

ARCA biopharma, Inc.
Form 10-K
March 21, 2017

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, 2016

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: 000-22873

ARCA BIOPHARMA, INC.

(Exact Name of Registrant as Specified in Its Charter)

Delaware
(State or Other Jurisdiction
of Incorporation or Organization)

36-3855489
(I.R.S. Employer
Identification No.)

11080 CirclePoint Road, Suite 140, Westminster, CO 80020

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(Address of Principal Executive Offices)

(Zip Code)

(720) 940-2200

(Registrant's telephone number, including area code)

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

Title of Each Class	Name of Each Exchange on Which Registered
Common Stock \$0.001 par value	Nasdaq Capital Market

Securities registered pursuant to Section 12(g) of the Exchange 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 and 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 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 "small 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 aggregate market value of the common stock held by non-affiliates of the Registrant on June 30, 2016, the last business day of the most recently completed second fiscal quarter, was \$13,785,280 based on the last sale price of the common stock as reported on that day by the Nasdaq Capital Market.

As of March 17, 2017, the Registrant had 9,130,926 shares of common stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the Registrant's Definitive Proxy Statement, which will be filed with the Commission pursuant to Section 14A in connection with the 2017 Annual Meeting of Stockholders, are incorporated by reference into Part III of this Form 10-K.

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PART I

Item 1. Business

Some of the statements under “Business,” “Risk Factors,” “Management’s Discussion and Analysis of Financial Condition and Results of Operations” and elsewhere in this Annual Report constitute forward-looking statements. In some cases, you can identify forward-looking statements by the following words: “may,” “will,” “could,” “would,” “should,” “expect,” “intend,” “plan,” “anticipate,” “believe,” “estimate,” “predict,” “project,” “potential,” “continue,” “ongoing” or the negative of these terms and comparable terminology, although not all forward-looking statements contain these words. Examples of these statements include, but are not limited to, statements regarding the following: the timing and results of any clinical trials, including GENETIC-AF, the potential that the data from at least 150 patients will support a recommendation that the GENETIC-AF trial transition to Phase 3 or completion of Phase 2B, the potential timeline for GENETIC-AF trial activities and related recommendations of the DSMB, potential timing for patient enrollment in the GENETIC-AF trial, the ongoing Gencaro trial for the prevention of atrial fibrillation, the potential for genetic variations to predict individual patient response to Gencaro, Gencaro’s potential to treat atrial fibrillation, future treatment options for patients with atrial fibrillation, and the potential for Gencaro to be the first genetically-targeted atrial fibrillation prevention treatment, the sufficiency of our current capital to reach certain of our corporate objectives, our ability to obtain additional funding when needed, including our ability to effect sales under the “at the market offering” agreement or enter into a strategic or other transaction, the extent to which our issued and pending patents may protect our products and technology, the potential of such product candidates to lead to the development of safe or effective therapies, our ability to enter into collaborations, our ability to maintain listing of our common stock on a national exchange, our future operating expenses, our future losses, our future expenditures, and the sufficiency of our cash resources to maintain operations. These statements involve known and unknown risks, uncertainties and other factors that may cause our actual results, levels of activity, performance or achievements to be materially different from the information expressed or implied by these forward-looking statements. While we believe that we have a reasonable basis for each forward-looking statement contained in this Annual Report, we caution you that these statements are based on a combination of facts and factors currently known by us and our projections of the future, about which we cannot be certain.

In addition, you should refer to the “Risk Factors” section of this Annual Report for a discussion of other important factors that may cause our actual results to differ materially from those expressed or implied by our forward-looking statements. As a result of these factors, we cannot assure you that the forward-looking statements in this Annual Report will prove to be accurate. Furthermore, if our forward-looking statements prove to be inaccurate, the inaccuracy may be material. In light of the significant uncertainties in these forward-looking statements, you should not regard these statements as a representation or warranty by us or any other person that we will achieve our objectives and plans in any specified time frame, or at all.

We undertake no obligation to publicly update any forward-looking statements, whether as a result of new information, future events or otherwise. You are advised, however, to consult any further disclosures we make on related subjects in our Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, and our website.

The terms “ARCA,” “the Company,” “we,” “us,” “our” and similar terms refer to ARCA biopharma, Inc.

Overview

We are a biopharmaceutical company applying a precision medicine approach to developing genetically-targeted therapies for cardiovascular diseases. Precision medicine refers to the tailoring of medical treatment to the individual characteristics of each patient through the ability to classify individuals into subpopulations that differ in their susceptibility to a particular disease, in the biology and/or prognosis of those diseases they may develop, or in their

response to a specific treatment. Our lead product candidate, Gencaro™ (bucindolol hydrochloride), is an investigational, pharmacologically unique beta-blocker and mild vasodilator that we are developing for the potential treatment of patients with atrial fibrillation, or AF, and chronic heart failure with reduced left ventricular ejection fraction, or HFrEF. HFrEF constitutes an estimated 50-60% of the total heart failure, or HF population, with the remainder comprised of HF with preserved ejection fraction, or HFpEF. We believe that Gencaro's efficacy is enhanced in a specific genotype that is present in approximately fifty percent of the general population in the United States, and can be identified by a genetic test. We believe that with this genetic test, we may be able to predict individual patient response to Gencaro, potentially improving the efficacy of treatment for AF in HFrEF patients with this particular genotype. We believe that Gencaro, if approved, could potentially be a safer and more effective therapy for treating or preventing AF in patients with HFrEF and could be the first genetically-targeted AF treatment. We also believe that Gencaro may have market exclusivity based on patents and new chemical entity status, if approved in the United States, Europe or other markets.

We are conducting a Phase 2B/Phase 3 clinical superiority trial, known as GENETIC-AF, in which we are evaluating Gencaro for the treatment and prevention of AF in HFrEF patients. In our trial, HFrEF is defined as a left ventricular ejection fraction, or LVEF, of less than 50%. GENETIC-AF compares Gencaro to TOPROL-XL (metoprolol succinate), a drug approved for treating HFrEF that is also prescribed, but not approved, for treating AF in patients with HFrEF. Enrollment in GENETIC-AF is limited to patients that possess the specific genotype that we believe enhances Gencaro's potential therapeutic effects. Our current development of Gencaro

is, in part, based on a prospectively designed DNA substudy of adrenergic receptor polymorphisms in the BEST trial, a previous Phase 3 study of 2,708 HF patients. Based on data from the BEST trial, Gencaro showed potential evidence of enhanced efficacy in treating AF and in reducing mortality and hospitalizations in HF patients with this specific genotype. In 2015, the U.S. Food and Drug Administration, or FDA, designated the investigation of Gencaro for the prevention of AF in a genetically targeted heart failure population (HF patients with reduced LVEF) as a Fast Track development program.

AF, the most common sustained cardiac arrhythmia, is a potentially serious disorder in which the normally regular and coordinated contraction pattern of the heart's two small upper chambers, or the atria, becomes irregular, rapid and uncoordinated. AF commonly occurs together with HFrEF, with AF being both a cause and a result of HFrEF. By increasing heart rate and producing irregular cycle lengths, AF may contribute to the disease processes that leads to the progression of HFrEF and worsening clinical outcomes.

AF is considered an epidemic cardiovascular disease and a major public health burden. The estimated number of individuals with AF globally in 2010 was 33.5 million. According to the 2017 American Heart Association report on Cardiovascular Disease, approximately 5.2 million people in the United States had atrial fibrillation in 2015. Hospitalization rates for AF increased by 23% among U.S. adults from 2000 to 2010 and hospitalizations account for the majority of the economic cost burden associated with AF. In a global registry of AF patients, the rates of heart failure (of all types) ranged from 33% in patients with paroxysmal (episodes lasting 7 days or less) to 56% in patients with permanent AF.

We believe there is a significant need for drug therapies that are safe and effective for HFrEF patients with AF, as the existing drug therapies for the treatment or prevention AF have certain safety disadvantages in HFrEF patients, such as toxic or cardiovascular adverse effects. Most of the approved drugs for AF are contra indicated or have warnings in their prescribing information for such patients. Consequently, in the treatment and prevention of AF in HFrEF patients, we believe there is an unmet medical need for new treatments that have fewer side effects and are more effective than currently available therapies.

We believe that data from the BEST trial indicate that Gencaro may have a genetically regulated effect in reducing or preventing AF in HFrEF patients. A retrospective analysis of data from the BEST trial shows that all patients in the trial treated with Gencaro had a 41% reduction in the risk of new onset AF (time-to-event) compared to placebo ($p = 0.0004$). In a substudy in the trial, which considered only patients with the genotype believed to enhance Gencaro's efficacy (known as the beta-1 389 arginine homozygous genotype), patients treated with Gencaro experienced a 74% ($p = 0.0003$) reduction in risk of AF, based on the same analysis. In addition, the BEST study, the beta-1 389 arginine homozygous genotype Gencaro demonstrated enhanced efficacy in reducing mortality, hospitalizations, and ventricular tachycardia /ventricular fibrillation, or VT/VF. Furthermore, patients with a beta 1 389 arginine homozygous genotype who entered the trial in AF had statistically significant reductions in major cardiovascular or HF mortality/hospitalization composite endpoints, which we believe is the first and thus far only demonstration of effectiveness of a beta-blocker in reducing major HF events in HFrEF patients with permanent AF. We believe that in HFrEF patients, the therapeutic efficacy of TOPROL-XL is not enhanced in patients with a beta-1 389 arginine homozygous genotype, and we believe that Gencaro may be potentially unique in the beta-blocker class of drugs due to its apparent pharmacologic interaction with this beta-1 adrenergic receptor polymorphism. The beta-1 389 arginine homozygous genotype was present in about 47% of the patients in the BEST pharmacogenetic substudy, and we estimate it is present in about 50% of the U.S. general population.

GENETIC-AF is an adaptive, seamless design Phase 2B/Phase 3, multi-center, randomized, double-blind, clinical superiority trial comparing the safety and efficacy of Gencaro against an active comparator, the beta-blocker TOPROL-XL (metoprolol succinate), that seeks to enroll a combined total of approximately 620 patients. Eligible patients will have HFrEF, a history of paroxysmal AF (episodes lasting 7 days or less) or persistent AF (episodes

lasting more than 7 days and less than 1 year) in the past 6 months, and the beta-1 389 arginine homozygous genotype that we believe responds most favorably to Gencaro. A subset of patients in the trial will also undergo continuous heart rhythm monitoring to assess AF burden, which is defined as the amount of time per day that a patient experiences AF. These data will be collected via newly or previously implanted Medtronic, Inc. devices capable of assessing AF burden (for example, implantable loop recorders, pacemakers, cardioverter-defibrillators, or cardiac resynchronization therapy devices). The primary endpoint of the study is time to first event of symptomatic AF/atrial flutter, or AFL, or all-cause mortality. The combined Phase 2B/Phase 3 trial is designed for 90 percent power at a p-value of less than 0.01 significance level to detect a 25 percent reduction in the primary endpoint for patients in the Gencaro arm compared to patients in the TOPROL-XL arm. We received guidance from the FDA regarding the GENETIC-AF clinical trial prior to initiation of the trial. Based on this FDA guidance, we believe that a successful GENETIC-AF Phase 3 clinical trial, with a p-value of less than or equal to 0.01 could be sufficient evidence of efficacy upon which to base a New Drug Application, or NDA, when submitted with the prior Phase 3 BEST trial data, for the approval of Gencaro for an AF indication in HFrEF patients. A second trial may be required if the GENETIC-AF trial results produce a p-value greater than 0.01. The trial is currently enrolling patients in the United States, Canada and Europe.

The GENETIC-AF Data and Safety Monitoring Board, or DSMB, will perform a pre-specified interim analysis of unblinded efficacy data when at least 150 patients have evaluable data. A randomized patient has evaluable data either when they experience their first composite endpoint event, AF/AFL or all-cause mortality, or after completion of the 24-week primary endpoint follow-up period. The analysis will be conducted for detection of evidence of safety and superior efficacy of Gencaro versus the active comparator, TOPROL-XL.

The prospectively defined features of this analysis include an estimate of Gencaro effectiveness relative to TOPROL-XL and an assessment of safety as characterized by adverse events. The relative benefit estimate will utilize Bayesian statistical methods to calculate the predictive probability of the Phase 3 patient cohort hazard ratio based on the interim Phase 2B data. Prospectively defined ranges of predictive probabilities have been predetermined to define three potential outcomes based on the projection of the Phase 2B interim results:

- 1) transition the trial to Phase 3 based on a likelihood of achieving a statistically significant hazard ratio in favor of Gencaro (evidence of an efficacy signal consistent with pretrial assumptions) and enroll up to a total of 620 patients (including the Phase 2B patients);
- 2) completion of the Phase 2B stage of the trial including 24-week follow-up of all randomized subjects (approximately 250 patients), based on an intermediate result that is potentially favorable but does not support transition of the trial to Phase 3 or;
- 3) immediate termination of the trial due to futility.

We, in collaboration with the GENETIC-AF Steering Committee, will determine the next steps for the trial based on the DSMB recommendation from this interim analysis and on our available capital. The unblinded statistical data available to the DSMB will not be disclosed to us or the public. We randomized our 175th patient in the trial in March 2017. We project that the outcome of the DSMB interim analysis and recommendation will be available in the third quarter of 2017. In February 2016, we amended the trial protocol to allow for up to 250 patients to be enrolled in the Phase 2B portion of the trial, which is intended to enable the study to continue enrolling patients while the DSMB interim analysis is underway. Should the DSMB recommend that the study continue to Phase 3, the trial would continue enrolling to a total of approximately 620 patients (i.e., up to 250 patients in Phase 2B and 370 patients in Phase 3), subject to our obtaining sufficient financing to fund the Phase 3 portion of the trial.

In February 2016, the GENETIC-AF protocol was amended to simplify certain operational aspects of the trial. We believe these modifications facilitated site recruitment and enrollment in existing trial sites and additional sites in European countries, where we are expanding the study to support both the latter portion of Phase 2B, as well as the potential Phase 3 portion of the trial. We believe inclusion of European investigative sites will also support potential European regulatory submissions and partnering activity. We received no objections from the FDA and Health Canada on the protocol amendments prior to their implementation. As such, we believe that these changes do not fundamentally alter or impact previous regulatory agreements.

Our GENETIC-AF clinical trial of Gencaro requires a companion diagnostic test to identify the patient's receptor genotype. We have an agreement with Laboratory Corporation of America, or LabCorp, to provide the companion diagnostic test and services to support our GENETIC-AF trial. LabCorp has developed the genetic test and obtained an Investigational Device Exemption, or IDE, from the FDA for the companion diagnostic test which is being used in our GENETIC AF clinical trial. We retain all rights to the genetic test.

Medtronic, Inc., or Medtronic, a global healthcare solutions company, is collaborating with us on the GENETIC-AF trial. Under the collaboration with Medtronic, ARCA is conducting a substudy that includes continuous monitoring of the cardiac rhythms in a subset of patients enrolled during the trial, which is the basis for a supportive endpoint in the trial known as AF burden. The collaboration is administered by a joint ARCA-Medtronic committee. Medtronic uses its proprietary CareLink System to collect and analyze the cardiac rhythm data from the implanted Medtronic devices

and the data will be used by the DSMB as part of the interim analysis. Medtronic will support the reimbursement process for U.S. patients enrolled in the Phase 2B portion, and will provide financial support of unreimbursed costs for a certain number of U.S. patients in the Phase 2B portion up to a certain maximum amount per patient. If GENETIC-AF continues to Phase 3, we will continue to enroll additional patients, with Medtronic devices for monitoring and recording AF burden, in the substudy. Medtronic will provide the agreed upon CareLink System cardiac rhythm data collection and analysis for the Phase 3 portion of the substudy and support the reimbursement process.

We have been granted patents in the United States, Europe, and other jurisdictions for methods of treating AF and HF patients with Gencaro based on genetic testing. We believe our patent portfolio and new chemical entity exclusivity may provide market exclusivity for the indications of Gencaro that we may develop, into approximately 2030 or 2031 in the United States, Europe and other markets.

To support the continued development of Gencaro, in June 2015, we completed a private placement that raised approximately \$34.2 million of net proceeds as additional funds for the Phase 2B portion of the GENETIC-AF trial and to support our ongoing operations. We are seeking to enroll up to 250 HFrEF patients in the Phase 2B portion of the GENETIC-AF trial, and we believe that our current cash and cash equivalents will be sufficient to fund our operations, at our projected cost structure, through the end of 2017. In January 2017, we entered into a sales agreement with an agent to sell, from time to time, our common stock having an aggregate offering price of up to \$7.3 million, in an “at the market offering.” We are not obligated to make any sales of our common stock, and, as of March 17, 2017, we have sold an aggregate of 43,156 shares of our common stock pursuant to the terms of such sales agreement for aggregate gross proceeds of approximately \$112,000, before paying commissions to our placement agent of approximately \$3,000. However, changing circumstances may cause us to consume capital significantly faster or slower than we

currently anticipate. We have based these estimates on assumptions that may prove to be wrong, and we could exhaust our available financial resources sooner than we currently anticipate. If we continue to the Phase 3 portion of GENETIC-AF, we will be required to raise additional funds.

Our Strategy

Our mission is to become a leading biopharmaceutical company developing cardiovascular therapies, using genetic targeting, where possible, to enhance therapeutic response. To achieve this goal, we are pursuing the following strategies:

- Advance the development of Gencaro. We plan to advance the clinical development of Gencaro for AF in HFrEF patients by completing the GENETIC-AF clinical trial, which dependent upon the outcome of the DSMB interim analysis and our available capital, could transition to Phase 3 in 2017. Additional development opportunities for Gencaro potentially include indication expansion or new formulation development. We are also pursuing co-development partnerships for Gencaro.
- Raise additional funding or complete a strategic transaction. To support the continued clinical development of Gencaro, including the GENETIC-AF clinical trial, we expect to seek additional funding, including through the sale of public or private equity or debt securities, or through the completion of a strategic transaction.
- Build a cardiovascular pipeline. Our management and employees, including our chief executive officer, are experienced in cardiovascular research, molecular genetics and clinical development of cardiovascular therapies. We are seeking to leverage this expertise to identify, acquire and develop other cardiovascular products or candidates, particularly those with potential for pharmacogenetic based development.
- Leverage our existing assets. We are pursuing opportunities to leverage certain of our development-stage product candidates. These opportunities include collaborations with institutions conducting proof of concept studies and government funded development.

Atrial Fibrillation in Heart Failure Market Background and Opportunity

AF is a common and potentially serious cardiac rhythm disorder. In AF, the normally regular and coordinated contraction pattern of the heart's two small upper chambers, or the atria, becomes irregular, rapid and uncoordinated. AF may produce uncomfortable symptoms, but can also have serious consequences. In addition to being a risk factor for stroke, AF can impair heart function by various mechanisms and lead to reduced cardiac function and progression of HF.

AF is considered an epidemic cardiovascular disease. According to the 2017 American Heart Association report on Cardiovascular Disease, approximately 5.2 million people in the United States had AF in 2015, with medical and indirect costs totaling an estimated \$31 billion. Hospitalization rates for AF increased by 23% among U.S. adults from 2000 to 2010 and hospitalizations account for the majority of the economic cost burden associated with AF. The approved therapies for the treatment or prevention AF have certain safety disadvantages in HFrEF patients, such as toxic or cardiovascular adverse effects, and most of the approved drugs for AF are contra indicated or have warnings in their prescribing information for such patients. We believe there is an unmet medical need for new AF treatments that have fewer side effects than currently available therapies and are more effective, particularly in HFrEF patients.

AF often occurs in patients with HF. HF is also one of the most prevalent and serious cardiac disorders. In HF, cardiac function and circulatory output become impaired and cannot meet the body's metabolic demands under normal conditions. A common type of HF is HFrEF, where left ventricular systolic function is reduced and the chamber becomes enlarged. The prevalence of AF in patients with HFrEF can vary from approximately 5% to over 50%, depending on HF severity and other factors. In an analysis of patients with new onset HF (of all types) in the Framingham Heart Study, 57% also had AF. In a survey of over 10,000 AF patients from 26 countries conducted in 2009 and 2010, the incidence of HF (of all types) ranged from approximately 33% to over 55%, depending on whether the patient's AF was paroxysmal, persistent or permanent. Therefore, there is a significant population of patients with both HF and AF, as well as HF patients at risk of developing AF.

AF and HFrEF are interrelated and share common disease processes. The presence of HFrEF makes it more likely AF will develop or perpetuate once it is initiated; in turn, AF in patients with HFrEF may predispose to HF progression including worsening of left ventricular dysfunction, increased hospitalization burden, and increased risk of death.

In treating AF, the risk of stroke is generally addressed through the use of anticoagulants. Beyond this, the goals of current medical therapy for AF are to maintain sinus rhythm or to control ventricular rate response in patients who cannot maintain sinus rhythm, in an effort to minimize patient symptoms and avoid the risk of further complications and disease progression. Current treatments include pharmaceutical therapy and device intervention. Device interventions, such as AF radiofrequency ablation or atrio-ventricular nodal ablation with pacemaker implantation, are considered second line therapy in treatment guidelines.

Addressing the rhythm and rate abnormalities of AF is believed to be particularly important in HFrEF patients because of the relationship between the presence of AF and HF progression. However, the current treatment options for controlling AF in these

patients have significant limitations. While anticoagulants are commonly prescribed to address the risk of stroke in AF patients, these drugs do not address the pathological effects of the irregular and rapid heartbeat that is the hallmark of AF. The drugs that are commonly used to control the rhythm disorder of AF, known as anti-arrhythmic drugs, have severe limitations in HFrEF patients. These drugs may have toxic or cardiovascular adverse effects, particularly with chronic use, and most are contraindicated or have warnings in their labels for use in HF patients.

Drugs in the class known as beta-blockers are commonly prescribed for treating HFrEF and to control rapid heart rate in HF patients with AF. Beta-blockers are generally safe for chronic use in these patients. However, the beta-blockers currently approved or used in HF patients are not approved for treating AF and have demonstrated mild efficacy in preventing AF. In addition, analyses of published trials indicate that current beta-blockers provide no significant benefit in improving clinical outcomes for patients with both AF and HFrEF.

We believe there is an unmet medical need for new therapeutics that may provide better treatment for patients with HFrEF and AF, which can safely treat the rhythm and rate disorders in these patients with greater efficacy, while improving their clinical outcomes and prognoses.

Gencaro

Gencaro (bucindolol hydrochloride) is an investigational, pharmacologically unique beta-blocker and mild vasodilator being developed for the treatment of AF. Gencaro is considered part of the beta-blocker class of compounds because of its property of blocking both beta-1 and beta-2, receptors in the heart. The blocking of these receptors prevents them from binding with other molecules, primarily the neurotransmitter norepinephrine, or NE, which activate these receptors. We believe that Gencaro is well-tolerated in cardiovascular patients because of its mild vasodilator effects. Originally developed by Bristol-Myers Squibb, or BMS, the active pharmaceutical ingredient, or API, in Gencaro, bucindolol hydrochloride, has been tested clinically in approximately 4,500 patients, including over 3,000 patients in seven clinical trials in HFrEF patients. Gencaro was the subject of a Phase 3 HF mortality trial in 2,708 patients, mostly in the United States, or the BEST trial. The BEST trial included a DNA bank of over 1,000 patients, which was used to evaluate the effect of genetic variation on patients' response to Gencaro.

At the time of the BEST trial, our scientific co-founders, Dr. Michael Bristow and Dr. Stephen Liggett, hypothesized that the unique pharmacologic properties of Gencaro would interact with common genetic variations of beta-1, beta-2 and alpha-2C, adrenergic receptors, which are important receptors that regulate cardiac or adrenergic (sympathetic) nerve function. They tested this hypothesis prospectively in a substudy conducted using data from the BEST DNA bank. On the basis of this study, Drs. Bristow and Liggett have determined that patients with certain variations in these receptors had substantially improved outcomes on primary and certain secondary clinical endpoints in the trial, such as mortality, HF progression, hospitalization and prevention of arrhythmias, relative to the counterpart genotype groups and the general patient population of the BEST trial. We believe that these genetically determined receptor variations, which are detectable using standard DNA testing technology, can serve as diagnostic markers for predicting enhanced therapeutic response to Gencaro, and potentially avoiding adverse events, in individual patients. We have patented our methods for treating AF and HF patients with Gencaro in the United States, Europe and other markets based on genetic testing.

Pharmacology and Pharmacogenetics

Gencaro's pharmacology appears to be different from other compounds in the beta-blocker class in several fundamental respects. First, the National Heart, Lung and Blood Institute of the National Institutes of Health, or NHLBI, and the Cooperative Studies Program of the Department of Veterans Affairs sponsored studies, or the Liggett-Bristow investigations, conducted by Drs. Bristow and Liggett indicated that in human myocardial preparations, Gencaro, but not other tested beta-blockers used to treat HF, predisposes to a shift in equilibrium of beta-1 389 arginine but not 389 glycine receptors from a constitutively active to an inactive state, a property known as inverse agonism. Second, other studies, including BEST, indicated that Gencaro lowers the systemic levels of the

neurotransmitter norepinephrine, or NE, released by cardiac and other adrenergic nerves. The beta-1 389 arginine receptor, 100% of the receptor population in patients with a 389 arginine homozygous genotype, has much higher affinity for binding to NE compared to 389 glycine receptors, and published data indicate that NE lowering from Gencaro is beneficial in patients who have only beta-1 389 arginine receptors. In contrast, patients with lower NE affinity beta-1 389 glycine genotypes may have blunting of efficacy from greater amounts of NE lowering. Third, Drs. Liggett and Bristow's investigations have revealed that NE lowering by Gencaro is in turn regulated by an adrenergic receptor polymorphism present in adrenergic nerve terminals, alpha-2C 322-325 insertion (Ins)/deletion (Del). The presence of 322-325 Del genotypes predisposes to greater amounts of Gencaro related NE lowering, which in the presence of beta-1 389 glycine genotypes can lead to compromise of efficacy. However, for patients with a beta-1 389 arginine homozygous genotype the high affinity of this receptor for NE means that any amount of NE lowering may be beneficial, and that it is not necessary to take the alpha-2C 322-325 Ins/ Del genotype into consideration. As a result, the GENETIC-AF trial is targeted at patients with a beta-1 389 arginine homozygous genotype, which has been present in approximately 50% of screened patients. We believe that these properties and their pharmacogenetic implications for modulating effectiveness are unique to Gencaro, and if the drug is approved, will be described in the prescribing information.

Gencaro has an important interaction with the beta-1 receptor found on muscle cells, or cardiac myocytes, of the heart. The general role of the beta-1 receptor and its downstream signaling cascades is to regulate the strength and rate of the heart's contractions. NE serves as an activator of the beta-1 receptor, causing the receptor to initiate signaling to the cardiac myocyte. Although this signaling may be beneficial to the failing heart in the short term, in chronic HFrEF patients the beta-1 receptor also initiates harmful, or cardiomyopathic, signaling which, over time, exacerbates the heart's structural and functional decline. Beta-blockers counteract this destructive process by reducing beta-1 receptor signaling and reversing abnormal patterns of gene expression. They do this by binding to the receptor and blocking NE molecules from binding and activating the signaling activity and, in Gencaro's case, by inactivating constitutively active (i.e. active in the absence of NE stimulation) beta-1 389 arginine receptors and lowering NE levels.

We believe Gencaro has a powerful interaction with the higher-function beta-1 389 arginine variation of the beta-1 receptor. Laboratory studies show that constitutively active receptors will continue to signal in the presence of standard beta-blockade with neutral antagonists. The Liggett-Bristow investigations have demonstrated that in isolated preparations of human ventricular myocardium, in beta-1 389 arginine receptors carvedilol and metoprolol are neutral antagonists, and that metoprolol can block the inverse agonist effects of Gencaro that reduce the signaling of constitutively active receptors. We believe that Gencaro's inverse agonist property contributes to the enhanced lowering of heart failure and arrhythmia event rates in HFrEF patients who are beta-1 389 arginine homozygous genotype relative to individuals who are beta-1 389 Gly carriers or to the general population. In addition, we believe the unique NE lowering properties of Gencaro have a selectively beneficial effect in patients who have only beta-1 389 arginine receptors, because of the high affinity of these receptors for NE.

The BEST trial

The NHLBI and Veterans Affairs Cooperative Studies funded BEST trial began in 1995. It was a double-blind, placebo-controlled, multi-center study of bucindolol's effect on reduction of mortality and morbidity in an advanced chronic HFrEF population. The primary endpoint of the BEST trial was all cause mortality, or ACM, and the pre-specified main secondary endpoint was progression of HF, defined as death from HF, cardiac transplant, HF hospitalization, or emergency room visit for the treatment of worsening HF not requiring hospitalization. The trial was planned to run four and one-half years, and enroll 2,800 patients. The trial enrolled a total of 2,708 chronic HF patients, who were mostly from the United States. Under the umbrella of the BEST trial substudies program, a DNA bank and substudy was created, and 1,040 of the BEST patients participated by providing blood for DNA analysis. The DNA bank provided data for the DNA substudy of BEST patients conducted by Drs. Bristow and Liggett.

In 1999, the BEST trial was terminated prior to the completion of follow-up, in response to a recommendation of the BEST trial DSMB. The primary reason for termination was loss of investigator equipoise; in other words, the fact that the BEST investigators were no longer uncertain regarding the comparative therapeutic merits of giving a placebo versus giving a beta-blocker to a HFrEF patient. Positive mortality results from two other HF trials involving other beta-blockers had been reported, and a substantial number of BEST trial investigators concluded that it was unethical to continue to give placebo to BEST trial participants. As a result, some investigators began to prescribe these other beta-blockers to patients in the trial, which threatened to destroy the trial's integrity; therefore the trial was terminated early.

Clinical Results and the DNA Substudy

Following termination, the preliminary results of the study were analyzed and published. The preliminary determination and general perception were that the BEST trial had failed on the basis of not meeting its primary endpoint of ACM. The published values were a 10% risk reduction in mortality with a p-value of 0.10. Subsequently, we reanalyzed the results from BEST, in accordance with the FDA approved, pre-specified statistical analysis plans, which had not been performed by the sponsors of BEST when the trial was terminated. Our reanalysis demonstrated a 13% risk reduction on the primary endpoint of all-cause mortality in the BEST trial with a p-value of 0.053.

In 2003 and 2004, the results of the DNA substudy conducted by Drs. Bristow and Liggett began to be analyzed and released. The DNA substudy results indicated a significant enhancement of response on the major heart failure clinical endpoints from the BEST trial in patients with the beta-1 389 arginine homozygous genotype. The risk reduction on HF clinical efficacy endpoints such as mortality and hospitalization ranged from 34% to 48% in this genotype. In addition, in arrhythmia endpoints of atrial fibrillation or VT/VF, tracked by adverse events, or AEs, and surveillance electrocardiograms, or ECGs, the risk reduction by bucindolol in the beta 1 389 arginine homozygous genotype appeared to be even greater, with risk reductions of 74% for both endpoints.

Shown below are certain of the primary and secondary endpoint data from the BEST HF DNA substudy results, by genotype:

BEST Trial Clinical Responses[†] by Genotype Groups

Endpoint (entire BEST DNA substudy, n = 1040 patients)	{beta-1 389 Arg/ Arg + any alpha-2C} “Very Favorable” Patient Type (47%)	{beta-1 389 Gly carrier+ alpha-2C Ins/Ins} “Favorable” Patient Type (40%)	{beta-1 389 Gly carrier + alpha-2C Del carrier} “Unfavorable” Patient Type (13%)
All Cause Mortality (ACM), TTE	38%*	25%	4%
Cardiovascular Mortality (CVM), TTE	48%*	40%*	11%
ACM + transplantation	43%*	24%	4%
HF (HF) Progression	34%**	20%	1%
HF Hosp days/patient	48%**	17%	19%
AF prevention (from AE and ECG db) ‡	74%**	6%	33%
VT/VF prevention (from AE db)	74%**	49%*	24%
Entered DNA substudy in AF, n = 111	beta-1 Arg/Arg, any alpha-2C	beta-1 389 Gly C, any alpha-2C	
ACM/HF Hosp, TTE	77%*	52%	
Cardiovascular (CV) mortality/CV Hosp	72%*	7%	

[†]Covariate adjusted, transplant censored analysis with 1 – hazard ratio estimates presented[‡] in 925 patients who entered in SR

*p<0.05; **p ≤ 0.007; TTE: Time To Event

Analysis of BEST trial for AF

The BEST study data were further analyzed focusing on AF prevention, rate control in patients with established AF, and on clinical outcomes of patients with AF. Although there was no pre-determined AF endpoint, including reduction in risk of AF, in the BEST trial, according to our analysis of adverse events and surveillance ECG’s during the trial, 7.9% of patients developed new onset AF, with a greater incidence observed in the placebo group (9.7%) compared to the bucindolol group (6.2%). This corresponded to a 36% reduction in the incidence of new onset AF (based on crude event rates) for patients receiving bucindolol (p = 0.002). In a time to event analysis, the risk of new onset AF was reduced by 41% (p = 0.0004) with bucindolol treatment. Patients in the BEST study with the beta-1 389 Arg/Arg genotype who received Gencaro had a 74% reduction in the risk of developing new onset AF (p = 0.0003).

Further published analyses of the data from BEST suggest that Gencaro may also have potential efficacy for other clinical endpoints and outcomes related to AF. A published analysis of the BEST data revealed that of the 303 patients in the BEST trial with established AF, 67% of those who received Gencaro achieved ventricular response rate control, defined as a resting heart rate of less than or equal to 80 beats per minute without symptomatic bradycardia (p < 0.005). In AF patients who achieved ventricular response rate control, Gencaro produced a 39% reduction (p = 0.025) in cardiovascular mortality/cardiovascular hospitalizations. In addition, Gencaro also improved cardiovascular clinical endpoints for those AF patients possessing the beta-1 389 arginine genotype that ARCA believes is most favorable for Gencaro response. In a substudy of 1,040 patients in BEST in which patient genotypes were analyzed, Gencaro was associated with a 72% decrease (p = 0.039) in cardiovascular mortality/cardiovascular hospitalizations in those 52 AF

patients in the substudy with the beta-1 389 arginine homozygous genotype.

Analysis of the BEST Study data also shows that Gencaro has potential efficacy against the serious arrhythmias of VT/VF, which also appears to be genetically regulated. A published report demonstrated that patients in the BEST Trial who received Gencaro experienced a 58% reduction in the incidence of VT/VF ($p = 0.00006$), adjusted for the competing risk of mortality. In addition, the authors of this report determined that Gencaro reduced the incidence of VT/VF by 74% ($p = 0.00005$) in patients with the beta-1 389 arginine homozygous genotype.

As with the overall study cohort, most patients (89%) in the 1,040 patient DNA substudy were free of AF (91% sinus rhythm, 9% other non-AF rhythms) at baseline. The proportion of patients free of AF at baseline was also similar in the two treatment groups for the overall DNA substudy cohort, as well as in the beta-1 389 genotype subgroups. In the BEST DNA substudy, the proportion of patients who developed new onset AF was similar compared to the overall study cohort for both the placebo group (11% and 10%, respectively) and the Gencaro group in the DNA substudy population compared to the overall study cohort (7% and 6%, respectively). Also, there was a similar reduction in new onset AF observed in the bucindolol group compared to placebo (43% and 41%, respectively, by time to event analysis). Therefore, the overall results from the genetic substudy population are consistent with the results from the overall study population.

In patients with all genotypes, the AF risk reduction of 41-43% by Gencaro in BEST is based on an analysis of adverse events and surveillance ECG's which was similar to AF risk reductions observed in a meta-analysis of data regarding seven placebo-controlled beta-blocker trials in HFrEF patients. In the meta-analysis, beta-blockers appeared to reduce the incidence of new onset AF in all but one trial, with an overall relative risk reduction of 27%. Despite what we believe to be potential evidence for the prevention of AF in HFrEF trials, no beta-blocker has FDA approval for use in this indication. However, the evidence of modest efficacy by beta-blockers approved for other indications will require that any Phase 3 trials with Gencaro will have an active beta-blocker comparator instead of a comparison against placebo. The Phase 2B/Phase 3 trial GENETIC-AF trial is only enrolling patients with the beta-1 389 arginine homozygous genotype. In the BEST trial, the post hoc analysis of patients with the beta-1 389 arginine homozygous genotype who received Gencaro had a 74% reduction in the risk of developing AF. In another trial, the active comparator we are using in GENETIC-AF, TOPROL-XL, reduced the risk of developing AF by 48% in all genotypes. Because these are not the same trials, the results should not be relied on as direct comparisons. However, we believe that these data from prior clinical trials indicate that Gencaro may have an advantage in preventing AF when compared to metoprolol in GENETIC-AF, in part because the trial is enrolling only patients with the beta-1 389 arginine homozygous genotype, who appear to respond best to Gencaro.

Clinical and Regulatory Strategy

The regulatory strategy for Gencaro is to conduct our adaptive design Phase 2B/Phase 3 clinical trial, GENETIC-AF, to obtain an AF approval in a genotype specific HFrEF population. We are enrolling certain patients with the beta-1 389 arginine homozygous genotype in our AF clinical trial because our analysis of the BEST DNA substudy indicated this group had a 74% reduction in risk for new AF events, in addition to reducing event rates for mortality and HF hospitalizations.

We have created an adaptive design for GENETIC-AF. We are seeking to enroll up to 250 HFrEF patients in the Phase 2B portion of the study. The GENETIC-AF DSMB will perform a pre-specified interim analysis of unblinded efficacy data when at least 150 patients have evaluable data. A randomized patient has evaluable data either when they experience their first composite endpoint event, AF/AFL or all-cause mortality, or after completion of the 24-week primary endpoint follow-up period. The analysis will be conducted for detection of evidence of safety and superior efficacy of Gencaro versus the active comparator, TOPROL-XL.

The prospectively defined features of this analysis include an estimate of Gencaro effectiveness relative to TOPROL-XL and an assessment of safety as characterized by adverse events. The relative benefit estimate will utilize Bayesian statistical methods to calculate the predictive probability of the Phase 3 patient cohort hazard ratio based on the interim Phase 2B data. Prospectively defined ranges of predictive probabilities have been predetermined to define three potential outcomes based on the projection of the Phase 2B interim results:

- 1) transition the trial to Phase 3 based on a likelihood of achieving a statistically significant hazard ratio in favor of Gencaro (evidence of an efficacy signal consistent with pretrial assumptions) and enroll up to a total of 620 patients (including the Phase 2B patients);
- 2) completion of the Phase 2B stage of the trial including 24-week follow-up of all randomized subjects (approximately 250 patients), based on an intermediate result that is potentially favorable but does not support transition of the trial to Phase 3 or;
- 3) immediate termination of the trial due to futility.

In February 2016, we amended the trial protocol to allow for up to 250 patients to be enrolled in the Phase 2B portion of the trial, which is intended to enable the study to continue enrolling patients while the DSMB interim analysis is underway. Should the DSMB recommend that the study proceed to Phase 3, the trial would continue enrolling to a total of approximately 620 patients (i.e., up to 250 patients in Phase 2B and 370 patients in Phase 3), subject to our obtaining sufficient financing to fund the Phase 3 portion of the trial.

We have received guidance from the FDA regarding our Phase 2B/Phase 3 clinical study comparing Gencaro to TOPROL-XL for the prevention of AF in approximately 620 patients. Based on this FDA guidance, we believe that a successful GENETIC-AF Phase 3 clinical trial, with a p-value of less than 0.01, could be sufficient evidence of efficacy upon which to base a New Drug Application, or NDA, for the approval of Gencaro for an AF indication in HFrEF patients. Our Investigational New Drug, or IND, application for atrial fibrillation, under which our GENETIC-AF trial is performed, has been accepted by FDA and is active. In March 2015, the GENETIC-AF protocol was revised to expand the target study population. Previously, the protocol required patients to have persistent AF at the time of screening to be eligible. Under the revised protocol, patients in sinus rhythm who have experienced symptomatic AF are eligible for inclusion in the trial, as are patients with paroxysmal AF. We believe this expanded target population has improved trial screening and enrollment rates and could broaden the potential commercial market for Gencaro, should it achieve regulatory approval in the future. In February 2016, the GENETIC-AF protocol was amended to simplify certain operational aspects of the trial. We believe these modifications facilitated site recruitment and enrollment in existing trial sites and potential sites in European countries, where we have expanded the study to support both the latter portion of Phase 2B, as well as the potential Phase 3 portion of the trial. We believe inclusion of European investigative sites may support potential European regulatory submissions and

partnering discussions. We received no objections from the FDA and Health Canada on the protocol amendments prior to their implementation. As such, we believe that these changes do not fundamentally alter or impact previous regulatory agreements.

In 2015, the FDA designated the investigation of Gencaro for the prevention of atrial fibrillation/atrial flutter in a genetically targeted heart failure population (heart failure patients with reduced left ventricular ejection fraction) as a Fast Track development program.

Fast Track drug development designation was included in the FDA Modernization Act of 1997, or FDAMA, as a formal process to enhance interactions with the FDA during drug development. A drug development program with Fast Track designation is eligible for consideration for some or all of the following programs for expediting development and review: scheduled meetings to seek FDA input into development plans, priority review of the NDA the option of submitting portions of an NDA for review prior to submission of the complete application and potential accelerated approval.

The Gencaro Test

If approved, we believe that Gencaro will be the first cardiovascular drug to be integrated with a companion diagnostic to predict enhanced efficacy. We believe the drug label we will propose for Gencaro would identify the patient receptor genotype studied in the trial that can expect enhanced efficacy and, and that the label would recommend receptor genotype testing prior to initiation of therapy. Therefore, the commercialization of Gencaro may require an FDA approved diagnostic test for this genotype be available. Such a test, or the Gencaro Test, could be performed by a variety of laboratory processes or platforms. We are currently using one such platform for the GENETIC-AF trial, and retain all rights to it. We believe the Genaro Test could be developed and commercialized through a preferred diagnostic provider, by the company marketing Gencaro, or a combination of approaches. We also believe that point of care genetic tests, which could be performed during the patient's visit to the physician, may become feasible as part of the commercialization strategy.

For our GENETIC-AF clinical trial, we have an agreement with LabCorp to provide the companion diagnostic test and services to support the trial. To provide those services, LabCorp has developed the genetic test and obtained from the FDA an IDE for the companion diagnostic test we use in our GENETIC-AF clinical trial.

Licensing and Royalty Obligations

We have licensed worldwide rights to Gencaro, including all preclinical and clinical data from Cardiovascular Pharmacology and Engineering Consultants, LLC, or CPEC, who has licensed rights in Gencaro from BMS. In addition, we have sublicensed CPEC's rights from BMS. CPEC is a licensing entity which holds the rights of the biotechnology companies that were the commercial sponsors of the BEST trial. If the FDA grants marketing approval for Gencaro, the license agreements state that we are required to make a milestone payment of \$8.0 million within six months after FDA approval. The license agreements also state that we are required to make milestone payments of up to \$5.0 million in the aggregate upon regulatory marketing approval in Europe and Japan. The licenses state that our royalty obligations range from 12.5% to 25% of revenue from the related product based on achievement of specified product sales levels including a 5% royalty that CPEC is obligated to pay BMS. The agreements state that we have the right to buy down the royalties to a range of 12.5% to 17% by making a payment to CPEC within six months of regulatory approval. We also have licensed worldwide rights to intellectual property covering the pharmacogenetic response of Gencaro based on the cardiac receptor polymorphisms, which is owned by the University of Colorado. We have no material future financial obligations under this license. We also have licensed exclusive, worldwide rights to develop and commercialize diagnostics for these receptor polymorphisms, for the purpose of prescribing Gencaro.

Development Pipeline

Our development activities are substantially focused on our lead product candidate, Gencaro, for the potential treatment of HF patients with AF. The primary endpoint of our current trial is the prevention of AF in these patients. We also believe, based upon data from the BEST trial, that Gencaro may have additional potential in providing rate control and clinical benefit for patients with permanent AF, in preventing VT/VF and in treating HF generally. We also have developed and patented an isomer version of bucindolol, which appears to be substantially more potent than the current formulation. We do not expect to pursue development of Gencaro for disease indications beyond HFrEF patients with AF without obtaining additional funding or entering into a strategic partnership or collaboration. We believe Gencaro has potential to address these additional indications, and that the clinical response of patients with these diseases may be genetically influenced, based on the same genetic markers we have identified for our proposed treatment of AF with Gencaro.

We also have exclusive pharmacogenetic and other patent rights to drug candidates that have potential indications in cardiovascular disease, oncology and other therapeutic areas, in both early and later stages of development. We may seek partners to assist us in the development of these candidates or who may license them. We may also seek funds to advance the development of the compounds on our own.

Competition

Current AF treatments include pharmaceutical intervention and device intervention. There are several antiarrhythmic drugs approved by the FDA for the treatment and/or prevention of recurrent AF. However, these drugs have safety and/or administration concerns and all but one have contraindications or label warnings regarding their prescription in patients with heart failure.

Drugs that are currently approved or used for the treatment or prevention of AF in HFrEF have notable risks due to adverse side effects or lack sufficient efficacy. Therefore, in HFrEF we believe there is a substantial unmet medical need for new AF treatments that have fewer side effects and are more effective than currently available therapies. We believe that Gencaro's prevention of AF in HFrEF patients would provide this patient population a safer treatment option than other treatments currently or approved by FDA.

The pharmaceutical industry is highly competitive. We face significant competition from pharmaceutical companies and biotechnology companies that are researching and selling products designed to treat cardiovascular conditions. Most of these companies have significantly greater financial, product development, manufacturing, and commercial resources than we have.

In addition, our proposed prescribing information for Gencaro includes a recommendation for genetic testing, which will add additional cost and procedures to the process of prescribing Gencaro, and which could make it more difficult for us to compete against existing or future therapies.

Manufacturing and Product Supply

Gencaro is a small molecule drug with an established manufacturing history. Multiple manufacturers of both the API and drug product have successfully produced Gencaro for use in clinical trials over the course of its clinical development. We outsource all manufacturing and analytical testing of the Gencaro API and drug product. We have selected third party contract manufacturing organizations on the basis of their technical and regulatory expertise. Our approach with our contract manufacturing partners has been to replicate the manufacturing processes that were used to support the prior pivotal clinical trial with Gencaro, and to minimize any changes from these baseline processes, thereby reducing technical and regulatory risk. We contracted with Groupe Novasep to complete the drug substance registration batches required for the Gencaro NDA. These batches were successful, and the resulting drug substance was used to supply the drug product registration campaign. Remaining inventory was placed in current Good Manufacturing Practice, or cGMP, storage to provide a backup supply for the GENETIC-AF trial, and for use as an initial source of drug substance to support eventual product launch, if approved.

For drug product production, we have contracted with Patheon, Inc. to manufacture the Gencaro tablets. Gencaro is produced in a tablet form, utilizing standard solid oral dosage processing techniques. Six separate dosage strengths are manufactured, with the maximum recommended dose of 50mg twice daily for patients weighing 75kg or less and 100mg twice daily for patients weighing more than 75kg. Registration batches were successfully completed by Patheon, Inc. and tablets from these runs have been placed in cGMP storage to supply the GENETIC-AF trial. In addition, we have contracted with a separate service provider for packaging and distribution of our clinical trial materials.

Our manufacturing focus for 2017 is to supply the blinded clinical trial materials for Gencaro and the comparator compound, and to manage the clinical distribution channels necessary for the successful execution of the GENETIC-AF trial.

Research and Development Expenses

Our research and development expenses totaled \$12.3 million for the year ended December 31, 2016 as compared to \$7.1 million for 2015, an increase of approximately \$5.3 million. R&D expense in 2017 is expected to be higher than 2016 as we continue to enroll patients in our GENETIC-AF clinical trial.

Government Regulation

Governmental authorities in the United States at the federal, state, and local levels and foreign countries extensively regulate, among other things, the research, development, testing, manufacture, labeling, promotion, advertising, marketing, distribution, sampling, and import and export of pharmaceutical and medical device products. In the United States, the FDA regulates these activities at the federal level pursuant to the Federal Food Drug and Cosmetic Act, or the FDCA, and the regulations promulgated thereunder. In Canada, Health Canada regulates these activities. In Europe, the Competent Authorities and Ethics Committees of the respective countries regulate these activities. We anticipate that all of our product candidates will require regulatory approval by governmental agencies prior to commercialization. The process of obtaining approval and the subsequent process of maintaining compliance with appropriate federal, state, local and foreign statutes and regulations require the expenditure of substantial time and financial resources. In addition, these statutes, rules, regulations and policies may change and our products may be subject to new legislation or regulations. Both before and after approval or clearance, failure to comply with the requirements of the FDA and other state and

federal statutes can lead to significant penalties or could disrupt our ability to manufacture and sell these products. In addition, the FDA could refuse to provide certificates needed to export our products if the agency determines that we are not in compliance.

Premarket Approval of Drugs

FDA approval is required for marketing of any new drug, dosage form, indication, or strength. The steps required before new human therapeutic drug products are marketed in the United States and foreign countries include rigorous preclinical and clinical testing and other approval requirements by regulatory agencies, such as the FDA and comparable agencies in foreign countries. There is no guarantee that products will be approved in a specific timeframe or at all.

Preclinical Phase. Preclinical studies are generally conducted in the laboratory to identify potential drug candidates and to evaluate their potential efficacy and safety. These studies include laboratory evaluation of product chemistry, formulation and stability, as well as studies to evaluate short and long-term toxicity in animals. Preclinical studies are governed by numerous regulations, including but not limited to FDA's Good Laboratory Practices.

Clinical Phase. Before human clinical trials can commence, an Investigational New Drug, or IND, application, submitted to FDA must become effective. For an IND to become effective, the applicant must submit, among other things, information on design of the proposed investigation, reports necessary to assess the safety of the drug for use in clinical investigation, and information on the chemistry and manufacturing of the drug, controls available for the drug, and primary data tabulations from animal or human studies. The clinical phase of development involves the performance of human studies, including adequate and well-controlled human clinical trials to establish the safety and efficacy of the product candidate for each proposed indication. Typically, clinical evaluation involves three sequential phases, which may overlap. During Phase 1, clinical trials are conducted with a relatively small number of subjects or patients to determine the early safety profile of a product candidate, as well as dose tolerance, absorption, and the pattern of drug distribution and drug metabolism. Phase 2 trials are conducted with groups of patients afflicted by a specific target disease to determine preliminary efficacy, optimal dosages and dosage tolerance and to identify possible adverse effects and safety risks. In Phase 3, larger-scale, multi-center trials are conducted with patients afflicted with a specific target disease over a longer term to confirm Phase 2 results and provide reliable and conclusive data supporting efficacy and safety of a drug as required by regulatory agencies for drug approval. The conduct of clinical trials is subject to extensive regulation. FDA may delay or suspend clinical trials through clinical holds.

NDA Submission. In the United States, the results of preclinical and clinical testing along with chemistry, manufacturing and controls information, are submitted to the FDA in the form of an NDA. Under the current Prescription Drug User Fee Act, or PDUFA, after submission of an NDA and payment, or waiver, of the required fee, the FDA's goal is to review most standard NDAs within 10 months from the time that a sponsor's application is accepted as filed by the FDA, which can occur within a 60-day window following the initial submission of the application. At the end of the 10 months, the FDA's goal is to issue a "complete response," or approve the NDA. While FDA's goal is to issue a complete response within 10 months, the process may take longer than 10 months, particularly if multiple review cycles are required. Gencaro has been granted Fast Track Designation which allows for a rolling review of a marketing application. A rolling review allows FDA to consider reviewing portions of a NDA before the sponsor submits the complete application.

In responding to an NDA, the FDA may grant marketing approval or deny the application if the FDA determines that the application does not satisfy the statutory and regulatory approval criteria. A denial may include a request for additional information, including additional clinical data and/or an additional Phase 3 clinical trial. Data from clinical trials are not always conclusive and FDA may interpret data differently than we interpret data. Under the Food and Drug Modernization Act of 1997, the FDA is authorized to approve a drug based on a single adequate and well-controlled study if such study and other confirmatory data are sufficient to establish the drug's effectiveness.

However, it has long been the FDA's general position that the standard of proof of a drug's effectiveness generally requires at least two well-controlled and adequate Phase 3 clinical studies demonstrating statistically significant results as compared to a placebo or active control (with p-values of less than 0.05) with respect to the primary endpoint or endpoints of the trial.

In addition, in accordance with current FDA law and regulations, the FDA may refer a drug to an advisory committee for review prior to approval. Most new compounds are referred to an FDA advisory committee, which could add additional time to the review process. There is no guarantee that the advisory committee will recommend approval of a drug candidate. In some cases, FDA may require completion, within a specified time period, of additional clinical studies after approval, referred to as Phase 4 clinical studies, to monitor the effect of a new product and may prevent or limit future marketing of the product based on the results of these post-marketing programs. Furthermore, prior to granting approval, the FDA generally conducts an inspection of the facilities, including outsourced facilities that will be involved in the manufacture, production, packaging, testing and control of the drug substance and finished drug product for compliance with current Good Manufacturing Practice, or cGMP, requirements.

If the FDA approves the NDA, the sponsor is authorized to begin commercialization of the drug in accordance with the approval. Even if the FDA approves the NDA, the FDA may decide later to suspend or withdraw product approval if compliance with regulatory

standards is not maintained or if safety problems are recognized after the product reaches the market. In addition, the FDA requires surveillance programs to monitor approved products that have been commercialized, and the agency has the power to require additional clinical studies, to require changes in labeling or to prevent further marketing of a product based on the results of these post-marketing programs. The FDA also has authority to request implementation of a risk evaluation and mitigation strategy, or REMS, that could restrict distribution of Gencaro or require us to provide additional risk information to prescribers. Whether or not FDA approval has been obtained, approval of a product candidate by comparable foreign regulatory authorities is necessary prior to the commencement of marketing of a product candidate in those countries. The approval procedures vary among countries and can involve additional testing. The time required to obtain approval may differ from that required for FDA approval.

Post-approval Compliance. If regulatory approval for a drug or medical device is obtained, the product and the facilities manufacturing the product are subject to periodic inspection and continued regulation by regulatory authorities, including compliance with cGMP, as well as labeling, advertising, promotion, recordkeeping, and reporting requirements, including the reporting of adverse events. In addition, the FDA closely regulates the post-approval marketing and promotion of drugs, including standards and regulations for labeling, promotion to health care professionals, direct-to-consumer advertising, off-label promotion, industry-sponsored scientific and educational activities and promotional activities involving the Internet. Drugs may be marketed only for the approved indications and in accordance with the provisions of the approved labeling. Companies are responsible for compliance with such requirements and would be responsible to ensure that all contract manufacturing organizations who perform work for them also comply with such requirements. Similarly, if a drug manufacturer hires contract sales representatives or consultants to promote its products, such organizations or individuals must comply with all of the same requirements applicable to the drug manufacturer. The FDA regularly inspects companies to determine compliance with cGMPs and other post-market requirements. Failure to comply with statutory requirements and the FDA's regulations can result in a variety of administrative or enforcement actions, including but not limited to an FDA Form 483 (which is issued by the FDA at the conclusions of an inspection when an investigator has observed any conditions that may constitute violations), a public warning letter, suspension or withdrawal of regulatory approvals, product recalls, product detentions, refusal to provide export certificates, seizure of products and criminal prosecution.

Drug Price Competition and Patent Term Restoration Act of 1984. Under the Drug Price Competition and Patent Term Restoration Act of 1984, also known as the Hatch-Waxman Act, Congress created an abbreviated FDA review process for generic versions of pioneer (brand name) drug products. The Hatch-Waxman Act also provides for patent term restoration and the award, in certain circumstances, of non-patent marketing exclusivities.

Generic Drug Approval. The Hatch-Waxman Act established an abbreviated FDA review process for drugs that are shown to be equivalent to approved pioneer drugs. Approval for a generic drug is obtained by filing an abbreviated NDA, or ANDA. Generic drug applications are "abbreviated" because they generally do not include clinical data to demonstrate safety and effectiveness. Instead, an ANDA applicant must establish that its product is bioequivalent to an approved drug and that it is the same as the approved drug with respect to active ingredient(s), route of administration, dosage form, strength and recommended conditions of use (labeling). The FDA will approve the generic as suitable for an ANDA if it finds that the generic does not raise questions of safety and effectiveness as compared to the pioneer drug. A drug is not eligible for ANDA approval if the FDA determines that it is not equivalent to the pioneer drug or if it is intended for a different use. Any applicant who files an ANDA seeking approval of a generic version of an approved drug listed in FDA's Approved Drug Products with Therapeutic Equivalence Evaluations, or the Orange Book, must certify to the FDA that (i) no patent information on the drug has been listed in the Orange Book; (ii) that each patent listed in the Orange Book for that approved drug has expired; (iii) FDA should approve the product on the date on which a listed patent expires; or (iv) that such patent is invalid, unenforceable or will not be infringed by the manufacture, use or sale of the generic drug. If the ANDA applicant makes a certification pursuant to (iv) above, or a Paragraph IV certification, and the NDA holder files an infringement suit against the ANDA applicant within 45 days of receiving the Paragraph IV notification, the NDA owner is entitled to an automatic 30-month stay of FDA's ability to approve the ANDA. This 30-month stay will end early upon any decision by a court that the patent is invalid, unenforceable or not infringed by the generic drug.

Patent Term Extension. While the term of a U.S. patent is generally 20 years from the earliest priority date of a patent application (excluding a provisional patent application), a U.S. patent that covers subject matter requiring regulatory approval to market is eligible for an extension of that patent term. The Hatch-Waxman Act provides for the restoration of a portion of the patent term lost during product development and FDA review of an application. Patent Term Extension, or PTE, extends the term of an issued patent for generally (i) the length of the FDA approval process, i.e., the complete period of NDA review, and (ii) half of the time spent in clinical trials, i.e., the IND period. However, the maximum period of restoration cannot exceed five years, or restore the total remaining term of the patent to greater than 14 years from the date of FDA approval of the product.

Under 35 U.S.C. § 156(a), a patent covering a method of using a product is eligible for PTE if the following conditions are met:

- 1) the patent has not yet expired;
 - 2) the patent was not previously extended;
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- 3) the patent owner submits an application for PTE that includes all necessary supporting information within 60 days of FDA approval;
- 4) the product was subject to regulatory review before its commercial marketing or use; and
- 5) the drug application is for the first permitted commercial marketing of the product.

We have obtained four U.S. patents (U.S. Patent Nos. 7,678,824; 8,080,578; 8,093,286; 8,946,284). We believe that, if Gencaro is approved by the FDA, any one of the U.S. patents may be eligible for PTE, which could provide approximately 5 years of additional patent life based on our current clinical trial plans.

A Supplementary Protection Certificate, or SPC, is a form of patent term extension that is available for pharmaceutical products approved for marketing in the European Union, or EU. We obtained a patent in Europe on methods for using Gencaro that is similar to US Patent 7,678,824 (EP 1802775); this EP patent is in force in certain countries in Europe, including the United Kingdom, France, Germany, Italy and Spain. We believe that this patent may be eligible for an SPC, if Gencaro is approved for marketing in any European country in which the patent is in force, which could provide up to five years of additional patent life. We believe that our patents in other jurisdictions may also be eligible for similar term extensions.

Non-Patent Marketing Exclusivities. Separate and apart from patent protection, the Hatch-Waxman Act entitles approved drugs to various periods of non-patent statutory protection, known as marketing exclusivity. The Hatch-Waxman Act provides five years of “new chemical entity” marketing exclusivity to the first applicant to gain approval of an NDA for a product that contains an active moiety not found in any other approved product. This exclusivity means that another manufacturer cannot submit an ANDA or 505(b)(2) NDA until the marketing exclusivity period ends. This exclusivity protects the entire new chemical entity franchise, including all products containing the active ingredient for any use and in any strength or dosage form, but will not prevent the submission or approval of stand-alone NDAs where the applicants have conducted their own clinical studies to demonstrate safety and effectiveness. There is an exception, however, for a competitor that seeks to challenge a patent with a Paragraph IV certification. Four years into the five-year exclusivity period, a manufacturer who alleges that one or more of the patents listed with the NDA is invalid, unenforceable or not infringed may submit an ANDA or 505(b)(2) NDA for a generic or modified version of the product.

The Hatch-Waxman Act also provides three years of “new use” marketing exclusivity for the approval of NDAs, and supplements, where those applications contain the results of new clinical investigations (other than bioavailability studies) essential to the FDA’s approval of the applications. Such applications may be submitted for new indications, dosage forms, strengths, or new conditions of use of approved products. So long as the studies are essential to the FDA’s approval or were conducted by or for the applicant, this three-year exclusivity prohibits the final approval of ANDAs or 505(b)(2) NDAs for products with the specific changes associated with those studies. It does not prohibit the FDA from approving ANDAs or 505(b)(2) NDAs for other products containing the same active ingredient, without those changes.

Similar non-patent market exclusivity is provided for in the EU and other international jurisdictions. We believe that, if approved in the EU, Gencaro may be eligible for ten years of market exclusivity in the EU, measured from the date of approval there.

FDA Premarket Review of Medical Devices

Unless an exemption applies, each medical device that a company wishes to market in the United States requires either approval of a premarket approval application, or PMA, or clearance of a premarket notification, commonly known as a “510(k)” from the FDA. The FDA classifies medical devices into one of three classes. Devices deemed to pose lower risks are placed in either class I or II, which may require the manufacturer to submit to the FDA a 510(k) requesting permission to commercially distribute the device. Clearance of a 510(k) usually requires between three months and one year from the time of submission of the 510(k), although the process may take longer. The FDA’s 510(k) clearance procedure is less rigorous than the PMA approval procedure, but is available only to companies who

can establish that their device is substantially equivalent to a legally-marketed “predicate” device that was (i) on the market prior to the enactment of the Medical Device Amendments of 1976, (ii) reclassified from Class III to Class II, or (iii) has been cleared through the 510(k) procedure. 510(k)s must typically be supported by performance data, including preclinical data, bench testing, and in some cases, clinical data. Some low risk devices are exempted from this requirement. Devices deemed by the FDA to pose the greatest risks, or for which there is no predicate, are placed in class III, and require a PMA.

PMA Pathway. Generally, a PMA must be supported by extensive data and valid scientific evidence, including, but not limited to, technical, preclinical, clinical trials, manufacturing and labeling to demonstrate to the FDA’s satisfaction a reasonable assurance of the safety and effectiveness of the device for its intended use. After a PMA is sufficiently complete, the FDA will accept the application and begin an in-depth review of the submitted information and will generally conduct a pre-approval inspection of the manufacturing facility or facilities to ensure compliance with FDA’s Quality System Regulations, or QSR. By statute, the FDA has 180 days to review the “accepted application”, although, generally, review of the application can take between one and three years, and it may take significantly longer. The PMA application process can be expensive, and there is a substantial “user fee” that must be paid to FDA in connection with the submission of a PMA application. If the FDA’s evaluation of the PMA application or the manufacturing facility is

not favorable, the FDA may deny approval of the PMA application or issue a “not approvable” letter. The FDA may also require additional clinical trials, which can delay the PMA approval process by several years. In addition, if FDA discovers that an applicant has submitted false or misleading information, FDA may refuse to review submissions until certain requirements are met pursuant to its Application Integrity Policy, or AIP. If the FDA approves the PMA, it may place restrictions on the device. After the PMA is approved, if significant changes are made to a device, its manufacturing or labeling, a PMA supplement containing additional information must be filed for prior FDA approval. PMA supplements often must be approved by the FDA before the modification to the device, the labeling, or the manufacturing process may be implemented. Delays in receipt of or failure to receive such clearances or approvals, the loss of previously received clearances or approvals, or the failure to comply with existing or future regulatory requirements could have a material adverse effect on our business, financial condition and results of operations.

Clinical Trials. Clinical trials are generally required to support a PMA application and are sometimes required for 510(k) clearance. These trials generally require an Investigational Device Exemption, or IDE, application approved in advance by the FDA for a specified number of patients, unless the proposed study is deemed a non-significant risk study, which is eligible for an exemption from the IDE requirements. The IDE application must be supported by appropriate data, such as animal and laboratory testing results. Clinical trials may begin if the IDE application is approved by the FDA and the appropriate institutional review boards, or IRBs, at the clinical trial sites. Submission of an IDE application does not give assurance that the FDA will issue the IDE. If the IDE application is approved, there can be no assurance the FDA will determine that the data derived from the trials support the safety and effectiveness of the device or warrant the continuation of clinical trials. An IDE supplement must be submitted to and approved by the FDA before a sponsor or investigator may make a change to the investigational plan in such a way that may affect its scientific soundness, study indication or the rights, safety or welfare of human subjects. The trial must also comply with the FDA’s regulations, including the requirement that informed consent be obtained from each subject. Even if a trial is completed, the results of clinical testing may not adequately demonstrate the safety and efficacy of the device or may otherwise not be sufficient to obtain FDA clearance to market the product in the United States.

In Vitro Diagnostic Companion Diagnostic Devices. FDA has described IVD companion diagnostic devices as in vitro diagnostic devices that provide information that is essential for the safe and effective use of a corresponding therapeutic product. The use of an IVD companion diagnostic device with a particular therapeutic product is stipulated in the instructions for use in the labeling of both the diagnostic device and the corresponding therapeutic product, as well as in the labeling of any generic equivalents of the therapeutic product. An IVD companion diagnostic device could be used to (i) identify patients who are most likely to benefit from a particular therapeutic product; (ii) identify patients likely to be at increased risk for serious adverse reactions as a result of treatment with a particular therapeutic product; or (iii) monitor response to treatment for the purpose of adjusting treatment (e.g., schedule, dose, discontinuation) to achieve improved safety or effectiveness. Although FDA’s regulation of IVD companion diagnostic devices is evolving and implemented on a case-by-case basis, FDA’s stated policy for a novel therapeutic product is that an IVD companion diagnostic device should be developed and approved or cleared contemporaneously to support the therapeutic product’s safe and effective use. The clinical performance and clinical significance of the IVD companion diagnostic device is to be established using data from the clinical development program of the corresponding therapeutic product. FDA recognizes, however, that there may be cases where contemporaneous development may not be possible. With respect to the Gencaro Test, there is no assurance that we will be able to develop and obtain approval or clearance contemporaneously with Gencaro. Failure to develop the Gencaro Test or obtain clearance or approval could delay approval of Gencaro, if FDA regards the Gencaro Test as an IVD companion diagnostic test that is essential to the safe and effective use of Gencaro.

Continuing Regulation. After a device is placed on the market, numerous regulatory requirements apply to the manufacturer, or holder of a PMA approval. Unless subject to an exemption, medical devices distributed in the United States must be manufactured in compliance with the FDA’s Quality System Regulations, or QSRs, and current good manufacturing practices. These regulations govern the manufacturing process, including design, manufacture, testing, release, packaging, distribution, documentation and purchasing, as well as complaint handling, corrective and

preventative actions and internal auditing. In complying with the QSRs, manufacturers must expend significant time, money and effort. Companies are also subject to other post-market and general requirements, including but not limited to product listing and establishment registration, post-market surveillance requirements, limitations on promotion, and requirements for recordkeeping and reporting of certain adverse events, malfunctions, corrections and removals. As discussed above, FDA regularly inspects companies to assess compliance with the QSRs and other post-market requirements. Failure to comply with these requirements can result in, among other things, adverse publicity, warning letters, and potential civil and criminal penalties. With respect to the Gencaro Test, we intend to seek a new or amended collaborative arrangement with a diagnostic company in which we could license them certain rights to perform the diagnostic test for patients with AF. As part of such arrangement, we will seek to have the diagnostic company take responsibility for compliance with the FDA's device approval and on-going regulatory requirements.

International Marketing Approvals. International sales of medical devices are subject to foreign government regulations, which vary substantially from country to country and are subject to change. The time required to obtain approval by a foreign country may be longer or shorter than that required for FDA clearance or approval, and the requirements may differ.

Other Regulatory Requirements. We are also subject to various federal, state and local laws, regulations and recommendations relating to safe working conditions, laboratory and manufacturing practices, the experimental use of animals and the use and disposal of hazardous or potentially hazardous substances, including radioactive compounds and infectious disease agents, used in connection with our work. The extent and character of governmental regulation that might result from future legislation or administrative action cannot be accurately predicted.

Medical Device Tax

In March 2010, the U.S. Congress adopted and President Obama signed into law comprehensive health care reform legislation. Among other initiatives, these laws impose significant new taxes on medical device makers in the form of a 2.3% excise tax on U.S. medical device sales, with certain exemptions, beginning on January 1, 2013. The Gencaro Test is likely to be subject to this tax.

Intellectual Property

The future success of our business will partly depend on our ability to maintain market exclusivity for Gencaro in the United States and important international markets, and for other products or product candidates that we may acquire or develop. We will rely on statutory protection, patent protection, trade secrets, know-how, and in-licensing of technology rights to maintain protection for our products.

We believe that both patent protection and data exclusivity statutes will give Gencaro market exclusivity in the United States and in major international markets. If approved by the FDA or international regulatory agencies, Gencaro will qualify as a New Chemical Entity, or NCE, as it has never received regulatory approval in any jurisdiction. As an NCE, Gencaro will enjoy market exclusivity in the United States and most international markets under data exclusivity statutes. These laws provide for an exclusivity period beginning from regulatory approval, during which any generic competitor is barred from submitting an application that relies on the data that has been submitted in connection with the approval of the NCE. In the United States, the Hatch-Waxman Act provides for an initial period of up to five years from approval of the NCE, during which a generic application attempting to rely on the data submitted for the NCE cannot be filed with the FDA. This period can be effectively extended to seven and one-half years from FDA approval because a provision of the Hatch-Waxman Act provides for an automatic 30-month extension of the exclusivity period if we promptly pursue litigation against a company attempting to enter the market with a generic for a drug that is covered by a composition of matter or method of use patent.

Many international markets have data exclusivity statutes that are analogous to Hatch-Waxman and often more protective. The analogous statute in the European Medicines Evaluation Agency will, in general, provide Gencaro with a minimum of ten years of protection before such a generic application may be approved. Protection under Hatch-Waxman and other data exclusivity statutes is sometimes considered superior to patent protection, as the generic cannot be marketed during the period of exclusivity, thus eliminating the need to initiate patent infringement litigation with its accompanying risks and costs.

In addition to protection under data exclusivity statutes, we believe that Gencaro's patent portfolio will also provide market exclusivity. We have been granted patents in the United States and Europe that claim the use of Gencaro in patients predicted to have a favorable response to the drug based on genetic polymorphisms in the genes encoding the beta-1 and/or alpha-2C receptors. We believe that this patent strategy may deter generic competition because of the threat of patent litigation or may exclude generic competition from the market until the patents expire if we are successful in litigation. Consequently, if our patent strategy is successful, we believe we may avoid generic competition with Gencaro in the United States or certain countries in Europe until at least the expiration of these patents, which would be no earlier than 2026 in the United States and into 2025 in Europe. In addition, we believe that if Gencaro is approved, any one of our U.S. patents may be entitled to an extension of its term and the European patent may be entitled to an extension through a supplemental protection certificate in one or more countries in Europe. The length of any such extension may vary by country. We cannot predict whether any such extensions will

be granted, but if they are, they may provide market exclusivity for Gencaro into approximately 2030 or 2031 in the United States and Europe. In addition, we were granted a patent on the S-isomer formulation of Gencaro, which we believe could be important in Gencaro's future development.

We also have other patent rights in additional drug candidates having possible indications in cardiovascular disease, oncology, and other therapeutic areas; these are in both early and later stages of development. We may seek collaborators to assist us in the development of these candidates or we may seek to raise funds to advance the development of the compounds on our own.

Employees

As of December 31, 2016, we had 20 full-time employees. None of our employees are represented by any collective bargaining unit. We believe that we maintain good relations with our employees.

Corporate Information

On January 27, 2009, we completed a business combination, or the Merger, between Nuvelo, Inc., or Nuvelo, a corporation originally incorporated in 1992, and its subsidiary, ARCA biopharma, Inc. Immediately following the Merger, we changed our name from Nuvelo, Inc. to ARCA biopharma, Inc. Our principal offices are located in Westminster, Colorado.

We file our annual reports on Form 10-K, quarterly reports on Form 10-Q and current reports on Form 8-K pursuant to Section 13(a) or 15(d) of the Securities Exchange Act of 1934 electronically with the SEC. The public may read or copy any materials that have been filed with the SEC at the SEC's Public Reference Rooms at 100 F Street, N.E., Washington, D.C. 20549 on official business days during the hours of 10:00 a.m. and 3:00 p.m. The public may obtain information on the operation of the Public Reference Room by calling the SEC at 1-800-SEC-0330. The SEC maintains an Internet site that contains reports, proxy and information statements, and other information regarding issuers that file electronically with the SEC. The address of that site is <http://www.sec.gov>.

You may obtain a free copy of our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and amendments to those reports on our website at <http://www.arcabiopharma.com> on the earliest practicable date following the filing with the SEC or by contacting the Investor Relations Department at our corporate office by calling (720) 940-2200. Information found on our website is not incorporated by reference into this report.

Item 1A. Risk Factors

An investment in ARCA's securities involves certain risks, including those set forth below and elsewhere in this report. In addition to the risks set forth below and elsewhere in this report, other risks and uncertainties not known to ARCA, that are beyond its control or that ARCA deems to be immaterial may also materially adversely affect ARCA's business operations. You should carefully consider the risks described below as well as other information and data included in this report.

Risks Related to Our Business and Financial Condition

If we encounter difficulties enrolling patients in our clinical trials, our trials could be delayed or otherwise adversely affected.

The GENETIC-AF clinical trial requires that we identify and enroll a large number of patients with the condition under investigation and the trial will enroll only those patients having a specific genotype, and certain patients who have or are willing to have a Medtronic device implanted for monitoring and recording AF burden data. Because of the rigorous enrollment criteria, we may not be able to enroll a sufficient number of patients to complete our clinical trial in a timely manner. To date, we have enrolled fewer patients in the trial than we had originally projected to enroll at this point.

Patient enrollment is affected by factors including:

- design of the protocol or amendments made to the protocol;
- the size of the patient population;

- eligibility criteria for the study in question;
- perceived risks and benefits of the drug under study;
- availability of competing therapies, including the off-label use of therapies approved for related indications;
- efforts to facilitate timely enrollment in clinical trials;
- the success of our personnel in making the arrangements with potential clinical trial sites necessary for those sites to begin enrolling patients;
- patient referral practices of physicians;
- availability of clinical trial sites;
- use of clinical trial sites outside the United States and regulatory compliance within other countries;
- other clinical trials seeking to enroll subjects with similar profiles;
- the number of patients having the specific genotype needed for our trial; and
- the number of patients having, or willing to have, a Medtronic device implanted for monitoring and recording AF burden data.

If we have difficulty enrolling a sufficient number of patients in our GENETIC-AF trial, we may need to delay or terminate our GENETIC-AF trial, which would have a negative impact on our business. Our projected clinical trial timeline assumes that we increase the rate of patient enrollment from the current rate. If our projections are inaccurate, the trial will take significantly longer than we project. For instance, we have amended the GENETIC-AF trial protocol three times. We believe that the prior amendments have increased the rate of patient screening and enrollment. We do not know if our current enrollment projections will prove to be accurate, or if our current enrollment rate will be sustained. Delays in enrolling patients in our clinical trial would also adversely affect our ability to generate any product, milestone and royalty revenues under collaboration agreements, if any, and could impose significant additional costs on us or on any future collaborators.

We will need to raise substantial additional funds through public or private equity transactions and/or complete one or more strategic transactions, to continue development of Gencaro. If we are unable to raise such financing or complete such a transaction, we may not be able to continue operations.

In light of the expected development timeline to potentially obtain FDA approval for Gencaro, if at all, the substantial additional costs associated with the development of Gencaro, including the costs associated with the GENETIC-AF clinical trial, and the substantial cost of commercializing Gencaro, if it is approved, we will need to raise substantial additional funding through public or private equity or debt transactions or a strategic combination or partnership. If we are delayed in obtaining funding or are unable to complete a strategic transaction, we may discontinue our development activities on Gencaro or discontinue our operations. Even if we are able to fund continued development and Gencaro is approved, we expect that we will need to complete a strategic transaction or raise substantial additional funding through public or private debt or equity securities to successfully commercialize Gencaro.

We believe our cash, cash equivalents and marketable securities balance as of December 31, 2016 will be sufficient to fund our operations, at our projected cost structure, through the end of 2017. In January 2017, we entered into a sales agreement with an agent to sell, from time to time, our common stock having an aggregate offering price of up to \$7.3 million, in an “at the market offering.” We are not obligated to make any sales of our common stock, and, as of March 17, 2017, we have sold an aggregate of 43,156 shares of our common stock pursuant to the terms of such sales agreement for aggregate gross proceeds of approximately \$112,000, before paying commissions to our placement agent of approximately \$3,000. Sales under this sales agreement will dilute the ownership interest of our stockholders and may cause the price per share of our common stock to decrease. Changing circumstances may cause us to consume capital significantly faster or slower than we currently anticipate. We have based these estimates on assumptions that may prove to be wrong, and we could exhaust our available financial resources sooner than we currently anticipate.

Our liquidity, and our ability to raise additional capital or complete any strategic transaction, depends on a number of factors, including, but not limited to, the following:

- progress of GENETIC-AF, including enrollment and any data that may become available;
- the costs and timing for potential additional clinical trials in order to gain possible regulatory approval for Gencaro;
- the market price of our stock and the availability and cost of additional equity capital from existing and potential new investors;
- our ability to retain the listing of our common stock on the Nasdaq Capital Market;
- general economic and industry conditions affecting the availability and cost of capital;
- our ability to control costs associated with our operations;
- the costs of filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights; and
- the terms and conditions of our existing collaborative and licensing agreements.

The sale of additional equity or convertible debt securities would likely result in substantial dilution to our stockholders. If we raise additional funds through the incurrence of indebtedness, the obligations related to such indebtedness would be senior to rights of holders of our capital stock and could contain covenants that would restrict our operations. We also cannot predict what consideration might be available, if any, to us or our stockholders, in

connection with any strategic transaction. Should strategic alternatives or additional capital not be available to us, or not be available on acceptable terms, we may be unable to realize value from our assets and discharge our liabilities in the normal course of business which may, among other alternatives, cause us to further delay, substantially reduce or discontinue operational activities to conserve our cash resources.

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If we are not able to successfully develop, obtain FDA approval for, and provide for the commercialization of Gencaro in a timely manner, we may not be able to continue our business operations.

We currently have no products that have received regulatory approval for commercial sale. The process to develop, obtain regulatory approval for and commercialize potential product candidates is long, complex and costly. We are screening and enrolling patients in our seamless design Phase 2B/Phase 3 adaptive design clinical study of Gencaro in up to 250 HFrEF patients with AF in the Phase 2B portion, and the trial could expand to a Phase 3 clinical study of approximately 370 additional HFrEF patients with AF (for a total trial enrollment of 620 patients). We began screening patients for the Phase 2B portion of GENETIC-AF in April 2014 and enrolled our first patient in June 2014. We implemented amendments to the GENETIC-AF protocol in March 2015 and February 2016, which we believe expanded the eligible target population, increased the patient screening and enrollment rate, and simplified trial procedures. We believe our March 2015 protocol amendment increased our patient screening and enrollment rate. We do not know if our current enrollment projections will prove to be accurate, or if our current enrollment rate will be sustained. The complex nature of the disease indication and the genotype required for the trial result in stringent enrollment criteria, which may cause GENETIC-AF to enroll more slowly and take longer than we currently project.

Failure to demonstrate that a product candidate, including Gencaro, is safe and effective, or significant delays in demonstrating such safety and efficacy, would adversely affect our business. Failure to obtain marketing approval of Gencaro from appropriate regulatory authorities, or significant delays in obtaining such approval, would also adversely affect our business and could, among other things, preclude us from completing a strategic transaction or obtaining additional financing necessary to continue as a going concern.

Even if approved for sale, a product candidate must be successfully commercialized to generate value. We do not currently have the capital resources or management expertise to commercialize Gencaro and, as a result, will need to complete a strategic transaction, or, alternatively, raise substantial additional funds to enable commercialization of Gencaro, if it is approved. Failure to successfully provide for the commercialization of Gencaro, if it is approved, would damage our business.

Our clinical trials for our product candidates may not yield results that will enable us to further develop our products and obtain regulatory approvals necessary to sell them.

We will receive regulatory approval for our product candidates only if we can demonstrate in carefully designed and conducted clinical trials that the product candidate is safe and effective. We do not know whether any current or future clinical trials, including the GENETIC-AF clinical trial for Gencaro, will demonstrate sufficient safety and efficacy to obtain the requisite regulatory approvals or will result in marketable products.

For example, GENETIC-AF is designed as an adaptive trial. The DSMB will conduct a pre-specified interim analysis of study endpoints for efficacy, safety and futility. Based on the results of the interim analysis, the DSMB may recommend that the trial proceed to Phase 3, the trial be completed as a Phase 2B study, or termination of the trial due to futility. The DSMB may also recommend changes to the study design before potentially proceeding to Phase 3. The Company, in consultation with the trial's Steering Committee and the DSMB, will make the final determination on the trial's next development steps. If we do not see sufficient efficacy and safety in the Phase 2B portion of the trial, we will not initiate the Phase 3 portion of the trial.

Clinical trials are lengthy, complex and expensive processes with uncertain results. We have spent, and expect to continue to spend, significant amounts of time and money in the clinical development of our product candidates. We have never conducted a Phase 2 or Phase 3 clinical trial and have limited staff with the requisite experience to do so. We therefore rely on contract research organizations, or CROs, to conduct certain aspects of our clinical trial. During the third quarter of 2014, we reduced the scope of our primary CRO's work and we have assumed those responsibilities for our GENETIC-AF clinical trial. While certain of our employees have experience in designing and

administering clinical trials, these employees have no such experience as employees of ARCA.

The results we obtain in preclinical testing and early clinical trials may not be predictive of results that are obtained in later studies. We may suffer significant setbacks in advanced clinical trials, even after seeing promising results in earlier studies. Based on results at any stage of clinical trials, we may decide to repeat or redesign a trial or discontinue development of one or more of our product candidates. If we fail to adequately demonstrate the safety and efficacy of our products under development, we will not be able to obtain the required regulatory approvals to commercialize our product candidates, and our business, results of operations and financial condition would be materially adversely affected.

Administering our product candidates to humans may produce undesirable side effects. These side effects could interrupt, delay or halt clinical trials of our product candidates and could result in the FDA or other regulatory authorities denying approval of our product candidates for any or all targeted indications.

If clinical trials for a product candidate are unsuccessful, we will be unable to commercialize the product candidate. If one or more of our clinical trials are delayed, we will be unable to meet our anticipated development timelines. Either circumstance could cause the market price of our common stock to decline.

We are relying on contract research organizations to conduct substantial portions of our GENETIC–AF clinical trial, and as a result, we will be unable to directly control the timing, conduct and expense of all aspects of the clinical trial.

We do not currently have sufficient staff with the requisite experience to conduct our clinical trial and are therefore relying on third parties to conduct certain aspects of our clinical trial. We have contracted with Duke University, as our CRO, to conduct components of our GENETIC-AF trial. As a result of this contract, we have less control over many details and steps of the trial, the timing and completion of the trial, the required reporting of adverse events and the management of data developed through the trial than would be the case if we were relying entirely upon our own staff. Communicating with outside parties can also be challenging, potentially leading to mistakes as well as difficulties in coordinating activities. Outside parties, such as CROs, may have staffing difficulties, may undergo changes in priorities or may become financially distressed, adversely affecting their willingness or ability to conduct our trial. We may experience unexpected cost increases that are beyond our control. Problems with the timeliness or quality of the work of a CRO may lead us to seek to terminate the relationship and use an alternative service provider. However, making this change may be costly and may delay ongoing trials, and contractual restrictions may make such a change difficult or impossible. Additionally, it may be impossible to find a replacement organization that can conduct clinical trials in an acceptable manner and at an acceptable cost. In February 2016, the GENETIC-AF protocol was amended to simplify certain operational aspects of the trial. In order to expand GENETIC-AF to Europe, we contracted with a European CRO for this portion of the study. Because we contracted with a European CRO to conduct the study in European countries, we will have less control over many details and steps of the trial, the timing and completion of the trial, the required reporting of adverse events and the management of data developed through the trial than would be the case if we were relying entirely upon our own staff. Additionally, we have no way of knowing if we will experience an increased or decreased number of restrictions in this regard as compared to our experience with our U.S. CRO.

Even though we are using CROs to conduct components of our clinical trial, and may rely on additional CROs in the future, we have to devote substantial resources and rely on the expertise of our employees to manage the work being done by the CROs. We have never conducted a clinical trial and the inability of our current staff to adequately manage any CRO that we engage may exacerbate the risks associated with relying on a CRO.

We may not achieve our projected development goals in the time frames we announce and expect.

We set goals for, and make public statements regarding, the timing of certain accomplishments, such as, the commencement and completion of clinical trials, particularly with respect to steps for commencing and continuing GENETIC-AF, the disclosure of trial results, the obtainment of regulatory approval and the sale of drug product, which we sometimes refer to as milestones. These milestones may not be achieved, and the actual timing of these events can vary dramatically due to a number of factors such as delays or failures in our clinical trials, disagreements with any collaborative partners, the uncertainties inherent in the regulatory approval process and manufacturing scale-up and delays in achieving manufacturing or marketing arrangements sufficient to commercialize our products. FDA approval of Gencaro, if it occurs, is expected to require years of additional clinical development, including the completion of genetic trials. There can be no assurance that our GENETIC-AF trial will fully enroll or be completed, or that we will make regulatory submissions or receive regulatory approvals as planned. If we fail to achieve one or more of these milestones as planned, our business will be materially adversely affected.

If we are not able to maintain the requirements for listing on the Nasdaq Capital Market, we could be delisted, which could have a material adverse effect on our ability to raise additional funds as well as the price and liquidity of our common stock.

Our common stock is currently listed on the Nasdaq Capital Market. To maintain the listing of our common stock on the Nasdaq Capital Market we are required to meet certain listing requirements, including, among others, (i) a minimum closing bid price of \$1.00 per share, (ii) a market value of publicly held shares (excluding shares held by our executive officers, directors and 10% or more stockholders) of at least \$1 million and (iii) either: (x) stockholders'

equity of at least \$2.5 million; or (y) a total market value of listed securities of at least \$35 million.

We have received two potential delisting notices from Nasdaq since 2012. In 2012 and 2015, we received notification from Nasdaq of potential delisting of our shares from the Nasdaq Capital Market because the closing bid price of our common stock had not met the minimum closing bid price of \$1.00 per share during the preceding 30 days. While we have subsequently regained compliance with Nasdaq's minimum closing bid price requirements, and despite effecting a 1 for 6 reverse split of our common stock in March 2013 and a 1 for 7 reverse split of our common stock in September 2015, there can be no assurance that the market price per share of our common stock will remain in excess of the \$1.00 minimum bid price for a sustained period of time. The continuing effect of our reverse stock splits on the market price of our common stock cannot be predicted with any certainty, and the history of similar stock split combinations for companies in like circumstances is varied. To date, the per share price of our common stock after these reverse stock splits has not been in proportion to the reduction in the number of shares of common stock outstanding resulting from the reverse stock split, effectively reducing our market capitalization. The market price of our common stock may vary based on other factors that are unrelated to the number of shares outstanding, including our future performance.

The delisting of our common stock from a national exchange could impair the liquidity and market price of the common stock. It could also materially, adversely affect our access to the capital markets, and any limitation on market liquidity or reduction in the price of the common stock as a result of that delisting could adversely affect our ability to raise capital on terms acceptable to us, or at all.

In future periods, if we do not meet the minimum stockholders' equity, minimum closing bid price requirements, or any other listing requirements, we would be subject to delisting from the Nasdaq Capital Market.

As of March 17, 2017, the closing price of our common stock was \$2.60 per share, and the total market value of our listed securities was approximately \$23.7 million. As of December 31, 2016, we had stockholders' equity of \$22.2 million.

We expect to depend on existing and future collaborations with third parties for the development of some of our product candidates. If those collaborations are not successful, we may not be able to complete the development of these product candidates.

We currently have a collaboration agreement with Medtronic for the support of our GENETIC-AF trial. Medtronic can terminate its collaboration with us for various reasons including uncured material breach of the collaboration by us, an ARCA bankruptcy, if, after FDA communication, it is reasonably concluded that the FDA will not allow GENETIC-AF to enroll or continue, or if Medtronic's obligations under the collaboration agreement are unilaterally expanded. We may seek additional third party collaborators for the development of Gencaro or other product candidates.

Under our current arrangement with Medtronic, as amended, we have limited control over the amount and timing of resources that they dedicate to the development of Gencaro. This is also likely to be true in any future collaboration with third parties. Our ability to benefit from these arrangements will depend on our collaborators' abilities to successfully perform the functions assigned to them in these arrangements.

Collaborations involving our product candidates pose the following risks to us:

- collaborators have significant discretion in determining the efforts and resources that they will apply to these collaborations;
- collaborators may not pursue development and commercialization of our product candidates or may elect not to continue or renew development or commercialization programs based on clinical trial results, changes in the collaborator's strategic focus or available funding, or external factors such as an acquisition that diverts resources or creates competing priorities;
- collaborators may delay clinical trials, provide insufficient funding for a clinical trial program, stop a clinical trial or abandon a product candidate, repeat or conduct new clinical trials or require a new formulation of a product candidate for clinical testing;
- collaborators could independently develop, or develop with third parties, products that compete directly or indirectly with our product candidates if the collaborators believe that competitive products are more likely to be successfully developed or can be commercialized under terms that are more economically attractive than ours;
- collaborators may not properly maintain or defend our intellectual property rights or may use our proprietary information in such a way as to invite litigation that could jeopardize or invalidate our proprietary information or expose us to potential litigation;
- disputes may arise between the collaborators and us that result in the delay or termination of the research, development or commercialization of our product candidates or that result in costly litigation or arbitration that diverts management attention and resources;
- collaborations may be terminated and, if terminated, may result in a need for additional capital to pursue further development or commercialization of the applicable product candidates;

collaborators may elect to take over manufacturing rather than retain us as manufacturers and may encounter problems in starting up or gaining approval for their manufacturing facility and so be unable to continue development of product candidates;

•we may be required to undertake the expenditure of substantial operational, financial and management resources in connection with any collaboration;

•we may be required to issue equity securities to collaborators that would dilute our existing stockholders' percentage ownership;

•we may be required to assume substantial actual or contingent liabilities;

•collaborators may not commit adequate resources to the marketing and distribution of our product candidates, limiting our potential revenues from these products; and

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Collaborators may experience financial difficulties.

We face a number of challenges in seeking additional collaborations. Collaborations are complex and any potential discussions may not result in a definitive agreement for many reasons. For example, whether we reach a definitive agreement for a collaboration will depend, among other things, upon our assessment of the collaborator's resources and expertise, the terms and conditions of the proposed collaboration, and the proposed collaborator's evaluation of a number of factors, such as the design or results of our clinical trials, the potential market for our product candidates, the costs and complexities of manufacturing and delivering our product candidates to patients, the potential of competing products, the existence of uncertainty with respect to ownership or the coverage of our intellectual property, and industry and market conditions generally. If we were to determine that additional collaborations for our Gencaro development is necessary and were unable to enter into such collaborations on acceptable terms, we might elect to delay or scale back the development or commercialization of Gencaro in order to preserve our financial resources or to allow us adequate time to develop the required physical resources and systems and expertise ourselves.

Collaboration agreements may not lead to development or commercialization of our product candidates in the most efficient manner, or at all. In addition, there have been a significant number of recent business combinations among large pharmaceutical companies that have resulted in a reduced number of potential future collaborators. If a present or future collaborator of ours were to be involved in a business combination, the continued pursuit and emphasis on our product development or commercialization program could be delayed, diminished or terminated.

Our GENETIC-AF clinical trial requires the use of a third-party diagnostic services provider to administer the genetic test needed to identify the patient receptor genotypes of clinical trial participants, and as a result, we will be unable to directly control the timing, conduct and expense of the genetic test.

Our GENETIC-AF clinical trial of Gencaro requires a companion diagnostic test that identifies the patient's receptor genotype. The trial will only enroll those patients with the receptor that has the potential for enhanced efficacy, the beta-1 389 Arg receptor as detected by a beta-1 389 Arg/Arg genotype. Accordingly, the GENETIC-AF trial requires the use of a third-party diagnostic service to perform the genetic testing. There has been limited experience in our industry in prospective development of companion diagnostics required to perform the required molecular profiling. We entered into an agreement with LabCorp to provide the diagnostic services of the genetic test needed to support our GENETIC-AF trial. To provide those services, LabCorp obtained from the FDA an IDE for the companion diagnostic test being used in our GENETIC-AF clinical trial.

The FDA and similar regulatory authorities outside the United States regulate companion diagnostics. Companion diagnostics require separate or coordinated regulatory approval prior to commercialization. Changes to regulatory advice could delay our development programs or delay or prevent eventual marketing approval for our product candidates that may otherwise be approvable. In July 2011, the FDA issued draft guidance that stated that if safe and effective use of a therapeutic depends on an in vitro diagnostic, the FDA generally will not approve the therapeutic unless the FDA approves or clears this "in vitro companion diagnostic device" at the same time that the FDA approves the therapeutic. The approval or clearance of the companion diagnostic would occur through the FDA's Center for Devices and Radiological Health. In 2014, the FDA issued guidance on in vitro companion diagnostic devices. It is difficult to predict how FDA will implement the guidance. For example, the guidance allows for flexibility by the FDA in the case of therapeutic products to treat serious conditions for which no alternative treatment exists and the benefits of using the companion diagnostic outweigh the risk, but it is unclear how this discretion will be applied by the agency. The FDA's evolving position on the topic of companion diagnostics could affect our clinical development programs that utilize companion diagnostics. In particular, the FDA may limit our ability to use retrospective data, otherwise disagree with our approaches to trial design, biomarker qualification, clinical and analytical validity, and clinical utility, or make us repeat aspects of a trial or initiate new trials.

Given our limited experience in developing diagnostics, we expect to rely primarily on third parties for the design and manufacture of the companion diagnostics for our product candidates. If we, or any third parties that we engage to assist us, are unable to successfully develop companion diagnostics for our product candidates that require such

diagnostics, or experience delays in doing so, the development of our product candidates may be adversely affected, our product candidates may not receive marketing approval and we may not realize the full commercial potential of any products that receive marketing approval. As a result, our business could be materially harmed.

We will need to establish a collaborative arrangement with a third-party diagnostics services provider to obtain marketing clearance or approval of the companion genetic test. There is no guarantee that the FDA will grant timely clearance or approval of the genetic test, if at all, and failure to obtain such timely clearance or approval would adversely affect our ability to market Gencaro.

The drug label we intend to seek for Gencaro would identify the patient receptor genotype for which the drug is approved. Accordingly, we believe developing a genetic test that is simple to administer and widely available will be critical to the successful commercialization of Gencaro and also to the ability to conduct our GENETIC-AF clinical trial. The genetic test will be subject to regulation by the FDA and by comparable agencies in various foreign countries. The process of complying with the requirements of the FDA and comparable agencies is costly, time consuming and burdensome.

Despite the time and expense expended, regulatory clearance or approval is never guaranteed. If regulatory clearance or approval is delayed, or if one or more third-party diagnostic services providers are unable to obtain FDA approval of the genetic test at all or in parallel with the approval of Gencaro, or are unable to commercialize the test successfully and in a manner that effectively supports the commercial efforts for Gencaro, or if the information concerning the differential response to Gencaro resulting from certain genetic variation is not included in the approval label for Gencaro, the commercial launch of Gencaro may be significantly and adversely affected.

Regulatory approval is required for the genetic test to be used in the GENETIC-AF trial and to support the commercialization of the test, if approved. Delays or failures in obtaining such regulatory approval, including any required validation analyses may prevent a third-party diagnostics provider from commercializing such genetic test and will adversely affect our business, operating results and prospects.

Before a genetic test can be used commercially, including in conjunction with Gencaro, if it is approved for marketing, the third-party diagnostics provider must obtain FDA Premarket Approval, or PMA, for such test. The FDA may require additional validation of the genetic test we are using in GENETIC-AF prior to any approval of Gencaro or the genetic test. We anticipate the genetic test will be required as a condition to prescribing Gencaro. There is no guarantee the FDA will approve the anticipated PMA submission for the genetic test. Even if the genetic test is eventually approved, performing additional validation work necessary to support the PMA, if required, for current or future genetic test products, including one associated with Gencaro, would require additional time and expense and the outcome would be uncertain. Moreover, such delays or increased costs or failures could adversely affect our business, operating results and prospects for commercializing the genetic test.

If a third-party diagnostics provider responsible for the genetic test or certain of its third-party suppliers fails to comply with ongoing FDA or other foreign regulatory authority requirements, or if there are unanticipated problems with the genetic test, these products could be subject to restrictions or withdrawal from use in a trial or from the market.

Any diagnostic for which a third-party diagnostics provider obtains clearance or approval, and the manufacturing processes, reporting requirements, post-approval clinical data and promotional activities for such product, will be subject to continued regulatory review, oversight and periodic inspections by the FDA and other domestic and foreign regulatory bodies. With respect to the genetic test, to the extent applicable, any third-party diagnostics provider and certain of its suppliers will be required to comply with the FDA's Quality System Regulation, or QSR, and International Standards Organization, or ISO, requirements which cover the methods and documentation of the design, testing, production, control, quality assurance, labeling, packaging, storage and shipping of any product for which clearance or approval is obtained. Regulatory bodies, such as the FDA, enforce the QSR and other regulations through periodic inspections. The failure by a third-party diagnostics provider, or certain of its third-party manufacturers or suppliers, as the case may be, to comply with applicable statutes and regulations administered by the FDA and other regulatory bodies, or the failure to timely and adequately respond to any adverse inspectional observations or product safety issues, could result in, among other things, enforcement actions. If any of these actions were to occur, it could

harm our reputation and cause product sales and profitability of Gencaro to suffer and may prevent us from generating revenue or utilizing the genetic test further in any clinical trial. Even if regulatory clearance or approval is granted, such clearance or approval may be subject to limitations on the intended uses for which the product may be marketed and reduce our potential to successfully commercialize the product and generate revenue from the product.

Future sales of Gencaro may suffer if its marketplace acceptance is negatively affected by the genetic test.

The genetic test is an important component of the commercial strategy for Gencaro in addition to being required for our GENETIC-AF trial. We believe that the genetic test helps predict patient response to Gencaro, and that this aspect of the drug is important to its ability to compete effectively with current therapies. The genetic test adds an additional step in the prescribing process, an additional cost for the patient and payors, the risk that the test results may not be rapidly available and the possibility that it may not be available at all to hospitals and medical centers. Although we anticipate that Gencaro, if approved in a timely manner, would be the first genetically-targeted cardiovascular drug, Gencaro will be one of a number of successful drugs in the beta-blocker class currently on the market. Prescribers may be more familiar with these other beta-blockers, and may be resistant to prescribing Gencaro as an AF therapy in patients with HF. Any one of these factors could affect prescriber behavior, which in turn may substantially impede market acceptance of the genetic test, which could cause significant harm to Gencaro's ability to compete, and in turn harm our business.

Our management and our independent registered public accountant, in their report on our financial statements as of and for the fiscal year ended December 31, 2016, have concluded that due to our need for additional capital, and the uncertainties surrounding our ability to raise such funding, substantial doubt exists as to our ability to continue as a going concern.

Our audited financial statements for the fiscal year ended December 31, 2016 were prepared assuming that we will continue as a going concern. The going concern basis of presentation assumes that we will continue in operation for the foreseeable future and will be able to realize our assets and discharge our liabilities and commitments in the normal course of business and do not include any adjustments to reflect the possible future effects on the recoverability and classification of assets or the amounts and classification of liabilities that may result from our inability to continue as a going concern. Our management and our independent registered public accountants concluded as of December 31, 2016 that due to our need for additional capital and the uncertainties surrounding our ability to raise such funding, substantial doubt exists as to our ability to continue as a going concern for a period from one year after our financial statements have been issued. In June 2015, we completed an equity financing for net proceeds of approximately \$34.2 million. We believe our cash, cash equivalents and marketable securities balance as of December 31, 2016 will be sufficient to fund our operations, at our projected cost structure, through the end of 2017. In January 2017, we entered into a sales agreement with an agent to sell, from time to time, our common stock having an aggregate offering price of up to \$7.3 million, in an "at the market offering." We are not obligated to make any sales of our common stock, and, as of March 17, 2017, we have sold an aggregate of 43,156 shares of our common stock pursuant to the terms of such sales agreement for aggregate gross proceeds of approximately \$112,000, before paying commissions to our placement agent of approximately \$3,000. We cannot be certain that we will be able to make sufficient sales of our common stock pursuant to this offering to cover our future capital needs, or at all. Changing circumstances may cause us to consume capital significantly faster or slower than we currently anticipate. If we are delayed in completing or are unable to complete additional funding and/or a strategic transaction, we may discontinue our development activities or operations, but there are no assurances that these reductions would be sufficient to allow us to continue to operate as a going concern. If we elect to continue to the Phase 3 portion of GENETIC-AF, we will be required to raise additional funds to complete the Phase 3 portion of GENETIC-AF clinical trial and submit for FDA approval of Gencaro. Therefore, even if we resolve this uncertainty, our independent registered public accountants and/or management could conclude that uncertainty as to our ability to continue as a going concern could exist at a future date.

We have based these estimates on assumptions that may prove to be wrong, and we could exhaust our available financial resources sooner than we currently anticipate. We may be forced to reduce our operating expenses and raise additional funds to meet our working capital needs, principally through the additional sales of our securities or debt financings. However, we cannot guarantee that we will be able to obtain sufficient additional funds when needed or that such funds, if available, will be obtainable on terms satisfactory to us. If we are unable to raise sufficient additional capital or complete a strategic transaction, we may be unable to continue to fund our operations, develop Gencaro or

our other product candidates, or realize value from our assets and discharge our liabilities in the normal course of business. If we cannot raise sufficient funds, we may have to liquidate our assets, and might realize significantly less than the values at which they are carried on our financial statements, and stockholders may lose all or part of their investment in our common stock.

Our failure to raise substantial additional funding or enter into a strategic transaction may materially and adversely affect our business.

Unless we are able to raise substantial additional funding for the development of Gencaro through other means, we will need to complete a strategic transaction to continue the development of Gencaro through Phase 3 of clinical development, the regulatory submission process, the commercialization phase, and to continue our other operations. The strategic transactions that we may consider include a potential combination or partnership. Our board of directors and management team have and will continue to devote substantial time and resources to obtaining additional capital or the consideration and implementation of any such strategic transaction. In addition, conditions in the financial markets may lead to an increased number of biotechnology companies that are also seeking to enter into strategic transactions, which may limit our ability to negotiate favorable terms for any such transaction. Further, our current employees do not have experience in the strategic transaction process, and our previous efforts to enter into a strategic transaction have not been successful. As a result of these and other factors, there is substantial risk that we may not be able to complete a strategic transaction on favorable terms, or at all. The failure to complete such a strategic transaction may materially and adversely affect our business.

We may be limited in our ability to access sufficient funding through a private equity or convertible debt offering.

Nasdaq rules impose restrictions on our ability to raise funds through a private offering of our common stock, convertible debt or similar instruments without obtaining stockholder approval. Under Nasdaq rules, an offering of more than 20% of our total shares outstanding for less than the greater of book or market value requires stockholder approval unless the offering qualifies as a “public offering” for purposes of the Nasdaq rules. As of December 31, 2016, we had approximately 9.1 million shares of common stock outstanding, 20% of which is approximately 1.8 million shares. SEC rules impose restrictions on our ability to raise funds through the registered offering of our securities pursuant to a “shelf” registration statement on Form S-3. Under SEC rules, we are prohibited from selling securities under such a registration statement if the aggregate market value of the securities sold thereunder in any twelve-month period exceeds one-third of the market value of our outstanding common stock held by non-affiliates. In January 2017, we entered into a sales agreement with an agent to sell, from time to time, our common stock having an aggregate offering price of up to \$7.3 million, in an “at the market offering.” We are not obligated to make any sales of our common stock, and, as of March 17, 2017, we have sold an aggregate of 43,156 shares of our common stock pursuant to the terms of such sales agreement for aggregate gross proceeds of approximately \$112,000, before paying commissions to our placement agent of approximately \$3,000. In addition, we are currently subject to certain contractual rights of investors arising from our public and private equity financing transactions that limit the nature and price of future public and private financing transactions that we may effect. For example, in January 2013, we entered into separate subscription agreements with certain institutional investors in connection with a private investment in public equity, pursuant to which we sold shares of our common stock and warrants to purchase shares of our common stock to the investors. In connection with this transaction, we agreed that, subject to certain exceptions, we would not, while the warrants issued in such financing are outstanding, effect or enter into an agreement to effect any issuance of common stock or securities convertible into, exercisable for or exchangeable for common stock in a “variable rate transaction,” which means a transaction in which we issue or sell any convertible securities either (A) at a conversion price, exercise price or exchange rate or other price that is based upon and/or varies with the trading prices of, or quotations for, the shares of common stock at any time after the initial issuance of such convertible securities, or (B) with a conversion, exercise or exchange price that is subject to being reset at some future date after the initial issuance of the convertible securities or upon the occurrence of the specified or contingent events directly or indirectly related to our business or the market for our common stock. The restrictions imposed by the terms of our previous offerings, and that could be imposed in future offerings, may limit our access to capital on agreeable terms and delay or make impossible certain otherwise available equity financing opportunities and could severely restrict our access to the capital necessary to conduct our business.

Unless we are able to generate sufficient product revenue, we will continue to incur losses from operations and will not achieve or maintain profitability. We are years away from commercializing a product and generating product

revenue.

Our historical losses have had and will continue to have an adverse effect on our stockholders' equity and working capital, among other things. We are years away from commercializing a product and generating any product revenue. As a result, we expect to continue to incur significant operating losses for the foreseeable future. Even if we ultimately receive regulatory approval for Gencaro or our other product candidates, sales of such products may not generate sufficient revenue for it to achieve or maintain profitability. Because of the numerous risks and uncertainties associated with developing therapeutic drugs, we may experience larger than expected future losses and may never reach profitability.

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Our product candidates are subject to extensive regulation, which can be costly and time-consuming, and unsuccessful or delayed regulatory approvals could increase our future development costs or impair our future revenue.

The preclinical and clinical development, testing, manufacture, safety, efficacy, labeling, storage, recordkeeping, and subsequent advertising, promotion, sale, marketing, and distribution, if approved, of our product candidates are subject to extensive regulation by the FDA and other regulatory authorities in the United States and elsewhere. These regulations also vary in important, meaningful ways from country to country. We are not permitted to market a potential drug in the United States until we receive approval of an NDA from the FDA for such drug. We have not received an NDA approval from the FDA for Gencaro or any of our other product candidates. There can be no guarantees with respect to our product candidates that clinical studies will adequately support an NDA, that the products will receive necessary regulatory approvals, or that they will prove to be commercially successful.

To receive regulatory approval for the commercial sale of any product candidates, we must demonstrate safety and efficacy in humans to the satisfaction of regulatory authorities through preclinical studies and adequate and well-controlled clinical trials of the product candidates. This process is expensive and can take many years, and failure can occur at any stage of the testing. Our failure to adequately demonstrate the safety and efficacy of our product candidates will prevent regulatory approval and commercialization of such products. In 2008, we submitted and the FDA accepted our NDA filing for Gencaro for the treatment of chronic HF. In 2009, the FDA issued a Complete Response Letter, or CRL, in which the FDA stated that it could not approve the Gencaro NDA in its current form and specified actions required for approval of the NDA, including conducting an additional Phase 3 clinical trial of Gencaro in patients with HF. We have initiated an adaptive, seamless design Phase 2B/Phase3 clinical study of Gencaro in HFREF patients to assess its efficacy in reducing or preventing AF. This trial has been initiated as a Phase 2B study in up to 250 patients and, depending on the outcome of the Phase 2B interim analysis, may be expanded to a Phase 3 study with up to approximately an additional 370 patients. We randomized our 175th patient in the trial in March 2017. We project that the outcome of the DSMB interim analysis and recommendation will be available in the third quarter of 2017. This product candidate will require years of clinical development. Even if we conduct additional studies in accordance with further FDA guidance and submit or file a new or amended NDA, the FDA may ultimately decide that the NDA does not satisfy the criteria for approval.

In the event that we or our collaborators conduct preclinical studies that do not comply with Good Laboratory Practices, or GLP, or incorrectly design or carry out human clinical trials in accordance with Good Clinical Practices, or GCP, or those clinical trials fail to demonstrate clinical significance, it is unlikely that we will be able to obtain FDA approval for product development candidates. Our inability to successfully initiate and effectively complete clinical trials for any product candidate on schedule, or at all, will severely harm our business. Significant delays in clinical development could materially increase product development costs or allow our competitors to bring products to market before we do, impairing our ability to effectively commercialize any future product candidate. We do not know whether planned clinical trials will begin on time, will need to be redesigned or will be completed on schedule, if at all. Clinical trials can be delayed for a variety of reasons, including:

- delays or failures in obtaining regulatory authorization to commence a trial because of safety concerns of regulators relating to our product candidates or similar product candidates of our competitors or failure to follow regulatory guidelines;
- delays or failures in obtaining clinical materials and manufacturing sufficient quantities of the product candidates for use in trials;
- delays or failures in reaching agreement on acceptable terms with prospective study sites;

- delays or failures in obtaining approval of our clinical trial protocol from an IRB to conduct a clinical trial at a prospective study site;
- delays in recruiting patients to participate in a clinical trial, which may be due to the size of the patient population, eligibility criteria, protocol design, perceived risks and benefits of the drug, availability of other approved and standard of care therapies or, availability of clinical trial sites;
- other clinical trials seeking to enroll subjects with similar profile;
- failure of our clinical trials and clinical investigators to be in compliance with GCP;
- unforeseen safety issues, including negative results from ongoing preclinical studies;
- inability to monitor patients adequately during or after treatment;
- difficulty recruiting and monitoring multiple study sites;
- failure of our third-party contract research organizations, clinical site organizations and other clinical trial managers, to satisfy their contractual duties, comply with regulations or meet expected deadlines; and
- an insufficient number of patients who have, or are willing to have, a Medtronic device implanted for monitoring and recording AF burden data.

In addition, any approvals we may obtain may not cover all of the clinical indications for which we seek approval or permit us to make claims of superiority over currently marketed competitive products. Also, an approval might contain significant limitations in the form of narrow indications, warnings, precautions or contraindications with respect to conditions of use. If the FDA determines that a risk evaluation and mitigation strategy, or REMS, is necessary to ensure that the benefits of the drug outweigh the risks, we may be required to include as part of the NDA a proposed REMS that may include a package insert directed to patients, a plan for communication with healthcare providers, restrictions on a drug's distribution, or a Medication Guide, to provide better information to consumers about the drug's risks and benefits. Finally, an approval could be conditioned on our commitment to conduct further clinical trials, which we may not have the resources to conduct or which may negatively impact our financial situation.

The manufacture and tableting of Gencaro is done by third party suppliers, who must also meet cGMP requirements and pass a pre-approval inspection of their facilities before we can obtain marketing approval.

All of our product candidates are prone to the risks of failure inherent in drug development. The results from preclinical animal testing and early human clinical trials may not be predictive of results obtained in later human clinical trials. Further, although a new product may show promising results in preclinical or early human clinical trials, it may subsequently prove unfeasible or impossible to generate sufficient safety and efficacy data to obtain necessary regulatory approvals. The data obtained from preclinical and clinical studies are susceptible to varying interpretations that may delay, limit or prevent regulatory approval, and the FDA and other regulatory authorities in the United States and elsewhere exercise substantial discretion in the drug approval process. The numbers, size and design of preclinical studies and clinical trials that will be required for FDA or other regulatory approval will vary depending on the product candidate, the disease or condition for which the product candidate is intended to be used and the regulations and guidance documents applicable to any particular product candidate. The FDA or other regulators can delay, limit or deny approval of any product candidate for many reasons, including, but not limited to:

- side effects;

- safety and efficacy;

- defects in the design of clinical trials;

- the fact that the FDA or other regulatory officials may not approve our or our third party manufacturer's processes or facilities; or

- the fact that new regulations may be enacted by the FDA or other regulators may change their approval policies or adopt new regulations requiring new or different evidence of safety and efficacy for the intended use of a product candidate.

In light of widely publicized events concerning the safety of certain drug products, regulatory authorities, members of Congress, the Government Accountability Office, medical professionals and the general public have raised concerns about potential drug safety issues. These events have resulted in the withdrawal of certain drug products, revisions to certain drug labeling that further limit use of the drug products and establishment of risk management programs that may, for instance, restrict distribution of drug products. The increased attention to drug safety issues may result in a more cautious approach by the FDA to clinical trials and approval. Data from clinical trials may receive greater scrutiny with respect to safety and the product's risk/benefit profile, which may make the FDA or other regulatory

authorities more likely to terminate clinical trials before completion, or require longer or additional clinical trials that may result in substantial additional expense, and a delay or failure in obtaining approval or approval for a more limited indication than originally sought. Aside from issues concerning the quality and sufficiency of submitted preclinical and clinical data, the FDA may be constrained by limited resources from reviewing and determining the approvability of the Gencaro NDA in a timely manner.

In pursuing clinical development of Gencaro for an AF indication, we will be required to amend the Gencaro HF NDA or prepare a new NDA. The FDA could approve Gencaro, but without including some or all of the prescribing information that we have requested. For instance, the FDA could approve Gencaro for AF in a more limited patient population or include additional warnings in the drug's label. This, in turn, could substantially and detrimentally impact our ability to successfully commercialize Gencaro and effectively protect our intellectual property rights in Gencaro.

If our product candidates receive regulatory approval, we would be subject to ongoing regulatory obligations and restrictions, which may result in significant expenses and limit our ability to develop and commercialize other potential products.

If a product candidate of ours is approved by the FDA or by another regulatory authority, we would be held to extensive regulatory requirements over product manufacturing, testing, distribution, labeling, packaging, adverse event reporting and other reporting to regulatory authorities, storage, advertising, marketing, promotion, distribution, and record keeping. Regulatory approvals may also be subject to significant limitations on the indicated uses or marketing of the product candidates. Potentially costly follow-up or post-marketing clinical studies may be required as a condition of approval to further substantiate safety or efficacy, or to investigate specific issues of interest to the regulatory authority. Previously unknown problems with the product candidate, including adverse events of unanticipated severity or frequency, may result in additional regulatory controls or restrictions on the marketing or use of the product or the need for post marketing studies, and could include suspension or withdrawal of the products from the market.

Furthermore, our third-party manufacturers and the manufacturing facilities that they use to make our product candidates are regulated by the FDA. Quality control and manufacturing procedures must continue to conform to cGMP after approval. Drug manufacturers and their subcontractors are required to register their facilities and products manufactured annually with the FDA and certain state agencies and are subject to periodic unannounced inspections by the FDA, state and/or other foreign authorities. Any subsequent discovery of problems with a product, or a manufacturing or laboratory facility used by us or our collaborators, may result in restrictions on the product, or on the manufacturing or laboratory facility, including a withdrawal of the drug from the market or suspension of manufacturing. Any changes to an approved product, including the way it is manufactured or promoted, often require FDA approval before the product, as modified, can be marketed. We and our third-party manufacturers will also be subject to ongoing FDA requirements for submission of safety and other post-market information.

The marketing and advertising of our drug products by our collaborators or us will be regulated by the FDA, certain state agencies or foreign regulatory authorities. Violations of these laws and regulations, including promotion of our products for unapproved uses or failing to disclose risk information, are punishable by criminal and civil sanctions and may result in the issuance of enforcement letters or other enforcement action by the FDA, U.S. Department of Justice, state agencies, or foreign regulatory authorities that could jeopardize our ability to market the product.

In addition to the FDA, state or foreign regulations, the marketing of our drug products by us or our collaborators will be regulated by federal, state or foreign laws pertaining to health care “fraud and abuse,” such as the federal anti-kickback law prohibiting bribes, kickbacks or other remuneration for the order or recommendation of items or services reimbursed by federal health care programs. Many states have similar laws applicable to items or services reimbursed by commercial insurers. Violations of these laws are punishable by criminal and civil sanctions, including, in some instances, imprisonment and exclusion from participation in federal and state health care programs, including the Medicare, Medicaid and Veterans Affairs healthcare programs. Because of the far-reaching nature of these laws, we may be required to discontinue one or more of our practices to be in compliance with these laws. Healthcare fraud and abuse regulations are complex, and even minor irregularities can potentially give rise to claims that a statute or prohibition has been violated. Any violations of these laws, or any action against us for violations of these laws, even if we successfully defend against it, could have a material adverse effect on our business, financial condition and results of operations.

We could also become subject to false claims litigation under federal statutes, which can lead to civil money penalties, restitution, criminal fines and imprisonment, and exclusion from participation in Medicare, Medicaid and other federal and state health care programs. These false claims statutes include the False Claims Act, which allows any person to bring a suit on behalf of the federal government alleging submission of false or fraudulent claims, or causing to present such false or fraudulent claims, under federal programs or contracts claims or other violations of the statute and to share in any amounts paid by the entity to the government in fines or settlement. These suits against pharmaceutical companies have increased significantly in volume and breadth in recent years. Some of these suits have been brought on the basis of certain sales practices promoting drug products for unapproved uses. This new growth in litigation has increased the risk that a pharmaceutical company will have to defend a false claim action, pay fines or restitution, or be excluded from the Medicare, Medicaid, Veterans Affairs and other federal and state healthcare programs as a result of an investigation arising out of such action. We may become subject to such litigation and, if we are not successful in defending against such actions, those actions may have a material adverse effect on our business, financial condition and results of operations. We could also become subject to false claims litigation and consumer protection claims under state statutes, which also could lead to civil monetary penalties, restitution, criminal fines and imprisonment, and exclusion from participation in state health care programs. Of note, over the past few years there has been an increased focus on the sales and marketing practices of the pharmaceutical industry at both the federal and state level. Additionally, the law or regulatory policies governing pharmaceuticals may change. New statutory requirements may be enacted or additional regulations may be adopted that could prevent or delay regulatory approval of our product candidates or limit our ability to commercialize our products. We cannot predict the likelihood, nature or extent of adverse government regulation that may arise from future legislation or administrative action, either in the United States or elsewhere.

If we, our collaborators or our third-party manufacturers fail to comply with applicable continuing regulatory requirements, our business could be seriously harmed because a regulatory agency may:

- issue untitled or warning letters;
- suspend or withdraw our regulatory approval for approved products;
- seize or detain products or recommend a product recall of a drug or medical device, or issue a mandatory recall of a medical device;
- refuse to approve pending applications or supplements to approved applications filed by us;
- suspend our ongoing clinical trials;
- restrict our operations, including costly new manufacturing requirements, or restrict the sale, marketing and/or distribution of our products;
- seek an injunction;

- pursue criminal prosecutions;
- close the facilities of our contract manufacturers; or
- impose civil or criminal penalties.

Reliance on third parties to commercialize Gencaro could negatively impact our business. If we are required to establish a direct sales force in the United States and are unable to do so, our business may be harmed.

Commercialization of Gencaro, particularly the establishment of a sales organization, will require substantial additional capital resources. We currently intend to pursue a strategic partnership alternative for the commercialization of Gencaro, if it is approved, and we have suspended our efforts to build internal sales, marketing and distribution capabilities. If we elect to rely on third parties to sell Gencaro and any other products, then we may receive less revenue than if we sold such products directly. In addition, we may have little or no control over the sales efforts of those third parties. If we are unable to complete a strategic transaction, we would be unable to commercialize Gencaro or any other product candidate without substantial additional capital. Even if such capital were secured, we would be required to build internal sales, marketing and distribution capabilities to market Gencaro in the United States. None of our current employees have experience in establishing and managing a sales force.

In the event we are unable to sell Gencaro and other selected product candidates, either directly or through third parties via a strategic transaction, the commercialization of Gencaro, if it is approved, may be delayed indefinitely.

We are dependent on our key personnel.

The success of our business is highly dependent on the principal members of our board of directors and executive management, including our President and Chief Executive Officer, Michael R. Bristow. The loss of the services of any such individual might seriously harm our product development, partnering and financing efforts. Recruiting and training personnel with the requisite skills is challenging and we compete for talent with companies that are larger and have more financial resources.

We have no manufacturing capacity which puts us at risk of lengthy and costly delays of bringing our products to market.

We do not currently operate manufacturing facilities for clinical or commercial production of our product candidates, including their active pharmaceutical ingredients, or API. We have no experience in drug formulation or manufacturing, and we lack the resources and the capabilities to manufacture any of our product candidates on a clinical or commercial scale. We do not intend to develop facilities for the manufacture of product candidates for clinical trials or commercial purposes in the foreseeable future. We have contracted with Groupe Novasep to manufacture the API for Gencaro. For drug production, we have contracted with Patheon, Inc. to manufacture the Gencaro tablets. In addition, we have contracted with a separate service provider for packaging and distribution of our clinical trial materials. These contract manufacturers may not perform as agreed or may not remain in the contract manufacturing business for the time required to successfully produce, store and distribute our products. In addition, these manufacturers may have staffing difficulties, may not be able to manufacture our products on a timely basis or may become financially distressed. In the event of errors in forecasting production quantities required to meet demand, natural disaster, equipment malfunctions or failures, technology malfunctions, strikes, lock-outs or work stoppages, regional power outages, product tampering, war or terrorist activities, actions of regulatory authorities, business failure, strike or other difficulty, we may be unable to find an alternative third-party manufacturer in a timely manner and the production of our product candidates would be interrupted, resulting in delays and additional costs, which could impact our ability to commercialize and sell our product candidates. We or our contract manufacturers may also fail to achieve and maintain required manufacturing standards, which could result in patient injury or death,

product recalls or withdrawals, an order by governmental authorities to halt production, delays or failures in product testing or delivery, stability testing failures, cost overruns or other problems that could seriously hurt our business. Contract manufacturers also often encounter difficulties involving production yields, quality control and quality assurance, as well as shortages of qualified personnel. In addition, our contract manufacturers are subject to ongoing inspections and regulation by the FDA, the U.S. Drug Enforcement Agency and corresponding foreign and state agencies and they may fail to meet these agencies' acceptable standards of compliance. If our contract manufacturers fail to comply with applicable governmental regulations, such as quality control, quality assurance and the maintenance of records and documentation, we may not be able to continue production of the API or finished product. If the safety of any API or product supplied is compromised due to failure to adhere to applicable laws or for other reasons, this may jeopardize our regulatory approval for Gencaro and other product candidates, and we may be held liable for any injuries sustained as a result. Upon the occurrence of one of the aforementioned events, the ability to switch manufacturers may be difficult for a number of reasons, including:

- the number of potential manufacturers is limited and we may not be able to negotiate agreements with alternative manufacturers on commercially reasonable terms, if at all;
- long lead times are often needed to manufacture drugs;
- the manufacturing process is complex and may require a significant learning curve; and

- the FDA must approve any replacement prior to manufacturing, which requires new testing and compliance inspections.

Transitioning from a clinical development stage company will require successful completion of a number of steps, many of which are outside of our control and, consequently, we can provide no assurance of our successful and timely transition from a clinical development stage company.

We are a clinical development stage biopharmaceutical company with a limited operating history. To date we have not generated any product revenue and have historically funded our operations through investment capital. Our future growth depends on our ability to emerge from the clinical development stage and successfully commercialize or provide for the commercialization of Gencaro and our other product candidates which in turn, will depend, among other things, on our ability to:

- conduct an additional clinical trial and develop and obtain regulatory approval for Gencaro or other product candidates;
- successfully partner a companion genetic test with the commercial launch of Gencaro;
- enter into a strategic transaction enabling the continued development and commercialization of Gencaro, or alternatively, raise significant additional capital to enable these activities;
- pursue additional indications for Gencaro and develop other product candidates, including other cardiovascular therapies; and
- obtain commercial quantities of Gencaro or other product candidates at acceptable cost levels.

Any one of these factors or other factors discussed in this report could affect our ability to successfully commercialize Gencaro and other product candidates, which could impact our ability to earn sufficient revenues to transition from a clinical development stage company and continue our business.

If approved by the FDA, Gencaro will be entering a competitive marketplace and may not succeed.

Gencaro is a new type of beta-blocker and vasodilator being developed for AF. While we anticipate that this drug, if approved, would be the first genetically-targeted cardiovascular drug, and potentially the only beta-blocker approved for AF, Gencaro will be one of a number of accepted treatments for AF. In addition, our proposed prescribing information for Gencaro is expected to include a requirement for genetic testing of the patient to ascertain if they have the genotype that we believe responds most favorably to Gencaro. This additional step will add incremental cost and procedures to prescribing Gencaro, which could make it more difficult to compete against existing therapies.

Our commercial opportunity may be reduced or eliminated if competitors develop and commercialize products that are safer, more effective, have fewer side effects, are more convenient or are less expensive than Gencaro. If products with any of these properties are developed, or any of the existing products are better marketed, then prescriptions of Gencaro by physicians and patient use of Gencaro could be significantly reduced or rendered obsolete and noncompetitive. Further, public announcements regarding the development of any such competing drugs could adversely affect the market price of our common stock and the value of our assets.

Future sales of our products may suffer if they are not accepted in the marketplace by physicians, patients and the medical community.

Gencaro or our other product candidates may not gain market acceptance among physicians, patients and the medical community. The degree of market acceptance of Gencaro or our other product candidates will depend on a number of factors, such as its effectiveness and tolerability, as compared with competitive drugs. Also, prevalence and severity of side-effects could negatively affect market acceptance of Gencaro or our other product candidates. Failure to achieve market acceptance of Gencaro would significantly harm our business.

If we are unable to obtain acceptable prices or adequate reimbursement from third-party payors for Gencaro, or any other product candidates that we may seek to commercialize, then our revenues and prospects for profitability will suffer.

Our or any strategic partner's ability to commercialize Gencaro, or any other product candidates that we may seek to commercialize, is highly dependent on the extent to which coverage and reimbursement for these product candidates will be available from:

- governmental payors, such as Medicare and Medicaid;

- private health insurers, including managed-care organizations; and

- other third-party payors.

Many patients will not be capable of paying for our potential products themselves and will rely on third-party payors to pay for their medical needs. A primary current trend in the U.S. health care industry is toward cost containment. Large private payors, managed-care organizations, group purchasing organizations and similar organizations are exerting increasing influence on decisions regarding the use of, and reimbursement levels for, particular treatments. Such third-party payors, including Medicare, are challenging the prices charged for medical products and services, and many third-party payors limit reimbursement for newly approved health care products.

Cost-control initiatives could decrease the price we might establish for products, which could result in product revenues lower than anticipated. If the prices for our product candidates decrease, or if governmental and other third-party payors do not provide adequate coverage and reimbursement levels, then our revenue and prospects for profitability will suffer.

Health care reform measures could materially and adversely affect our business.

The business and financial condition of pharmaceutical and biotechnology companies are affected by the efforts of governmental and third-party payors to contain or reduce the costs of health care. The U.S. Congress has enacted legislation to reform the health care system. While we anticipate that this legislation may, over time, increase the number of patients who have insurance coverage for pharmaceutical products, it also imposes cost containment measures that may adversely affect the amount of reimbursement for pharmaceutical products. These measures include increasing the minimum rebates for products covered by Medicaid programs and extending such rebates to drugs dispensed to Medicaid beneficiaries enrolled in Medicaid managed care organizations as well as expansion of the 340(B) Public Health Services drug discount program. In addition, such legislation contains a number of provisions designed to generate the revenues necessary to fund the coverage expansion, including new fees or taxes on certain health-related industries, including medical device manufacturers. Each medical device manufacturer has to pay an excise tax (or sales tax) in an amount equal to 2.3% of the price for which such manufacturer sells its medical devices. Such excise taxes may impact any potential sales of the genetic test if it is approved for marketing. In foreign jurisdictions there have been, and we expect that there will continue to be, a number of legislative and regulatory proposals aimed at changing the health care system. For example, in some countries other than the United States, pricing of prescription drugs is subject to government control and we expect to see continued efforts to reduce healthcare costs in international markets.

Some states are also considering legislation that would control the prices of drugs, and state Medicaid programs are increasingly requesting manufacturers to pay supplemental rebates and requiring prior authorization by the state program for use of any drug for which supplemental rebates are not being paid. Managed care organizations continue to seek price discounts and, in some cases, to impose restrictions on the coverage of particular drugs. Government efforts to reduce Medicaid expenses may lead to increased use of managed care organizations by Medicaid programs. This may result in managed care organizations influencing prescription decisions for a larger segment of the population and a corresponding constraint on prices and reimbursement for drugs. It is likely that federal and state legislatures and health agencies will continue to focus on additional health care reform in the future although we are unable to predict what additional legislation or regulation, if any, relating to the health care industry or third-party coverage and reimbursement may be enacted in the future or what effect such legislation or regulation would have on our business. We or any strategic partner's ability to commercialize Gencaro, or any other product candidates that we may seek to commercialize, is highly dependent on the extent to which coverage and reimbursement for these product candidates will be available from government payors, such as Medicare and Medicaid, private health insurers, including managed care organizations, and other third-party payors, and any change in reimbursement levels could materially and adversely affect our business. Further, the pendency or approval of future proposals or reforms could result in a decrease in our stock price or limit our ability to raise capital or to obtain strategic partnerships or licenses.

Our competitors may be better positioned in the marketplace and thereby may be more successful than us at developing, manufacturing and marketing approved products.

Many of our competitors currently have significantly greater financial resources and expertise in conducting clinical trials, obtaining regulatory approvals, managing manufacturing and marketing approved products than us. Other early-stage companies may also prove to be significant competitors, particularly through collaborative arrangements with large and established companies. In addition, these third parties compete with us in recruiting and retaining qualified scientific and management personnel, establishing clinical trial sites and patient registration for clinical trials, as well as in acquiring therapies and therapy licenses complementary to our programs or advantageous to our business. We expect that our ability to compete effectively will depend upon our ability to:

- successfully and rapidly complete clinical trials for any product candidates and obtain all requisite regulatory approvals in a cost-effective manner;
- build an adequate sales and marketing infrastructure, raise additional funding, or enter into strategic transactions enabling the commercialization of our products;
- develop competitive formulations of our product candidates;
- attract and retain key personnel; and
- identify and obtain other product candidates on commercially reasonable terms.

If we fail to identify and license or acquire other products or product candidates, then we may be unable to expand our business, and the acquisition or licensing of other products or product candidates may put a strain on our operations and will likely require us to seek additional financing.

One of our strategies is to license or acquire clinical-stage products or product candidates and further develop them for commercialization. The market for licensing and acquiring products and product candidates is intensely competitive and many of our competitors may have greater resources than we do. If we undertake any additional acquisitions, whether of product candidates or other biopharmaceutical companies, the process of integrating an acquired product candidate or complementary company into our business may put a strain on our operations, divert personnel, financial resources and management's attention. In 2016, our research and development activities were dedicated to, and we expect our research and development activities in 2017 will continue to be primarily dedicated to Gencaro. If we are not able to substantially expand our research and development efforts, or identify, or license or acquire other products or product candidates or complete future acquisitions, then we will likely be unable expand our pipeline of product candidates. In addition, any future acquisition would give rise to additional operating costs and will likely require us to seek additional financing. Future acquisitions could result in additional issuances of equity securities that would dilute the ownership of existing stockholders. Future acquisitions could also result in the incurrence of debt, contingent liabilities or the amortization of expenses related to other intangible assets, any of which could adversely affect our operating results.

We would be subject to applicable regulatory approval requirements of the foreign countries in which we market our products, which are costly and may prevent or delay us from marketing our products in those countries.

In addition to regulatory requirements in the United States, we would be subject to the regulatory approval requirements in each foreign country where we market our products. In addition, we might be required to identify one or more collaborators in these foreign countries to develop, seek approval for and manufacture our products and any companion genetic test for Gencaro. If we decide to pursue regulatory approvals and commercialization of our product candidates internationally, we may not be able to obtain the required foreign regulatory approvals on a timely basis, if at all, and any failure to do so may cause us to incur additional costs or prevent us from marketing our products in foreign countries, which may have a material adverse effect on our business, financial condition and results of operations.

If our internal control over financial reporting is not considered effective, our business and stock price could be adversely affected.

Section 404 of the Sarbanes-Oxley Act of 2002 requires us to evaluate the effectiveness of our internal control over financial reporting as of the end of each fiscal year, and to include a management report assessing the effectiveness of our internal control over financial reporting in our annual report on Form 10-K for that fiscal year. Our management, including our principal executive officer and principal financial officer, does not expect that our internal control over financial reporting will prevent all error and all fraud. We continue to operate with a small staff for financial reporting. Though the process and design of our internal controls over financial reporting have not been altered, the small number of staff involved in financial reporting may limit our ability to properly segregate internal control procedures which could result in deficiencies or material weaknesses in our internal controls in the future. A control system, no matter how well designed and operated, can provide only reasonable, not absolute, assurance that the control system's objectives will be met. Further, the design of a control system must reflect the fact that there are resource constraints, and the benefits of controls must be considered relative to their costs. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud involving a company have been, or will be, detected. The design of any system of controls is based in part on certain assumptions about the likelihood of future events, and we cannot assure you that any design will succeed in achieving its stated goals under all potential future conditions. Over time, controls may become ineffective because of changes in conditions or deterioration in the degree of compliance with policies or procedures. Because of the inherent limitations in a cost-effective control system, misstatements due to error or fraud may occur and not be

detected. We cannot assure you that we or our independent registered public accounting firm will not identify a material weakness in our internal control over financial reporting in the future. A material weakness in our internal control over financial reporting would require management to consider our internal control over financial reporting as ineffective. If our internal control over financial reporting is not considered effective, we may experience a loss of public confidence, which could have an adverse effect on our business and on the market price of our common stock.

Risks Related to Intellectual Property and Other Legal Matters

If product liability lawsuits are successfully brought against us, then we will incur substantial liabilities and may be required to limit commercialization of Gencaro or other product candidates.

We face product liability exposure related to the testing of our product candidates in human clinical trials, and may face exposure to claims by an even greater number of persons once we begin marketing and distributing our products commercially. If we cannot successfully defend against product liability claims, then we will incur substantial liabilities.

Regardless of merit or eventual outcome, liability claims may result in:

- decreased demand for our products and product candidates;
- injury to our reputation;
- withdrawal of clinical trial participants;
- costs of related litigation;
- substantial monetary awards to patients and others;
- loss of revenues; and
- the inability to commercialize our products and product candidates.

We have obtained limited product liability insurance coverage. Such coverage, however, may not be adequate or may not continue to be available to us in sufficient amounts or at an acceptable cost, or at all. We may not be able to obtain commercially reasonable product liability insurance for any product candidate.

Defending against claims relating to improper handling, storage or disposal of hazardous chemicals, radioactive or biological materials could be time consuming and expensive.

Our research and development of product candidates may involve the controlled use of hazardous materials, including chemicals, radioactive and biological materials. We cannot eliminate the risk of accidental contamination or discharge and any resultant injury from the materials. Various laws and regulations govern the use, manufacture, storage, handling and disposal of hazardous materials. We may be sued or be required to pay fines for any injury or contamination that results from our use or the use by third parties of these materials. Compliance with environmental laws and regulations may be expensive, and current or future environmental regulations may impair our research, development and production efforts.

The loss of any rights to market key products would significantly impair our operating results.

We have licensed from CPEC, who has licensed rights in Gencaro from BMS the exclusive rights to Gencaro for all therapeutic and diagnostic uses in any country until the later of (i) 10 years from the first commercial sale of Gencaro in such country, or (ii) the termination of our commercial exclusivity in such country. This license includes a sublicense to us from BMS. We are obligated to use commercially reasonable efforts to develop and commercialize Gencaro, including obtaining regulatory approvals. Our ability to develop and commercialize Gencaro is dependent on numerous factors, including some factors that are outside of our control. CPEC has the right to terminate our license if we materially breach our obligations under the license agreement and fail to cure any such breach within the terms of the license.

If our license agreement with CPEC is terminated for reasons related to non-payment of fees, or for any other breach, then we would have no further rights to develop and commercialize Gencaro for any indication. The termination of this license, or of any other agreement which enables us to market a key product or product candidate, could significantly and adversely affect our business.

Certain intellectual property licensed by us is the subject of additional licensing arrangements to which the party that has licensed rights to us is subject. If such parties were to breach the terms of such licenses or such licenses were otherwise to terminate, our and our partners' rights to use such technology and develop and commercialize their products such as the genetic test may terminate and our business would be materially harmed.

Third parties may own or control patents or patent applications that we may be required to license to commercialize our product candidates or that could result in litigation that would be costly and time consuming.

Our or any strategic partner's ability to commercialize Gencaro and other product candidates depends upon our ability to develop, manufacture, market and sell these drugs without infringing the proprietary rights of third parties. A number of pharmaceutical and biotechnology companies, universities and research institutions have or may be granted patents that cover technologies similar to the technologies owned by or licensed to us. We may choose to seek, or be required to seek, licenses under third party patents, which would likely require the payment of license fees or royalties or both. We may also be unaware of existing patents that may be infringed by Gencaro, the genetic testing we intend to use in connection with Gencaro or our other product candidates. Because patent applications can take many years to issue, there may be other currently pending applications that may later result in issued patents that are infringed by Gencaro or our other product candidates. Moreover, a license may not be available to us on commercially reasonable terms, or at all.

There is a substantial amount of litigation involving patent and other intellectual property rights in the biotechnology and biopharmaceutical industries generally. If a third party claims that we are infringing on its technology, then our business and results of operations could be harmed by a number of factors, including:

- infringement and other intellectual property claims, even if without merit, are expensive and time-consuming to litigate and can divert management's attention from our core business;
- monetary damage awards for past infringement can be substantial;
- a court may prohibit us from selling or licensing product candidates unless the patent holder chooses to license the patent to us; and
- if a license is available from a patent holder, we may have to pay substantial royalties.

We may also be forced to bring an infringement action if we believe that a competitor is infringing our protected intellectual property. Any such litigation will be costly, time-consuming and divert management's attention, and the outcome of any such litigation may not be favorable to us.

Our intellectual property rights may not preclude competitors from developing competing products and our business may suffer.

Our competitive success will depend, in part, on our ability to obtain and maintain patent protection for our inventions, technologies and discoveries, including intellectual property that we license. The patent positions of biotechnology companies involve complex legal and factual questions, and we cannot be certain that our patents and licenses will successfully preclude others from using our technology. Consequently, we cannot be certain that any of our patents will provide significant market protection or will not be circumvented or challenged and found to be unenforceable or invalid. In some cases, patent applications in the United States and certain other jurisdictions are maintained in secrecy until patents issue, and since publication of discoveries in the scientific or patent literature often lags behind actual discoveries, we cannot be certain of the priority of inventions covered by pending patent applications. Moreover, we may have to participate in interference proceedings declared by the U.S. Patent and Trademark Office to determine priority of invention, in opposition proceedings in a foreign patent office, or in a post-grant challenge proceeding such as an ex parte reexamination or inter partes review at the U.S. Patent and Trademark Office, any of which could result in substantial cost to us, even if the eventual outcome is favorable. There

can be no assurance that a court of competent jurisdiction would hold any claims in any issued patent to be valid. An adverse outcome could subject us to significant liabilities to third parties, require disputed rights to be licensed from third parties or require us to cease using such technology. Regardless of merit, the listing of patents in the FDA Orange Book for Gencaro may be challenged as being improperly listed. We may have to defend against such claims and possible associated antitrust issues. We could also incur substantial costs in seeking to enforce our proprietary rights against infringement.

While the composition of matter patents on the compound that comprises Gencaro have expired, we hold the intellectual property concerning the interaction of Gencaro with the polymorphisms of the beta-1 and alpha-2C receptors. We have obtained patents that claim methods involving Gencaro after a patient's receptor genotype has been determined. Our NDA requested a label that will include a claim that efficacy varies based on receptor genotype and a recommendation in the prescribing information that prospective patients be tested for their receptor genotype. We believe that under applicable law, a generic bucindolol label would likely be required to include this recommendation as it pertains directly to the safe or efficacious use of the drug. Such a label may be considered as inducing infringement, carrying the same liability as direct infringement. If the label with the genotype information for Gencaro is not approved, or if generic labels are not required to copy the approved label, competitors could have an easier path to introduce competing products and our business may suffer. The approved label may not contain language covered by the patents, or we may be unsuccessful in enforcing them.

We may not be able to effectively protect our intellectual property rights in some foreign countries, as our patents are limited by jurisdiction and many countries do not offer the same level of legal protection for intellectual property as the United States.

We require our employees, consultants, business partners and members of our scientific advisory board to execute confidentiality agreements upon the commencement of employment, consulting or business relationships with us. These agreements provide that all confidential information developed or made known during the course of the relationship with us be kept confidential and not disclosed to third parties except in specific circumstances. In the case of employees, the agreements provide that all inventions resulting from work performed for us, utilizing the property or relating to our business and conceived or completed by the individual during employment shall be our exclusive property to the extent permitted by applicable law.

Third parties may breach these and other agreements with us regarding our intellectual property and we may not have adequate remedies for the breach. Third parties could also fail to take necessary steps to protect our licensed intellectual property, which could seriously harm our intellectual property position.

If we are not able to protect our proprietary technology, trade secrets and know-how, then our competitors may develop competing products. Any issued patent may not be sufficient to prevent others from competing with us. Further, we have trade secrets relating to Gencaro, and such trade secrets may become known or independently discovered. Our issued patents and those that may issue in the future, or those licensed to us, may be challenged, opposed, invalidated or circumvented, which could allow competitors to market similar products or limit the patent protection term of our product candidates. All of these factors may affect our competitive position.

If the manufacture, use or sale of our products infringe on the intellectual property rights of others, we could face costly litigation, which could cause us to pay substantial damages or licensing fees and limit our ability to sell some or all of our products.

Extensive litigation regarding patents and other intellectual property rights has been common in the biopharmaceutical industry. Litigation may be necessary to assert infringement claims, enforce patent rights, protect trade secrets or know-how and determine the enforceability, scope and validity of certain proprietary rights. Litigation may even be necessary to defend disputes of inventorship or ownership of proprietary rights. The defense and prosecution of intellectual property lawsuits, U.S. Patent and Trademark Office interference proceedings, and related legal and administrative proceedings (e.g., a reexamination, inter partes review, or post-grant review) in the United States and internationally involve complex legal and factual questions. As a result, such proceedings are costly and time-consuming to pursue, and their outcome is uncertain.

Regardless of merit or outcome, our involvement in any litigation, interference or other administrative proceedings could cause us to incur substantial expense and could significantly divert the efforts of our technical and management personnel. Any public announcements related to litigation or interference proceedings initiated or threatened against us could cause our stock price to decline. Adverse outcomes in patent litigation may potentially subject us to antitrust litigation which, regardless of the outcome, would adversely affect our business. An adverse determination may subject us to the loss of our proprietary position or to significant liabilities, or require us to seek licenses that may include substantial cost and ongoing royalties. Licenses may not be available from third parties, or may not be obtainable on satisfactory terms. An adverse determination or a failure to obtain necessary licenses may restrict or prevent us from manufacturing and selling our products, if any. These outcomes could materially harm our business, financial condition and results of operations.

Risks Related to Stock Price Volatility

Our stock price is expected to be volatile.

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

- the regulatory status of Gencaro and the genetic test, and whether and when they are approved for sale, if at all, and the labeling or other conditions of use imposed by the FDA;
- our ability to secure additional funding or complete a strategic transaction or to complete development of and commercialize Gencaro;
- progress of GENETIC-AF and enrollment and any data that may become available;
- the results of our future clinical trials and any future NDAs of our current and future product candidates;
- the entry into, or termination of, key agreements, including key strategic alliance agreements;
- the results and timing of regulatory reviews relating to our product candidates;
- failure of any of our product candidates, if approved, to achieve commercial success;
- general and industry-specific economic conditions that may affect our research and development expenditures;
- the results of clinical trials conducted by others on drugs that would compete with our product candidates;
- issues in manufacturing our product candidates or any approved products;

- the initiation of or material developments in or the conclusion of litigation to enforce or defend any of our intellectual property rights;
- the loss of key employees;
- the introduction of technological innovations or new commercial products by our competitors;
- changes in estimates or recommendations by securities analysts, if any, who cover our common stock;
- future sales of our common stock;
- changes in the structure of health care payment systems;
- period-to-period fluctuations in our financial results; and
- our ability to retain the listing of our common stock on the Nasdaq Capital Market.

Moreover, the stock markets in general have experienced substantial volatility that has often been unrelated to the operating performance of individual companies. These broad market fluctuations may also adversely affect the trading price of our common stock. In the past, following periods of volatility in the market price of a company's securities, stockholders have often instituted class action securities litigation against those companies. Such litigation, if instituted, could result in substantial costs and diversion of management attention and resources, which could significantly harm our profitability and reputation.

Future sales or the possibility of future sales of our common stock may depress the market price of our common stock.

Sales in the public market of substantial amounts of our common stock could depress prevailing market prices of our common stock. As of December 31, 2016, approximately 9.1 million shares of common stock were outstanding, and all of these shares are freely transferable without restriction or further registration under the Securities Act, except for shares held by our directors, officers and other affiliates and unregistered shares held by non-affiliates. The sale of these additional shares, or the perception that such sales may occur, could depress the market price of our common stock.

As of December 31, 2016, approximately 3.7 million shares of our common stock were issuable upon the exercise of outstanding warrants. Once a warrant is exercised, if the shares of our common stock issued upon the exercise of any such warrant are not available for sale in the open market without further registration under the Securities Act, then the holder can arrange for the resale of shares either by invoking any applicable registration rights, causing the shares to be registered under the Securities Act and thus freely transferable, or by relying on an exemption to the Securities Act. For instance, in July 2015, we filed a registration statement on Form S-3 which registered for resale an aggregate of 2.4 million shares of our common stock issuable upon exercise of outstanding warrants. If these registration rights, or similar registration rights that may apply to securities we may issue in the future, are exercised, it could result in additional sales of our common stock in the market, which may have an adverse effect on our stock price.

As of December 31, 2016, there were approximately 660,000 shares of our common stock which may be issued upon the exercise of outstanding stock options and the vesting of restricted stock units, and we anticipate that we will continue to issue stock option and restricted stock unit awards to our employees and consultants in the fiscal year ended December 31, 2017 and thereafter. If and when these options are exercised and these restricted stock units are vested, such shares will be available for sale in the open market without further registration under the Securities Act. The existence of these outstanding options and restricted stock units may negatively affect our ability to complete future equity financings at acceptable prices and on acceptable terms. The exercise of those options and vesting of the restricted stock units, and the prompt resale of shares of our common stock received, may also result in downward pressure on the price of our common stock.

In the absence of a significant strategic transaction, we will need to raise significant additional capital to finance the research, development and commercialization of Gencaro. If future securities offerings occur, they would dilute our current stockholders' equity interests and could reduce the market price of our common stock.

We do not expect to pay cash dividends, and accordingly, stockholders must rely on stock appreciation for any return on their investment.

We anticipate that we will retain our earnings, if any, for future growth and therefore do not anticipate paying cash dividends in the future. As a result, only appreciation of the price of our common stock will provide a return to stockholders. Investors seeking cash dividends should not invest in our common stock.

We have implemented anti-takeover provisions that could discourage, prevent or delay a takeover, even if the acquisition would be beneficial to our stockholders.

Provisions of our certificate of incorporation and bylaws, as well as provisions of Delaware law, could make it more difficult for a third party to acquire us, even if doing so would benefit our stockholders. These provisions:

- establish a classified board of directors so that not all members of our board may be elected at one time;
- authorize the issuance of up to approximately 5 million additional shares of preferred stock that could be issued by our board of directors to increase the number of outstanding shares and hinder a takeover attempt;
- limit who may call a special meeting of stockholders;
- prohibit stockholder action by written consent, thereby requiring all stockholder actions to be taken at a meeting of our stockholders; and
- establish advance notice requirements for nominations for election to our board of directors or for proposing matters that can be acted upon at a stockholder meeting.

Specifically, our certificate of incorporation provides that all stockholder action must be effected at a duly called meeting and not by a written consent. The bylaws provide, however, that our stockholders may call a special meeting of stockholders only upon a request of stockholders owning at least 50% of our outstanding common stock. These provisions of our certificate of incorporation and bylaws could discourage potential acquisition proposals and could delay or prevent a change in control. We designed these provisions to reduce our vulnerability to unsolicited acquisition proposals and to discourage certain tactics that may be used in proxy fights. These provisions, however, could also have the effect of discouraging others from making tender offers for our shares. As a consequence, they also may inhibit fluctuations in the market price of our shares that could result from actual or rumored takeover attempts. Such provisions also may have the effect of preventing changes in our management.

We are permitted to issue shares of our preferred stock without stockholder approval upon such terms as our board of directors determines. Therefore, the rights of the holders of our common stock are subject to, and may be adversely affected by, the rights of the holders of our preferred stock that may be issued in the future. In addition, the issuance of preferred stock could have a dilutive effect on the holdings of our current stockholders.

We are subject to the Delaware anti-takeover laws regulating corporate takeovers. These anti-takeover laws prevent a Delaware corporation from engaging in a merger or sale of more than 10% of its assets with any stockholder, including all affiliates and associates of the stockholder, who owns 15% or more of the corporation's outstanding voting stock, for three years following the date that the stockholder acquired 15% or more of the corporation's stock unless:

- the board of directors approved the transaction where the stockholder acquired 15% or more of the corporation's stock;

- after the transaction in which the stockholder acquired 15% or more of the corporation's stock, the stockholder owned at least 85% of the corporation's outstanding voting stock, excluding shares owned by directors, officers and employee stock plans in which employee participants do not have the right to determine confidentially whether shares held under the plan will be tendered in a tender or exchange offer; or
- on or after this date, the merger or sale is approved by the board of directors and the holders of at least two-thirds of the outstanding voting stock that is not owned by the stockholder.

The provisions of our governing documents and current Delaware law may, collectively:

- lengthen the time required for a person or entity to acquire control of us through a proxy contest for the election of a majority of our board of directors;
- discourage bids for our common stock at a premium over market price; and
- generally deter efforts to obtain control of us.

Item 1B. Unresolved Staff Comments

Not applicable.

Item 2. Properties

Our headquarters facility consists of approximately 5,300 square feet of office space in Westminster, Colorado, which is leased until November 2019. We believe that this facility is adequate to meet our current needs.

Item 3. Legal Proceedings

Not applicable.

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

As of March 7, 2011, our common stock began trading on the Nasdaq Capital Market under the symbol “ABIO”, and was previously traded under the same symbol on the Nasdaq Global Market. Prior to completion of the merger with Nuvelo, Nuvelo’s common stock traded under the symbol “NUVO” on the Nasdaq Global Market from January 31, 2003 to January 27, 2009 (except for the period between June 19, 2003 and March 19, 2004, where it temporarily traded under the symbol “NUVOD”).

On September 3, 2015, we filed a Certificate of Amendment to our Amended and Restated Certificate of Incorporation, to implement a seven-for-one reverse split of our common stock, as previously authorized and approved at our annual meeting of stockholders on June 22, 2015. On September 4, 2015, our common stock began trading on The NASDAQ Capital Market on a post-split basis.

The reverse split effected a proportionate adjustment to the per share exercise price and the number of shares issuable upon the exercise or settlement of all outstanding options and warrants to purchase shares of our common stock, and the number of shares reserved for issuance pursuant to our existing stock option plans were reduced proportionately. No fractional shares were issued as a result of the reverse split, and stockholders who otherwise would have been entitled to a fractional share received in lieu thereof, a cash payment based on the closing sale price of our common stock as reported on The NASDAQ Capital Market on September 3, 2015. The reverse split did not alter the par value of our common stock or modify any voting rights or other terms of the common stock.

The following table sets forth, for the periods indicated, the high and low sales prices for our common stock, as reported by the Nasdaq Capital Market in 2016 and 2015 (adjusted for the one-for-seven reverse stock split effective September 3, 2015):

Year ended December 31, 2016	High	Low
First quarter	\$4.92	\$3.05
Second quarter	\$4.35	\$2.73
Third quarter	\$3.36	\$2.75
Fourth quarter	\$3.00	\$2.15

Year ended December 31, 2015	High	Low
First quarter	\$7.42	\$4.51
Second quarter	\$8.61	\$5.11
Third quarter	\$10.85	\$4.75
Fourth quarter	\$6.97	\$4.65

Stockholders

As of March 17, 2017, we had approximately 51 stockholders of record of our common stock, and the last sale price reported on the Nasdaq Capital Market for our common stock was \$2.60 per share.

Dividend Policy

The holders of our common stock are entitled to dividends in such amounts and at such times, if any, as may be declared by our Board of Directors out of legally available funds. We have not paid any dividends on our common stock and do not anticipate paying any cash dividends in the foreseeable future.

Securities Authorized for Issuance Under Equity Compensation Plans

Information relating to our equity compensation plans as of December 31, 2016, under which our equity securities were authorized for issuance, is included in Item 12 of Part III of this Annual Report.

Unregistered Sales of Equity Securities and Use of Proceeds

None.

Issuer Purchases of Equity Securities

None.

Item 6. Selected Financial Data

Not applicable.

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

We have included or incorporated by reference into this Management's Discussion and Analysis of Financial Condition and Results of Operations and elsewhere in this Annual Report on Form 10-K, and from time to time our management may make, statements that constitute "forward-looking statements" within the meaning of Section 27A of the Securities Act and Section 21E of the Exchange Act. Forward-looking statements may be identified by words including "anticipate," "plan," "believe," "intend," "estimate," "expect," "should," "may," "potential" and similar expressions. statements involve known and unknown risks, uncertainties and other factors that may cause our actual results, levels of activity, performance or achievements to be materially different from the information expressed or implied by these forward-looking statements. While we believe that we have a reasonable basis for each forward-looking statement contained in this Annual Report, we caution you that these statements are based on a combination of facts and factors currently known by us and our projections of the future, about which we cannot be certain. We undertake no obligation to publicly update any forward-looking statements, whether as a result of new information, future events or otherwise. You are advised, however, to consult any further disclosures we make on related subjects in our Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, and our website.

Overview

We are a biopharmaceutical company applying a precision medicine approach to developing genetically-targeted therapies for cardiovascular diseases. Precision medicine refers to the tailoring of medical treatment to the individual characteristics of each patient through the ability to classify individuals into subpopulations that differ in their susceptibility to a particular disease, in the biology and/or prognosis of those diseases they may develop, or in their response to a specific treatment. Our lead product candidate, Gencaro™ (bucindolol hydrochloride), is an investigational, pharmacologically unique beta-blocker and mild vasodilator that we are developing for the potential treatment of patients with atrial fibrillation, or AF, and chronic heart failure with reduced left ventricular ejection fraction, or HFrEF. HFrEF constitutes an estimated 50-60% of the total heart failure, or HF population, with the remainder comprised of HF with preserved ejection fraction, or HFpEF. We believe that Gencaro's efficacy is enhanced in a specific genotype that is present in approximately fifty percent of the general population in the United States, and can be identified by a genetic test. We believe that with this genetic test, we may be able to predict individual patient response to Gencaro, potentially improving the efficacy of treatment for AF in HFrEF patients with this particular genotype. We believe that Gencaro, if approved, could potentially be a safer and more effective therapy for treating or preventing AF in patients with HFrEF and could be the first genetically-targeted AF treatment. We also believe that Gencaro may have market exclusivity based on patents and new chemical entity status, if approved in the United States, Europe or other markets.

We are conducting a Phase 2B/Phase 3 clinical superiority trial, known as GENETIC-AF, in which we are evaluating Gencaro for the treatment and prevention of AF in HFrEF patients. In our trial, HFrEF is defined as a left ventricular ejection fraction, or LVEF, of less than 50%. GENETIC-AF compares Gencaro to TOPROL-XL (metoprolol succinate), a drug approved for treating HFrEF that is also prescribed, but not approved, for treating AF in patients with HFrEF. Enrollment in GENETIC-AF is limited to patients that possess the specific genotype that we believe enhances Gencaro's potential therapeutic effects. Our current development of Gencaro is, in part, based on a prospectively designed DNA substudy of adrenergic receptor polymorphisms in the BEST trial, a previous Phase 3 study of 2,708 HF patients. Based on data from the BEST trial, Gencaro showed potential evidence of enhanced efficacy in treating AF and in reducing mortality and hospitalizations in HF patients with this specific genotype. In 2015, the U.S. Food and Drug Administration, or FDA, designated the investigation of Gencaro for the prevention of

AF in a genetically targeted heart failure population (HF patients with reduced LVEF) as a Fast Track development program.

AF, the most common sustained cardiac arrhythmia, is a potentially serious disorder in which the normally regular and coordinated contraction pattern of the heart's two small upper chambers, or the atria, becomes irregular, rapid and uncoordinated. AF commonly occurs together with HFrEF, with AF being both a cause and a result of HFrEF. By increasing heart rate and producing irregular cycle lengths, AF may contribute to the disease processes that leads to the progression of HFrEF and worsening clinical outcomes.

AF is considered an epidemic cardiovascular disease and a major public health burden. The estimated number of individuals with AF globally in 2010 was 33.5 million. According to the 2017 American Heart Association report on Cardiovascular Disease, approximately 5.2 million people in the United States had atrial fibrillation in 2015. Hospitalization rates for AF increased by 23% among U.S. adults from 2000 to 2010 and hospitalizations account for the majority of the economic cost burden associated with AF. In a global registry of AF patients, the rates of heart failure (of all types) ranged from 33% in patients with paroxysmal (episodes lasting 7 days or less) to 56% in patients with permanent AF.

We believe there is a significant need for drug therapies that are safe and effective for HFrEF patients with AF, as the existing drug therapies for the treatment or prevention AF have certain safety disadvantages in HFrEF patients, such as toxic or cardiovascular

adverse effects. Most of the approved drugs for AF are contra indicated or have warnings in their prescribing information for such patients. Consequently, in the treatment and prevention of AF in HFrEF patients, we believe there is an unmet medical need for new treatments that have fewer side effects and are more effective than currently available therapies.

We believe that data from the BEST trial indicate that Gencaro may have a genetically regulated effect in reducing or preventing AF in HFrEF patients. A retrospective analysis of data from the BEST trial shows that all patients in the trial treated with Gencaro had a 41% reduction in the risk of new onset AF (time-to-event) compared to placebo ($p = 0.0004$). In a substudy in the trial, which considered only patients with the genotype believed to enhance Gencaro's efficacy (known as the beta-1 389 arginine homozygous genotype), patients treated with Gencaro experienced a 74% ($p = 0.0003$) reduction in risk of AF, based on the same analysis. In addition, the BEST study, the beta-1 389 arginine homozygous genotype Gencaro demonstrated enhanced efficacy in reducing mortality, hospitalizations, and ventricular tachycardia /ventricular fibrillation, or VT/VF. Furthermore, patients with a beta 1 389 arginine homozygous genotype who entered the trial in AF had statistically significant reductions in major cardiovascular or HF mortality/hospitalization composite endpoints, which we believe is the first and thus far only demonstration of effectiveness of a beta-blocker in reducing major HF events in HFrEF patients with permanent AF. We believe that in HFrEF patients, the therapeutic efficacy of TOPROL-XL is not enhanced in patients with a beta-1 389 arginine homozygous genotype, and we believe that Gencaro may be potentially unique in the beta-blocker class of drugs due to its apparent pharmacologic interaction with this beta-1 adrenergic receptor polymorphism. The beta-1 389 arginine homozygous genotype was present in about 47% of the patients in the BEST pharmacogenetic substudy, and we estimate it is present in about 50% of the U.S. general population.

GENETIC-AF is an adaptive, seamless design Phase 2B/Phase 3, multi-center, randomized, double-blind, clinical superiority trial comparing the safety and efficacy of Gencaro against an active comparator, the beta-blocker TOPROL-XL (metoprolol succinate), that seeks to enroll a combined total of approximately 620 patients. Eligible patients will have HFrEF, a history of paroxysmal AF (episodes lasting 7 days or less) or persistent AF (episodes lasting more than 7 days and less than 1 year) in the past 6 months, and the beta-1 389 arginine homozygous genotype that we believe responds most favorably to Gencaro. A subset of patients in the trial will also undergo continuous heart rhythm monitoring to assess AF burden, which is defined as the amount of time per day that a patient experiences AF. These data will be collected via newly or previously implanted Medtronic, Inc. devices capable of assessing AF burden (for example, implantable loop recorders, pacemakers, cardioverter-defibrillators, or cardiac resynchronization therapy devices). The primary endpoint of the study is time to first event of symptomatic AF/atrial flutter, or AFL, or all-cause mortality. The combined Phase 2B/Phase 3 trial is designed for 90 percent power at a p-value of less than 0.01 significance level to detect a 25 percent reduction in the primary endpoint for patients in the Gencaro arm compared to patients in the TOPROL-XL arm. We received guidance from the FDA regarding the GENETIC-AF clinical trial prior to initiation of the trial. Based on this FDA guidance, we believe that a successful GENETIC-AF Phase 3 clinical trial, with a p-value of less than or equal to 0.01 could be sufficient evidence of efficacy upon which to base a New Drug Application, or NDA, when submitted with the prior Phase 3 BEST trial data, for the approval of Gencaro for an AF indication in HFrEF patients. A second trial may be required if the GENETIC-AF trial results produce a p-value greater than 0.01. The trial is currently enrolling patients in the United States, Canada and Europe.

The GENETIC-AF Data and Safety Monitoring Board, or DSMB, will perform a pre-specified interim analysis of unblinded efficacy data when at least 150 patients have evaluable data. A randomized patient has evaluable data either when they experience their first composite endpoint event, AF/AFL or all-cause mortality, or after completion of the 24-week primary endpoint follow-up period. The analysis will be conducted for detection of evidence of safety and superior efficacy of Gencaro versus the active comparator, TOPROL-XL.

The prospectively defined features of this analysis include an estimate of Gencaro effectiveness relative to TOPROL-XL and an assessment of safety as characterized by adverse events. The relative benefit estimate will utilize Bayesian statistical methods to calculate the predictive probability of the Phase 3 patient cohort hazard ratio based on the interim Phase 2B data. Prospectively defined ranges of predictive probabilities have been predetermined to define three potential outcomes based on the projection of the Phase 2B interim results:

- 1) transition the trial to Phase 3 based on a likelihood of achieving a statistically significant hazard ratio in favor of Gencaro (evidence of an efficacy signal consistent with pretrial assumptions) and enroll up to a total of 620 patients (including the Phase 2B patients);
- 2) completion of the Phase 2B stage of the trial including 24-week follow-up of all randomized subjects (approximately 250 patients), based on an intermediate result that is potentially favorable but does not support transition of the trial to Phase 3 or;
- 3) immediate termination of the trial due to futility.

We, in collaboration with the GENETIC-AF Steering Committee, will determine the next steps for the trial based on the DSMB recommendation from this interim analysis and on our available capital. The unblinded statistical data available to the DSMB will not be disclosed to us or the public. We randomized our 175th patient in the trial in March 2017. We project that the outcome of the

DSMB interim analysis and recommendation will be available in the third quarter of 2017. In February 2016, we amended the trial protocol to allow for up to 250 patients to be enrolled in the Phase 2B portion of the trial, which is intended to enable the study to continue enrolling patients while the DSMB interim analysis is underway. Should the DSMB recommend that the study continue to Phase 3, the trial would continue enrolling to a total of approximately 620 patients (i.e., up to 250 patients in Phase 2B and 370 patients in Phase 3), subject to our obtaining sufficient financing to fund the Phase 3 portion of the trial.

In February 2016, the GENETIC-AF protocol was amended to simplify certain operational aspects of the trial. We believe these modifications facilitated site recruitment and enrollment in existing trial sites and additional sites in European countries, where we are expanding the study to support both the latter portion of Phase 2B, as well as the potential Phase 3 portion of the trial. We believe inclusion of European investigative sites will also support potential European regulatory submissions and partnering activity. We received no objections from the FDA and Health Canada on the protocol amendments prior to their implementation. As such, we believe that these changes do not fundamentally alter or impact previous regulatory agreements.

We have been granted patents in the United States, Europe, and other jurisdictions for methods of treating AF and HF patients with Gencaro based on genetic testing. We believe our patent portfolio and new chemical entity exclusivity may provide market exclusivity for the indications of Gencaro that we may develop, into approximately 2030 or 2031 in the United States, Europe and other markets.

To support the continued development of Gencaro, in June 2015, we completed a private placement that raised approximately \$34.2 million of net proceeds as additional funds for the Phase 2B portion of the GENETIC-AF trial and to support our ongoing operations. We are seeking to enroll up to 250 HFrEF patients in the Phase 2B portion of the GENETIC-AF trial, and we believe that our current cash, cash equivalents and marketable securities will be sufficient to fund our operations, at our projected cost structure, through the end of 2017. In January 2017, we entered into a sales agreement with an agent to sell, from time to time, our common stock having an aggregate offering price of up to \$7.3 million, in an “at the market offering.” We are not obligated to make any sales of our common stock, and, as of March 17, 2017, we have sold an aggregate of 43,156 shares of our common stock pursuant to the terms of such sales agreement for aggregate gross proceeds of approximately \$112,000, before paying commissions to our placement agent of approximately \$3,000. However, changing circumstances may cause us to consume capital significantly faster or slower than we currently anticipate. We have based these estimates on assumptions that may prove to be wrong, and we could exhaust our available financial resources sooner than we currently anticipate. If we continue to the Phase 3 portion of GENETIC-AF, we will be required to raise additional funds.

Results of Operations

Research and Development Expenses

Research and development, or R&D, expense is comprised of clinical, regulatory, and manufacturing process development activities and costs. Our research and development expenses totaled \$12.3 million for the year ended December 31, 2016 as compared to \$7.1 million for 2015. The \$5.3 million increase in research and development expenses in 2016 as compared to 2015 was primarily due to the increased expense of our GENETIC-AF clinical trial.

Clinical expense increased approximately \$3.0 million during the year ended December 31, 2016. The increase in costs were related to our GENETIC-AF clinical trial, including CRO costs, clinical site initiation and monitoring activities, patient visit costs and increased costs to support expanding into Europe.

Research and development personnel costs increased approximately \$0.3 million during the year ended December 31, 2016.

Manufacturing process development costs increased approximately \$1.9 million for the year ended December 31, 2016 compared to the corresponding period of 2015. The increase was a result of production of clinical trial materials to be used in our GENETIC-AF clinical trial and related product testing.

We expect R&D expense in 2017 to be higher than 2016 as we activate new clinical sites and enroll additional patients in our GENETIC-AF clinical trial.

General and Administrative Expenses

General and administrative expenses, or G&A, primarily consist of personnel costs, consulting and professional fees, insurance, facilities and depreciation expenses, and various other administrative costs.

G&A expenses were \$4.3 million for the year ended December 31, 2016, compared to \$4.4 million for 2015, a decrease of approximately \$127,000. The decrease in expenses during 2016 was comprised primarily of 2015 costs related to a reverse stock split in September 2015, with no corresponding transaction in 2016, and lower corporate franchise taxes in 2016 as compared to 2015.

G&A expenses in 2017 are expected to be consistent with those in 2016 as we maintain administrative activities to support our GENETIC-AF clinical trial.

Interest and Other Income

Interest and other income was \$169,000 for the year ended December 31, 2016 as compared to \$14,000 for 2015, resulting in an increase of \$155,000. This increase was due to investing our cash in higher yield securities. We expect interest income to be slightly lower in 2017, as we use our current cash balance to fund operations.

Interest and Other Expense

We had no interest or other expense during the year ended December 31, 2016. Interest and other expense was \$4,000 for the year ended December 31, 2015. The amounts were nominal to our overall operations. Based on our current capital structure, interest expense is expected to be negligible in 2017.

Liquidity and Capital Resources

Cash and Cash Equivalents

	December 31,	
	2016	2015
	(in thousands)	
Cash and cash equivalents	\$7,401	\$38,802
Marketable securities, short and long-term	16,114	—
Cash, cash equivalents and marketable securities	\$23,515	\$38,802

As of December 31, 2016, we had total cash, cash equivalents and marketable securities of approximately \$23.5 million, as compared to \$38.8 million as of December 31, 2015. The net decrease of \$15.3 million during the year primarily reflects the approximately \$15.0 million of cash used to fund operating activities during year ended December 31, 2016.

Cash Flows from Operating, Investing and Financing Activities

	Years Ended	
	December 31,	December 31,
	2016	2015
	(in thousands)	
Net cash provided by (used in):		
Operating activities	\$(14,987)	\$(10,534)
Investing activities	(16,414)	(11)
Financing activities	—	33,993
Net (decrease) increase in cash and cash equivalents	\$(31,401)	\$23,448

Net cash used in operating activities for the year ended December 31, 2016 increased approximately \$4.5 million compared with the 2015 period. This is primarily due to higher outflows related to a higher net loss in 2016, as

discussed in more detail above, offset by changes in operating assets and liabilities.

Net cash used in investing activities for the year ended December 31, 2016 was \$16.4 million. This is related to \$20.5 million for the purchases of marketable securities and \$12,000 for the purchase of property and equipment, offset by \$4.1 million of proceeds from the maturities of marketable securities. Net cash used in investing activities for the year ended December 31, 2015 was \$11,000 for the purchase of property and equipment.

There was no net cash provided by financing activities for the year ended December 31, 2016. Net cash provided by financing activities was \$34.0 million for the year ended December 31, 2015 representing approximately \$34.2 million of net proceeds from our private placement completed in June 2015, less approximately \$193,000 in payments on a vendor financing arrangement.

Sources and Uses of Capital

Our primary sources of liquidity to date have been capital raised from issuances of shares of our preferred and common stock. The primary uses of our capital resources to date have been to fund operating activities, including research, clinical development and drug manufacturing expenses, license payments, and spending on capital items.

In January 2017, we entered into a sales agreement with an agent to sell, from time to time, our common stock having an aggregate offering price of up to \$7.3 million, in an “at the market offering.” We are not obligated to make any sales of our common stock, and, as of March 17, 2017, we have sold an aggregate of 43,156 shares of our common stock pursuant to the terms of such sales agreement for aggregate gross proceeds of approximately \$112,000, before paying commissions to our placement agent of approximately \$3,000.

On June 10, 2015, we entered into a securities purchase agreement, or the Purchase Agreement, with a group of institutional investors in connection with a private placement of units made up of shares of our common stock and warrants to purchase shares of common stock. On June 16, 2015, pursuant to the Purchase Agreement, we sold 6,003,082 units at price of \$6.1635 per unit, for aggregate net proceeds of approximately \$34.2 million. The warrants issued in the private placement were first exercisable on December 13, 2015, expire on June 16, 2022 and have an exercise price of \$6.1012 per share. Our Registration Statement on Form S-3 registering the shares of common stock, including the shares of common stock underlying the warrants, issued in the transaction for public resale was declared effective on July 20, 2015. Pursuant to our engagement agreement with our sole placement agent for the transaction, we paid our placement agent a fee for its services in the transaction equal to 7% of the gross financing proceeds received by us.

We initiated our GENETIC-AF Phase 2B/Phase 3 clinical trial during 2014. Our ability to execute our GENETIC-AF Phase 2B trial in accordance with our projected time line depends on a number of factors, including, but not limited to, the following:

- recruitment of sufficient clinical trial sites, enrollment of patients and enrollment at a rate consistent with our projected timeline;
- effects of protocol amendments and their projected impact on enrollment;
- our ability to control costs associated with the clinical trial and our operations;
- our ability to retain the listing of our common stock on the Nasdaq Capital Market;
- the market price of our stock and the availability and cost of additional equity capital from existing and potential new investors;
- general economic and industry conditions affecting the availability and cost of capital;
- the costs of filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights; and
- the terms and conditions of our existing collaborative and licensing agreements.

In order to increase the pool of patients eligible for enrollment in GENETIC-AF, consistent with the adaptive design nature of the trial, we consulted with the GENETIC-AF Steering Committee and implemented amendments to the trial protocol in March 2015 and February 2016. In March 2015, the GENETIC-AF protocol was revised to expand the target study population. Previously, the protocol required patients to have persistent AF at the time of screening to be eligible. Under the revised protocol, patients in sinus rhythm who have experienced symptomatic AF are eligible for inclusion in the trial, as are patients with paroxysmal AF. We believe this expanded target population has improved trial screening and enrollment rates and could broaden the potential commercial market for Gencaro, should it achieve regulatory approval in the future. In February 2016, the GENETIC-AF protocol was amended to simplify certain operational aspects of the trial. We believe these modifications have and will facilitate site recruitment and enrollment in existing trial sites and additional sites in European countries, where we are expanding the study to support both the latter portion of Phase 2B, as well as the potential Phase 3 portion of the trial. We believe inclusion of European investigative sites will also support potential European regulatory submissions and partnering activity. We randomized our 175th patient in the trial in March 2017. We project that the outcome of the DSMB interim analysis and recommendation will be available in the third quarter of 2017.

We believe that our current cash and cash equivalents and marketable securities, will be sufficient to fund our operations, at our projected cost structure, through the end of 2017. However, our forecast of the period of time through which our financial resources will be adequate to support our current and forecasted operations could vary materially. If we elect to continue to the Phase 3 portion of GENETIC-AF, the sale of additional equity or convertible debt securities or a strategic transaction or collaboration will be necessary for us to complete the Phase 3 of the GENETIC-AF clinical trial and submit for FDA approval of Gencaro. Such financing would likely result in additional dilution to our existing stockholders. If we raise additional funds through the incurrence of indebtedness, the obligations related to such indebtedness would be senior to rights of holders of our capital stock and could contain covenants that would restrict our operations. The significant uncertainties surrounding the clinical development timelines and costs and the ability to raise a significant amount of capital raises substantial doubt about our ability to continue as a going concern from one year after the Company's financial statements have been issued.

Critical Accounting Policies and Estimates

A critical accounting policy is one that is both important to the portrayal of our financial condition and results of operation and requires management's most difficult, subjective or complex judgments, often as a result of the need to make estimates about the effect of matters that are inherently uncertain. While our significant accounting policies are described in Note 1 of "Notes to Financial Statements" included within Item 8 in this report, we believe the following critical accounting policy affected our most significant judgments, assumptions, and estimates used in the preparation of our financial statements and, therefore, is important in understanding our financial condition and results of operations.

Accrued Expenses

As part of the process of preparing our financial statements, we are required to estimate accrued expenses. This process involves identifying services that third parties have performed on our behalf and estimating the level of service performed and the associated cost incurred for these services as of the balance sheet date. Examples of estimated accrued expenses include contract service fees, such as fees payable to contract manufacturers in connection with the production of materials related to our drug product, and professional service fees, such as attorneys, consultants, and clinical research organizations. We develop estimates of liabilities using our judgment based upon the facts and circumstances known at the time.

Off-Balance Sheet Arrangements

We have not participated in any transactions with unconsolidated entities, such as special purpose entities, which would have been established for the purpose of facilitating off-balance sheet arrangements.

Indemnifications

In the ordinary course of business, we enter into contractual arrangements under which we may agree to indemnify certain parties from any losses incurred relating to the services they perform on our behalf or for losses arising from certain events as defined within the particular contract. Such indemnification obligations may not be subject to maximum loss clauses. We have entered into indemnity agreements with each of our directors, officers and certain employees. Such indemnity agreements contain provisions, which are in some respects broader than the specific indemnification provisions contained in Delaware law. We also maintain an insurance policy for our directors and executive officers insuring against certain liabilities arising in their capacities as such.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk

Not applicable.

Item 8. Financial Statements and Supplementary Data

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Report of Independent Registered Public Accounting Firm

The Board of Directors and Stockholders

ARCA biopharma, Inc.:

We have audited the accompanying balance sheets of ARCA biopharma, Inc. (the Company) as of December 31, 2016 and 2015, and the related statements of operations and comprehensive loss, stockholders' equity, and cash flows for each of the years in the two-year period ended December 31, 2016. 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. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as 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 financial position of ARCA biopharma, Inc. as of December 31, 2016 and 2015, and the results of its operations and its cash flows for each of the years in the two-year period ended December 31, 2016, in conformity with U.S. generally accepted accounting principles.

The accompanying financial statements have been prepared assuming that the Company will continue as a going concern. As discussed in note 1 to the financial statements, the Company has incurred substantial losses from operations and needs to raise a significant amount of capital to fund its clinical development programs. The Company's ability to raise such capital is uncertain. As a result, there is substantial doubt about the Company's ability to continue as a going concern for a period from one year after the Company's financial statements have been issued. Management's plans in regard to these matters are also described in note 1. The financial statements do not include any adjustments that might result from the outcome of this uncertainty.

/s/ KPMG LLP

Denver, Colorado

March 21, 2017

ARCA BIOPHARMA, INC.

BALANCE SHEETS

	As of December 31,	
	2016	2015
	(in thousands, except share	
	and per share	
	amounts)	
ASSETS		
Current assets:		
Cash and cash equivalents	\$7,401	\$38,802
Marketable securities	13,762	—
Other current assets	282	114
Total current assets	21,445	38,916
Marketable securities	2,352	—
Property and equipment, net	66	28
Other assets	766	630
Total assets	\$24,629	\$39,574
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable	\$1,205	\$364
Accrued compensation and employee benefits	719	669
Accrued expenses and other liabilities	472	471
Total current liabilities	2,396	1,504
Deferred rent, net of current portion	39	—
Total liabilities	2,435	1,504
Commitments and contingencies		
Stockholders' equity:		
Preferred stock, \$0.001 par value; 5 million shares authorized;		
no shares issued or outstanding at December 31, 2016 and 2015	—	—
Common stock, \$0.001 par value; 100 million shares authorized	9	9

at December 31, 2016 and 2015; 9,082,366 and 9,051,217

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shares issued and outstanding at December 31, 2016 and

2015, respectively

Additional paid-in capital	134,715	134,128
Accumulated other comprehensive loss	(19)	—
Accumulated deficit	(112,511)	(96,067)
Total stockholders' equity	22,194	38,070
Total liabilities and stockholders' equity	\$24,629	\$39,574

See accompanying Notes to Financial Statements

ARCA BIOPHARMA, INC.

STATEMENTS OF OPERATIONS AND COMPREHENSIVE LOSS

	Years Ended December 31,	
	2016	2015
	(in thousands, except share	
	and per share amounts)	
Costs and expenses:		
Research and development	\$ 12,348	\$ 7,063
General and administrative	4,265	4,392
Total costs and expenses	16,613	11,455
Loss from operations	(16,613)	(11,455)
Interest and other income	169	14
Interest expense	—	(4)
Net loss	\$(16,444)	\$(11,445)
Change in unrealized loss on marketable securities	(19)	—
Comprehensive loss	\$(16,463)	\$(11,445)
Net loss per share:		
Basic and diluted	\$(1.81)	\$(1.82)
Weighted average shares outstanding:		
Basic and diluted	9,067,438	6,289,305

See accompanying Notes to Financial Statements

ARCA BIOPHARMA, INC.

STATEMENTS OF STOCKHOLDERS' EQUITY

	Stockholders' Equity					Total
	Common stock Shares	Amount	Additional Paid-In Capital	Accumulated Other Comprehensive Loss	Accumulated Deficit	
Balance, December 31, 2014	3,021,498	\$ 3	\$ 99,360	\$ —	\$ (84,622)	\$ 14,741
Issuance of common stock for cash, net of offering costs	6,003,082	6	34,169	—	—	34,175
Issuance of common stock upon vesting						
of Restricted Stock Units	26,669	—	—	—	—	—
Adjustment for fractional shares	(32)	—	—	—	—	—
Share-based compensation	—	—	599	—	—	599
Net loss	—	—	—	—	(11,445)	(11,445)
Balance, December 31, 2015	9,051,217	9	134,128	—	(96,067)	38,070
Issuance of common stock upon vesting						
of Restricted Stock Units	31,149	—	—	—	—	—
Share-based compensation	—	—	576	—	—	576
Change in unrealized loss on						
marketable securities	—	—	—	(19)	—	(19)
Other	—	—	11	—	—	11
Net loss	—	—	—	—	(16,444)	(16,444)
Balance, December 31, 2016	9,082,366	\$ 9	\$ 134,715	\$ (19)	\$ (112,511)	\$ 22,194

See accompanying Notes to Financial Statements

ARCA BIOPHARMA, INC.

STATEMENTS OF CASH FLOWS

	Years Ended December 31,	
	2016	2015
	(in thousands)	
Cash flows from operating activities:		
Net loss	\$(16,444)	\$(11,445)
Adjustments to reconcile net loss to net cash used		
in operating activities:		
Depreciation	24	19
Amortization of other assets	296	189
Amortization of premiums and discounts on marketable securities	161	—
Share-based compensation	576	599
Change in operating assets and liabilities:		
Other current assets	(47)	213
Other assets	(432)	(211)
Accounts payable	841	(431)
Accrued compensation and employee benefits	50	340
Accrued expenses and other liabilities	(3)	196
Other	(9)	(3)
Net cash used in operating activities	(14,987)	(10,534)
Cash flows from investing activities:		
Purchase of property and equipment	(12)	(11)
Purchases of marketable securities	(20,504)	—
Proceeds from maturities of marketable securities	4,102	—
Net cash used in investing activities	(16,414)	(11)
Cash flows from financing activities:		
Proceeds from the issuance of common stock	—	37,000
Common stock offering costs	—	(2,814)
Repayment of principal on vendor finance agreement	—	(193)
Net cash provided by financing activities	—	33,993
Net (decrease) increase in cash and cash equivalents	(31,401)	23,448
Cash and cash equivalents, beginning of period	38,802	15,354
Cash and cash equivalents, end of period	\$7,401	\$38,802
Supplemental cash flow information:		
Interest paid	\$—	\$4
Supplemental disclosure of noncash investing and financing		
transactions:		
Common stock offering costs accrued but not yet paid	\$(11)	\$11
Change in unrealized loss on marketable securities	\$(19)	\$—
Leasehold improvement lease incentive	\$48	\$—

See accompanying Notes to Financial Statements

ARCA BIOPHARMA, INC.

NOTES TO FINANCIAL STATEMENTS

(1) The Company and Summary of Significant Accounting Policies

Description of Business

ARCA biopharma, Inc. (the Company or ARCA), a Delaware corporation, is headquartered in Westminster, Colorado. The Company is a biopharmaceutical company applying a precision medicine approach to developing genetically-targeted therapies for cardiovascular diseases. The Company's lead product candidate, Gencaro™ (bucindolol hydrochloride), is an investigational, pharmacologically unique beta-blocker and mild vasodilator that ARCA is developing for the potential treatment of patients with atrial fibrillation (AF) and chronic heart failure in patients with heart failure with reduced left ventricular ejection fraction (HFrEF).

The Company is conducting a Phase 2B/Phase 3 clinical superiority trial, known as GENETIC-AF, in which the Company is evaluating Gencaro for the treatment of AF in HFrEF patients against TOPROL-XL (metoprolol succinate), a drug approved for treating HFrEF that is also prescribed, but not approved, for treating AF in patients with HFrEF. Enrollment in GENETIC-AF is limited to patients that possess the specific genotype that the Company believes enhances Gencaro's potential therapeutic effects. The current development of Gencaro is, in part, based on a prospectively designed DNA substudy of adrenergic receptor polymorphisms in the BEST trial, a previous Phase 3 study of 2,708 HF patients. In the BEST trial, Gencaro showed evidence of potential efficacy in treating AF and in reducing mortality and hospitalizations in patients with this specific genotype.

GENETIC-AF is an adaptive, seamless design Phase 2B/Phase 3, multi-center, randomized, double-blind, clinical superiority trial comparing the safety and efficacy of Gencaro against an active comparator, the beta-blocker TOPROL-XL (metoprolol succinate), that seeks to enroll a combined total of approximately 620 patients. Eligible patients will have HFrEF, a history of paroxysmal AF (episodes lasting 7 days or less) or persistent AF (episodes lasting more than 7 days and less than 1 year) in the past 6 months, and the beta-1 389 arginine homozygous genotype that the Company believes responds most favorably to Gencaro. The primary endpoint of the study is time to first event of symptomatic AF/atrial flutter (AFL), or all-cause mortality. The GENETIC-AF Data and Safety Monitoring Board (DSMB) will conduct a pre-specified interim analysis of study endpoints for efficacy, safety and futility to recommend whether or not the trial should proceed to Phase 3. The DSMB will make its recommendation based on a predictive probability analysis of certain trial data after a sufficient number of patients have evaluable endpoint data. A randomized patient has evaluable endpoint data either when they experience their first composite endpoint event, AF/AFL or all-cause mortality, or after completion of the 24-week primary endpoint follow up period. The DSMB interim analysis will focus on analyses of the AF/AFL endpoints in the trial using both clinical-based intermittent monitoring and device-based continuous monitoring techniques. Based on the results of the interim analysis, the DSMB may recommend that the trial proceed to Phase 3, the trial be completed as a Phase 2B study, or termination of the trial due to futility. ARCA, in collaboration with the GENETIC-AF Steering Committee, will determine the next steps for the trial based on the DSMB recommendation from this interim analysis and on the Company's available financing. The Company randomized the 175th patient in the trial in March 2017. The Company projects that the outcome of the DSMB interim analysis and recommendation will be available in the third quarter of 2017. Should the DSMB recommend that the study continue to Phase 3, the trial would continue enrolling to a total of approximately 620 patients, subject to the Company obtaining sufficient financing to fund the Phase 3 portion of the

trial.

If the Company continues with the Phase 3 portion of the GENETIC-AF, it will need to raise additional capital to complete the Phase 3 portion of the GENETIC-AF clinical trial and submit for FDA approval. If the Company is unable to obtain additional funding or is unable to complete a strategic transaction, it may have to discontinue development activities on Gencaro or discontinue its operations.

On January 27, 2009, the Company completed a business combination (the Merger) with Nuvelo, Inc. (Nuvelo). Immediately following the Merger, the Company changed its name from Nuvelo, Inc. to ARCA biopharma, Inc.

Liquidity and Going Concern

The Company devotes substantially all of its efforts towards obtaining regulatory approval and raising capital necessary to fund its operations and it is subject to a number of risks associated with clinical research and development, including dependence on key individuals, the development of and regulatory approval of commercially viable products, the need to raise adequate additional financing necessary to fund the development and commercialization of its products, and competition from larger companies. The Company has not generated revenue to date and has incurred substantial losses and negative cash flows from operations since its inception. The Company has historically funded its operations through issuances of common and preferred stock.

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In June 2015, the Company raised approximately \$34.2 million in net proceeds to provide additional funds for the Phase 2B/3 GENETIC-AF trial and the Company's ongoing operations. The Company is enrolling patients in the Phase 2B portion of the GENETIC-AF trial, and the Company believes that its current cash, cash equivalents and marketable securities will be sufficient to fund its operations, at its projected cost structure, through the end of 2017. In January 2017, the Company entered into a sales agreement with an agent to sell, from time to time, its common stock having an aggregate offering price of up to \$7.3 million, in an "at the market offering." The Company is not obligated to make any sales of its common stock, and we have not executed any significant sales through this facility. However, notwithstanding this sales agreement, in light of the significant uncertainties regarding clinical development timelines and costs for developing drugs such as Gencaro, the Company expects it will need to raise additional capital to finance the completion of GENETIC-AF and the Company's future operations. If the Company is delayed in completing or is unable to complete additional funding and/or a strategic transaction, the Company may discontinue its development activities or operations.

The Company's liquidity, and its ability to raise additional capital or complete any strategic transaction, depends on a number of factors, including, but not limited to, the following:

- progress of GENETIC-AF, including enrollment and any data that may become available;
- the costs and timing for the potential additional clinical trials in order to gain possible regulatory approval for Gencaro;
- the market price of the Company's stock and the availability and cost of additional equity capital from existing and potential new investors;
- the Company's ability to retain the listing of its common stock on the Nasdaq Capital Market;
- general economic and industry conditions affecting the availability and cost of capital;
- the Company's ability to control costs associated with its operations;
- the costs of filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights; and
- the terms and conditions of the Company's existing collaborative and licensing agreements.

The sale of additional equity or convertible debt securities would likely result in substantial additional dilution to the Company's stockholders. If the Company raises additional funds through the incurrence of indebtedness, the obligations related to such indebtedness would be senior to rights of holders of the Company's capital stock and could contain covenants that would restrict the Company's operations. The Company also cannot predict what consideration might be available, if any, to the Company or its stockholders, in connection with any strategic transaction. Should strategic alternatives or additional capital not be available to the Company, or not be available on acceptable terms, the Company may be unable to realize value from its assets and discharge its liabilities in the normal course of business which may, among other alternatives, cause the Company to further delay, substantially reduce or discontinue operational activities to conserve its cash resources.

The significant uncertainties surrounding the clinical development timelines and costs and the need to raise a significant amount of capital raises substantial doubt about the Company's ability to continue as a going concern from one year after the Company's financial statements have been issued. The Company could delay or cancel certain significant planned expenditures related to the GENETIC-AF trial and/or implement cost reduction measures to conserve our cash balances; however, there is no assurance that those measures would be adequate to allow the Company to continue as a going concern for a period beyond one year from the issuance of these financial statements. These financial statements have been prepared with the assumption that the Company will continue as a going concern and will be able to realize its assets and discharge its liabilities in the normal course of business and do not include any adjustments to reflect the possible future effects on the recoverability and classification of assets or the amounts and classification of liabilities that may result from the inability of the Company to continue as a going concern. The Company may not be able to raise sufficient capital on acceptable terms, or at all, to continue development of Gencaro or to otherwise continue operations and may not be able to execute any strategic transaction.

Basis of Presentation

The accompanying financial statements have been prepared in accordance with U.S. generally accepted accounting principles (U.S. GAAP) and include all adjustments necessary for the fair presentation of our financial position, results of operations and cash flows for the periods presented. Our management performed an evaluation of our activities through the date of filing of this Annual Report on Form 10-K, and the subsequent events are disclosed in Note 11.

Recent Accounting Pronouncements

In August 2014, the Financial Accounting Standards Board (FASB) issued FASB Accounting Standards Update (ASU No. 2014-15), Presentation of Financial Statements – Going Concern (Subtopic 205-40): Disclosure of Uncertainties about an Entity’s Ability to Continue as a Going Concern. ASU No. 2014-15 will be effective for fiscal years and interim periods ending after December 15, 2016, with early adoption being permitted for annual and interim periods for which financial statements have not been issued. ASU 2014-15 requires that management evaluate at each annual and interim reporting period whether there is a substantial doubt about an

entity's ability to continue as a going concern within one year of the date that the financial statements are issued. There are significant uncertainties surrounding the Company's clinical development timelines and costs and the Company will likely need to raise a significant amount of capital in the future. The Company adopted this guidance for the year ended December 31, 2016. The adoption did not have an impact on the financial position or results of operations and the related disclosures are included in the "Liquidity and Going Concern" disclosure above.

In April 2015, the FASB issued Accounting Standards Update No. 2015-05: Intangibles - Goodwill and Other - Internal-Use Software (Subtopic 350-40): Customer's Accounting for Fees Paid in a Cloud Computing Arrangement (ASU 2015-05). The amendments in this update provide guidance to customers about whether a cloud computing arrangement includes a software license. If a cloud computing arrangement includes a software license, the update specifies that the customer should account for the software license element of the arrangement consistent with the acquisition of other software licenses. The update further specifies that the customer should account for a cloud computing arrangement as a service contract if the arrangement does not include a software license. ASU 2015-05 will be effective for fiscal years beginning after December 31, 2015. The Company adopted this guidance as of January 1, 2016 and there was no impact to the financial statements.

In January 2016, FASB issued ASU No. 2016-01, Recognition and Measurement of Financial Assets and Financial Liabilities (ASU 2016-01). ASU 2016-01 requires equity investments to be measured at fair value with changes in fair value recognized in net income; simplifies the impairment assessment of equity investments without readily determinable fair values by requiring a qualitative assessment to identify impairment; eliminates the requirement for public business entities to disclose the method(s) and significant assumptions used to estimate the fair value that is required to be disclosed for financial instruments measured at amortized cost on the balance sheet; requires public business entities to use the exit price notion when measuring the fair value of financial instruments for disclosure purposes; requires an entity to present separately in other comprehensive income the portion of the total change in the fair value of a liability resulting from a change in the instrument-specific credit risk when the entity has elected to measure the liability at fair value in accordance with the fair value option for financial instruments; requires separate presentation of financial assets and financial liabilities by measurement category and form of financial assets on the balance sheet or the accompanying notes to the financial statements and clarifies that an entity should evaluate the need for a valuation allowance on a deferred tax asset related to available-for-sale securities in combination with the entity's other deferred tax assets. ASU 2016-01 is effective for financial statements issued for fiscal years beginning after December 15, 2017, and interim periods within those fiscal years. The Company is currently evaluating the impact that ASU 2016-01 will have on its financial statements and related disclosures.

In February 2016, the FASB issued ASU No. 2016-02, Leases (Topic 842) (ASU 2016-02), which requires lessees to recognize assets and liabilities for the rights and obligations created by most leases on their balance sheet. The guidance is effective for fiscal years beginning after December 15, 2018, including interim periods within those fiscal years. Early application is permitted. ASU 2016-02 requires modified retrospective adoption for all leases existing at, or entered into after, the date of initial application, with an option to use certain transition relief. While the Company is currently evaluating the impact that ASU 2016-02 will have on its financial statements and related disclosures, we expect that the operating lease commitment discussed in Note 6 will be recognized as operating lease liability and right-of-use asset.

In March 2016, the FASB issued ASU No. 2016-09, Compensation - Stock Compensation: Improvements to Employee Share-Based Payment Accounting (ASU 2016-09), which changes how companies account for certain aspects of share-based payments to employees. The new guidance requires all income tax effects of awards to be recognized in the income statement when the awards vest or are settled, allows an employer to repurchase more of an employee's shares than previously allowed for tax withholding purposes without triggering liability accounting, allows a company to make a policy election to account for forfeitures as they occur, and eliminates the requirement that excess tax benefits be realized before companies can recognize them. The new guidance also requires excess tax benefits and tax shortfalls to be presented on the cash flow statement as an operating activity rather than as a financing activity, and clarifies that cash paid to a tax authority when shares are withheld to satisfy its statutory income tax withholding obligation are to be presented as a financing activity. For the years ended December 31, 2016 and 2015, the Company recognized no such excess tax benefits and did not withhold shares to satisfy statutory income tax withholding obligations. The standard is effective for its financial statements issued for fiscal years beginning after December 15, 2016, and interim periods within those fiscal years. Early adoption is permitted. The Company does not expect the provisions of ASU 2016-09 to have a material impact on its financial statements and related disclosures.

The Company reviewed all other recently issued accounting pronouncements and concluded that they were either not applicable or not expected to have a significant impact to the financial statements.

Accounting Estimates in the Preparation of Financial Statements

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of expenses during the reporting period. The Company bases estimates on various assumptions that are believed to be reasonable under the circumstances. The

Company believes significant judgment was involved in estimating the clinical trial accruals, and in estimating other accrued liabilities, stock-based compensation, and income taxes. Management is continually evaluating and updating these estimates, and it is possible that these estimates will change in the future or that actual results may differ from these estimates.

Cash Equivalents

Cash equivalents generally consist of money market funds and debt securities with maturities of 90 days or less at the time of purchase. The Company invests its excess cash in securities with strong ratings and has established guidelines relative to diversification and maturity with the objective of maintaining safety of principal and liquidity.

Marketable Securities

The Company has designated its marketable securities as of each balance sheet date as available-for-sale securities and account for them at their respective fair values. Marketable securities are classified as short-term or long-term based on the nature of the securities and their availability to meet current operating requirements. Marketable securities that are readily available for use in current operations are classified as short-term available-for-sale securities and are reported as current marketable securities in the accompanying balance sheets. Marketable securities that are not considered available for use in current operations are classified as long-term available-for-sale securities and are reported as a component of long-term assets in the accompanying balance sheets.

Securities that are classified as available-for-sale are measured at fair value, including accrued interest, with temporary unrealized gains and losses reported as a component of stockholders' equity until their disposition. The Company reviews all available-for-sale securities at each period end to determine if they remain available-for-sale based on our then current intent and ability to sell the security if it is required to do so.

All of the Company's marketable securities are subject to a periodic impairment review. The Company recognizes an impairment charge when a decline in the fair value of its investments below the cost basis is judged to be other-than-temporary.

Concentrations of Credit Risk

Financial instruments that potentially subject the Company to significant concentrations of credit risk consist primarily of cash and cash equivalents. The Company has no off-balance-sheet concentrations of credit risk, such as foreign exchange contracts, option contracts, or foreign currency hedging arrangements. The Company maintains cash and cash equivalent balances in the form of bank demand deposits and money market fund accounts with financial institutions that management believes are creditworthy. Such balances may at times exceed the insured amount.

Property and Equipment

Property and equipment are stated at cost less accumulated depreciation and amortization. Cost includes expenditures for equipment, leasehold improvements, replacements, and renewals. Maintenance and repairs are charged to expense as incurred. When assets are sold, retired, or otherwise disposed of, the cost and accumulated depreciation are removed from the accounts and any resulting gain or loss is reflected in operations. The cost of property and equipment is depreciated using the straight-line method over the estimated useful lives of the related assets. Leasehold improvements are amortized over the shorter of the life of the lease or the estimated useful life of the assets.

Accrued Expenses

As part of the process of preparing its financial statements, the Company is required to estimate accrued expenses. This process involves identifying services that third parties have performed on the Company's behalf and estimating the level of service performed and the associated cost incurred for these services as of the balance sheet date. Examples of estimated accrued expenses include contract service fees, such as fees payable to contract manufacturers in connection with the production of materials related to the Company's drug product, and professional service fees, such as attorneys, consultants, and clinical research organizations. The Company develops estimates of liabilities using its judgment based upon the facts and circumstances known at the time.

Segments

The Company operates in one segment. Management uses one measure of profitability and does not segment its business for internal reporting.

Research and Development

Research and development costs are expensed as incurred. These consist primarily of salaries, contract services, and supplies.

Costs related to clinical trial and drug manufacturing activities are based upon estimates of the services received and related expenses incurred by contract research organizations, or CROs, clinical study sites, drug manufacturers, collaboration partners, laboratories, consultants, or otherwise. Related contracts vary significantly in length, and could be for a fixed amount, a variable amount based on actual costs incurred, capped at a certain limit, or for a combination of these elements. Activity levels are monitored through communications with the vendors, including detailed invoices and task completion review, analysis of expenses against budgeted amounts, and pre-approval of any changes in scope of the services to be performed. Certain significant vendors may also provide an estimate of costs incurred but not invoiced on a periodic basis. Expenses related to the CROs and clinical studies, as well as contract drug manufacturers, are primarily based on progress made against specified milestones or targets in each period.

In accordance with certain research and development agreements, we are obligated to make certain upfront payments upon execution of the agreement. We record these upfront payments as prepaid research and development expenses, which are included in Other current assets or Other assets in the accompanying Balance Sheets. Such payments are recorded to research and development expense as services are performed. We evaluate on a quarterly basis whether events and circumstances have occurred that may indicate impairment of remaining prepaid research and development expenses.

Stock-Based Compensation

The Company's stock-based compensation cost recognized is based on the estimated grant date fair value. The Company recognizes compensation costs for its stock-based awards on a straight-line basis over the requisite service period for the entire award, as adjusted for expected forfeitures. The Company recognizes compensation costs for its performance based stock-based awards over the performance period, once the performance condition is probable, and as adjusted for expected forfeitures.

Income Taxes

The current benefit for income taxes represents actual or estimated amounts payable or refundable on tax returns filed or to be filed each year. Deferred tax assets and liabilities are recognized for the estimated future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases and operating loss and tax credit carryforwards. The effect on deferred tax assets and liabilities of a change in tax rates is recognized in the period that includes the enactment date. The overall change in deferred tax assets and liabilities for the period measures the deferred tax expense or benefit for the period. The measurement of deferred tax assets may be reduced by a valuation allowance based on judgmental assessment of available evidence if deemed more likely than not that some or all of the deferred tax assets will not be realized. The Company has recorded a valuation allowance against all of its deferred tax assets, as management has concluded that it is more likely than not that the net deferred tax asset will not be realized through future taxable income, based primarily on the Company's history of operating losses. The Company has not performed an Internal Revenue Code Section 382 limitation study. Depending on the outcome of such a study, the gross amount of net operating losses recognizable in future tax periods could be limited.

(2) Net Loss Per Share

The Company calculates basic earnings per share by dividing loss attributable to common stockholders by the weighted average common shares outstanding during the period. Diluted earnings per share is computed by dividing loss attributable to common stockholders by the weighted average number of common shares outstanding during the period increased to include, if dilutive, the number of additional common shares that would have been outstanding if

the potential common shares had been issued. The Company's potentially dilutive shares include stock options, restricted stock units and warrants for common stock.

Because the Company reported a net loss for the years ended December 31, 2016 and 2015, all potentially dilutive shares of common stock have been excluded from the computation of the dilutive net loss per share for all periods presented. Such potentially dilutive shares of common stock consist of the following:

	Years Ended December	
	31,	
	2016	2015
Potentially dilutive securities, excluded:		
Outstanding stock options	629,629	161,278
Unvested restricted stock units	30,739	62,359
Warrants to purchase common stock	3,686,894	3,739,948
	4,347,262	3,963,585

(3) Marketable Securities and Fair Value Disclosures

Marketable securities consisted of the following as of December 31, 2016 (in thousands):

	December 31, 2016			
	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Fair Value
Short-term available-for-sale securities:				
Corporate bonds	\$13,778	\$ —	\$ (16)	\$13,762
Total	\$13,778	\$ —	\$ (16)	\$13,762
Long-term available-for-sale securities:				
Corporate bonds	\$2,355	\$ 3	\$ (6)	\$2,352
Total	\$2,355	\$ 3	\$ (6)	\$2,352

The investments have been in an unrealized loss position for less than twelve months. Based upon the Company's evaluation of all relevant factors, the Company believes that the decline in fair value of securities held at December 31, 2016 below cost is temporary, and the Company intends to retain its investment in these securities for a sufficient period of time to allow for recovery of the fair value.

As of December 31, 2016, the amortized cost and estimated fair value of available-for-sale securities by contractual maturity were as follows (in thousands):

	Amortized Cost	Fair Value
Due in one year or less	\$ 13,778	\$13,762
Due in one to two years	2,355	2,352
Total	\$ 16,133	\$16,114

Fair value is defined as the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date (exit price). Inputs used to measure fair value are classified into the following hierarchy:

- Level 1—Unadjusted quoted prices in active markets for identical assets or liabilities. The Company's Level 1 assets consist of money market investments. The Company does not have any Level 1 liabilities.
- Level 2—Unadjusted quoted prices in active markets for similar assets or liabilities; unadjusted quoted prices for identical or similar assets or liabilities in markets that are not active; or inputs other than quoted prices that are observable for the asset or liability. The Company's Level 2 assets consist of corporate bonds and commercial paper securities. The Company does not have any Level 2 liabilities.
- Level 3—Unobservable inputs for the asset or liability. The Company does not have any Level 3 assets or liabilities.

The following table identifies the Company's assets that were measured at fair value on a recurring basis (in thousands):

	Balance	Level 1	Level 2	Level 3
December 31, 2016				
Money market	\$7,672	\$7,672	\$—	\$—
Corporate bonds	16,114	—	16,114	—
Total	\$23,786	\$7,672	\$16,114	\$—
December 31, 2015				
Money market	\$38,728	\$38,728	\$—	\$—
Total	\$38,728	\$38,728	\$—	\$—

As of December 31, 2016 and 2015, the Company had \$7.7 million and \$38.7 million, respectively, of cash equivalents consisting of money market funds with maturities of 90 days or less. The Company has the ability to liquidate these investments without restriction. The Company determines fair value for these money market funds and equity securities with Level 1 inputs through quoted market prices. There were no transfers between any fair value hierarchy levels in 2016 or 2015.

Fair Value of Other Financial Instruments

The carrying amount of other financial instruments, including cash and accounts payable, approximated fair value due to their short maturities. As of December 31, 2016 and 2015, the Company did not have any debt outstanding.

(4) Property and Equipment

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

	Estimated Life	December 31, 2016	December 31, 2015
Computer equipment	3 years	\$ 84	\$ 90
Lab equipment	5 years	142	142
Furniture and fixtures	5 years	83	91
Computer software	3 years	85	84
Leasehold improvements	Lesser of useful life or life of the lease	59	8
		453	415
Accumulated depreciation and amortization		(387)	(387)
Property and equipment, net		\$ 66	\$ 28

For the years ended December 31, 2016 and 2015, depreciation and amortization expense was \$24,000 and \$19,000, respectively.

(5) Related Party Arrangements

Transactions with the Company's President and Chief Executive Officer

The Company has entered into unrestricted research grants with its President and Chief Executive Officer's academic research laboratory at the University of Colorado. Funding of any unrestricted research grants is contingent upon the Company's financial condition, and can be deferred or terminated at the Company's discretion. Total expense under these arrangements for the years ended December 31, 2016 and 2015 was \$427,000 and \$375,000, respectively.

(6) Commitments and Contingencies

The Company has or is subject to the following commitments and contingencies:

Employment Agreements

The Company maintains employment agreements with several key executive employees. The agreements may be terminated at any time by the Company with or without cause upon written notice to the employee, and entitle the employee to wages in lieu of notice

for periods not exceeding one calendar year from date of termination without cause or by the employee for good reason. Certain of these agreements also provide for payments to be made under certain conditions related to a change in control of the Company.

Operating Lease

On August 1, 2013 the Company entered into a lease agreement for approximately 5,300 square feet of office facilities in Westminster, Colorado which has served as the Company's primary business office since October 1, 2013. Effective March 2, 2016, the lease was renewed for an additional 38 month term beginning October 1, 2016 and expiring on November 30, 2019.

Below is a summary of the future minimum lease payments committed for the Company's facility in Westminster, Colorado as of December 31, 2016 (in thousands):

2017	\$83
2018	88
2019	83
Total future minimum lease payments	\$254

Rent expense under these leases for the years ended December 31, 2016 and 2015 was \$81,000 and \$81,000, respectively.

Duke University

In November 2013, the Company entered into a clinical research agreement with Duke University (Duke) to serve as the clinical research organization for the Company's GENETIC-AF clinical study. Under the agreement the Company is responsible to pay Duke for their work managing certain aspects of the clinical study. Upon completion of the clinical study, the agreement will terminate. The agreement can be terminated earlier by the Company for any reason with 90 days written notice to Duke. In the event of an early termination, the Company and Duke would coordinate efforts for an orderly wind-down of the study, and the Company would be responsible to pay Duke for time and effort incurred through the date of termination and through the wind-down period.

Cardiovascular Pharmacology and Engineering Consultants, LLC

ARCA has licensed worldwide rights to Gencaro, including all preclinical and clinical data, from Cardiovascular Pharmacology and Engineering Consultants, LLC (CPEC), who has licensed rights in Gencaro from Bristol Myers Squibb (BMS). CPEC is a licensing subsidiary of Indevus Pharmaceuticals Inc. (a wholly owned subsidiary of Endo Pharmaceuticals), holding ownership rights to certain clinical trial data of Gencaro. Under the terms of its license agreement with CPEC, the Company will incur milestone and royalty obligations upon the occurrence of certain events. If the FDA grants marketing approval for Gencaro, the license agreement states that the Company will owe CPEC a milestone payment of \$8.0 million within six months after FDA approval. The license agreement states that a milestone payment of up to \$5.0 million in the aggregate shall be paid upon regulatory marketing approval in Europe and Japan. The license agreement also states that the Company's royalty obligation ranges from 12.5% to 25% of revenue from the related product based on achievement of specified product sales levels, including a 5% royalty that CPEC is obligated to pay under its original license agreement for Gencaro. The agreement states that the Company has the right to buy down the royalties to a range of 12.5% to 17% by making a payment to CPEC within six months of regulatory approval.

(7) Equity Financings and Warrants

2015 Equity Financing

Private Investment in Public Entity (PIPE) Transaction

On June 16, 2015, the Company sold an aggregate of 6,003,082 security units, made up of an aggregate 6,003,082 shares of the Company's common stock and warrants to purchase an aggregate of 2,401,233 shares of the Company's common stock, at a purchase price of \$6.1635 per unit, for aggregate net proceeds of approximately \$34.2 million.

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The warrants became exercisable on December 13, 2015, expire on June 16, 2022, and have an exercise price of \$6.1012 per share. The warrants provide for cashless exercise and settlement in unregistered shares if there is no effective registration statement registering, or the prospectus contained therein is not available for the issuance of the shares of common stock underlying the warrants at the time of exercise. The Company's Registration Statement on Form S-3 registering these shares of common stock, including the shares of common stock underlying the warrants, issued in the transaction for public resale was declared effective by the Securities and Exchange Commission on July 20, 2015.

Warrants

Warrants to purchase shares of common stock were granted as part of various financing and business agreements. All outstanding warrants were recorded in additional paid-in capital at their estimated fair market value at the date of grant using a Black-Scholes option-pricing model.

As of December 31, 2016, these warrants, by year of expiration, are summarized below:

	Number	Weighted Average
Year of Expiration	of Warrants	Exercise Price
2017	53,886	\$ 42.46
2018	963,153	11.77
2019	224,323	15.73
2020	44,299	15.96
2022	2,401,233	6.10
	3,686,894	\$ 8.82

(8) Share-based Compensation

Stock Plans

The Company's equity incentive plan, the 2013 Equity Incentive Plan (the Equity Plan), was approved by stockholders on September 17, 2013, and amended in June 2016 to increase the reserve for issuance under this Equity Plan by 1,000,000 shares. The maximum number of shares issuable under this plan is 1,321,428 shares.

The Equity Plan provides for the granting of stock options (including indexed options), restricted stock units, stock appreciation rights, restricted stock purchase rights, restricted stock bonuses, performance shares, performance units and deferred stock units. Under the Equity Plan, awards may be granted to employees, directors and consultants of ARCA, except for incentive stock options, which may be granted only to employees. As of December 31, 2016, options and awards for 651,227 shares were outstanding under the Equity Plan, and 592,430 shares were reserved for future awards.

In general, the Equity Plan authorizes the grant of stock options that vest at rates set by the Board of Directors or the Compensation Committee thereof. Generally, stock options granted by ARCA under the equity incentive plans become exercisable ratably for a period of three to four years from the date of grant and have a maximum term of ten

years. The exercise prices of stock options under the equity incentive plan generally meet the following criteria: the exercise price of incentive stock options must be at least 100% of the fair market value on the grant date and exercise price of options granted to 10% (or greater) stockholders must be at least 110% of the fair market value on the grant date.

In conjunction with the adoption of the Equity Plan, the Company discontinued grants under its previous plan, the Amended and Restated ARCA biopharma, Inc. 2004 Equity Incentive Plan (the 2004 Plan), effective September 17, 2013. The 2004 Plan expired in 2014; however, options outstanding under the 2004 plan will continue to vest according to the original terms of each grant. As of December 31, 2016, options to purchase 5,643 shares with a weighted average exercise price of \$102.64 per share were outstanding under this plan. Other stock plans that were assumed by ARCA in the Merger still have options outstanding that will continue to vest according to the original terms of each grant, but no new options can be granted under these plans, as the plans have expired. As of December 31, 2016, options to purchase 3,498 shares with a weighted average exercise price of \$157.35 were outstanding under these plans.

The Company granted options and awards for 487,700 and 52,801 shares of common stock in the years ended December 31, 2016 and 2015, respectively. The fair values of the majority of employee stock options granted in the years ended December 31, 2016 and 2015 were estimated at the date of grant using the Black-Scholes model with the following assumptions and had the following estimated weighted average grant date fair value per share:

	Years Ended	
	December 31, 2016	2015
Expected term	5.7 years	5.8 years
Expected volatility	72 %	89 %
Risk-free interest rate	1.29%	1.61 %
Expected dividend yield	0 %	0 %
Weighted-average grant date fair value per share	\$2.01	\$3.57

A summary of ARCA's stock option activities for the years ended December 31, 2016 and 2015, and related information as of December 31, 2016, is as follows:

	Options Outstanding		Weighted Average Remaining Contractual Term (in years)	Aggregate Intrinsic Value (in thousands)
	Number of Options	Weighted Average Exercise Price		
Options outstanding - December 31, 2014	152,584	\$ 20.20		
Granted	21,492	4.92		
Exercised	—	—		
Forfeited and cancelled	(12,798)	18.45		

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Options outstanding - December 31, 2015	161,278	\$ 18.30	6.97	\$ —
Granted	487,700	3.22		
Exercised	—	—		
Forfeited and cancelled	(19,349)	28.70		
Options outstanding - December 31, 2016	629,629	\$ 6.30	8.86	\$ 25
Options exercisable - December 31, 2016	181,518	\$ 13.19	7.46	\$ —
Options vested and expected to vest -				
December 31, 2016	628,928	\$ 6.30	8.86	\$ 25

The aggregate intrinsic value in the table above represents the total pretax intrinsic value, based on our closing price as of December 31 of the respective year, which would have been received by the option holders had all the option holders with in-the-money options exercised as of that date. The total intrinsic value of options exercised for the years ended December 31, 2016 and 2015 was \$0 and \$0, respectively. As of December 31, 2016, the unrecognized compensation expense related to unvested options, excluding estimated forfeitures, was \$932,000 which is expected to be recognized over a weighted average period of 1.3 years. The Company recognizes compensation costs for its share-based awards on a straight-line basis over the requisite service period for the entire award, as adjusted for expected forfeitures.

Restricted Stock Units

The Company began granting restricted stock units (RSUs) to employees during 2013 in conjunction with the adoption of the Equity Plan. The fair value of RSU awards is the closing price of the Company's common stock on the date of grant and is recognized as

compensation expense on a straight-line basis over the respective vesting period. The stock awards granted have a requisite service period between three and four years with annual vesting on the grant anniversary date.

A summary of RSU activity for the years ended December 31, 2016 and 2015 is presented below:

	Restricted Stock Units Outstanding Weighted Average Grant Number Date of Shares Fair Value	
RSUs outstanding - December 31, 2014	67,274	\$ 11.33
Granted	31,309	4.77
Vested and released	(26,669)	10.75
Forfeited and cancelled	(9,555)	10.90
RSUs outstanding - December 31, 2015	62,359	\$ 8.36
Granted	—	—
Vested and released	(31,149)	8.85
Forfeited and cancelled	(471)	4.69
RSUs outstanding - December 31, 2016	30,739	\$ 7.91

As of December 31, 2016, the total unrecognized compensation cost related to unvested stock awards was approximately \$143,000. This cost will be recognized on a straight-line basis over the next 1.2 years and will be adjusted for estimated forfeitures.

Non-cash Stock-based Compensation

For the years ended December 31, 2016 and 2015, the Company recognized the following non-cash, share-based compensation expense (in thousands):

	Years Ended December 31, 2016	2015
Research and development	\$ 167	\$ 175
General and administrative	409	424
Total	\$ 576	\$ 599

Stock-based compensation expense related to non-employees was negligible in 2016 and approximately \$25,000 in 2015. ARCA did not recognize any tax benefit related to employee stock-based compensation cost as a result of the full valuation allowance on its net deferred tax assets.

(9) Employee Benefit Plans

The Company has a 401(k) plan and makes a matching contribution equal to 100% of the employee's first 3% of the employee's contributions and 50% of the employee's next 2% of contributions. The Company adopted the plan in 2006 and contributed \$119,000 and \$122,000 for the years ended December 31, 2016 and 2015, respectively.

(10) Income Taxes

Effective June 1, 2005, the Company changed from an S-Corporation to a C-Corporation. As an S-Corporation, the net operating loss carryforwards were distributed to the Company's stockholders; such amounts were not significant. Since June 2005 through December 31, 2016, for federal income tax purposes, the Company has net operating loss carryforwards of approximately \$139.7 million, and approximately \$1.4 million of research and development credits that may be used to offset future taxable income. The Company's net operating loss carryforwards will expire beginning 2025 through 2036. Utilization of net operating losses and tax credits, including those acquired as a result of the Merger, will be subject to an annual limitation due to ownership change limitations provided by Internal Revenue Code Section 382. The Company believes that an ownership change limitation as defined under Section 382 of the U.S. Internal Revenue Code occurred as a result of its various historical financing transactions, and its offering of common stock completed in June 2015. Future utilization of the federal net operating losses and tax credit carryforwards accumulated from June 2005 to the change in ownership date will be subject to annual limitations to offset future taxable income. The annual

limitation may result in the expiration of the net operating losses and credits before utilization. As such, a portion of the Company's net operating loss carryforwards may be limited.

In assessing the realizability of deferred tax assets, management considers whether it is more likely than not that some portion or all of the deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent upon the generation of future taxable income during the period in which those temporary differences become deductible. Management considers the scheduled reversal of deferred tax liabilities, projected future taxable income and tax planning strategies in making this assessment. Due primarily to the Company's history of operating losses, management is unable to conclude that it is more likely than not that the Company will realize the benefits of these deductible differences, and accordingly has provided a valuation allowance against the entire net deferred tax asset of approximately \$54.8 million at December 31, 2016, reflecting an increase of approximately \$6.2 million from December 31, 2015. The deferred tax assets are primarily comprised of net operating loss carryforwards and research and experimentation credit carryforwards. As of December 31, 2016, the Company has not performed an Internal Revenue Code Section 382 limitation study. Depending on the outcome of such a study, the gross amount of net operating losses recognizable in future tax periods could be limited. A limitation in the carryforwards would decrease the carrying amount of the gross amount of the net operating loss carryforwards, with a corresponding decrease in the valuation allowance recorded against these gross deferred tax assets.

Income tax benefit attributable to our loss from operations before income taxes differs from the amounts computed by applying the U.S. federal statutory income tax rate of 34% for 2016 and 2015, as a result of the following (in thousands):

	Years ended December 31,	
	2016	2015
U.S. federal income tax benefit at statutory rates	\$(5,591)	\$(3,891)
State income tax benefit, net of federal benefit	(502)	(350)
Research and experimentation credits	(268)	(181)
Deferred tax asset adjustment	65	76
Other	137	188
Change in valuation allowance	6,159	4,158
	\$—	\$—

Deferred income taxes reflect the net tax effects of temporary differences between the carrying amounts of assets and liabilities for financial reporting and the amounts used for income tax purposes, as well as operating loss and tax credit carryforwards. The income tax effects of temporary differences and carryforwards that give rise to significant portions of the Company's net deferred tax assets consisted of the following (in thousands):

	Years ended December 31,	
	2016	2015
Net operating loss carryforwards	\$51,758	\$46,056
Charitable contribution carryforwards	552	454
Research and experimentation credits	1,440	1,172
Capitalized intangibles	781	746
Stock based compensation	193	162

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Depreciation and amortization	6	2
Vacation accrual	35	28
Other	14	—
Total deferred tax assets	54,779	48,620
Valuation allowance	(54,779)	(48,620)
Net deferred tax assets	\$—	\$—

Since the Company is in a loss carryforward position, the Company is generally subject to U.S. federal and state income tax examinations by tax authorities for all years for which a loss carryforward is available. Thus, the Company's open tax years extend back to 2009. The Company believes that its tax filing positions and deductions related to tax periods subject to examination will be sustained upon audit and does not anticipate any adjustment will result in a material adverse effect on the Company's financial condition, result of operations, or cash flow. For the years ended December 31, 2016 and 2015, the Company has no reserve for uncertain tax positions. The Company does not expect that the total amounts of unrecognized tax benefits will significantly increase or

decrease within the subsequent twelve months. In the event the Company concludes it is subject to interest or penalties arising from uncertain tax positions, the Company will record interest and penalties as a component of other income and expense. No interest or penalties were recognized in the financial statements for the years ended December 31, 2016 and 2015.

(11) Subsequent Event

On January 11, 2017, the Company entered into a Capital on DemandTM Sales Agreement (the Sales Agreement) with JonesTrading Institutional Services LLC, as agent (JonesTrading), pursuant to which the Company may offer and sell, from time to time through JonesTrading, shares of the Company's common stock, par value \$0.001 per share (the Common Stock), having an aggregate offering price of up to \$7.3 million (the Shares).

Under the Sales Agreement, JonesTrading may sell the Shares by any method permitted by law and deemed to be an "at the market offering" as defined in Rule 415 promulgated under the Securities Act of 1933, as amended, including sales made directly on or through The NASDAQ Capital Market, on any other existing trading market for the Common Stock or to or through a market maker. In addition, under the Sales Agreement, JonesTrading may sell the Shares by any other method permitted by law, including in negotiated transactions. The Company may instruct JonesTrading not to sell Shares if the sales cannot be effected at or above the price designated by the Company from time to time.

The Company is not obligated to make any sales of the Shares under the Sales Agreement. The offering of Shares pursuant to the Sales Agreement will terminate upon the earlier of (a) the sale of all of the Shares subject to the Sales Agreement or (b) the termination of the Sales Agreement by JonesTrading or the Company, as permitted therein.

The Company will pay JonesTrading a commission rate equal to 3.0% of the aggregate gross proceeds from each sale of Shares and have agreed to provide JonesTrading with customary indemnification and contribution rights. The Company will also reimburse JonesTrading for certain specified expenses in connection with entering into the Sales Agreement.

We have not executed any significant sales through this facility.

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

Not applicable.

Item 9A. Controls and Procedures

Evaluation of Disclosure Controls and Procedures

Under the supervision and with the participation of management, including our Principal Executive Officer and our Principal Financial Officer, we have evaluated the effectiveness of the design and operation of our disclosure controls and procedures. Disclosure controls and procedures are controls and procedures that are designed to ensure that information required to be disclosed in our reports filed or submitted under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in the SEC's rules and forms. Based on this evaluation, our Principal Executive Officer and Principal Financial Officer have concluded that our disclosure controls and procedures were effective as of the end of the period covered by this annual report.

Management's Report on Internal Control over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting (as defined in Rules 13a-15(f) and 15(d)-15(f) under the Exchange Act). Our internal control system was designed to provide reasonable assurance to management and our board of directors regarding the preparation and fair presentation of published financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Under the supervision and with the participation of management, including our Principal Executive Officer and Principal Financial Officer, we have assessed the effectiveness of our internal control over financial reporting as of December 31, 2016. In making our assessment of internal control over financial reporting, we used the criteria issued in the report Internal Control-Integrated Framework (2013) by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). We have concluded that our internal control over financial reporting was effective as of December 31, 2016 based on these criteria.

This annual report does not include an attestation report of our independent registered public accounting firm regarding internal control over financial reporting. Management's report was not subject to attestation by our independent registered public accounting firm pursuant to the exemption from Section 404(b) of the Sarbanes-Oxley Act for non-accelerated filers provided by the Dodd-Frank Wall Street Reform and Consumer Protection Act.

Changes in Internal Control over Financial Reporting

During the fourth quarter of 2016, there were no changes in our internal control over financial reporting that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting. On May 14, 2013, the Committee of Sponsoring Organizations of the Treadway Commission (COSO) published an updated Internal Control - Integrated Framework (2013) and related illustrative documents. The Company adopted the new framework in 2014.

Limitations on the Effectiveness of Controls

Our management, including our Principal Executive Officer and Principal Financial Officer, does not expect that our disclosure controls and procedures or our internal control over financial reporting will prevent all errors and all fraud. A control system, no matter how well designed and operated, can provide only reasonable, not absolute, assurance that the objectives of the control system are met. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, within our company have been detected.

Item 9B. Other Information

None

PART III

Item 10. Directors, Executive Officers and Corporate Governance

The information required by this item is incorporated by reference to “Election of Board of Directors,” “Section 16(a) Beneficial Ownership Reporting Compliance” and “Executive Officers” in our Definitive Proxy Statement to be filed pursuant to Regulation 14A under the Securities Exchange Act of 1934, relating to our 2017 Annual Meeting of Stockholders.

Item 11. Executive Compensation

The response to this item is incorporated by reference to “Executive Compensation” in our Definitive Proxy Statement to be filed pursuant to Regulation 14A under the Exchange Act, relating to our 2017 Annual Meeting of Stockholders.

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

The response to this item is incorporated by reference to “Equity Compensation Plan Information” and “Security Ownership of Certain Beneficial Owners and Management” in our Definitive Proxy Statement to be filed pursuant to Regulation 14A under the Exchange Act, relating to our 2017 Annual Meeting of Stockholders.

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

The response to this item is incorporated by reference to “Certain Relationships and Related Transactions” in our Definitive Proxy Statement to be filed pursuant to Regulation 14A under the Securities Exchange Act of 1934, relating to our 2017 Annual Meeting of Stockholders.

Item 14. Principal Accountant Fees and Services

The response to this item is incorporated by reference to “Ratification of Selection of the Independent Registered Public Accounting Firm ” in our Definitive Proxy Statement to be filed pursuant to Regulation 14A under the Securities Exchange Act of 1934, relating to our 2017 Annual Meeting of Stockholders.

PART IV

Item 15. Exhibits and Financial Statement Schedules

(a) The following documents are filed as part of this Report:

1. Financial statements filed as part of this Report are listed under Part II, Item 8, page 45 of this Annual Report on Form 10 K.
2. No schedules are required because either the required information is not present or is not present in amounts sufficient to require submission of the schedule, or because the information required is included in the consolidated financial statements or the notes thereto.

(b) Exhibits

A list of exhibits filed with this report or incorporated herein by reference is found in the Exhibit Index immediately following the signature page of this Annual Report on Form 10-K.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) 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.

ARCA biopharma, Inc.

By: /S/ BRIAN L. SELBY

Brian L. Selby

Vice President, Finance

(Principal Financial Officer and Principal Accounting Officer)

Date: March 21, 2017

POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Michael R. Bristow and Brian L. Selby, and each of them, as his true and lawful attorneys-in-fact and agents, with full power of substitution for him, and in his name in any and all capacities, to sign any and all amendments to this Annual Report on Form 10-K, and to file the same, with exhibits thereto and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents, and each of them, full power and authority to do and perform each and every act and thing requisite and necessary to be done therewith, as fully to all intents and purposes as he might or could do in person, hereby ratifying and confirming all that said attorneys-in-fact and agents, and any of them or his or her substitute or substitutes, may lawfully do or cause to be done by virtue hereof.

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

Signature	Title	Date
/S/ Michael R. Bristow Michael R. Bristow	President and Chief Executive Officer and Director (Principal Executive Officer)	March 21, 2017
/S/ Brian L. Selby Brian L. Selby	Vice President, Finance (Principal Financial Officer and Principal Accounting Officer)	March 21, 2017
/S/ Linda Grais Linda Grais	Director	March 21, 2017

/s/ Raymond Woosley Director March 21, 2017
Raymond Woosley

/s/ Robert Conway Director March 21, 2017
Robert Conway

/s/ Daniel Mitchell Director March 21, 2017
Daniel Mitchell

/s/ Anders Hove Director March 21, 2017
Anders Hove

EXHIBIT INDEX

Exhibit No.	Description	Incorporated by Reference		
		Filing Form	Date	Filed Number Herewith
3.1	Amended and Restated Certificate of Incorporation of the Registrant, as amended.	10-K	3/27/2009	3.1
3.1(a)	Certificate of Amendment to Restated Certificate of Incorporation.	8-K	3/5/2013	5.1
3.1(b)	Certificate of Amendment to Restated Certificate of Incorporation.	8-K	9/3/2015	3.1
3.2	Second Amended and Restated Bylaws of the Registrant, as amended.	10-Q	11/16/2009	3.2
4.1	Form of Common Stock Certificate.	8-K	1/28/2009	4.1
4.2	Warrant to Purchase Stock Agreement, dated July 17, 2007, by and between ARCA Discovery, Inc. and Silicon Valley Bank.	10-K	3/27/2009	4.3
4.3	Amendment No. 1 to Warrant to Purchase Stock Agreement, dated February 19, 2009, by and between ARCA biopharma, Inc. and SVB Financial Group.	10-K	3/27/2009	4.4
4.4	Warrant to Purchase Stock Agreement, dated August 19, 2008, by and between ARCA biopharma, Inc. and Silicon Valley Bank.	10-K	3/27/2009	4.5
4.5	Amendment No. 1 to Warrant to Purchase Stock Agreement, dated February 19, 2009, by and between ARCA biopharma, Inc. and SVB Financial Group.	10-K	3/27/2009	4.6
4.6	Form of Warrant to Purchase Common Stock.	8-K	12/22/2011	4.1

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4.7	Form of Common Stock Purchase Warrant.	8-K	8/3/2012	4.1
4.8	Form of Warrants to Purchase Shares of Common Stock, dated October 22, 2012.	8-K	10/23/2012	4.1
4.9	Form of Warrants to Purchase Shares of Common Stock, dated December 20, 2012.	8-K	12/19/2012	4.1
4.10	Form of Warrants to Purchase Shares of Common Stock.	8-K	1/23/2013	4.1
4.11	Form of Common Stock Purchase Warrant.	8-K	2/1/2013	4.1
4.12	Form of Warrant Agency Agreement by and between ARCA biopharma, Inc. and Computershare Trust Company, N.A. dated May 31, 2013.	S-1/A	5/15/2013	4.1
4.13	Form of Common Stock Purchase Warrant.	S-1/A	5/15/2013	4.3
4.14	Form of Common Stock Purchase Warrant.	8-K	2/4/2014	4.1
4.15	Warrant Agency Agreement by and among ARCA biopharma, Inc., Computershare Inc. and Computershare Trust Company, N.A. dated February 3, 2014.	8-K	2/4/2014	4.3

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Exhibit No.	Description	Incorporated by Reference		Filed Number Herewith
		Form	Filing Date	
4.16	Form of Warrant to Purchase shares of Common Stock.	8-K	6/11/2015	4.1
4.17	Form of Warrant to Purchase shares of Common Stock.	8-K	6/11/2015	4.2
4.18	Reference is made to Exhibits 3.1, 3.1(a), 3.1(b) and 3.2			
10.1§	License and Sublicense Agreement, dated October 28, 2003, by and between ARCA Discovery, Inc. and CPEC, L.L.C.	10-Q	5/15/2009	10.1
10.2	Amendment to License and Sublicense Agreement, dated February 22, 2006, by and between ARCA Discovery, Inc. and CPEC L.L.C.	10-Q	5/15/2009	10.2
10.3§	Manufacturing Agreement, dated September 11, 2006, by and between ARCA Discovery, Inc. and Patheon, Inc.	10-Q	5/15/2009	10.10
10.4†	ARCA Discovery, Inc. 2004 Stock Incentive Plan.	8-K	1/28/2009	10.1
10.5†	Amendment No. 1 to the ARCA Discovery, Inc. 2004 Stock Incentive Plan.	8-K	1/28/2009	10.2
10.6†	Amendment No. 2 to the ARCA Discovery, Inc. 2004 Stock Incentive Plan.	8-K	1/28/2009	10.3
10.7†	Amendment No. 3 to the ARCA Discovery, Inc. 2004 Stock Incentive Plan.	8-K	1/28/2009	10.4
10.8†	Amendment No. 4 to the ARCA Discovery, Inc. 2004 Stock Incentive Plan.	8-K	1/28/2009	10.5
10.9†	Amendment No. 5 to the ARCA Discovery, Inc. 2004 Stock Incentive Plan.	8-K	1/28/2009	10.6

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10.10†	Amendment No. 6 to the ARCA Discovery, Inc. 2004 Stock Incentive Plan.	8-K	1/28/2009	10.7
		8-K	1/28/2009	10.8
10.11†	ARCA biopharma, Inc. 2004 Stock Incentive Plan, Form of Executive Incentive Stock Option Agreement.	8-K	1/28/2009	10.9
10.12†	ARCA biopharma, Inc. 2004 Stock Incentive Plan, Form of Non-Executive Incentive Stock Option Agreement.	8-K	1/28/2009	10.10
10.13†	ARCA biopharma, Inc. 2004 Stock Incentive Plan, Form of Nonqualified Stock Option Agreement.	10-K	3/27/2009	10.34
10.14†	ARCA biopharma, Inc. 2004 Equity Incentive Plan (f/k/a Nuvelo, Inc. 2004 Equity Incentive Plan), Form of Partial Acceleration Stock Option Agreement.	10-K	3/27/2009	10.35
10.15†	ARCA biopharma, Inc. 2004 Equity Incentive Plan (f/k/a Nuvelo, Inc. 2004 Equity Incentive Plan), Form of No Acceleration Stock Option Agreement.	10-K	3/27/2009	10.36
10.16†	ARCA biopharma, Inc. 2004 Equity Incentive Plan (f/k/a Nuvelo, Inc. 2004 Equity Incentive Plan), Form of Director Stock Option Agreement.	10-K	3/27/2009	10.37
10.17†	ARCA biopharma, Inc. 2004 Equity Incentive Plan (f/k/a Nuvelo, Inc. 2004 Equity Incentive Plan), Form of Notice of Grant of Stock Option.			

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Exhibit No.	Description	Incorporated by Reference		
		Form	Filing Date	Filed Number Herewith
10.18†	ARCA biopharma, Inc. 2004 Equity Incentive Plan (f/k/a Nuvelo, Inc. 2004 Equity Incentive Plan), Form of Notice of Director Grant of Stock Option.	10-K	3/27/2009	10.38
10.19†	Amended and Restated Employment and Retention Agreement, dated June 4, 2008, by and between ARCA biopharma, Inc. and Michael R. Bristow.	10-K	3/27/2009	10.43
10.20	Assignment and Assumption Agreement, dated January 26, 2009, by and between ARCA biopharma, Inc. and ARCA biopharma Colorado, Inc.	10-K	3/27/2009	10.46
10.21†	Amended and Restated Employment Agreement, dated June 12, 2008, by and between ARCA biopharma, Inc. and Christopher D. Ozeroff.	10-K	3/27/2009	10.45
10.22	Assignment and Assumption Agreement, dated January 26, 2009, by and between ARCA biopharma, Inc. and ARCA biopharma Colorado, Inc.	10-K	3/27/2009	10.48
10.23†	Amended and Restated ARCA biopharma, Inc. 2004 Equity Incentive Plan.	10-Q/A	8/21/2009	10.1
10.24†	Form of Option Amendment pursuant to ARCA biopharma, Inc. 2004 Equity Incentive Plan and ARCA biopharma, Inc. 2004 Stock Option Plan (change of control).	10-Q	8/10/2009	10.5
10.25†	Form of Option Agreement and Grant Notice pursuant to ARCA biopharma, Inc. 2004 Equity Incentive Plan (NDA/change of control acceleration).	10-Q	8/10/2009	10.6
10.26	Form of Indemnification Agreement between ARCA biopharma, Inc. and its directors and officers.	10-K	3/27/2009	10.52
10.27	Form of Subscription Agreement.	8-K	4/18/2011	10.1

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10.28	Capital on Demand™ Sales Agreement, dated January 11, 2017, by and between ARCA biopharma, Inc. and JonesTrading Institutional Services LLC.	8-K	1/11/2017	10.1
10.29§	Amended and Restated Exclusive License Agreement, dated August 12, 2011, by and between the Regents of the University of Colorado and ARCA biopharma, Inc.	10-Q	8/15/2011	10.5
10.30	Form of Subscription Agreement.	8-K	12/22/2011	10.1
10.31	Form of Registration Rights Agreement.	8-K	12/22/2011	10.1
10.32	Form of Subscription Agreement.	8-K	8/3/2012	10.1
10.33	Form of Subscription Agreement by and among the Company and the purchasers identified therein, dated October 22, 2012.	8-K	10/23/2012	10.1
10.34	Form of Registration Rights Agreement.	8-K	10/23/2012	10.2
10.35	Form of Subscription Agreement by and among the Company and the purchasers identified therein, dated December 18, 2012.	8-K	12/19/2012	10.1

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Exhibit No.	Description	Incorporated by Reference	
		Filing Form Date	Filed Number Herewith
10.36	Form of Registration Rights Agreement.	8-K 12/19/2012	10.2
10.37	Form of Amendment to the Registration Rights Agreement, dated December 18, 2012.	8-K 12/19/2012	10.3
10.38	Form of Subscription Agreement by and among the Company and the purchasers identified therein, dated January 22, 2013.	8-K 1/23/2013	10.1
10.39	Form of Registration Rights Agreement.	8-K 1/23/2013	10.2
10.40	Subscription Agreement.	8-K 2/1/2013	10.1
10.41	Placement Agency Agreement by and between ARCA biopharma, Inc. and Dawson James Securities, Inc., dated January 21, 2014.	8-K 2/4/2014	1.1
10.41(a)	Amendment No. 1 Placement Agency Agreement by and between ARCA biopharma, Inc. and Dawson James Securities, Inc., dated January 31, 2014.	8-K 2/4/2014	1.2
10.42	Securities Purchase Agreement by and among the Company and the purchasers identified therein, dated June 10, 2015.	8-K 6/11/2015	10.1
10.43	Office Lease Agreement by and between ARCA biopharma, Inc. and Circle Point Properties, LLC, effective August 1, 2013.	8-K 8/6/2013	10.1
10.44	Amendment to Office Lease Agreement by and between ARCA biopharma, Inc. and Circle Point Properties, LLC, effective March 2, 2016.	8-K 3/7/2016	10.1
10.45†	Amendment Agreement by and between ARCA biopharma, Inc. and Michael R. Bristow, effective as of June 13, 2013.	10-Q 8/13/2013	10.6
10.46†		10-Q 8/13/2013	10.8

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Amendment Agreement by and between ARCA biopharma, Inc. and Christopher Ozeroff, effective as of June 13, 2013.

10.47†	ARCA biopharma, Inc. 2013 Equity Incentive Plan.	8-K	9/23/2013	10.1
10.48†	Form of Stock Option Agreement and Option Grant Notice under 2013 Equity Incentive Plan (Standard).	8-K	9/23/2013	10.2
10.49†	Form of Stock Option Agreement and Option Grant Notice under 2013 Equity Incentive Plan (Officer).	8-K	9/23/2013	10.3
10.50†	Form of Stock Option Agreement and Option Grant Notice under 2013 Equity Incentive Plan (Director).	8-K	9/23/2013	10.4
10.51†	Form of Restricted Stock Unit Award Agreement and Notice of Grant Award under 2013 Equity Incentive Plan (Standard).	8-K	9/23/2013	10.5
10.52†	Form of Restricted Stock Unit Award Agreement and Notice of Grant Award under 2013 Equity Incentive Plan (Officer).	8-K	9/23/2013	10.6
10.53	Clinical Trial Collaboration Agreement between ARCA biopharma, Inc. and Medtronic, Inc. dated as of April 18, 2013.	8-K	4/22/2013	10.1

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Exhibit No.	Description	Incorporated by Reference		
		Form	Filing Date	Filed Number Herewith
10.54	Letter Agreement between ARCA biopharma, Inc. and Medtronic, Inc. dated as of July 26, 2013.	10-Q	8/13/2013	10.2
10.55§	First Amendment to Clinical Trial Collaboration Agreement between ARCA biopharma, Inc. and Medtronic, Inc. dated July 28, 2014.	10-Q	8/13/2014	10.1
10.56§	Second Amendment to Clinical Trial Collaboration Agreement between ARCA biopharma, Inc. and Medtronic, Inc. dated September 9, 2014.	10-Q	11/12/2014	10.2
10.57§	Canadian Addendum to Clinical Trial Collaboration Agreement between ARCA biopharma, Inc. and Medtronic, Inc. dated February 4, 2015.	10-K	3/19/2015	10.64
10.58§	European Addendum to Clinical Trial Collaboration Agreement between ARCA biopharma, Inc. and Medtronic, Inc. dated September 19, 2016.			X
10.59†	Employment Agreement, dated December 29, 2014, by and between ARCA biopharma, Inc. and Brian Selby.	8-K/A	12/30/2014	10.1
10.60†	Amended and Restated Employment Agreement, dated December 29, 2014, by and between ARCA biopharma, Inc. and Thomas A. Keuer.	8-K/A	12/30/2014	10.1
23.1	Consent of KPMG LLP, Independent Registered Public Accounting Firm.			X
24.1	Power of Attorney (included in the signature page hereto).			X
31.1	Certification of Principal Executive Officer pursuant to Rule 13a-14(a) or 15d-14(a) under the Securities Exchange Act of 1934, as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of			X

2002.

		X
31.2	Certification of Principal Financial Officer pursuant to Rule 13a-14(a) or 15d-14(a) under the Securities Exchange Act of 1934, as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.	
32.1	Certification of Principal Executive Officer and Principal Financial Officer pursuant to 18 U.S.C. sec. 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.	X
101.INS	XBRL Instance Document (filed electronically herewith)	X
101.SCH	XBRL Taxonomy Extension Schema Document (filed electronically herewith)	X
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document (filed electronically herewith)	X
101.LAB	XBRL Taxonomy Extension Label Linkbase Document (filed electronically herewith)	X
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document (filed electronically herewith)	X
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document (filed electronically herewith)	X

*Previously filed with the SEC as an Exhibit to and incorporated herein by reference from Nuvelo, Inc.'s Form 8-K, File No. 000-22873.

Indicates management contract or compensatory plan or arrangement required to be filed as an exhibit pursuant to Item 15(b) of Form 10-K.

§ Confidential treatment has been requested for portions of this document, which are omitted and filed separately with the SEC. Omitted portions have been filed with the Securities and Exchange Commission pursuant to Rule 24b-2 of the Securities Exchange Act of 1934, as amended.