	—	—	—	—
Accretion to redemption value of redeemable convertible preferred stock	—	343	—	—	—	—	—	(252)	(91)	—	—	(343)
Stock-based compensation	—	—	—	—	—	—	—	55	243	—	—	298
Change in fair value of redeemable non-controlling interest	—	—	—	—	—	—	—	—	(154)	—	—	(154)
Consolidated net loss	—	—	—	—	—	—	—	—	—	—	(15,871)	(15,871)
Net loss attributable to redeemable non-controlling interest	—	—	—	—	—	—	—	—	—	—	154	154
Unrealized gain on investment securities	—	—	—	—	—	—	—	—	—	9	—	9
Balance at December 31, 2012	116,424,125	52,274	12,138,080	5,450	1	1	884,179	—	64,166	9	(92,591)	(28,416)
Stock-based compensation	—	—	—	—	—	—	—	—	1,388	—	—	1,388
Change in fair value of redeemable non-controlling interest	—	—	—	—	—	—	—	—	(3,105)	—	—	(3,105)
Share exchange related to non-controlling interest and special voting stock	10,716,405	7,824	—	—	(1)	(1)	—	—	—	—	—	—
Deemed dividend	—	—	—	—	—	—	—	—	(856)	—	—	(856)
Consolidated net loss	—	—	—	—	—	—	—	—	—	—	(20,091)	(20,091)
Net loss attributable to redeemable non-controlling interest	—	—	—	—	—	—	—	—	—	—	96	96
Unrealized loss on investment securities	—	—	—	—	—	—	—	—	—	(7)	—	(7)
Balance at December 31, 2013	127,140,530	$ 60,098	12,138,080	$ 5,450	—	$ —	884,179	$ —	$ 61,593	$ 2	$ (112,586)	$ (50,991)

See accompanying notes.

Celladon Corporation
(A Development Stage Company)

Consolidated Statements of Cash Flows
(in thousands)

	Years Ended December 31,		Six Months Ended December 31,	Year Ended June 30,	Period from December 21, 2000 (inception) to December 31,
	2013	2012	2011	2011	2013
Cash flows from operating activities					
Consolidated net loss	$(20,091)	$(15,871)	$ (2,861)	$ (6,990)	$ (112,836)
Adjustments to reconcile net loss to net cash used in operating activities					
Depreciation	67	64	31	73	473
Stock-based compensation	1,388	298	82	217	3,075
Forgiveness of notes receivable	—	—	—	—	72
Noncash interest expense	59	108	683	1,123	2,250
Amortization of investment premium (discount)	255	124	—	—	379
Change in fair value of warrant liability	162	—	—	—	162
Loss on disposal of property and equipment	—	—	—	92	92
Deferred rent	17	28	—	—	45
Changes in operating assets and liabilities:					
Prepaid expenses and other assets	104	(266)	(6)	133	(192)
Accounts payable and accrued expenses	1,843	878	489	(259)	3,621
Net cash used in operating activities	(16,196)	(14,637)	(1,582)	(5,611)	(102,859)
Cash flows from investing activities					
Purchases of investment securities	(17,860)	(26,751)	—	—	(44,611)
Proceeds from maturities of investment securities	28,801	4,966	—	—	33,767
Purchases of property and equipment	(87)	(48)	—	(2)	(766)
Proceeds from sale of property and equipment	—	—	—	37	59
Net cash provided by (used in) investing activities	10,854	(21,833)	—	35	(11,551)
Cash flows from financing activities					
Proceeds from issuance of common stock	—	—	—	90	106
Proceeds from issuance of preferred stock, net	—	45,140	—	—	105,822
Proceeds from issuance of exchangeable shares	—	4,814	—	—	4,814
Proceeds from issuance of convertible debt	1,097	—	1,450	4,400	13,447
Repayment of convertible debt	—	(111)	—	—	(111)
Proceeds from equipment loan	—	—	—	—	175
Repayment of equipment loan	—	—	—	(18)	(175)
Issuance of notes receivable	—	—	—	—	(72)
Costs paid in connection with initial public offering	(1,693)	—	—	—	(1,693)
Net cash provided by financing activities	(596)	49,843	1,450	4,472	122,313
Net (decrease) increase in cash and cash equivalents	(5,938)	13,373	(132)	(1,104)	7,903
Cash and cash equivalents, beginning of period	13,841	468	600	1,704	—
Cash and cash equivalents, end of period	$ 7,903	$ 13,841	$ 468	$ 600	$ 7,903
Supplemental disclosure of cash flow information					
Interest paid	$ —	$ —	$ 6	$ 1	$ 107
Supplemental schedule of noncash investing and financing activities					
Conversion of convertible debt and accrued interest for Series A-1 and Junior preferred and common stock	$ —	$ 14,430	$ —	$ —	$ 14,430
Share exchange related to non-controlling interest and special voting stock	$ 7,824	$ —	$ —	$ —	$ 7,824
Deemed dividend	$ 856	$ —	$ —	$ —	$ 856
Accrued purchases of property and equipment	$ 166	$ —	$ —	$ —	$ 166

See accompanying notes.

Celladon Corporation
(A Development Stage Company)

Notes to Consolidated Financial Statements

1. Organization and Summary of Significant Accounting Policies

Organization

Celladon Corporation (Celladon or the Company) was incorporated in California on December 21, 2000 (inception) and reincorporated in Delaware in April 2012. The Company changed its fiscal year end from June 30 to December 31, effective for the fiscal period ended December 31, 2011. The Company is a biotechnology company focused on developing treatments for heart failure, diabetes and neurodegenerative diseases. Celladon's lead product candidate targets SERCA2a, an enzyme that becomes deficient in patients with heart failure.

As of December 31, 2013, the Company has devoted substantially all of its efforts to product development, raising capital and building infrastructure and has not generated revenues from its planned principal operations. Accordingly, the Company is considered to be in the development stage.

Use of Estimates

The Company's consolidated financial statements are prepared in accordance with U.S. generally accepted accounting principles (GAAP). The preparation of the Company's consolidated financial statements requires it to make estimates and assumptions that impact the reported amounts of assets, liabilities and expenses and the disclosure of contingent assets and liabilities in the Company's consolidated financial statements and accompanying notes. The most significant estimates in the Company's consolidated financial statements relate to the fair value of equity awards, the fair value of the convertible debt and warrant liability, and clinical trial expense accruals. Although these estimates are based on the Company's knowledge of current events and actions it may undertake in the future, actual results may ultimately materially differ from these estimates and assumptions.

Reverse Stock Split

On October 25, 2013, the Company filed an amendment to its amended and restated certificate of incorporation under which each share of the Company's common stock was reverse split on a 1-for-12.49 basis. The Company's preferred stock conversion rate was adjusted in an equivalent amount. The accompanying consolidated financial statements and notes to the consolidated financial statements give retroactive effect to the reverse split for all periods presented.

Principles of Consolidation

On April 27, 2012, Celladon formed a subsidiary, Celladon Europe B.V. (Celladon EU), a Dutch limited liability company, for the purpose of managing the new capital investment made by Cooperatief LSP IV U.A. (LSP) related to Celladon's Series A-1 preferred stock (see Note 2). From its inception to June 6, 2013 the subsidiary was 90% owned by Celladon and subsequent to June 6, 2013 the subsidiary is wholly owned by Celladon. The financial statements of Celladon EU are consolidated with those of the Company. All intercompany transactions and balances are eliminated in consolidation. The U.S. dollar is the functional currency of Celladon EU. The Company remeasures Celladon EU's assets and liabilities related to monetary assets and liabilities to the U.S. dollar and records the net gains or losses resulting from remeasurement in other income (expense) in the consolidated statements of operations and comprehensive loss. During the years ended December 31, 2013 and 2012, the Company did not record any material gains or losses from remeasurement.

Segment Reporting

Operating segments are identified as components of an enterprise about which separate discrete financial information is available for evaluation by the chief operating decision-maker in making decisions regarding resource allocation and assessing performance. The Company views its operations and manages its business in one operating segment.

Cash and Cash Equivalents

Cash and cash equivalents consists primarily of readily available checking, money market accounts and money market funds. The Company considers all highly liquid investments with an original maturity of three months or less at the date of purchase to be cash equivalents.

Investment Securities

Investment securities primarily consist of investment grade corporate debt securities. The Company classifies all investment securities as available-for-sale. Investments with maturity dates greater than 12 months from the end of each reporting period are classified as long-term. Investment securities are carried at fair value, with the unrealized gains and losses reported as a component of other comprehensive income (loss) in stockholders' equity (deficit) until realized. Realized gains and losses from the sale of investment securities, if any, are determined on a specific identification basis. A decline in the market value of any investment security below cost that is determined to be other than temporary will result in an impairment charge to earnings and a new cost basis for the security is established. No such impairment charges were recorded for any period presented. As of December 31, 2013 and December 31, 2012, none of the investment securities have been in an unrealized loss position for more than 12 months. Premiums and discounts are amortized or accreted over the life of the related security as an adjustment to yield using the straight-line method and are included in interest income. Interest income is recognized when earned.

The following table sets forth the composition of the Company's investment securities (in thousands):

As of December 31, 2013	Maturity in Years	Amortized Cost	Unrealized Gains	Unrealized Losses	Fair Value
Corporate debt securities	Less than 1 year	$ 10,465	$ 2	$ —	$ 10,467

As of December 31, 2012	Maturity in Years	Amortized Cost	Unrealized Gains	Unrealized Losses	Fair Value
Corporate debt securities	Less than 1 year	$ 18,798	$ 12	$ (2)	$ 18,808
Corporate debt securities	Greater than 1 year	$ 2,863	$—	$ (1)	$ 2,862

Concentration of Credit Risk

Financial instruments, which potentially subject the Company to significant concentration of credit risk, consist primarily of cash, cash equivalents and investment securities. The Company has established guidelines regarding diversification of investments and their maturities, which are designed to maintain principal and maximize liquidity. 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 and management believes that the Company is not exposed to significant credit risk due to the financial position of the depository institutions in which those deposits are held.

Property and Equipment

Property and equipment are recorded at cost and depreciated using the straight-line method over the estimated useful lives of the assets (generally three to five years) and generally consist of furniture and fixtures, computers, and office equipment. Repairs and maintenance costs are charged to expense as incurred.

Impairment of Long-Lived Assets

Long-lived assets consist primarily of property and equipment. An impairment loss is recorded if and when events and circumstances indicate that assets might be impaired and the undiscounted cash flows estimated to be generated by those assets are less than the carrying amount of those assets. While the Company's current and historical operating losses and negative cash flows are indicators of impairment, management believes that future cash flows to be received support the carrying value of its long-lived assets and, accordingly, has not recognized any impairment losses since inception.

Clinical Trial Accruals

As part of the process of preparing its financial statements, the Company is required to estimate its expenses resulting from its obligations under contracts with vendors and consultants and clinical site agreements in connection with conducting clinical trials. The financial terms of these contracts are subject to negotiations which vary from contract to contract and may result in payment flows that do not match the periods over which materials or services are provided to us under such contracts. The Company's objective is to reflect the appropriate trial expenses in its financial statements by matching those expenses with the period in which services and efforts are expended. The Company accounts for these expenses according to the progress of the trial as measured by patient progression and the timing of various aspects of the trial. The Company determines accrual estimates through financial models taking into account discussion with applicable personnel and outside service providers as to the progress or state of consummation of trials, or the services completed. During the course of a clinical trial, the Company adjusts its rate of clinical expense recognition if actual results differ from its estimates. The Company makes estimates of its accrued expenses as of each balance sheet date in its financial statements based on the facts and circumstances known at that time. Although the Company does not expect its estimates to be materially different from amounts actually incurred, its understanding of the status and timing of services performed relative to the actual status and timing of services performed may vary and may result in us reporting amounts that are too high or too low for any particular period. Through December 31, 2013, there have been no material adjustments to the Company's prior period estimates of accrued expenses for clinical trials. The Company's clinical trial accrual is dependent upon the timely and accurate reporting of contract research organizations and other third-party vendors.

Preferred Stock Warrant Liability

The Company has issued freestanding warrants to purchase shares of its convertible preferred stock. The fair value of these warrants is classified as a current liability in the accompanying consolidated balance sheets since the underlying redeemable convertible preferred stock is classified as temporary equity in the accompanying consolidated balance sheets instead of in stockholders' equity (deficit) in accordance with authoritative guidance for the classification and measurement of redeemable securities. The warrants were recorded at fair value using the Black-Scholes option pricing model with any changes in fair value being recognized as a component of other income (expense) in the accompanying consolidated statements of operations and comprehensive loss.

Deferred Rent

Deferred rent consists of the difference between cash payments and the recognition of rent expense on a straight-line basis for the facility the Company occupies. The Company's lease for its facility provides for fixed increases in minimum annual rental payments. The total amount of rental payments due over the lease term is being charged to rent expense ratably over the life of the lease.

Preferred Stock

The Company classifies preferred stock that is redeemable or subject to liquidation outside of the Company's control outside of permanent equity. For preferred stock that is contractually redeemable outside of the Company's control, the carrying value was increased to its redemption value by accretion in the period of issuance. In the absence of retained earnings, these accretion charges were recorded against additional paid-in capital.

Research and Development Costs

Research and development expenses consist primarily of salaries and related overhead expenses; fees paid to consultants and contract research organizations; costs related to acquiring and manufacturing clinical trial materials; costs related to compliance with regulatory requirements; and maintenance and license payments related to licensed product candidates and technologies. All research and development costs are expensed as incurred.

Patent Costs

Costs related to filing and pursuing patent applications are recorded as general and administrative expense and expensed as incurred since recoverability of such expenditures is uncertain.

Stock-Based Compensation

Stock-based compensation expense represents the cost of the grant date fair value of employee stock option grants recognized over the requisite service period of the awards (usually the vesting period) on a straight-line basis, net of estimated forfeitures. The Company estimates the fair value of stock option grants using the Black-Scholes option pricing model.

The Company accounts for stock options granted to non-employees using the fair value approach. These option grants are subject to periodic revaluation over their vesting terms.

Income Taxes

The Company accounts for income taxes under the asset and liability method, which requires the recognition of deferred tax assets and liabilities for the expected future tax consequences of events that have been included in the financial statements. Under this method, deferred tax assets and liabilities are determined on the basis of the differences between the financial statements and tax basis of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse. The effect of a change in tax rates on deferred tax assets and liabilities is recognized in income in the period that includes the enactment date.

The Company recognizes net deferred tax assets to the extent that management believes these assets are more likely than not to be realized. In making such a determination, management considers all available positive and negative evidence, including future reversals of existing taxable temporary differences, projected future taxable income, tax-planning strategies, and results of recent operations. If management determines that the Company would be able to realize its deferred tax assets in the future in excess of their net recorded amount, management would make an adjustment to the deferred tax asset valuation allowance, which would reduce the provision for income taxes.

The Company records uncertain tax positions on the basis of a two-step process whereby (1) management determines whether it is more likely than not that the tax positions will be sustained on the basis of the technical merits of the position and (2) for those tax positions that meet the more-likely-than-not recognition threshold, management recognizes the largest amount of tax benefit that is more than 50% likely to be realized upon ultimate settlement with the related tax authority. The Company recognizes interest and penalties related to unrecognized tax benefits within income tax expense. Any accrued interest and penalties are included within the related tax liability.

Comprehensive Loss

Comprehensive loss is defined as a change in equity during a period from transactions and other events and circumstances from non-owner sources. The Company's only component of other comprehensive loss is unrealized gains (losses) on investment securities. Comprehensive loss has been reflected in the consolidated statements of operations and comprehensive loss and as a separate component of the statements of stockholders' deficit for all periods presented.

Net Loss Per Share Attributable to Common Stockholders

Basic net loss per share attributable to common stockholders is calculated by dividing the net loss attributable to common stockholders by the weighted-average number of common shares outstanding for the period, without consideration for common stock equivalents. Diluted net loss per share attributable to common stockholders is computed by dividing the net loss attributable to common stockholders by the weighted-average number of common share equivalents outstanding for the period determined using the treasury-stock method. Dilutive common stock equivalents are comprised of convertible preferred stock and rights to acquire convertible preferred stock (non-controlling interest), warrants for the purchase of common stock and options outstanding under the Company's stock option plans. For all periods presented, there is no difference in the number of shares used to calculate basic and diluted shares outstanding due to the Company's net loss position.

Potentially dilutive securities not included in the calculation of diluted net loss per share attributable to common stockholders because to do so would be anti-dilutive are as follows (in common stock equivalent shares):

	Years Ended December 31,	
	2013	2012
Redeemable convertible preferred stock	10,179,372	9,321,385
Convertible preferred stock	971,820	971,820
Warrants for common stock	702	702
Redeemable non-controlling interest	—	857,998
Common stock options	1,543,469	1,289,635
	12,695,363	12,441,540

Recent Accounting Pronouncements

In February 2013, the Financial Accounting Standards Board (FASB), issued guidance to provide information about the amounts reclassified out of accumulated other comprehensive income (AOCI), by component. An entity is required to present, either on the face of the consolidated financial statements or in the notes, significant amounts reclassified out of AOCI by the respective line items of net income, but only if the amount reclassified is required to be reclassified in its entirety in the same reporting period. For amounts that are not required to be reclassified in their entirety to net income, an entity is required to cross-reference to other disclosures that provide additional details about those amounts. On January 1, 2013, the Company adopted this standard, which had no impact on its financial position or results of operations.

In July 2013, the FASB issued Accounting Standards Update (ASU) No. 2013-11, *Presentation of an Unrecognized Tax Benefit When a Net Operating Loss Carryforward, a Similar Tax Loss, or a Tax Credit Carryforward Exists*. ASU 2013-11 provides explicit guidance on the financial statement presentation of an unrecognized tax benefit when a net operating loss carryforward, a similar tax loss, or a tax credit carryforward exists. The guidance is effective prospectively for fiscal years, and interim periods within those years, beginning after December 15, 2013, with an option for early adoption. The Company intends to adopt this guidance at the beginning of its first quarter of fiscal year 2014, and does not believe the adoption of this standard will have a material impact on its financial position, results of operations or related financial statement disclosures.

2. Celladon Europe B.V.

In April 2012 and June 2012, LSP invested an aggregate of $4.8 million in Celladon EU. In exchange for the investment, the Company issued LSP one share of Special Preferred Voting stock and Celladon EU issued LSP 1,999 non-voting B shares. The 1,999 B shares were exchangeable into 10,716,405 shares of the Company's Series A-1 preferred stock at the option of LSP. The Company determined that the investment held by LSP in Celladon EU should be classified as a redeemable non-controlling interest, as the shares of Celladon EU were not in-substance common stock. In-substance common stock is an investment in an entity that has risk and reward characteristics that are substantially similar to that entity's common stock. Due to the liability characteristics associated with the shares of Celladon EU held by LSP, the Company concluded that the investor's shares were not substantially similar to common stock. The liability characteristics include the investor's put rights, which provide the investor with the ability to exchange its shares in Celladon EU for Series A-1 preferred stock of the Company.

The redeemable non-controlling interest was initially valued using the fair value of the Series A-1 preferred stock. At each reporting period, the Company adjusts the carrying value of the redeemable non-controlling interest by the net loss attributable to the redeemable non-controlling interest. Any difference between the fair value and the adjusted carrying value of the redeemable non-controlling interest is recorded as an adjustment to additional paid-in capital and presented as a component of net loss attributable to common stockholders in the accompanying consolidated statements of operations and comprehensive loss.

On June 6, 2013, LSP delivered a notice to exchange its 1,999 B shares of Celladon EU for 10,716,405 shares of the Company's Series A-1 preferred stock. Concurrently, the one share of outstanding Special Preferred Voting stock was cancelled. As of June 6, 2013, the redeemable non-controlling interest was adjusted to fair value and reclassified to Series A-1 preferred stock on the accompanying consolidated balance sheet.

From April 2012 through June 6, 2013, LSP owned approximately 10% of Celladon EU.

During the years ended December 31, 2013 and 2012, the Company adjusted the loss attributable to common stockholders as a result of increases in the fair value of the redeemable non-controlling interest of approximately $3.1 million and $0.2 million, respectively. The increases in fair value increased the loss attributable to common stockholders.

As of December 31, 2013 and 2012, the $0.8 million and $0.3 million, respectively, of liabilities recognized as a result of consolidating Celladon EU do not represent additional claims on the Company's general assets; rather, they represent claims against the specific assets of Celladon EU. As of December 31, 2013 and 2012, the $0.6 million and $3.6 million, respectively, of assets recognized as a result of consolidating Celladon EU do not represent additional assets that could be used to satisfy claims against the Company's general assets. The assets of Celladon EU represent the only significant assets of the Company not located in the United States.

3. Balance Sheet Details

Property and equipment consist of the following (in thousands):

	As of December 31,	
	2013	2012
Office furniture and other equipment	$ 555	$ 332
Accumulated depreciation	(247)	(210)
	$ 308	$ 122

Accounts payable and accrued expenses consist of the following (in thousands):

	As of December 31,	
	2013	2012
Accounts payable	$1,397	$ 569
Current portion of deferred rent	8	—
Accrued compensation	664	460
Accrued other	839	105
	$2,908	$1,134

4. Fair Value Measurements

The Company's financial instruments primarily consist of cash and cash equivalents, investment securities, accounts payable and accrued liabilities. The carrying value of these financial instruments generally approximates fair value due to their short-term nature. Investment securities, warrant liabilities and redeemable non-controlling interest are recorded at fair value. Based on the borrowing rates currently available to the Company for loans with similar terms, which is considered a Level 2 input, the Company believes that the fair value of its convertible debt approximates its carrying value.

The accounting guidance defines fair value, establishes a consistent framework for measuring fair value and expands disclosure for each major asset and liability category measured at fair value on either a recurring or nonrecurring basis. Fair value is defined as an exit price, representing the amount that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants. As such, fair value is a market-based measurement that should be determined based on assumptions that market participants would use in pricing an asset or liability. As a basis for considering such assumptions, the accounting guidance establishes a three-tier fair value hierarchy, which prioritizes the inputs used in measuring fair value as follows:

Level 1: Observable inputs such as quoted prices in active markets;

Level 2: Inputs, other than the quoted prices in active markets, that are observable either directly or indirectly; and

Level 3: Unobservable inputs in which there is little or no market data, which require the reporting entity to develop its own assumptions

As of December 31, 2013 and 2012, cash and cash equivalents consist primarily of bank deposits with third-party financial institutions and highly liquid money market securities with original maturities at date of purchase of 90 days or less and are stated at cost which approximate fair value and are classified within the Level 1 designation discussed above. Marketable securities are recorded at fair value, defined as the exit price in the principal market in which the Company would transact, representing the amount that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants. Level 2 securities are valued using quoted market prices for similar instruments, non-binding market prices that are corroborated by observable market data, or discounted cash flow techniques and include the Company's investments in corporate debt securities and commercial paper. Financial assets and liabilities that are measured or disclosed at fair value on a recurring basis, and are classified within the Level 3 designation, include the warrant liability and redeemable non-controlling interest. None of the Company's non-financial assets and liabilities are recorded at fair value on a non-recurring basis. No transfers between levels have occurred during the periods presented.

Cash equivalents measured at fair value as of December 31, 2013 and 2012, are all classified within Level 1. Below is a summary of assets and liabilities measured at fair value (in thousands):

	As of December 31, 2013	Fair Value Measurements at Reporting Date Using: Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Assets:				
Corporate debt securities	$ 10,467	$ —	$ 10,467	$ —
Liabilities:				
Convertible notes	$ 1,044	—	—	$ 1,044
Warrant liability	1,116	—	—	1,116
	$ 2,160	$ —	$ —	$ 2,160

	As of December 31, 2012	Fair Value Measurements at Reporting Date Using: Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Assets:				
Corporate debt securities	$ 21,670	$ —	$ 21,670	$ —
Liabilities:				
Redeemable non-controlling interest	$ 4,814	$ —	$ —	$ 4,814

The Company determined the fair value of the convertible notes utilizing an estimated cost of debt for comparable venture backed and mezzanine financings.

The fair value per share of the Company's underlying Series A-1 preferred stock was used to determine the fair value of the redeemable non-controlling interest and the warrant liability. As of December 31, 2013, October 15, 2013 (issuance date of Series A-1 warrants), June 6, 2013 (exchange date of exchangeable shares) and December 31, 2012, the fair value of the Series A-1 preferred stock was $0.64, $0.91, $0.73 and $0.449, respectively. The fair value of the Series A-1 preferred stock was determined using either an option pricing model, a hybrid option pricing and probability weighted expected return model or, in the case of the December 31, 2013, derived from the Company's IPO price. The key inputs into the models included the probability and timing of expected liquidity event dates, discount rates and the selection of appropriate market comparable transactions and multiples to apply to the Company's various historical and forecasted operational metrics.

In addition to the fair value of the underlying Series A-1 preferred stock, the following assumptions were used in the Black-Scholes option pricing model to determine the fair value of the preferred stock warrant liability:

	October 15, 2013	December 31, 2013
Risk-free interest rate	1.37%	1.58%
Expected volatility	79%	82%
Expected term (in years)	5.0	4.8
Expected dividend yield	0.0%	0.0%

The following table provides a reconciliation of all liabilities measured at fair value using Level 3 significant unobservable inputs (in thousands):

	Redeemable Non-Controlling Interest	Convertible Notes	Warrant Liability
Balance at December 31, 2011	$ —	$ —	$ —
Issuance of shares of redeemable non-controlling interest	4,814	—	—
Net loss attributable to redeemable non-controlling interest	(154)	—	—
Change in fair value	154	—	—
Balance at December 31, 2012	4,814	—	—
Issuance of warrants in connection with note and warrant purchase agreement	—	—	954
Issuance of debt	—	999	—
Net loss attributable to redeemable non-controlling interest	(96)	—	—
Changes in fair value	3,105	45	162
Exchange of redeemable non-controlling interest for Series A-1 preferred stock	(7,823)	—	—
Balance at December 31, 2013	$ —	$ 1,044	$ 1,116

5. Commitments and Contingencies

Note and Warrant Purchase Agreement

In October 2013, the Company entered into a note and warrant purchase agreement with certain existing investors for the sale of up to an aggregate of $1,097,017 of convertible promissory notes (the 2013 Notes) and warrants exercisable to purchase shares of Series A-1 Preferred Stock (the 2013 Warrants). Prior to their conversion in connection with the closing of the Company's initial public offering, the 2013 Notes accrued interest at a rate of 6% per annum, compounded annually. The 2013 notes had a maturity date of the earlier of (1) March 31, 2014 or (2) the occurrence of a deemed liquidation event as defined in the Company's amended and restated certificate of incorporation, subject in each case to their earlier conversion upon the Company's completion of a qualified initial public offering or private placement of its equity securities. The terms of the 2013 Notes provided for their automatic conversion (including accrued interest) upon a qualified initial public offering or private placement of equity securities into common stock or other equity securities issued in such private placement at a conversion price per share equal to the initial public offering price or per share purchase price to investors in the private placement. The 2013 Warrants were exercisable for an aggregate of 2,895,570 shares of Series A-1 Preferred Stock at an exercise price of $0.449 per share and will expire in October 2018. Upon completion of the Company's initial public offering in February 2014, the 2013 Warrants became exercisable for an aggregate of 231,821 shares of common stock at an exercise price of $5.61 per share.

The conversion of the 2013 Notes in the event of a qualified initial public offering or private placement of equity was deemed to be the predominant settlement mechanism. As this predominant settlement mechanism provided for the settlement of a fixed monetary amount in a variable number of equity instruments, the Company concluded that it was appropriate to recognize the 2013 Notes at fair value. The Company valued the 2013 Notes utilizing an estimated cost of debt for comparable venture backed and mezzanine financings. The Company concluded that a 20% discount rate was appropriate, resulting in an initial fair value for the 2013 Notes of approximately $1.0 million. The resulting debt discount of $0.1 million was amortized to interest expense on a

straight-line basis through the earliest maturity date of March 31, 2014. Upon completion of the Company's initial public offering in February 2014, the 2013 Notes plus approximately $20,000 of accrued interest automatically converted into 139,644 shares of common stock.

The 2013 Warrants were initially accounted for as liabilities with subsequent changes in fair value recognized within the consolidated statement of operations. The Company determined that the initial fair value of the 2013 Warrants was $1.0 million. The fair value of the 2013 Warrants was derived from the probability weighted expected return model the Company used to value its common stock. Upon completion of the Company's initial public offering in February 2014, the warrants no longer require liability accounting and the then fair value of the warrant liability was reclassified into equity.

The initial recognition of the 2013 Notes and 2013 Warrants at fair value resulted in a deemed dividend in the amount of $0.9 million that was accounted for as additional net loss attributable to common stockholders.

Sublicense Agreement and Amended and Restated License Agreement with AmpliPhi

Sublicense Agreement

In June 2012, the Company entered into a sublicense agreement (the AmpliPhi Sublicense) with AmpliPhi Biosciences Corporation (AmpliPhi), pursuant to which AmpliPhi sublicensed to the Company certain rights under a separate agreement which AmpliPhi entered into in 2009 with the Trustees of University of Pennsylvania (UPenn). Under the terms of the AmpliPhi Sublicense, the Company obtained an exclusive, worldwide sublicense from AmpliPhi under certain UPenn patents related to AAV1 vectors for the development, manufacture, use and sale of companion diagnostics to MYDICAR. In addition, the Company is required to use commercially reasonable efforts to meet certain developmental, regulatory and commercial milestones with respect to companion diagnostics under the agreement. The Company is currently in compliance with these milestone requirements. In consideration for the sublicense granted to the Company under the agreement, the Company paid to AmpliPhi a sublicense initiation fee of $310,000, and the Company is obligated to pay to AmpliPhi an annual sublicense maintenance fee of $310,000. The Company is also required to pay to AmpliPhi a low single-digit percentage royalty based on net sales of any companion diagnostic covered by a licensed patent sold by the Company, its affiliates or its sublicensees. The Company's royalty obligations continue on a companion diagnostic-by-companion diagnostic and country-by-country basis until the expiration of the last-to-expire valid claim in a licensed patent covering the applicable companion diagnostic in such country. Finally, the Company is obligated to pay to AmpliPhi all royalty and milestone payments that become due and payable by AmpliPhi to UPenn under AmpliPhi's agreement with UPenn as a result of the Company's exercise of the sublicense granted under the Company's agreement with AmpliPhi, including a low single-digit tiered percentage royalty on net sales of any companion diagnostic sold by the Company, its affiliates or its sublicensees, which royalty is separate from and in addition to the royalty payable to AmpliPhi described above, and up to an aggregate of $850,000 in potential milestone payments per product covered by the licensed patents.

The Company may unilaterally terminate the agreement upon 30 days' written notice to AmpliPhi. Absent early termination, the agreement will automatically terminate upon the expiration of the last-to-expire licensed patent, which is expected to be in 2019.

The Company has recorded research and development expense related to sublicense fees under the agreement of $0.3 million, $0.3 million, and $0.6 million, respectively, for the years ended December 31, 2013 and 2012, and the period from December 21, 2000 (inception) to December 31, 2013. Through December 31, 2013, no milestone obligations were incurred under the agreement.

Amended and Restated License Agreement

The Company entered into an amended and restated license agreement with AmpliPhi concurrently with the AmpliPhi Sublicense that both amended the terms of the license agreement which the Company entered into with

AmpliPhi in 2009 and terminated its manufacturing agreement with AmpliPhi which the Company entered into in 2009. Under the agreement, the Company obtained an exclusive, worldwide license under certain patents and know-how related to AmpliPhi's AAV vector and manufacturing technology for the development, manufacture, use and sale of MYDICAR. In addition, the Company has agreed to use commercially reasonable efforts to meet certain diligence milestones with respect to the development and commercialization of at least one product covered by the UPenn patent rights licensed to AmpliPhi by UPenn under the Company's agreement with UPenn.

The Company is currently in compliance with these milestone requirements. During the term of the agreement, the Company is not obligated to make annual license or maintenance payments, but is obligated to pay to AmpliPhi all royalty and milestone payments that become due and payable by AmpliPhi to UPenn under AmpliPhi's agreement with UPenn as a result of the Company's exercise of the sublicense granted under the Company's agreement with AmpliPhi. This includes a low single-digit tiered percentage royalty on net sales of MYDICAR and any other product covered by the licensed patents sold by the Company, its affiliates or its sublicensees, and up to $850,000 in milestone payments upon the achievement of certain developmental and regulatory milestones related to MYDICAR and any other product covered by the licensed patents. Through December 31, 2013, $0.3 million of milestone obligations were incurred under the agreement. The agreement does not provide either party with termination rights and does not have a provision for expiration or automatic termination. In addition, the Company paid $3.2 million in exchange for certain intangible assets associated with the license agreement that the Company acquired from AmpliPhi in June 2012, which were expensed as in-process research and development during the year ended December 31, 2012.

Exclusive Patent License with the Regents of the University of Minnesota

In May 2009, the Company entered into an exclusive patent license agreement with the Regents of the University of Minnesota (UMinn) under which it obtained an exclusive license to UMinn's joint ownership interest in a patent application related to screening technology for isolation of small molecule modulators of SERCA enzymes. The agreement does not encompass a manufacturing agreement.

The Company has agreed to meet certain performance milestones under the agreement, the deadline for which may be extended at the Company's request provided that the Company has used commercially reasonable efforts to achieve such milestones by the applicable deadlines. The Company is currently in compliance with these milestone requirements. The Company has the first right to prosecute and maintain the applicable patent family.

The Company made an upfront payment to UMinn of $120,000. In addition, the Company is obligated to pay to UMinn an annual license fee of $120,000. The annual license fee will increase to $325,000 if the Company (1) undergoes a change of control, (2) assigns the agreement, any of its rights or obligations under the agreement or as joint ownership interest in the licensed technology, (3) receives a certain amount in license and sublicense revenues under the agreement, (4) files an investigational new drug application, or IND, new drug application, biologic license application or orphan drug application (or a foreign equivalent of any such application) for a product covered by the licensed technology, or (5) enters into any agreement with a third party to market or use the licensed technology, subject to certain exceptions.

The Company may unilaterally terminate the agreement upon 90 days' written notice to UMinn. UMinn may terminate the agreement upon 10 days' written notice to the Company upon the Company's insolvency or for its breach of the agreement if such breach remains uncured for 90 days after the Company receives notice of such breach, or 30 days in the case of a non-payment breach. Absent early termination, the agreement will automatically terminate upon the expiration of all active claims in any licensed patent or patent application, which is expected to occur no earlier than January 2030.

The Company has recorded research and development expense related to license and annual maintenance fees under the agreement of $0.1 million, $0.1 million, $0, $0.1 million and $0.6 million, respectively, for the

years ended December 31, 2013 and 2012, the six months ended December 31, 2011, the year ended June 30, 2011 and the period from December 21, 2000 (inception) to December 31, 2013. Through December 31, 2013, no milestone obligations were incurred under the agreement.

Other License Agreements

The Company has entered into various license agreements pursuant to which the Company acquired certain intellectual property. Pursuant to each agreement the Company paid a license fee and reimbursed historical patent costs. Additionally, under each agreement, the Company may be required to pay annual maintenance fees, royalties, milestone payments and sublicensing fees. Each of the license agreements is generally cancelable by the Company, given appropriate prior written notice. Minimum annual payments to maintain these cancelable licenses total an aggregate of approximately $0.2 million and potential future milestone payments total an aggregate of approximately $3.3 million. The Company has recorded research and development expense related to license and annual maintenance fees under the agreements of $0.2 million, $0.2 million, $20,000, $0.2 million, and $1.1 million, respectively, for the years ended December 31, 2013 and 2012, the six months ended December 31, 2011, the year ended June 30, 2011 and the period from December 21, 2000 (inception) to December 31, 2013.

Through December 31, 2013, the Company has recorded research and development expense of $0.1 million related to milestone obligations incurred under the agreements.

Leases

The Company maintains an office facility in San Diego, California. On March 6, 2012, the Company entered into a long-term operating lease that expires in November 2017. During 2011, the Company was under a month-to-month lease. Rent expense was $0.1 million, $0.1 million, $28,000, $0.1 million and $0.6 million for the years ended December 31, 2013 and 2012, the six months ended December 31, 2011, the year ended June 30, 2011 and the period from December 21, 2000 (inception) to December 31, 2013, respectively.

The future minimum annual rental commitments under the lease obligations are as follows (in thousands):

	Lease Obligations
Year ending December 31:	
2014	$ 92
2015	95
2016	97
2017	83
Thereafter	—
Total	$ 367

6. Preferred Stock and Stockholders' Equity (Deficit)

In addition to its redeemable convertible preferred stock, the Company's convertible preferred stock has been classified as temporary equity on the accompanying consolidated balance sheets instead of in stockholders' deficit in accordance with authoritative guidance for the classification and measurement of potentially redeemable securities whose redemption is based upon certain change in control events that are outside of the control of the Company, including liquidation, sale or transfer of control of the Company.

The authorized, issued and outstanding shares of preferred stock by series are as follows (in thousands, except share amounts):

As of December 31, 2013	Shares Authorized	Shares Outstanding	Liquidation Preference	Redemption Amount
Redeemable convertible preferred stock:				
Series A-1	135,826,497	127,140,530	$ 114,172	$ 57,086
Convertible preferred stock:				
Junior preferred stock	12,138,080	12,138,080	5,450	—
Total	147,964,577	139,278,610	$ 119,622	$ 57,086

As of December 31, 2012	Shares Authorized	Shares Outstanding	Liquidation Preference	Redemption Amount
Redeemable convertible preferred stock:				
Series A-1	131,594,871	116,424,125	$ 104,549	$ 52,274
Convertible preferred stock:				
Junior preferred stock	12,138,080	12,138,080	5,450	—
Special voting preferred	1	1	—	—
Total	143,732,952	128,562,206	$ 109,999	$ 52,274

Description of Securities

Dividends

Each holder of preferred stock is entitled to non-cumulative dividends at an annual rate of 8.0% of the original issue price when and if declared by the board of directors. Dividends are paid with the following preference: (i) Series A-1 preferred stock, (ii) Junior preferred stock and, finally, (iii) common stock. If dividends are paid to the holders of common stock, the holders of Series A-1 preferred stock will participate as if they had converted to common stock. As of December 31, 2013, the board of directors of the Company has not declared any dividends.

Liquidation Preferences

Liquidation amounts are paid with the same preference as the dividends above. Once all series of preferred stock have been paid the liquidation preference, plus declared but unpaid dividends, all remaining assets of the Company would be distributed to holders of common stock and Series A-1 preferred stock as if they had converted to common stock.

Conversion

Each holder of preferred stock has the right, at the option of the holder, to convert each 12.49 shares of preferred stock into one share of common stock. Each share of preferred stock will convert into shares of common stock, at the then-effective applicable conversion rate, upon such time as: (i) may be designated by the holders of at least 60% of the Series A-1 preferred stock, voting as a separate class on an as-if-converted to common stock basis; or (ii) is immediately prior to the closing of a firmly underwritten public offering in which the Company receives gross proceeds (after deduction of underwriting commissions and expenses) of at least $50 million and the offering price per share is not less than $16.824.

Voting

The holder of each share of preferred stock is entitled to one vote for each share of common stock into which it would convert.

Redemption Requirements

The Series A-1 preferred stock is redeemable upon the consent of at least 60% of the then-outstanding shares of Series A-1 preferred stock on or after January 27, 2017. The redemptions shall occur in three annual installments, with the first redemption occurring within 60 days of written notice.

Preferred Stock and Related Transactions

Beginning in September 2004 through September 2009, the Company issued 43,262,477 shares of preferred stock for aggregate gross proceeds of $61.1 million. The Company incurred offering costs of $0.4 million, receiving net proceeds of $60.7 million. In fiscal 2006, 4,000,068 shares of preferred stock were converted into common stock due to the nonparticipation of certain preferred stockholders in a preferred stock financing. In fiscal 2009, an additional 75,602 shares of preferred stock were cancelled. In connection with the Company's reincorporation in Delaware in April 2012, the 39,186,807 remaining outstanding shares of preferred stock were converted into common stock on a basis of one share of common stock for each 1,249 shares of preferred stock.

Beginning in December 2009 through December 2011, the Company issued $10.0 million and $2.4 million in non-secured and secured convertible promissory notes, respectively, to its Series C convertible preferred stockholders. The notes accrued interest at 12% annually. On January 27, 2012, the Company closed its Series A-1 preferred stock and Junior preferred stock financing. The financing included the conversion of the outstanding convertible notes to Series A-1 preferred stock and Junior preferred stock and conversion of approximately $2.2 million of accrued interest to common stock.

In January 2012, the Company issued 27,616,923 shares of Series A-1 preferred stock and 12,138,080 of Junior preferred stock under the initial closing of a Series A-1 and Junior preferred stock purchase agreement at a price of $0.449 per share for net proceeds of $17.8 million, which included the conversion of $12.2 million in outstanding convertible debt and $2.2 million of accrued interest.

In March 2012 and June 2012, the Company issued 1,913,987 and 86,893,215 shares of Series A-1 preferred stock for gross proceeds of $0.9 million and $39.1 million, respectively.

Common Warrants

The following table summarizes the fully exercisable warrants outstanding for the purchase of common stock as of December 31, 2013 and 2012:

Share Issuable upon Exercise	Exercise Price	Expiration Date
80	$224.82	January 2015
622	$12.49	October 2016
702		

Stock Options

In December 2001, the Company adopted its 2001 Stock Option Plan (the 2001 Plan) and in January 2012 adopted its 2012 Equity Incentive Plan (the 2012 Plan, and collectively the Plans). The 2001 Plan has no remaining shares available for future grant. The 2012 Plan, as amended, provides for the grant of up to 1,564,029 incentive stock options, non-statutory stock options, stock appreciation rights, restricted stock awards, restricted stock unit awards, and other stock awards to eligible recipients. Options granted under the Plans generally expire no more than ten years from the date of grant and generally vest and become exercisable over a period not to exceed four years, as determined by the board of directors. Recipients of stock options are eligible to purchase shares of the Company's common stock at an exercise price equal to no less than the estimated fair market value of such stock on the date of grant.

A summary of the Company's stock option activity under the Plans is as follows:

	Options	Weighted-Average Exercise Price Per Share	Weighted-Average Remaining Contractual Term	Aggregate Intrinsic Value (in 000's)
Outstanding at December 31, 2012	1,289,635	$ 2.25	9.45	$ —
Granted	279,850	7.32		
Canceled	(26,016)	2.55		
Outstanding at December 31, 2013	1,543,469	3.19	8.66	$ 9,128
Options exercisable, vested and expected to vest at December 31, 2013	1,543,469	3.19	8.66	$ 9,128

The weighted-average grant date fair value of employee option grants during the years ended December 31, 2013 and 2012 was $7.27 and $0.75 per share, respectively.

2013 Equity Incentive Plan

In October 2013, the Company's stockholders approved the 2013 Equity Incentive Plan, as amended (2013 Plan), which became effective in February 2014. Under the 2013 Plan, the Company may grant stock options, stock appreciation rights, restricted stock, restricted stock units, performance-based stock awards and other awards to individuals who are then employees, officers, non-employee directors or consultants of the Company and its affiliates. Additionally, the 2013 Plan provides for the grant of performance cash awards. Initially, the aggregate number of shares of common stock that may be issued pursuant to stock awards under the 2013 Plan is the sum of (1) 1,473,738 shares, plus (2) the number of shares (not to exceed 1,569,905 shares) (i) the 26,294 shares reserved for issuance under the 2012 Plan at the time the 2013 Plan became effective, and (ii) any shares subject to outstanding stock options or other stock awards that were granted under the 2012 Plan or 2001 Plan that are forfeited, terminate, expire or are otherwise not issued. Additionally, the number of shares of common stock reserved for issuance under the 2013 Plan will automatically increase on January 1 of each year, beginning on January 1, 2015 and continuing through and including January 1, 2023, by 5% of the total number of shares of the Company's capital stock outstanding on December 31 of the preceding calendar year, or a lesser number of shares determined by the Company's board of directors.

2013 Employee Stock Purchase Plan

In October 2013, the Company's stockholders approved the 2013 Equity Stock Purchase Plan (ESPP) which became effective in February 2014. Initially, the ESPP authorizes the issuance of 165,732 shares of common stock pursuant to purchase rights granted to the Company's employees or to employees of any of the Company's designated affiliates. The number of shares of common stock reserved for issuance will automatically increase on January 1 of each calendar year, from January 1, 2015 through January 1, 2023 by the least of (1) 1% of the total number of shares of the Company's common stock outstanding on December 31 of the preceding calendar year, (2) 384,307 shares, or (3) a number determined by the Company's board of directors that is less than (1) and (2).

Stock-Based Compensation Expense

The weighted-average assumptions used in the Black-Scholes option pricing model to determine the fair value of the employee stock option grants were as follows:

	Years Ended December 31,	
	2013	2012
Risk-free interest rate	1.62%	2.29%
Expected volatility	79%	84%
Expected term (in years)	5.6	5.9
Expected dividend yield	0.0%	0.0%

Risk-free interest rate. The Company bases the risk-free interest rate assumption on observed interest rates appropriate for the expected term of the stock option grants.

Expected volatility. The expected volatility assumption is based on volatilities of a peer group of similar companies whose share prices are publicly available. The peer group was developed based on companies in the biotechnology industry.

Expected term. The expected term represents the period of time that options are expected to be outstanding. Because the Company does not have historical exercise behavior, it determines the expected life assumption using the simplified method, which is an average of the contractual term of the option and its vesting period.

Expected dividend yield. The Company bases the expected dividend yield assumption on the fact that it has never paid cash dividends and has no present intention to pay cash dividends.

The allocation of stock-based compensation for all equity awards is as follows (in thousands):

	Years Ended December 31,	
	2013	2012
Research and development	$ 1,264	$ 222
General and administrative	123	76
	$ 1,387	$ 298

As of December 31, 2013 and 2012, the unrecognized compensation cost related to outstanding employee options, was $2.7 million and $0.6 million, respectively, and is expected to be recognized as expense over approximately 2.7 years and 3.0 years, respectively.

Common Stock Reserved for Future Issuance

Common stock reserved for future issuance as of December 31, 2013 and 2012 is as follows:

	December 31,	
	2013	2012
Granted and outstanding under the Plans	1,543,469	1,289,635
Available for grant under the 2012 Plan	26,294	204,864
Warrants issued and outstanding	702	702
Rights to acquire convertible preferred stock (non-controlling interest)	—	857,998
Convertible preferred stock	11,151,192	10,293,205
	12,721,657	12,646,404

7. Income Taxes

The following is a reconciliation of the expected statutory federal income tax provision to the actual income tax provision (in thousands):

	Year Ended December 31, 2013	Year Ended December 31, 2012	Six Months Ended December 31, 2011	Year Ended June 30, 2011
Tax computed at federal statutory rate	$ (6,831)	$ (5,396)	$ (972)	$ (2,376)
State income tax, net of federal benefit	(987)	(907)	(166)	(402)
Non-deductible interest	20	36	274	447
Other permanent items	756	214	7	32
Research credits	(728)	(93)	(67)	(346)
Remove (restore) DTA for NOL and Credits – IRC 382	(12,666)	2,135	589	1,418
Uncertain tax position	859	—	—	—
Valuation allowance	19,577	4,011	335	1,227
Provision (benefit) for income taxes	$ —	$ —	$ —	$ —

The components of the Company's deferred tax assets are summarized as follows (in thousands):

	December 31,	
	2013	2012
Deferred tax assets:		
Net operating loss carryforwards	$ 19,288	$ —
Research credits	1,092	1
Capitalized R&D	6,391	7,670
Other	803	324
Deferred tax assets	27,574	7,995
Valuation allowance	(27,574)	(7,995)
Net deferred tax assets	$ —	$ —

The Company has established a valuation allowance for all deferred tax assets (DTA) including those for new operating loss and tax credit carryforwards. A valuation allowance of approximately $27.6 million of which approximately $19.6 million relates to 2013, has been recognized to offset the deferred tax assets, as realization of such assets is uncertain.

At December 31, 2013, the Company had federal and California net operating loss (NOL) carryforwards of approximately $48.2 million and $49.6 million, respectively. The federal and state NOL carryforwards will begin to expire in 2027 and 2014, respectively, unless previously utilized. At December 31, 2013, the Company had federal and state research tax credits of $662,000 and $1.2 million, respectively. The federal research tax credits begin to expire in 2032 unless previously utilized. The California research credit will carry forward indefinitely until utilized.

Utilization of the NOL and research tax credit carryforwards may be subject to a substantial annual limitation due to ownership change limitations that have occurred or that could occur in the future, as required by Section 382 of the Code, as well as similar state and foreign provisions. These ownership changes may limit the

amount of NOL and research tax credit carryforwards that can be utilized annually to offset future taxable income and tax, respectively. In general, an "ownership change" as defined by Section 382 of the Code results from a transaction or series of transactions over a three-year period resulting in an ownership change of more than 50 percentage points of the outstanding stock of a company by certain stockholders or public groups.

The Company completed a study to assess whether an ownership change, as defined by Section 382 of the Code, had occurred from the Company's formation through December 31, 2013. Based upon this study, the Company determined that several ownership changes had occurred. Accordingly, the Company has reduced its deferred tax assets related to the federal and state NOL carryforwards and the federal research tax credit carryforwards that are anticipated to expire unused as a result of these ownership changes. These tax attributes have been excluded from the deferred tax assets with a corresponding reduction in the valuation allowance with no net effect on income tax expense or the effective tax rate. Future ownership changes may further limit the Company's ability to utilize its remaining tax attributes.

The Company adopted the provisions of Financial Accounting Standards Board (FASB) ASC 740-10 *Income Taxes*, relating to accounting for uncertain tax positions on July 1, 2009.

The following table summarized the activity related to the Company's unrecognized tax benefits (in thousands):

	Year Ended December 31, 2013
Balance beginning of the year	$ —
Increase related to prior year tax positions	681
Increase related to current year tax positions	1,028
Balance at end of year	$ 1,709

There were no unrecognized tax benefits prior to 2013. Approximately $1.7 million of the unrecognized tax benefits would reduce the Company's annual effective tax rate, if recognized, subject to the valuation allowance. It is not anticipated that there will be significant change in the unrecognized tax benefits over the next 12 months.

Due to the net operating loss carryforwards, the U.S. federal and state returns are open to examination by the Internal Revenue Service and significant state and foreign jurisdictions for all years beginning with the inception of the Company. The Company's policy is to recognize interest expense and penalties related to income tax matters as a component of income tax expense. There was no interest and penalties associated with uncertain tax positions as of December 31, 2013.

8. Employee Benefits

All employees of the Company are eligible to participate in the 401(k) Plan. The 401(k) matching contributions, if any, are determined by the Company at its sole discretion. During the years ended December 31, 2013 and 2012, the six months ended December 31, 2011, the year ended June 30, 2011 and the period from December 21, 2000 (inception) to December 31, 2013, the Company made matching contributions totaling $0.1 million, $0.1 million, $20,000, $0.1 million and $0.5 million, respectively.

9. Subsequent Events

Initial Public Offering and Related Transactions

In February 2014, the Company completed its initial public offering in which it sold 6,325,000 shares of common stock at a public offering price of $8.00 per share. Estimated net proceeds from the initial public offering were determined as follows (in thousands):

Gross proceeds (including over-allotment)	$50,600
Underwriting discounts and commissions	(3,542)
Estimated total offering costs (including costs paid as of December 31, 2013)	(2,800)
Offering costs paid as of December 31, 2013	1,693
Estimated net proceeds to be received subsequent to December 31, 2013	$45,951

In addition, each of the following occurred on February 4, 2014 in connection with the Company's initial public offering:

- the conversion of all outstanding shares of convertible preferred stock into 11,151,192 shares of the Company's common stock;
- the conversion of $1.1 million of outstanding principal and accrued interest on convertible notes into 139,644 shares of common stock and the write-off of $0.1 million of unamortized debt discount related to the convertible notes;
- the conversion of warrants to purchase 2,895,570 shares of Series A-1 preferred stock into warrants to purchase 231,821 shares of the Company's common stock and the resultant reclassification of the warrant liability to additional paid-in capital; and
- the amendment and restatement of the Company's certificate of incorporation, authorizing 200,000,000 shares of common stock and 10,000,000 shares of undesignated preferred stock.

The following table summarizes certain actual balance sheet data and unaudited pro forma balance sheet data to reflect the activities related to the Company's initial public offering noted above, as of December 31, 2013 (in thousands):

	December 31, 2013	Pro Forma December 31, 2013 (unaudited)
Cash, cash equivalents and investments	$ 18,370	$ 64,321
Other assets	2,296	12
Accounts payable and accrued expenses	2,908	2,317
Accrued interest	14	—
Convertible notes, net of discount	1,044	—
Preferred stock warrant liability	1,116	—
Redeemable convertible preferred stock	60,098	—
Convertible preferred stock	5,450	—
Common stock	—	2
Additional paid-in capital	61,593	173,624
Deficit accumulated during the development stage	(112,586)	(112,639)
Total stockholders' (deficit) equity	(50,991)	60,989

Material Transfer and Exclusivity Agreement

In February 2014, we and Servier entered into a material transfer and exclusivity agreement, pursuant to which we agreed to transfer to Servier samples of certain proprietary compounds from our small molecule SERCA2b modulator program and granted to Servier a non-exclusive, non-sublicensable, royalty-free license to

conduct certain studies of the samples for the purpose of evaluating Servier's interest in negotiating a potential license and research collaboration agreement with us relating to small molecule SERCA2b modulators, or Compounds, for the treatment of type 2 diabetes and other metabolic diseases.

Subject to earlier termination of the agreement as described below, the term of Servier's license to conduct the evaluation, or the evaluation period, will expire six months after Servier's initial receipt from us of the samples, provided that Servier may extend the evaluation period for up to an additional two months.

Under the terms of the agreement, we also granted to Servier the exclusive right to negotiate for an exclusive, royalty-bearing license to develop and commercialize Compounds, and products containing Compounds, in the field of type 2 diabetes and other metabolic diseases, or the field, solely outside of the United States and its territories and possessions, or ex-U.S. territory, on the terms and conditions set forth in the agreement and other commercially reasonable terms to be negotiated in good faith by the parties and set forth in a definitive license and research collaboration agreement.

10. Quarterly Financial Data (Unaudited)

The following financial information reflects all normal recurring adjustments, which are, in the opinion of management, necessary for a fair statement of the results of the interim periods. Summarized quarterly data for fiscal 2013 and 2012 are as follows (in thousands, except per share data):

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
2013				
Total operating expenses	$ 3,472	$ 4,992	$ 5,523	$ 5,977
Consolidated Net loss	(3,530)	(4,929)	(5,453)	(6,179)
Basic and diluted net loss per share	$ (3.99)	$ (8.98)	$ (6.17)	$ (7.96)
2012				
Total operating expenses	$ 2,748	$ 6,502	$ 2,740	$ 3,955
Consolidated Net loss	(2,855)	(6,556)	(2,626)	(3,834)
Basic and diluted net loss per share	$ (4.91)	$ (7.52)	$ (2.97)	$ (4.34)

ITEM 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure

None.

ITEM 9A. Controls and Procedures

Evaluation of Disclosure Controls and Procedures.

We are responsible for maintaining disclosure controls and procedures, as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act. Disclosure controls and procedures are controls and other procedures designed to ensure that the information required to be disclosed by us in the reports that we file or submit under the Exchange Act is recorded, processed, summarized, and reported within the time periods specified in the SEC's rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by us in the reports that we file or submit under the Exchange Act is accumulated and communicated to our management, including our principal executive officer and our principal financial officer, as appropriate to allow timely decisions regarding required disclosure.

Based on our management's evaluation (with the participation of our principal executive officer and our principal financial officer) of our disclosure controls and procedures as required by Rule 13a-15 under the Exchange Act, our principal executive officer and our principal financial officer have concluded that our disclosure controls and procedures were effective to achieve their stated purpose as of December 31, 2013, the end of the period covered by this report.

Management's Report on Internal Control over Financial Reporting.

This annual report does not include a report management's assessment regarding internal control over financial reporting or an attestation report of the Company's registered public accounting firm due to a transition period established by rules of the SEC for newly public companies.

Changes in Internal Control over Financial Reporting.

There were no changes in our internal control over financial reporting during the quarter ended December 31, 2013 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

ITEM 9B. Other Information

None.

PART III

ITEM 10. Directors, Executive Officers and Corporate Governance

The information required by this item and not set forth below will be set forth in the sections entitled “Election of Directors,” “Executive Officers” and “Section 16(a) Beneficial Ownership Reporting Compliance” in our definitive proxy statement for our 2014 Annual Meeting of Stockholders, or our Proxy Statement, to be filed with the SEC within 120 days after the end of the fiscal year ended December 31, 2013, and is incorporated herein by reference.

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 the Corporate Governance section of our website, which is located at www.celladon.net. 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

The information required by this item will be set forth in the section entitled “Executive Compensation” in our Proxy Statement and is incorporated herein by reference.

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

The information required by this item will be set forth in the sections entitled “Equity Compensation Plan Information” and “Principal Stockholders” in our Proxy Statement and is incorporated herein by reference.

ITEM 13. Certain Relationships and Related Party Transactions, and Director Independence

The information required by this item will be set forth in the sections entitled “Certain Relationships and Related Party Transactions” and “Election of Directors” in our Proxy Statement and is incorporated herein by reference.

ITEM 14. Principal Accounting Fees and Services

The information required by this item will be set forth in the section entitled “Principal Accounting Fees and Services” in our Proxy Statement and is incorporated herein by reference.

PART IV

ITEM 15. Exhibits and Financial Statement Schedules

(a) Financial Statements and Financial Statement Schedules

1. Financial Statements:

The financial statements of Celladon Corporation listed below are set forth in Item 8 of this Report for the year ended December 31, 2013:

2. Financial Statement Schedules:

All other schedules are omitted because they are not applicable or the required information is shown in the financial statements or notes thereto.

(b) Exhibits

Exhibit Number	Description
3.1	Amended and Restated Certificate of Incorporation of the Registrant (incorporated by reference to Exhibit 3.1 to the Registrant's Current Report on Form 8-K, filed with the SEC on February 10, 2014).
3.2	Amended and Restated Bylaws of the Registrant (incorporated by reference to Exhibit 3.2 to the Registrant's Current Report on Form 8-K, filed with the SEC on February 10, 2014).
4.1	Reference is made to Exhibits 3.1 and 3.2.
4.2	Form of Common Stock Certificate of the Registrant (incorporated by reference to Exhibit 4.1 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
4.3	Amended and Restated Investor Rights Agreement by and among the Registrant and certain of its stockholders, dated February 4, 2014 (incorporated by reference to Exhibit 4.2 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
4.4	Form of Warrant to Purchase Common Stock issued to participants in the Registrant's Convertible Debt and Warrant financing, dated October 15, 2013 (incorporated by reference to Exhibit 4.3 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.1+	Form of Indemnity Agreement by and between the Registrant and its directors and officer (incorporated by reference to Exhibit 10.1 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).

Exhibit Number	Description
10.2+	Celladon Corporation 2001 Stock Option Plan and Form of Notice of Grant of Stock Option, Stock Option Agreement and Stock Option Exercise Notice thereunder (incorporated by reference to Exhibit 10.2 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.3+	Celladon Corporation 2012 Equity Incentive Plan and Form of Stock Option Grant Notice, Option Agreement and Notice of Exercise thereunder (incorporated by reference to Exhibit 10.3 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.4+	Celladon Corporation 2013 Equity Incentive Plan and Form of Stock Option Grant Notice, Option Agreement and Notice of Exercise thereunder (incorporated by reference to Exhibit 10.4 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.5+	Celladon Corporation 2013 Employee Stock Purchase Plan (incorporated by reference to Exhibit 10.5 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.6+	Celladon Corporation Non-Employee Director Compensation Policy (incorporated by reference to Exhibit 10.6 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.7+	Employment Agreement by and between the Registrant and Jeffrey J. Rudy, dated September 3, 2013, as amended (incorporated by reference to Exhibit 10.7 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.8+	Employment Agreement by and between the Registrant and Rebecque Laba, dated September 3, 2013, as amended (incorporated by reference to Exhibit 10.8 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.9+	Employment Agreement by and between the Registrant and Ryan K. Takeya, dated September 2, 2013, as amended (incorporated by reference to Exhibit 10.9 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.10+	Employment Agreement by and between the Registrant and Fredrik Wiklund, dated September 3, 2013, as amended (incorporated by reference to Exhibit 10.10 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.11+	Employment Agreement by and between the Registrant and Krisztina M. Zsebo, Ph.D., dated August 30, 2013, as amended (incorporated by reference to Exhibit 10.11 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.12+	Letter Agreement by and between the Registrant and Gregg Huber Alton, dated August 30, 2013 (incorporated by reference to Exhibit 10.12 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.13+	Letter Agreement by and between the Registrant and Graham Cooper, dated September 2, 2013 (incorporated by reference to Exhibit 10.13 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).

Exhibit Number	Description
10.14	Office Lease by and between the Registrant and Arden Realty, Inc., dated March 6, 2012, as amended (incorporated by reference to Exhibit 10.14 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.15*	License Agreement by and between the Registrant and the Regents of the University of California, dated February 10, 2001, as amended (incorporated by reference to Exhibit 10.15 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.16*	Exclusive License Agreement by and between the Registrant and Martin J. Kaplitt, M.D., dated June 7, 2006 (incorporated by reference to Exhibit 10.16 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.17*	Non-Exclusive License Agreement by and between the Registrant and AskBio, LLC, dated January 15, 2008 (incorporated by reference to Exhibit 10.17 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.18	License Agreement by and between the Registrant and AdVec Inc., dated February 24, 2009 (incorporated by reference to Exhibit 10.18 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.19*	Exclusive Patent License Agreement by and between the Registrant and the Regents of the University of Minnesota, dated May 11, 2009 (incorporated by reference to Exhibit 10.19 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.20*	Non-Exclusive License Agreement by and between the Registrant and Virovek Incorporation, dated November 4, 2010 (incorporated by reference to Exhibit 10.20 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.21*	Amended and Restated License Agreement by and between the Registrant and AmpliPhi Biosciences Corporation, dated June 27, 2012 (incorporated by reference to Exhibit 10.21 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.22*	Sublicense Agreement by and between the Registrant and AmpliPhi Biosciences Corporation, dated June 27, 2012 (incorporated by reference to Exhibit 10.22 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.23*	Amended and Restated Manufacturing Services Agreement by and between the Registrant and Lonza Houston, Inc., dated August 26, 2013 (incorporated by reference to Exhibit 10.23 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.24+	Letter Agreement by and between the Registrant and Michael Narachi, dated October 16, 2013 (incorporated by reference to Exhibit 10.24 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
23.1	Consent of Independent Registered Public Accounting Firm.
24.1	Power of Attorney. Reference is made to the signature page hereto.
31.1	Certification of the Principal Executive Officer pursuant to Rule 13a-14(a) or 15d-14(a) of the Securities Exchange Act of 1934.

Exhibit Number	Description
31.2	Certification of the Principal Financial Officer pursuant to Rule 13a-14(a) or 15d-14(a) of the Securities Exchange Act of 1934.
32.1	Certification of the Principal Executive Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.
32.2	Certification of the Principal Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.

+ Indicates management contract or compensatory plan.
* Confidential treatment has been granted with respect to certain portions of this exhibit. Omitted portions have been filed separately with the SEC.

Table of Contents

SIGNATURES

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

Celladon Corporation

Date: March 31, 2014

By: /s/ Krisztina M. Zsebo
Krisztina M. Zsebo, Ph.D.
President and Chief Executive Officer

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Krisztina M. Zsebo and Rebecque J. Laba, jointly and severally, his or her attorneys-in-fact, each with the power of substitution, for him or her in any and all capacities, to sign any amendments to this 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 each of said attorneys-in-fact, or his or her substitute or substitutes may do or cause to be done by virtue hereof.

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

Signature	Title	Date
/s/ Krisztina M. Zsebo Krisztina M. Zsebo, Ph.D.	President, Chief Executive Officer and Member of the Board of Directors *(Principal Executive Officer)*	March 31, 2014
/s/ Rebecque J. Laba Rebecque J. Laba	Vice President, Finance and Administration *(Principal Financial and Accounting Officer)*	March 31, 2014
/s/ Michael Narachi Michael Narachi	Chairman of the Board of Directors	March 31, 2014
/s/ Gregg Alton Gregg Alton	Member of the Board of Directors	March 31, 2014
/s/ Graham Cooper Graham Cooper	Member of the Board of Directors	March 31, 2014
/s/ Barbara J. Dalton Barbara J. Dalton, Ph.D.	Member of the Board of Directors	March 31, 2014
/s/ Todd Foley Todd Foley	Member of the Board of Directors	March 31, 2014
/s/ Joshua Funder Joshua Funder, Ph.D.	Member of the Board of Directors	March 31, 2014
/s/ Peter K. Honig Peter K. Honig, M.D., M.P.H	Member of the Board of Directors	March 31, 2014
/s/ Patrick Y. Yang Patrick Y. Yang, Ph.D.	Member of the Board of Directors	March 31, 2014

INDEX TO EXHIBITS

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4.3	Amended and Restated Investor Rights Agreement by and among the Registrant and certain of its stockholders, dated February 4, 2014 (incorporated by reference to Exhibit 4.2 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
4.4	Form of Warrant to Purchase Common Stock issued to participants in the Registrant's Convertible Debt and Warrant financing, dated October 15, 2013 (incorporated by reference to Exhibit 4.3 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.1+	Form of Indemnity Agreement by and between the Registrant and its directors and officer (incorporated by reference to Exhibit 10.1 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.2+	Celladon Corporation 2001 Stock Option Plan and Form of Notice of Grant of Stock Option, Stock Option Agreement and Stock Option Exercise Notice thereunder (incorporated by reference to Exhibit 10.2 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.3+	Celladon Corporation 2012 Equity Incentive Plan and Form of Stock Option Grant Notice, Option Agreement and Notice of Exercise thereunder (incorporated by reference to Exhibit 10.3 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.4+	Celladon Corporation 2013 Equity Incentive Plan and Form of Stock Option Grant Notice, Option Agreement and Notice of Exercise thereunder (incorporated by reference to Exhibit 10.4 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.5+	Celladon Corporation 2013 Employee Stock Purchase Plan (incorporated by reference to Exhibit 10.5 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.6+	Celladon Corporation Non-Employee Director Compensation Policy (incorporated by reference to Exhibit 10.6 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.7+	Employment Agreement by and between the Registrant and Jeffrey J. Rudy, dated September 3, 2013, as amended (incorporated by reference to Exhibit 10.7 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).

Exhibit Number	Description
10.8+	Employment Agreement by and between the Registrant and Rebecque Laba, dated September 3, 2013, as amended (incorporated by reference to Exhibit 10.8 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.9+	Employment Agreement by and between the Registrant and Ryan K. Takeya, dated September 2, 2013, as amended (incorporated by reference to Exhibit 10.9 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.10+	Employment Agreement by and between the Registrant and Fredrik Wiklund, dated September 3, 2013, as amended (incorporated by reference to Exhibit 10.10 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.11+	Employment Agreement by and between the Registrant and Krisztina M. Zsebo, Ph.D., dated August 30, 2013, as amended (incorporated by reference to Exhibit 10.11 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.12+	Letter Agreement by and between the Registrant and Gregg Huber Alton, dated August 30, 2013 (incorporated by reference to Exhibit 10.12 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.13+	Letter Agreement by and between the Registrant and Graham Cooper, dated September 2, 2013 (incorporated by reference to Exhibit 10.13 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.14	Office Lease by and between the Registrant and Arden Realty, Inc., dated March 6, 2012, as amended (incorporated by reference to Exhibit 10.14 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.15*	License Agreement by and between the Registrant and the Regents of the University of California, dated February 10, 2001, as amended (incorporated by reference to Exhibit 10.15 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.16*	Exclusive License Agreement by and between the Registrant and Martin J. Kaplitt, M.D., dated June 7, 2006 (incorporated by reference to Exhibit 10.16 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.17*	Non-Exclusive License Agreement by and between the Registrant and AskBio, LLC, dated January 15, 2008 (incorporated by reference to Exhibit 10.17 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.18	License Agreement by and between the Registrant and AdVec Inc., dated February 24, 2009 (incorporated by reference to Exhibit 10.18 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.19*	Exclusive Patent License Agreement by and between the Registrant and the Regents of the University of Minnesota, dated May 11, 2009 (incorporated by reference to Exhibit 10.19 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.20*	Non-Exclusive License Agreement by and between the Registrant and Virovek Incorporation, dated November 4, 2010 (incorporated by reference to Exhibit 10.20 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).

Exhibit Number	Description
10.21*	Amended and Restated License Agreement by and between the Registrant and AmpliPhi Biosciences Corporation, dated June 27, 2012 (incorporated by reference to Exhibit 10.21 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.22*	Sublicense Agreement by and between the Registrant and AmpliPhi Biosciences Corporation, dated June 27, 2012 (incorporated by reference to Exhibit 10.22 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.23*	Amended and Restated Manufacturing Services Agreement by and between the Registrant and Lonza Houston, Inc., dated August 26, 2013 (incorporated by reference to Exhibit 10.23 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
10.24+	Letter Agreement by and between the Registrant and Michael Narachi, dated October 16, 2013 (incorporated by reference to Exhibit 10.24 to the Registrant's Registration Statement on Form S-1, as amended (File No. 333-191688), originally filed with the SEC on October 11, 2013).
23.1	Consent of Independent Registered Public Accounting Firm.
24.1	Power of Attorney. Reference is made to the signature page hereto.
31.1	Certification of the Principal Executive Officer pursuant to Rule 13a-14(a) or 15d-14(a) of the Securities Exchange Act of 1934.
31.2	Certification of the Principal Financial Officer pursuant to Rule 13a-14(a) or 15d-14(a) of the Securities Exchange Act of 1934.
32.1	Certification of the Principal Executive Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.
32.2	Certification of the Principal Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.

+ Indicates management contract or compensatory plan.

* Confidential treatment has been granted with respect to certain portions of this exhibit. Omitted portions have been filed separately with the SEC.

Exhibit 23.1

Consent of Independent Registered Public Accounting Firm

We consent to the incorporation by reference in the Registration Statement (Form S-8 No. 333-193662) pertaining to the 2001 Stock Option Plan, the 2012 Equity Incentive Plan, the 2013 Equity Incentive Plan and the 2013 Employee Stock Purchase Plan of Celladon Corporation of our report dated March 31, 2014, with respect to the consolidated financial statements of Celladon Corporation included in this Annual Report (Form 10-K) for the year ended December 31, 2013.

/s/ Ernst & Young LLP

San Diego, California
March 31, 2014

Exhibit 31.1

CERTIFICATION OF PRINCIPAL EXECUTIVE OFFICER
PURSUANT TO RULE 13a-14(a) AND 15d-14(a) OF THE SECURITIES EXCHANGE ACT, AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002

I, Krisztina M. Zsebo, Ph.D., certify that:

1. I have reviewed this Annual Report on Form 10-K of Celladon 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 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)) 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. 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

c. 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 and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

a. All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

b. Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 31, 2014

/s/ Krisztina M. Zsebo, Ph.D.
Krisztina M. Zsebo, Ph.D.
President and Chief Executive Officer
(Principal Executive Officer)

Exhibit 31.2

CERTIFICATION OF PRINCIPAL FINANCIAL OFFICER
PURSUANT TO RULE 13a-14(a) AND 15d-14(a) OF THE SECURITIES EXCHANGE ACT, AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002

I, Rebecque J. Laba, certify that:

1. I have reviewed this Annual Report on Form 10-K of Celladon 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 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)) 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. 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

c. 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 and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

a. All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

b. Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 31, 2014

/s/ Rebecque J. Laba
Rebecque J. Laba
Vice President, Finance and Administration
(Principal Financial Officer)

Exhibit 32.1

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

I, Krisztina M. Zsebo, Ph.D., Chief Executive Officer of Celladon Corporation (the "Registrant"), do hereby certify in accordance with 18 U.S.C. 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, based upon my knowledge:

(1) this Annual Report on Form 10-K of the Registrant, to which this certification is attached as an exhibit (the "Report"), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m); and

(2) the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Registrant.

Date: March 31, 2014

/s/ Krisztina M. Zsebo, Ph.D.
Krisztina M. Zsebo, Ph.D.
President and Chief Executive Officer

The foregoing certification is being furnished solely pursuant to 18 U.S.C. Section 1350 and is not being filed as part of the Report or as a separate disclosure document.

Exhibit 32.2

CERTIFICATION PURSUANT TO SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

I, Rebecque J. Laba, Vice President, Finance and Administration of Celladon Corporation (the "Registrant"), do hereby certify in accordance with 18 U.S.C. 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, based upon my knowledge:

(1) this Annual Report on Form 10-K of the Registrant, to which this certification is attached as an exhibit (the "Report"), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m); and

(2) the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Registrant.

Date: March 31, 2014

/s/ Rebecque J. Laba
Rebecque J. Laba
Vice President, Finance and Administration

The foregoing certification is being furnished solely pursuant to 18 U.S.C. Section 1350 and is not being filed as part of the Report or as a separate disclosure document.