As filed with the Securities and Exchange Commission on July 31, 2018

Registration No. 333-225970

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

Amendment No. 4
to
FORM S-1
REGISTRATION STATEMENT
UNDER
THE SECURITIES ACT OF 1933

Bionano Genomics, Inc.
(Exact Name of Registrant as Specified in its Charter)

Delaware (State or Other Jurisdiction of Incorporation or Organization)	3826 (Primary Standard Industrial Classification Code Number)	26-1756290 (I.R.S. Employer Identification Number)

Bionano Genomics, Inc.
9640 Towne Centre Drive, Suite 100
San Diego, California 92121
(858) 888-7600
(Address, Including Zip Code, and Telephone Number, Including Area Code, of Registrant's Principal Executive Offices)

R. Erik Holmlin, Ph.D.
President and Chief Executive Officer
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Copies to:

Thomas A. Coll, Esq. Kenneth J. Rollins, Esq. James C. Pennington, Esq. Cooley LLP 4401 Eastgate Mall San Diego, California 92121 (858) 550-6000	R. Erik Holmlin, Ph.D. President and Chief Executive Officer Bionano Genomics, Inc. 9640 Towne Centre Drive, Suite 100 San Diego, California 92121 (858) 888-7600	Mitchell Nussbaum, Esq. Angela Dowd, Esq. Loeb & Loeb LLP 345 Park Ave. New York, NY 10154 (212) 407-4000

Approximate date of commencement of proposed sale to the public: As soon as practicable after the effective date of this registration statement.

If any of the securities being registered on this Form are to be offered on a delayed or continuous basis pursuant to Rule 415 under the Securities Act of 1933, check the following box: ☐

If this Form is filed to register additional securities for an offering pursuant to Rule 462(b) under the Securities Act, please check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering. ☐

If this Form is a post-effective amendment filed pursuant to Rule 462(c) under the Securities Act, check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering. ☐

If this Form is a post-effective amendment filed pursuant to Rule 462(d) under the Securities Act, check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering. ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company" and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	☐	Accelerated filer	☐
Non-accelerated filer	☐ (Do not check if a smaller reporting company)	Smaller reporting company	☒
		Emerging growth company	☒

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided to Section 7(a)(2)(B) of the Securities Act. ☐

CALCULATION OF REGISTRATION FEE

Title of each Class of Securities to be Registered	Proposed Maximum Aggregate Offering Price(1)(2)	Amount of Registration Fee
Common stock, par value $0.0001 per share(3)	$37,950,000	$4,725(4)

(1) Estimated solely for the purpose of calculating the registration fee in accordance with Rule 457(o) of the Securities Act of 1933, as amended.
(2) Includes the aggregate offering price of additional shares that the underwriters have the option to purchase, if any.
(3) In accordance with Rule 416(a), the Registrant is also registering hereunder an indeterminate number of additional shares of Common Stock that shall be issuable pursuant to Rule 416 to prevent dilution resulting from stock splits, stock dividends or similar transactions.
(4) Previously paid.

The Registrant hereby amends this Registration Statement on such date or dates as may be necessary to delay its effective date until the Registrant will file a further amendment which specifically states that this Registration Statement will thereafter become effective in accordance with Section 8(a) of the Securities Act of 1933, as amended, or until the Registration Statement will become effective on such date as the Securities and Exchange Commission, acting pursuant to said Section 8(a), may determine.

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The information in this preliminary prospectus is not complete and may be changed. We may not sell these securities until the registration statement related to these securities filed with the Securities and Exchange Commission is declared effective. This prospectus is not an offer to sell or a solicitation of an offer to buy these securities and we are not soliciting offers to buy these securities in any state where the offer or sale is not permitted.

PRELIMINARY PROSPECTUS SUBJECT TO COMPLETION, DATED JULY 31, 2018

5,500,000 Shares

Common Stock

We are offering 5,500,000 shares of our common stock. This is our initial public offering and no public market currently exists for our common stock. The initial public offering price of our common stock is expected to be between $5.00 and $6.00 per share. Our common stock has been approved for listing on The Nasdaq Stock Market LLC under the symbol "BNGO."

We are an "emerging growth company" as defined by the Jumpstart Our Business Startups Act of 2012, and as such, have elected to comply with reduced public company reporting requirements and may elect to comply with reduced public company reporting requirements in future filings.

Investing in our common stock involves risks. See "Risk Factors" beginning on page 14 of this prospectus for a discussion of the risks that you should consider in connection with an investment in our securities.

	Per Share	Total
Initial public offering price	$	$
Underwriting discounts and commissions(1)	$	$
Proceeds to Bionano Genomics, Inc. (before expenses)	$	$

(1) See "Underwriting" beginning on page 143 for additional information regarding underwriting compensation.

We have granted the underwriters an option to buy up to an additional 825,000 shares of common stock from us at the initial public offering price, less the underwriting discounts and commissions, to cover over-allotments, if any. The underwriters may exercise this option at any time during the 30-day period from the date of this prospectus.

Certain of our existing stockholders, including entities affiliated with certain of our directors, have indicated an interest in purchasing an aggregate of approximately $6.35 million in shares of our common stock in this offering at the initial public offering price per share. However, because indications of interest are not binding agreements or commitments to purchase, the underwriters may determine to sell more, less or no shares in this offering to any of these persons or entities, or any of these persons or entities may determine to purchase more, less or no shares in this offering. The underwriters will receive the same underwriting discount on any shares purchased by these persons or entities as they will on any other shares sold to the public in this offering.

The underwriters expect to deliver the shares against payment on or about , 2018.

Neither the Securities and Exchange Commission nor any other regulatory body has approved or disapproved of these securities or passed upon the accuracy or adequacy of this prospectus. Any representation to the contrary is a criminal offense.

Sole Book-Running Manager

Roth Capital Partners

Lead Manager

Maxim Group LLC

The date of this prospectus is , 2018.

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Neither we nor any of the underwriters have authorized anyone to provide you with any information or to make any representations other than as contained in this prospectus or in any free writing prospectuses we have prepared. Neither we nor the underwriters take responsibility for, and provide no assurance about the reliability of, any information that others may give you. This prospectus is an offer to sell only the shares offered hereby, but only under circumstances and in jurisdictions where it is lawful to do so. The information contained in this prospectus is accurate only as of the date of this prospectus, regardless of the time of delivery of this prospectus or any sale of the common stock. Our business, financial condition, results of operations and prospects may have changed since that date.

Unless otherwise indicated, all references in this prospectus to "Bionano," the "company," "we," "our," "us" or similar terms refer to Bionano Genomics, Inc. and its subsidiaries.

No action is being taken in any jurisdiction outside the U.S. to permit a public offering of our common stock or possession or distribution of this prospectus in any such jurisdiction. Persons who come into possession of this prospectus in jurisdictions outside the U.S. are required to inform themselves about and to observe any restrictions about this offering and the distribution of this prospectus applicable to those jurisdictions.

Through and including , 2018 (the 25th day after the date of this prospectus), all dealers effecting transactions in these securities, whether or not participating in this offering, may be required to deliver a prospectus. This is in addition to a dealer's obligation to deliver a prospectus when acting as an underwriter and with respect to an unsold allotment or subscription.

PROSPECTUS SUMMARY

This summary highlights information contained elsewhere in this prospectus. This summary does not contain all of the information you should consider before investing in our common stock. You should read this entire prospectus carefully, including "Risk Factors," "Management's Discussion and Analysis of Financial Condition and Results of Operations," and our financial statements and the related notes included elsewhere in this prospectus, before making an investment decision.

BIONANO GENOMICS, INC.

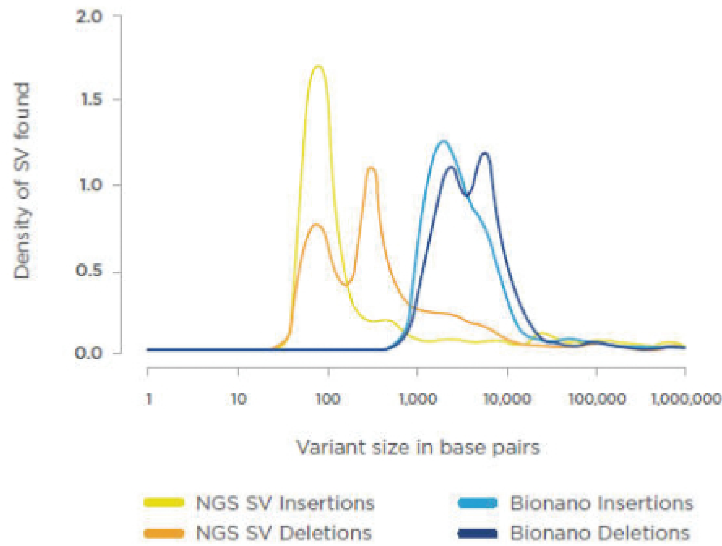
Overview

We are a life sciences instrumentation company in the genome analysis space. We develop and market the Saphyr system, a platform for ultra-sensitive and ultra-specific structural variation detection that enables researchers and clinicians to accelerate the search for new diagnostics and therapeutic targets and to streamline the study of changes in chromosomes, which is known as cytogenetics. Our Saphyr system comprises an instrument, chip consumables, reagents and a suite of data analysis tools.

Structural variation refers to large-scale structural differences in the genomic DNA of one individual compared to another. Each structural variation involves the rearrangement or repetition of as few as hundreds to as many as tens of millions of DNA base pairs. Structural variations may be inherited or arise spontaneously and many cause genetic disorders and diseases. Until our commercial launch of the Saphyr system in February 2017, and since, we believe no products existed or exist that could more comprehensively and cost and time-efficiently detect structural variation.

We have established relationships with key opinion leaders in genomics research and clinical applications, including rare diseases and oncology, and our installed base of over 90 systems made up of Saphyr and its predecessor includes some of the world's most prominent clinical, translational research, basic research, academic and government institutions as well as leading pharmaceutical and diagnostic companies. Examples include Children's National Health System, DuPont Pioneer, Garvan Institute of Medical Research, Genentech, Icahn School of Medicine at Mount Sinai, McDonnell Genome Institute at Washington University, National Institutes of Health, Pennsylvania State University and Salk Institute for Biological Studies. Our revenues in 2017 were $9.5 million, representing approximately 40% growth over the prior year, and for the first half of 2018 our revenues were $5.2 million, representing approximately 32% growth over the prior year comparable period. Our cumulative revenues for the period from January 1, 2016 through June 30, 2018 from each of the customers listed above were, respectively, $0.5M, $0.5M, $0.3M, $0.3M, $0.1M, $0.4M, $0.1M, $0.3M, and $0.1M.

Approximately 6,000 research use only, or RUO, high throughput sequencers are currently installed worldwide. Sequencing is very good at detecting genome differences involving just a few base pairs or single-nucleotide variations, but sequencing, including next-generation sequencing, or NGS, cannot reliably detect the larger structural variations that our system can detect. Therefore, Saphyr is being adopted alongside this installed base of sequencers as a complement that gives users the ability to see a much wider scope of genome variation than ever before. As shown in the graphic below, the Garvan Institute of Medical Research generated data that we expect to be published which shows the density of structural variations found relative to the size of the structural variation found for our system (blue lines) against next-generation sequencing (Illumina; orange lines). Next-generation sequencing has a very significant deficiency in detecting structural variations. Given our system's ability to detect structural variations, it picks up essentially where next-generation sequencing drops off, as shown below.



The Saphyr system, which is for RUO, is also beginning to be adopted by cytogenetics labs that seek to use it in commercial clinical tests of its patients as a laboratory developed test, or LDT. These labs currently rely on existing methods such as karyotyping, fluorescence in situ hybridization, or FISH, and microarrays for clinical tests and research that look at chromosomal structure, location and function in cells. Major guidelines for oncology and genetic disease clinical diagnostics recommend first-line structural variation testing by these existing methods. The organizations issuing these guidelines include, among many others, World Health Organization (WHO), National Comprehensive Cancer Network (NCCN), American College of Medical Genetics (ACMG) and American College of Obstetricians & Gynecologists (ACOG).

We estimate that approximately 2,500 clinical cytogenetics labs exist worldwide. We believe Saphyr makes clinical testing for structural variations simpler, higher throughput, more cost effective and more scalable. In addition, we believe that Saphyr makes it easier for cytogenetics labs to accommodate new content when the research community validates newly discovered structural variation-based biomarkers for clinical diagnostics. Importantly, Saphyr can be used alone to provide comprehensive detection of structural variations and enable diagnostic calls without the need for any sequencing or cytogenetic technology.

Saphyr and its predecessor system, which we collectively refer to as our system in this prospectus, have been cited by researchers and clinicians in approximately 130 publications covering structural variations in areas of high unmet medical need and research interest, such as rare and undiagnosed pediatric diseases, muscular diseases, developmental delays and disorders, prostate cancer and leukemia.

Market Opportunity

According to Research and Markets, the worldwide market for genomics products and services is expected to reach approximately $23.9 billion by 2022, up from approximately $14.7 billion in 2017, representing a compound annual growth rate of 10.2%.

We believe that the discovery research and cytogenetics segments together comprise an addressable opportunity for us to sell up to approximately 8,500 Saphyr systems, representing a current total instrument market opportunity of approximately $2.1 billion. In addition to the instrument sales opportunity, Saphyr instruments generate recurring revenue from chip consumables that are used on a per-sample basis. We believe each Saphyr instrument has the potential to create recurring revenue in a range of approximately $75,000 to approximately $150,000 per year, suggesting a potential annual recurring revenue opportunity of approximately $0.6 billion to approximately $1.3 billion. Therefore, we believe that our currently addressable portion of the genome analysis market is estimated to be between $2.7 billion and $3.4 billion.

Existing Technologies and Their Limitations

Even though both single nucleotide variation and structural variation are each very common, a much larger number of variant nucleotides in the average human genome are found in structural variations as compared to single nucleotide variations. A recent study showed that 30 million base pairs, on average, in the human genome are part of structural variations while only 10 million are single nucleotide variations. Sequencing and cytogenetics simply do not elucidate comprehensive structural variations in a systematic and cost- and time-efficient manner. Most structural variations found to date that have been implicated in disease were discovered through laborious, expensive, unindustrialized and non-comprehensive methods over the course of many years.

The Limitations of Sequencing

Nearly all genome sequencing, including next-generation sequencing, uses a method called sequencing by synthesis. Sequencing by synthesis is an in-vitro process for synthesizing a copy of DNA, one base at a time in a way that makes it possible to measure the identity of each base as it is incorporated into the growing DNA copy. The read lengths typical for next-generation sequencing are often too short to determine the right location and orientation of a reading frame in the genome because many of the reads from one chromosome are identical to reads from either another chromosome or even another location on the same chromosome. These short lengths disconnect and destroy most of the structural information of the original genome and make next-generation sequencing unable to reliably detect genomic variations larger than a few hundred base pairs.

The recognition of the need for greater lengths of sequence reads to determine genome structure, birthed the so-called long-read sequencing submarket. Because of the need for long-read sequencing, Pacific Biosciences of California developed a system that uses another alternative form of sequencing by synthesis, while Oxford Nanopore Technologies developed a system that uses nanopore technology. These systems provide users with average read lengths in the tens of thousands of base pairs. However, these read lengths have proven not to be long enough to reliably and comprehensively detect structural variations. Pacific Biosciences' polymerases cannot regularly produce reads that are the necessary hundreds of thousands of base pairs in length. In addition, Oxford Nanopore's system has difficulty reliably feeding molecules that are, on average, hundreds of thousands of base pairs in length through each nanopore. The time and cost of providing a comprehensive whole genome analysis of a patient in a clinical setting is prohibitive when using these longer-read technologies.

The Limitations of Cytogenetics

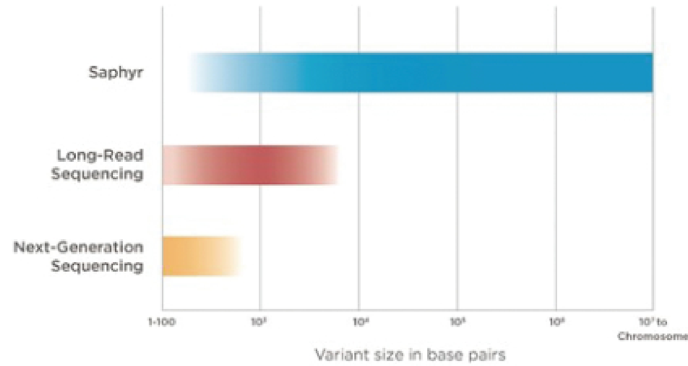
Cytogenetics is the study of chromosomal structure and how structural variations impact health. The field has historically relied on karyotyping, FISH and more recently, microarrays. These methods each can detect some structural variations, but they are all inadequate solutions for high volume and low cost genetic testing for structural variations, and none is an approach that can comprehensively detect structural variations with the ultra-high sensitivity and ultra-high specificity of the Saphyr system.

- Karyotyping is the gross optical examination of the chromosomes using a microscope. In this method, chromosomes are directly viewed on a slide by a pathologist with a microscope, resulting in resolution that is limited to structural events that are larger than five million base pairs. When karyotyping is used to diagnose unknown genetic disease, only about 5% of karyotyping tests result in a confirmed pathogenic finding. The test is costly, and its results are subject to each pathologist’s interpretation which introduces variability in diagnostic calls and makes the methodology not amenable to automation.
- FISH is a molecular cytogenetic technique that is used to detect chromosomal aberrations. FISH is limited to known targets and cannot be used for discovery. Every FISH test performed needs to be chosen to look for a specific genetic marker that the clinician anticipates may be found based on the clinical symptoms of the patient. In addition, the test results can be ambiguous and inconclusive, and reproducibility and variability among users can be a significant issue. Like karyotyping, FISH’s diagnostic yield is very low when used to diagnose unknown genetic disease with only an estimated 7% of FISH providing a confirmed pathogenic finding. In addition, FISH is expensive, especially for the limited amount of information that it provides.
- Chromosomal microarrays and SNP (single nucleotide polymorphism) arrays are tests consisting of slides that contain thousands of spots of DNA fragments that bind to the DNA of the sample. Microarrays have limited utility as a diagnostic tool as they are only useful when there are gains and losses of base pairs within the sample’s genome that are specific to the probes that are populated on the array. Microarrays are also limited in their ability to provide specific locations of gains or losses on a chromosome, or even identify on which chromosome that the gains or losses occur. In addition, microarrays have low resolution as they cannot reliably detect structural variants smaller than 50,000 base pairs. Also, the diagnostic yield of microarrays is low. Only an estimated 20% of microarray tests provide a confirmed pathogenic finding when used to diagnose unknown genetic disease.

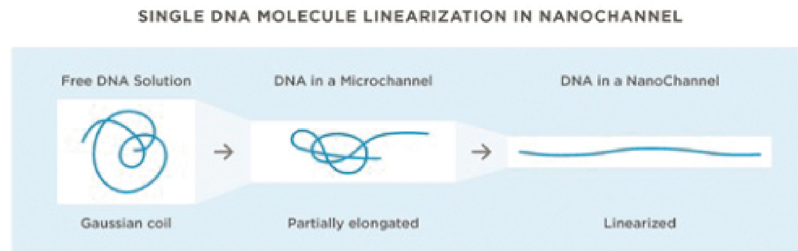
Our Solution

Our approach to measuring genome structure and structural variation is novel and highly differentiated. Our Saphyr system directly observes extremely long genomic DNA without any amplification to construct a physical map that accurately assigns the chromosomal location, order, orientation and quantity of all the genome's functional elements. Our solution is built upon four key elements:

- **Extremely long molecules for analysis.** The Saphyr system is capable of analyzing single molecules that are on average approximately 250,000 base pairs long. These lengths are over 1,000 times longer than the average read length with Illumina systems and approximately 10 times longer than the average read lengths with Pacific Biosciences and Oxford Nanopore systems. Building a picture of the genome with massive building blocks overcomes the inherent challenge of genome complexity and is the key to Saphyr's unprecedented sensitivity and specificity.



- **Proprietary nanotechnology for massively parallel linearization and analysis of long molecules with single molecule imaging.** Analyzing these extremely long chromosomal fragments required invention. Molecules of this size are more like balls of yarn in a test tube and must be unraveled for meaningful analysis. We invented, patented, developed and commercialized nanochannel arrays to capture them from solution and unwind and linearize them for structural variation analysis. Each molecule is imaged separately, making it possible to deconvolute complex mixtures including haplotypes and heterogeneous tumors, as shown in the graphic below.



- **DNA labeling chemistry specifically for physical mapping.** The detailed analysis of sequence we use is also highly unique and novel. Instead of identifying the sequence of every base pair in these long fragments, we label and detect specific sequence patterns or motifs that occur universally across every genome with an average frequency of approximately one site for every few thousand base pairs.
- **Bioinformatic tools for structural variation analysis.** Finally, our approach includes a novel bioinformatics platform that we developed from the ground-up to take advantage of the unique benefits of our solution. It comprises proprietary algorithms for the construction of a structurally accurate physical map of the genome without using a reference genome in assignment of structure. Physical maps of a test subject are then compared in cross-mapping analysis that allows our system to detect genome wide structural variation, including the most complex balanced events.

Our Focus Areas

Our Saphyr system serves many segments of the genomics market seeking to find and understand structural variation. We have identified focus areas where we concentrate our resources to ensure robust adoption of our system and frequent utilization of consumables. We have selected these segments because of their urgent need to detect structural variations and the significant economic opportunity they represent. Our current focus areas are human genetic diseases, including rare diseases and oncology.

- **Rare diseases.** In genetic disease, existing tools have reached a plateau where almost half of patients with genetic disease who are tested in clinical laboratories fail to receive a molecular diagnosis. In order to increase diagnostic yield, a massive increase in the understanding of the complete structure and variation of the genome is essential.
- **Cancer.** In cancer, each patient has a unique disease with a complex pattern of genome changes. Traditional and recently-developed treatments do not attack the individual changes in each patient’s tumor. Recent personalized medicine programs aim to provide clinicians with individual treatments specifically targeting the mutations found in each patient’s cancer. For personalized cancer medicine to be successful, all variants in the cancer genome need to be detected, which is not feasible with cytogenetic or whole genome sequencing approaches.

Our Saphyr system, which is for RUO, is being used for basic and translational research and also beginning to be adopted by cytogenetics labs that seek to use it in commercial clinical tests of its patients as an LDT.

Our Strengths

We have established ourselves as one of the leaders in the field of genome analysis, and we believe we are the industry’s performance leader in structural variation detection. Below are our strengths that we believe will enable us to capture a significant portion of the genome analysis market and retain our leadership position in structural variation:

- ***Highly differentiated technology platform enables researchers and clinicians to obtain information that cannot be had systematically and cost efficiently from traditional technologies.*** Saphyr’s unique ability to systematically and cost efficiently see structural variations across the genome from 500 base pairs to tens of millions of base pairs is unique in the industry. We believe this greater insight will facilitate a paradigm shift in healthcare from an emphasis on treatment with relatively untargeted therapies to a focus on earlier detection, more precise diagnosis and treatment with better targeted therapies.
- ***Validated solution recognized industry-wide.*** We have deep and expanding scientific validation as evidenced by the quickly expanding base of publications regarding our system. We believe our technology is becoming a vital tool in cutting-edge life sciences research.

- ***Strong installed base of premier customers.*** We have sold more than 90 of our systems to over 80 customers globally, including some of the world's most prominent clinical, translational research, basic research, academic and government institutions as well as leading pharmaceutical and diagnostic companies.
- ***Attractive business model with a growing, high-margin recurring revenue component.*** As we continue to grow our installed base of Saphyr systems, optimize workflows and expand our structural variation detection capabilities, we expect to rapidly increase our high-margin revenues derived from consumables.
- ***Industry-leading intellectual property portfolio.*** We have developed a global patent portfolio that includes 43 issued patents across 14 patent families and an exclusively licensed portfolio of patents and applications from Princeton University, which includes 22 patents across two families. This global patent portfolio has filing dates ranging from 2001 to 2017.
- ***Highly experienced senior management team.*** We are led by a dedicated and highly experienced senior management team with significant industry experience and proven ability to develop novel solutions. Each of the members of our senior management has more than 20 years of relevant experience.

Our Strategy

Our goal is to enable new research in genomics to allow greater insight into their role in human health in ways that have not been possible with any other current research and diagnostic technologies.

Our strategy to achieve this includes:

- drive adoption of Saphyr in discovery research and cytogenetics markets;
- support the publication of findings with Saphyr by our customers and partners;
- expand gross margins through economies of scale and growing sales of consumables;
- continue to innovate our products and technologies; and
- partner with industry-leading companies and laboratories to accelerate adoption in clinical markets.

Risk Factors Summary

Investing in our common stock involves substantial risk. The risks described under the heading "Risk Factors" immediately following this summary may cause us to not realize the full benefits of our strengths or may cause us to be unable to successfully execute all or part of our strategy. Some of the more significant challenges include the following:

- we have incurred losses since we were formed and expect to incur losses in the future. We cannot be certain that we will achieve or sustain profitability;
- our quarterly and annual operating results and cash flows have fluctuated in the past and might continue to fluctuate, which could cause the market price of our common stock to decline substantially;
- we are an early, commercial-stage company and have a limited operating history, which may make it difficult to evaluate our current business and predict our future performance;
- if we are unable to maintain adequate revenue growth or do not successfully manage such growth, our business and growth prospects will be harmed;

- our future capital needs are uncertain and we may need to raise additional funds in the future;
- if our products fail to achieve and sustain sufficient market acceptance, our revenue will be adversely affected;
- our future success is dependent upon our ability to further penetrate our existing customer base and attract new customers;
- we are currently limited to “research use only” with respect to many of the materials and components used in our consumable products including our assays;
- in the near term, our business will depend on levels of research and development spending by academic and governmental research institutions and biopharmaceutical companies, a reduction in which could limit demand for our products and adversely affect our business and operating results;
- if we do not successfully manage the development and launch of new products, our financial results could be adversely affected;
- if the U.S. Food and Drug Administration determines that our products are medical devices or if we seek to market our products for clinical diagnostic or health screening use, we will be required to obtain regulatory clearance(s) or approval(s), and may be required to cease or limit sales of our then marketed products, which could materially and adversely affect our business, financial condition and results of operations. Any such regulatory process would be expensive, time-consuming and uncertain both in timing and in outcome;
- if we are unable to protect our intellectual property, it may reduce our ability to maintain any technological or competitive advantage over our competitors and potential competitors, and our business may be harmed; and
- our principal stockholders and management own a significant percentage of our stock and will be able to exert significant control over matters subject to stockholder approval.

Corporate Information

We were formed in January 2003 as BioNanomatrix LLC, a Delaware limited liability company. In August 2007, we became BioNanomatrix Inc., a Delaware corporation. In October 2011, we changed our name to BioNano Genomics, Inc., and in July 2018, we changed our name to Bionano Genomics, Inc.

Our principal executive offices are located at 9640 Towne Centre Drive, Suite 100, San Diego, California 92121, and our telephone number is (858) 888-7600. Our website address is www.bionanogenomics.com. Information contained in, or that can be accessed through, our website is not incorporated by reference into this prospectus, and you should not consider information on our website to be part of this prospectus. Our design logo, “Bionano,” and our other registered and common law trade names, trademarks and service marks are the property of Bionano Genomics, Inc.

We are an “emerging growth company” as defined in the Jumpstart Our Business Startups Act of 2012, or the JOBS Act. We may take advantage of certain exemptions from various public company reporting requirements, including not being required to have our internal control over financial reporting audited by our independent registered public accounting firm under Section 404 of the Sarbanes-Oxley Act of 2002, reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements, and exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and any golden parachute payments. We may take advantage of these exemptions for up to five years or until we are no

longer an "emerging growth company," whichever is earlier. In particular, in this prospectus, we have provided only two years of audited financial statements and have not included all of the executive compensation related information that would be required if we were not an emerging growth company. Accordingly, the information contained herein may be different than the information you receive from other public companies in which you hold stock.

In addition, the JOBS Act provides that an emerging growth company can take advantage of an extended transition period for complying with new or revised accounting standards. This provision allows an emerging growth company to delay the adoption of new or revised accounting standards that have different transition dates for public and private companies until those standards would otherwise apply to private companies. We have elected to use this extended transition period. As a result of this election, our timeline to comply with these standards will in many cases be delayed as compared to other public companies that are not eligible to take advantage of this election or have not made this election. Therefore, our financial statements may not be comparable to those of companies that comply with the public company effective dates for these standards.

The Offering

Common stock offered by us	5,500,000 shares
Common stock to be outstanding after this offering	14,923,797 shares
Option to purchase additional shares of common stock offered by us	825,000 shares
Use of proceeds	We estimate that our net proceeds from this offering will be $25.7 million (or approximately $29.6 million if the underwriters' option to purchase additional shares of our common stock from us is exercised in full), after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us. We intend to use the net proceeds we receive from this offering to expand our commercial capabilities in selling and marketing related to our products, to fund our ongoing research and development activities, and for general corporate purposes, including working capital, operating expenses and capital expenditures. See "Use of Proceeds" for additional information.
Risk factors	You should carefully read and consider the information in the section titled "Risk Factors" and all other information set forth in this prospectus before deciding to purchase any shares of our common stock.
Nasdaq trading symbol	"BNGO"

The number of shares of our common stock to be outstanding after this offering is based on 5,856,698 shares of our common stock as of June 30, 2018, after giving effect to the conversion of shares of our convertible preferred stock outstanding as of June 30, 2018 into an aggregate of 5,700,572 shares of our common stock immediately prior to the closing of this offering, and excludes:

- 833,960 shares of our common stock issuable upon the exercise of stock options outstanding as of June 30, 2018 under our Amended and Restated 2006 Equity Compensation Plan, as amended, or 2006 Plan, with a weighted-average exercise price of $2.53 per share;
- 2,098,909 shares of our common stock reserved for future issuance under our 2018 Equity Incentive Plan, or 2018 Plan, which will become effective once the registration statement of which this prospectus forms a part is declared effective, with such shares including 1,100,000 new shares plus the number of shares (not to exceed 998,909 shares) (i) that remain available for the issuance of awards under our 2006 Plan at the time our 2018 Plan becomes effective, and (ii) any shares underlying outstanding stock awards granted under our 2006 Plan that expire or are repurchased, forfeited, cancelled or withheld, as more fully described in the section titled "Executive Compensation – Equity Incentive Plans";
- 240,000 shares of our common stock reserved for issuance under our 2018 Employee Stock Purchase Plan, or ESPP, which will become effective once the registration statement of which this prospectus forms a part is declared effective, and any automatic increases in the number of shares of common stock reserved for future issuance under our ESPP;

- 2,003 shares of our common stock issuable upon the exercise of an outstanding warrant which, prior to the completion of this offering, is exercisable for 42,872 shares of our Series B convertible preferred stock;
- 3,505 shares of our common stock issuable upon the exercise of outstanding warrants which, prior to the completion of this offering, are exercisable for 75,027 shares of our Series B-1 convertible preferred stock;
- 23,851 shares of our common stock issuable upon the exercise of an outstanding warrant which, prior to the completion of this offering, is exercisable for 510,417 shares of our Series D convertible preferred stock;
- 42,834 shares of our common stock issuable upon the exercise of outstanding warrants which, prior to the completion of this offering, are exercisable for 916,667 shares of our Series D-1 convertible preferred stock; and
- up to 189,750 shares of common stock issuable upon exercise of warrants to be issued to the Underwriters in connection with this offering, which will have an exercise price equal to 150% of the initial public offering price per share in this offering.

Unless we specifically state otherwise, the information in this prospectus assumes or gives effect to:

- the filing of our amended and restated certificate of incorporation, which will be in effect upon the completion of this offering;
- the conversion of all of our outstanding shares of convertible preferred stock into an aggregate of 5,700,572 shares of common stock upon the closing of this offering;
- the conversion of outstanding convertible promissory notes and a conversion date of June 30, 2018 into 3,567,099 shares of common stock (based on an assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus) and a conversion date of June 30, 2018);
- that the initial public offering price of our shares of common stock is $5.50 per share, which is the midpoint of the price range set forth on the cover page of this prospectus;
- no exercise of the outstanding options described above;
- no exercise of the underwriters' option to purchase up to an additional 825,000 shares of common stock from us in this offering; and
- a 1-for-21.4 reverse stock split of our common stock effected on July 16, 2018.

Certain of our existing stockholders, including entities affiliated with certain of our directors, have indicated an interest in purchasing an aggregate of approximately $6.35 million in shares of our common stock in this offering at the initial public offering price per share. However, because indications of interest are not binding agreements or commitments to purchase, the underwriters may determine to sell more, less or no shares in this offering to any of these persons or entities, or any of these persons or entities may determine to purchase more, less or no shares in this offering. The underwriters will receive the same underwriting discount on any shares purchased by these persons or entities as they will on any other shares sold to the public in this offering.

Summary Financial Data

The summary statement of operations data for the years ended December 31, 2016 and 2017 and the balance sheet data as of December 31, 2017 are derived from our audited financial statements that are included elsewhere in this prospectus. The summary statement of operations data for the six months ended June 30, 2017 and 2018 and the balance sheet data as of June 30, 2018 are derived from our unaudited financial statements that are included elsewhere in this prospectus. Our historical results are not necessarily indicative of our results in any future period and results from our interim period may not necessarily be indicative of the results of the entire year.

You should read the following summary financial data together with "Management's Discussion and Analysis of Financial Condition and Results of Operations" and our financial statements and the related notes included elsewhere in this prospectus. The summary financial data in this section are not intended to replace our financial statements and the related notes and are qualified in their entirety by the financial statements and related notes included elsewhere in this prospectus.

	Year ended December 31,		Six Months Ended June 30,	
	2016	2017	2017	2018
			(unaudited)	
Total revenue	$ 6,792,789	$ 9,505,043	$ 3,916,864	$ 5,158,494
Operating expenses				
Cost of revenue	3,578,692	6,030,512	2,844,117	2,654,879
Research and development	11,431,941	12,009,170	6,584,614	4,465,919
Selling, general and administrative	12,950,572	14,079,658	7,436,426	6,385,378
Impairment of property and equipment	—	604,511	—	—
Total operating expenses	27,961,205	32,723,851	16,865,157	13,506,176
Interest expense	(470,072)	(590,927)	(286,095)	(709,616)
Other income	2,802,797	462,923	896,758	1,907,742
Provision for income taxes	(12,924)	(18,552)	(22,358)	(9,282)
Net loss	$ (18,848,615)	$ (23,365,364)	$ (12,359,988)	$ (7,158,838)
Net loss per share(1):				
Basic and diluted	$ (156.20)	$ (163.86)	$ (88.04)	$ (46.10)
Pro forma net loss per share(1):				
Basic and diluted		$ (4.33)		$ (0.85)

(1) See Note 2 to our financial statements included elsewhere in this prospectus for a description of how we compute basic and diluted net income per share attributable to common stockholders and preferred stockholders and pro forma basic and diluted net loss per share attributable to common stockholders.

	As of June 30, 2018		
	Actual	Pro Forma(1) (unaudited)	Pro Forma As Adjusted(2)(3)
Balance Sheet Data:			
Cash and cash equivalents	$ 7,624,289	$ 7,624,289	$ 33,336,789
Working capital(4)	(6,773,417)	9,161,262	34,873,762
Total assets	18,094,156	18,094,156	43,806,656
Convertible note	14,329,843	—	—
Long-term debt	8,956,143	8,956,143	8,956,143
Total liabilities	32,361,630	16,426,951	16,426,951
Convertible preferred stock	43,010,137	—	—
Accumulated deficit	(61,424,874)	(61,424,874)	(61,424,874)
Total stockholders' (deficit) equity	(57,277,611)	1,666,885	27,379,385

(1) The pro forma balance sheet data gives effect to (i) the automatic conversion of all of our outstanding shares of convertible preferred stock into an aggregate of 5,700,572 shares of common stock, and (ii) the conversion of approximately $14.4 million aggregate principal amount of outstanding convertible promissory notes plus accrued interest thereon into 3,567,099 shares of common stock (based on an assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus) and a conversion date of June 30, 2018).

(2) The pro forma as adjusted balance sheet data reflects (i) the items described in footnote (1) above and (ii) our receipt of estimated net proceeds from the sale of 5,500,000 shares of common stock at the assumed initial public offering price of $5.50 per share, after deducting the estimated underwriting discounts and commissions and estimated offering expenses payable by us.

(3) A $1.00 increase (decrease) in the assumed initial public offering price of $5.50 per share would increase (decrease) cash and cash equivalents, working capital, total assets, total liabilities, additional paid-in capital and total stockholders' (deficit) equity by $4.7 million, assuming that the number of shares offered by us, as set forth on the cover page of this prospectus, remains the same, after deducting the estimated underwriting discounts and commissions. Similarly, each increase (decrease) of 1.0 million shares in the number of shares of common stock offered by us would increase (decrease) each of cash and cash equivalents, working capital, total assets, additional paid-in capital and total stockholders' (deficit) equity by $4.7 million, assuming the assumed initial public offering price of $5.50 per share remains the same, and after deducting the estimated underwriting discounts and commissions.

(4) Working capital is calculated as current assets minus current liabilities.

RISK FACTORS

Investing in our common stock involves a high degree of risk. You should consider and read carefully all of the risks and uncertainties described below, as well as other information included in this prospectus, including our financial statements and related notes appearing at the end of this prospectus, before making an investment decision. The risks described below are not the only ones facing us. The occurrence of any of the following risks or additional risks and uncertainties not presently known to us or that we currently believe to be immaterial could materially and adversely affect our business, financial condition or results of operations. In such case, the trading price of our common stock could decline, and you may lose all or part of your original investment. This prospectus also contains forward-looking statements and estimates that involve risks and uncertainties. Our actual results could differ materially from those anticipated in the forward-looking statements as a result of specific factors, including the risks and uncertainties described below.

Risks related to our financial condition and need for additional capital

We have incurred losses since we were formed and expect to incur losses in the future. We cannot be certain that we will achieve or sustain profitability.

We incurred net losses of $18.8 million and $23.4 million for the years ended December 31, 2016 and 2017, respectively. We incurred net losses of $12.4 million and $7.2 million for the six months ended June 30, 2017 and 2018, respectively. As of June 30, 2018, we had an accumulated deficit of $61.4 million. We cannot predict if we will achieve sustained profitability in the near future or at all. We expect that our losses will continue for the foreseeable future as we plan to invest significant additional funds toward expansion of our commercial organization and the development of our technology. In addition, as a public company, we will incur significant legal, accounting, and other expenses that we did not incur as a private company. These increased expenses will make it harder for us to achieve and sustain future profitability. We may incur significant losses in the future for a number of reasons, many of which are beyond our control, including the other risks described in this prospectus, the market acceptance of our products, future product development and our market penetration and margins.

Our quarterly and annual operating results and cash flows have fluctuated in the past and might continue to fluctuate, which could cause the market price of our common stock to decline substantially.

Numerous factors, many of which are outside our control, may cause or contribute to significant fluctuations in our quarterly and annual operating results. These fluctuations may make financial planning and forecasting uncertain. In addition, these fluctuations may result in unanticipated decreases in our available cash, which could negatively affect our business and prospects. In addition, one or more of such factors may cause our revenue or operating expenses in one period to be disproportionately higher or lower relative to the others. As a result, comparing our operating results on a period-to-period basis might not be meaningful. You should not rely on our past results as indicative of our future performance. Moreover, our stock price might be based on expectations of future performance that are unrealistic or that we might not meet and, if our revenue or operating results fall below the expectations of investors or securities analysts, the price of our common stock could decline substantially.

Our operating results have varied in the past. In addition to other risk factors listed in this section, some of the important factors that may cause fluctuations in our quarterly and annual operating results include:

- adoption of our systems and related products;
- the timing of customer orders to purchase our systems;
- the rate of utilization of consumables by our customers;
- receipt and timing of revenue for services provided by out data solutions service;

- the timing of the introduction of new systems, products, system and product enhancements and services; and
- the receipt and timing of revenue from our distribution and marketing arrangements.

In addition, a significant portion of our operating expense is relatively fixed in nature, and planned expenditures are based in part on expectations regarding future revenue. Accordingly, unexpected revenue shortfalls could decrease our gross margins and cause significant changes in our operating results from quarter to quarter. If this occurs, the trading price of our common stock could fall substantially.

We are an early, commercial-stage company and have a limited operating history, which may make it difficult to evaluate our current business and predict our future performance.

We are an early, commercial-stage company and have a limited commercial history. Our limited commercial history may make it difficult to evaluate our current business and makes predictions about our future success or viability subject to significant uncertainty. We will continue to encounter risks and difficulties frequently experienced by early, commercial-stage companies, including scaling up our infrastructure and headcount. If we do not address these risks successfully, our business will suffer.

If we are unable to maintain adequate revenue growth or do not successfully manage such growth, our business and growth prospects will be harmed.

We have experienced significant revenue growth in a short period of time. We may not achieve similar growth rates in future periods. Investors should not rely on our operating results for any prior periods as an indication of our future operating performance. To effectively manage our anticipated future growth, we must continue to maintain and enhance our financial, accounting, manufacturing, customer support and sales administration systems, processes and controls. Failure to effectively manage our anticipated growth could lead us to over-invest or under-invest in development, operational and administrative infrastructure; result in weaknesses in our infrastructure, systems, or controls; give rise to operational mistakes, losses, loss of customers, productivity or business opportunities; and result in loss of employees and reduced productivity of remaining employees.

Our continued growth could require significant capital expenditures and might divert financial resources from other projects such as the development of new products and services. As additional products are commercialized, we may need to incorporate new equipment, implement new technology systems, or hire new personnel with different qualifications. Failure to manage this growth or transition could result in turnaround time delays, higher product costs, declining product quality, deteriorating customer service, and slower responses to competitive challenges. A failure in any one of these areas could make it difficult for us to meet market expectations for our products, and could damage our reputation and the prospects for our business.

If our management is unable to effectively manage our anticipated growth, our expenses may increase more than expected, our revenue could decline or grow more slowly than expected and we may be unable to implement our business strategy. The quality of our products and services may suffer, which could negatively affect our reputation and harm our ability to retain and attract customers.

Our future capital needs are uncertain and we may need to raise additional funds in the future.

We believe that the net proceeds from this offering, together with our cash generated from commercial sales and our existing cash and cash equivalents, including the proceeds from our recent financings, will enable us to fund our operating expenses and capital expenditure requirements for at least the next 18 months. However, we may need to raise substantial additional capital to:

- expand our sales and marketing efforts to further commercialize our products;

- expand our research and development efforts to improve our existing products and develop and launch new products, particularly if any of our products are deemed by the U.S. Food and Drug Administration, or FDA, to be medical devices or otherwise subject to additional regulation by the FDA;
- seek FDA approval to market our existing products or new products utilized for diagnostic purposes;
- lease a larger facility or build out our existing facility as we continue to grow our employee headcount;
- hire additional personnel;
- enter into collaboration arrangements, if any, or in-license other products and technologies;
- add operational, financial and management information systems; and
- incur increased costs as a result of operating as a public company.

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

- market acceptance of our products;
- the cost and timing of establishing additional sales, marketing and distribution capabilities;
- the cost of our research and development activities;
- the success of our existing distribution and marketing arrangements and our ability to enter into additional arrangements in the future; and
- the effect of competing technological and market developments.

We cannot assure you that we will be able to obtain additional funds on acceptable terms, or at all. If we raise additional funds by issuing equity or equity-linked securities, our stockholders may experience dilution. Future debt financing, if available, may involve covenants restricting our operations or our ability to incur additional debt. Any debt or equity financing may contain terms that are not favorable to us or our stockholders. If we raise additional funds through collaboration and licensing arrangements with third parties, it may be necessary to relinquish some rights to our technologies or our products, or grant licenses on terms that are not favorable to us. If we do not have, or are not able to obtain, sufficient funds, we may have to delay development or commercialization of our products. We also may have to reduce marketing, customer support or other resources devoted to our products or cease operations. Any of these factors could have a material adverse effect on our financial condition, operating results and business.

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

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

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

As of June 30, 2018, we had aggregate U.S. net operating loss carryforwards of approximately $30.5 million and aggregate U.S. research and development credits of approximately $4.1 million. These net operating loss carryforwards could expire unused and be unavailable to offset future income tax liabilities. Under the newly enacted federal income tax law, federal net operating losses incurred in 2018 and in future years may be carried forward indefinitely, but the deductibility of such federal net operating losses is limited. It is uncertain if and to what extent various states will conform to the newly enacted federal tax law. In addition, under Sections 382 and 383 of the Internal Revenue Code of 1986, as amended, and corresponding provisions of state law, if a corporation undergoes an "ownership change" (which is generally defined as a greater than 50% change (by value) in its equity ownership over a three-year period), the corporation's ability to use its pre-change net operating loss carryforwards and other pre-change tax attributes to offset its post-change income or taxes may be limited. We have experienced an ownership change in the past and we may also experience additional ownership changes in the future as a result of subsequent shifts in our stock ownership, some of which may be outside of our control. If an ownership change occurs and our ability to use our net operating loss carryforwards is materially limited, it would harm our future operating results by effectively increasing our future tax obligations.

U.S. taxation of international business activities or the adoption of tax reform policies could materially impact our future financial position and results of operations.

Limitations on the ability of taxpayers to claim and utilize foreign tax credits and the deferral of certain tax deductions until earnings outside of the U.S. are repatriated to the U.S., as well as changes to U.S. tax laws that may be enacted in the future, could impact the tax treatment of future foreign earnings. Should the scale of our international business activities expand, any changes in the U.S. taxation of such activities could increase our worldwide effective tax rate and harm our future financial position and results of operations.

The terms of our credit facility place restrictions on our operating and financial flexibility, and failure to comply with covenants or to satisfy certain conditions of the agreement governing the credit facility may result in acceleration of our repayment obligations and foreclosure on our pledged assets, which could significantly harm our liquidity, financial condition, operating results, business and prospects and cause the price of our common stock to decline.

In June 2018, we entered into a credit and security agreement with Midcap Financial Trust, or Midcap, that is secured by a lien covering substantially all of our assets, including intellectual property. The credit and security agreement provides for a five year $15 million term loan facility, of which we drew $10 million at closing. The remaining $5 million may be drawn upon satisfaction of certain conditions. The loan and security agreement governing the credit facility requires us to comply with a number of covenants (affirmative and negative), including restrictive covenants that limit our ability to: incur additional indebtedness; encumber the collateral securing the loan; acquire, own or make investments; repurchase or redeem any class of stock or other equity interest; declare or pay any cash dividend or make a cash distribution on any class of stock or other equity interest; transfer a material portion of our assets; acquire other businesses; and merge or consolidate with or into any other organization or otherwise suffer a change in control, in each case subject to exceptions. Our intellectual property is also subject to customary negative covenants. In addition, subject to limited exceptions, Midcap could declare an event of default upon the occurrence of any event that it interprets as having a material adverse effect upon our business, operations, properties, assets, or financial condition or upon our ability to perform or pay the secured obligations under the loan and security agreement or upon the collateral or Midcap's liens on the collateral under the agreement, thereby requiring us to repay the loan immediately, together with a prepayment charge of up to 4% of the then outstanding principal balance, together with other fees.

If we default under the credit facility, Midcap may accelerate all of our repayment obligations and, if we are unable to access funds to meet those obligations or to renegotiate our agreement, Midcap could take control of our pledged assets and we could immediately cease operations. If we were to renegotiate our agreement under

such circumstances, the terms may be significantly less favorable to us. If we were liquidated, Midcap's right to repayment would be senior to the rights of our stockholders to receive any proceeds from the liquidation. Any declaration by Midcap of an event of default could significantly harm our liquidity, financial condition, operating results, business, and prospects and cause the price of our common stock to decline.

We may incur additional indebtedness in the future. The debt instruments governing such indebtedness may contain provisions that are as, or more, restrictive than the provisions governing our existing indebtedness under the credit and security agreement with Midcap. If we are unable to repay, refinance or restructure our indebtedness when payment is due, the lenders could proceed against the collateral or force us into bankruptcy or liquidation.

Risks related to our business

If our products fail to achieve and sustain sufficient market acceptance, our revenue will be adversely affected.

Our success depends on our ability to develop and market products that are recognized and accepted as reliable, enabling and cost-effective. Most of the potential customers for our products already use expensive research systems in their laboratories that they have used for many years and may be reluctant to replace those systems with ours. Market acceptance of our systems will depend on many factors, including our ability to convince potential customers that our technology is an attractive alternative to existing technologies. Compared to some competing technologies, our technology is new and complex, and many potential customers have limited knowledge of, or experience with, our products. Prior to adopting our systems, some potential customers may need to devote time and effort to testing and validating our systems. Any failure of our systems to meet these customer benchmarks could result in potential customers choosing to retain their existing systems or to purchase systems other than ours. In addition, it is important that our gene mapping systems be perceived as accurate and reliable by the scientific and medical research community as a whole. Historically, a significant part of our sales and marketing efforts has been directed at demonstrating the advantages of our technology to industry leaders and encouraging such leaders to publish or present the results of their evaluation of our system. If we are unable to continue to motivate leading researchers to use our technology, or if such researchers are unable to achieve or unwilling to publish or present significant experimental results using our systems, acceptance and adoption of our systems will be slowed and our ability to increase our revenue would be adversely affected.

Our future success is dependent upon our ability to further penetrate our existing customer base and attract new customers.

Our current customer base is primarily composed of academic and governmental research institutions, as well as biopharmaceutical and contract research companies. Our success will depend upon our ability to respond to the evolving needs of, and increase our market share among, existing customers and additional potential customers, marketing new products as we develop them. Identifying, engaging and marketing to customers who are unfamiliar with our current products requires substantial time, expertise and expense and involves a number of risks, including:

- our ability to attract, retain and manage the sales, marketing and service personnel necessary to expand market acceptance for our technology;
- the time and cost of maintaining and growing a specialized sales, marketing and service force; and
- our sales, marketing and service force may be unable to execute successful commercial activities.

We have utilized third parties to assist with sales, distribution and customer support in certain regions of the world. There is no guarantee, when we enter into such arrangements, that we will be successful in attracting desirable sales and distribution partners. There is also no guarantee that we will be able to enter into such arrangements on favorable terms. Any failure of our sales and marketing efforts, or those of any third-party sales and distribution partners, would adversely affect our business.

We are currently limited to "research use only" with respect to many of the materials and components used in our consumable products including our assays.

Our instruments, consumable products and assays are purchased from suppliers with a restriction that they be used for research use only, or RUO. While we have focused initially on the life sciences research market and RUO products only, part of our business strategy is to expand our product line to encompass products that are intended to be used for the diagnosis of disease and precision healthcare, either alone or in collaboration with third parties. The use of our products for any such diagnostic purposes would require that we obtain regulatory clearance or approval to market our products for those purposes and also that we acquire the materials and components used in such products from suppliers without an RUO restriction. There can be no assurance that we will be able to acquire these materials and components for use in diagnostic products on acceptable terms, if at all. If we are unable to do so, we would not be able to expand our product offerings beyond RUO, and our business and prospects would suffer.

The FDA Guidance on "Distribution of In Vitro Diagnostic Products Labeled for Research Use Only or Investigational Use Only", or, the RUO/IUO Labeling Guidance, emphasizes that the FDA will review the totality of the circumstances when evaluating whether equipment and testing components are properly labeled as RUO. It further states that merely including a labeling statement that a product is intended for research use only will not necessarily render the device exempt from the FDA's 510(k) clearance, PMA, or other requirements, if the circumstances surrounding the distribution of the product indicate that the manufacturer intends for its product to be offered for clinical diagnostic use. These circumstances may include written or verbal marketing claims or links to articles regarding a product's performance in clinical applications, a manufacturer's provision of technical support for clinical validation or clinical applications, or solicitation of business from clinical laboratories, all of which could be considered evidence of intended uses that conflict with RUO labeling. If the FDA were to determine that our RUO products were intended for use in clinical investigation, diagnosis or treatment decisions, or that express or implied clinical or diagnostic claims were made for our RUO products, those products could be considered misbranded or adulterated under the Federal Food, Drug, and Cosmetic Act. If the FDA determines that our RUO products are being marketed for clinical diagnostic use without the required PMA or 510(k) clearance, we may be required to cease marketing our products as planned, recall the products from customers, revise our marketing plans, and/or suspend or delay the commercialization of our products until we obtain the required authorization. We also may be subject to a range of enforcement actions by the FDA, including warning or untitled letters, injunctions, civil monetary penalties, criminal prosecution, and recall and/or seizure of products, as well as significant adverse publicity.

If, in the future, we choose to commercialize our products for clinical diagnostic use, we will be required to comply with the FDA's premarket review and post-market control requirements for IVDs, as may be applicable. Complying with the FDA's PMA and/or 510(k) clearance requirements may be expensive, time-consuming, and subject us to significant and/or unanticipated delays. Our efforts may never result in an approved PMA or 510(k) clearance for our products. Even if we obtain a PMA or 510(k) clearance, where required, such authorization may not be for the use or uses we believe are commercially attractive and/or are critical to the commercial success of our products. As a result, being subject to the FDA's premarket review and/or post-market control requirements for our products could materially and adversely affect our business, financial condition and results of operations.

In the near term, our business will depend on levels of research and development spending by academic and governmental research institutions and biopharmaceutical companies, a reduction in which could limit demand for our products and adversely affect our business and operating results.

In the near term, we expect that our revenue will be derived primarily from sales of our instruments and consumables to academic and governmental research institutions, as well as biopharmaceutical and contract research companies worldwide for research applications. The demand for our products will depend in part upon the research and development budgets of these customers, which are impacted by factors beyond our control, such as:

- changes in government programs that provide funding to research institutions and companies;
- macroeconomic conditions and the political climate;
- changes in the regulatory environment;
- differences in budgetary cycles; and
- market acceptance of relatively new technologies, such as ours.

For example, in March 2017, the federal government announced the intent to cut federal biomedical research funding by as much as 18%. While there has been significant opposition to these funding cuts, the uncertainty regarding the availability of research funding for potential customers may adversely affect our operating results. Our operating results may fluctuate substantially due to reductions and delays in research and development expenditures by these customers. Any decrease in customers' budgets or expenditures, or in the size, scope or frequency of capital or operating expenditures, could materially and adversely affect our business, operating results and financial condition.

The sales cycle for our systems can be lengthy and variable, which makes it difficult for us to forecast revenue and other operating results.

The sales process for our systems generally involves numerous interactions with multiple individuals within an organization, and often includes in-depth analysis by potential customers of our technology and products and a lengthy review process. Our customers' evaluation processes often involve a number of factors, many of which are beyond our control. As a result of these factors, the capital investment required to purchase our systems and the budget cycles of our customers, the time from initial contact with a customer to our receipt of a purchase order can vary significantly. Given the length and uncertainty of our sales cycle, we have in the past experienced, and expect to in the future experience, fluctuations in our sales on a period-to-period basis. In addition, any failure to meet customer expectations could result in customers choosing to retain their existing systems, use existing assays not requiring capital equipment or purchase systems other than ours.

Our long-term results depend upon our ability to improve existing products and introduce and market new products successfully.

Our business is dependent on the continued improvement of our existing products and our development of new products utilizing our current or other potential future technology. As we introduce new products or refine, improve or upgrade versions of existing products, we cannot predict the level of market acceptance or the amount of market share these products will achieve, if any. We cannot assure you that we will not experience material delays in the introduction of new products in the future. For example, the introduction of our Saphyr system replaced our Irys system, and as a result we may never sell the remaining Irys units currently in our inventory. Therefore, we may from time to time determine it necessary to write down or write off units of our Irys inventory.

Consistent with our strategy of offering new products and product refinements, we expect to continue to use a substantial amount of capital for product development and refinement. We may need additional capital for product development and refinement than is available on terms favorable to us, if at all, which could adversely affect our business, financial condition or results of operations.

We generally sell our products in industries that are characterized by rapid technological changes, frequent new product introductions and changing industry standards. If we do not develop new products and product enhancements based on technological innovation on a timely basis, our products may become obsolete over time and our revenues, cash flow, profitability and competitive position will suffer. Our success will depend on several factors, including our ability to:

- correctly identify customer needs and preferences and predict future needs and preferences;
- allocate our research and development funding to products with higher growth prospects;
- anticipate and respond to our competitors' development of new products and technological innovations;
- innovate and develop new technologies and applications, and acquire or obtain rights to third-party technologies that may have valuable applications in the markets we serve;
- successfully commercialize new technologies in a timely manner, price them competitively and manufacture and deliver sufficient volumes of new products of appropriate quality on time; and
- convince customers to adopt new technologies.

In addition, if we fail to accurately predict future customer needs and preferences or fail to produce viable technologies, we may invest heavily in research and development of products that do not lead to significant revenue. Even if we successfully innovate and develop new products and product enhancements, we may incur substantial costs in doing so, and our profitability may suffer.

Our ability to develop new products based on innovation can affect our competitive position and often requires the investment of significant resources. Difficulties or delays in research, development or production of new products and services or failure to gain market acceptance of new products and technologies may reduce future revenues and adversely affect our competitive position.

If we do not successfully manage the development and launch of new products, our financial results could be adversely affected.

We face risks associated with launching new products. If we encounter development or manufacturing challenges or discover errors during our product development cycle, the product launch dates of new products may be delayed. The expenses or losses associated with unsuccessful product development or launch activities or lack of market acceptance of our new products could adversely affect our business or financial condition.

Undetected errors or defects in our products could harm our reputation, decrease market acceptance of our products or expose us to product liability claims.

Our products may contain undetected errors or defects when first introduced or as new versions or new products are released. Disruptions affecting the introduction or release of, or other performance problems with, our products may damage our customers' businesses and could harm their and our reputation. If that occurs, we may incur significant costs, the attention of our key personnel could be diverted, or other significant customer relations problems may arise. We may also be subject to warranty and liability claims for damages related to errors or defects in our products. In addition, if we do not meet industry or quality standards, if applicable, our products may be subject to recall. A material liability claim, recall or other occurrence that harms our reputation or decreases market acceptance of our products could harm our business and operating results.

Although we do not, and cannot currently, promote the use of our products, or services based on our products, for diagnostic purposes, if our customers develop or use them for diagnostic purposes, someone could file a product liability claim alleging that one of our products contained a design or manufacturing defect that resulted in the failure to adequately perform, leading to death or injury. A product liability claim could result in

substantial damages and be costly and time consuming to defend, either of which could materially harm our business or financial condition. We cannot assure investors that our product liability insurance would adequately protect our assets from the financial impact of defending a product liability claim. Any product liability claim brought against us, with or without merit, could increase our product liability insurance rates or prevent us from securing insurance coverage in the future.

Our reliance on distributors for sales of our products outside of the United States could limit or prevent us from selling our products and could impact our revenue.

We intend to continue to grow our business internationally, and to do so we must attract additional distributors and retain existing distributors to maximize the commercial opportunity for our products. There is no guarantee that we will be successful in attracting or retaining desirable sales and distribution partners or that we will be able to enter into such arrangements on favorable terms. Distributors may not commit the necessary resources to market and sell our products to the level of our expectations or may choose to favor marketing the products of our competitors. If current or future distributors do not perform adequately, or we are unable to enter into effective arrangements with distributors in particular geographic areas, we may not realize long-term international revenue growth. In addition, if our distributors fail to comply with applicable laws and ethical standards, including anti-bribery laws, this could damage our reputation and could have a significant adverse effect on our business and our revenues.

We expect to generate a substantial portion of our revenue internationally in the future and can become further subject to various risks relating to our international activities, which could adversely affect our business, operating results and financial condition.

During 2017 approximately 60% of our product revenue was generated from customers located outside of the U.S. We believe that a substantial percentage of our future revenue will come from international sources as we expand our overseas operations and develop opportunities in additional areas. We have limited experience operating internationally and engaging in international business involves a number of difficulties and risks, including:

- required compliance with existing and changing foreign regulatory requirements and laws;
- difficulties and costs of staffing and managing foreign operations;
- difficulties protecting or procuring intellectual property rights;
- required compliance with anti-bribery laws, such as the U.S. Foreign Corrupt Practices Act, data privacy requirements, labor laws and anti-competition regulations;
- export or import restrictions;
- laws and business practices favoring local companies;
- longer payment cycles and difficulties in enforcing agreements and collecting receivables through certain foreign legal systems;
- political and economic instability; and
- potentially adverse tax consequences, tariffs, customs charges, bureaucratic requirements and other trade barriers.

Historically, most of our revenue has been denominated in U.S. dollars. In the future, we may sell our products and services in local currency outside of the U.S. As our operations in countries outside of the U.S. grow, our results of operations and cash flows may be subject to fluctuations due to changes in foreign currency exchange rates, which could harm our business in the future. For example, if the value of the U.S. dollar increases relative to foreign currencies, in the absence of a corresponding change in local currency prices, our

revenue could be adversely affected as we convert revenue from local currencies to U.S. dollars. If we dedicate significant resources to our international operations and are unable to manage these risks effectively, our business, operating results and financial condition will suffer.

We are subject to U.S. and foreign anti-corruption and anti-money laundering laws with respect to our operations and non-compliance with such laws can subject us to criminal and/or civil liability and harm our business.

We are subject to the U.S. Foreign Corrupt Practices Act, as amended, the U.S. domestic bribery statute contained in 18 U.S.C. § 201, the U.S. Travel Act, the USA PATRIOT Act, the United Kingdom Bribery Act 2010, and other state and national anti-bribery and anti-money laundering laws in countries in which we conduct activities. Anti-corruption laws are interpreted broadly and prohibit companies and their employees and third-party intermediaries from authorizing, promising, offering, providing, soliciting, or accepting, directly or indirectly, improper payments or benefits to or from any person whether in the public or private sector for the purpose of obtaining or retaining business or securing any other improper advantage. We rely on third-party representatives, distributors, and other business partners to support sales of our products and services and our efforts to ensure regulatory compliance. In addition, as we increase our international sales and business, we may engage with additional business partners. We can be held liable for the corrupt or other illegal activities of our employees, representatives, contractors, business partners, and agents, even if we do not explicitly authorize or have actual knowledge of such activities.

Any violations of anti-corruption and anti-money laundering laws, or allegations of such violations, could disrupt our operations, involve significant management distraction, involve significant costs and expenses, including legal fees, and could result in a material adverse effect on our business, prospects, financial condition, or results of operations. We could also incur severe penalties, including criminal and civil penalties, disgorgement, and other remedial measures.

We are subject to governmental export and import controls that could impair our ability to compete in international markets due to licensing requirements and subject us to liability if we are not in compliance with applicable laws.

Our products are subject to export control and import laws and regulations, including the U.S. Export Administration Regulations, U.S. Customs regulations, and various economic and trade sanctions regulations administered by the U.S. Treasury Department's Office of Foreign Assets Controls. Exports of our products must be made in compliance with these laws and regulations. If we fail to comply with these laws and regulations, we and certain of our employees could be subject to substantial civil or criminal penalties, including the possible loss of export or import privileges; fines, which may be imposed on us and responsible employees or managers; and, in extreme cases, the incarceration of responsible employees or managers.

In addition, changes in our products or changes in applicable export or import laws and regulations may create delays in the introduction and sale of our products in international markets, prevent our customers from deploying our products or, in some cases, prevent the export or import of our products to certain countries, governments or persons altogether. Any change in export or import laws and regulations, shift in the enforcement or scope of existing laws and regulations, or change in the countries, governments, persons or technologies targeted by such laws and regulations, could also result in decreased use of our products, or in our decreased ability to export or sell our products to existing or potential customers. Any decreased use of our products or limitation on our ability to export or sell our products would likely adversely affect our business, financial condition and results of operations.

If we are unable to recruit, train, retain, motivate and integrate key personnel, we may not achieve our goals.

Our future success depends on our ability to recruit, train, retain, motivate and integrate key personnel, including our recently expanded senior management team, as well as our research and development,

manufacturing and sales and marketing personnel. Competition for qualified personnel is intense. Our growth depends, in particular, on attracting and retaining highly-trained sales personnel with the necessary scientific background and ability to understand our systems at a technical level to effectively identify and sell to potential new customers and develop new products. Because of the complex and technical nature of our products and the dynamic market in which we compete, any failure to attract, train, retain, motivate and integrate qualified personnel could materially harm our operating results and growth prospects.

We have limited experience in marketing and selling our products, and if we are unable to successfully commercialize our products, our business and operating results will be adversely affected.

We have limited experience marketing and selling our products. We currently sell all our products for research use only, through our direct field sales and support organizations located in North America and Europe and through a combination of our own sales force and third-party distributors in additional major markets such as Australian, China, Japan and South Korea.

The future sales of our products will depend in large part on our ability to effectively market and sell our products, successfully manage and expand our sales force, and increase the scope of our marketing efforts. We may also enter into additional distribution arrangements in the future. Because we have limited experience in marketing and selling our products, our ability to forecast demand, the infrastructure required to support such demand and the sales cycle to customers is unproven. If we do not build an efficient and effective sales force, our business and operating results will be adversely affected.

We rely on a single contract manufacturer for our systems and rely on a single contract manufacturer for our chip consumables. If either of these manufacturers should fail or not perform satisfactorily, our ability to supply these instruments would be negatively and adversely affected.

We currently rely on a single contract manufacturer to manufacture and supply all of our instruments. See “Business–Key Agreements.” In addition, we rely on a single contract manufacturer to manufacture and supply all of our chip consumables. Since our contracts with these manufacturers do not commit them to supply quantities beyond the amounts included in our purchase orders, and do not commit them to carry inventory or make available any particular quantities, these contract manufacturers may give other customers’ needs higher priority than ours, and we may not be able to obtain adequate supplies in a timely manner or on commercially reasonable terms. If either of these manufacturers were to be unable to supply instruments, our business would be harmed.

In the event it becomes necessary to utilize different contract manufacturers for our instruments or chip consumables, we would experience additional costs, delays and difficulties in doing so as a result of identifying and entering into an agreement with a new supplier as well as preparing such new supplier to meet the logistical requirements associated with manufacturing our units, and our business would suffer. We may also experience additional costs and delays in the event we need access to or rights under any intellectual property of these current manufacturers.

We may experience manufacturing problems or delays that could limit the growth of our revenue or increase our losses.

We may encounter unforeseen situations that would result in delays or shortfalls in our production as well as delays or shortfalls caused by our outsourced manufacturing suppliers and by other third-party suppliers who manufacture components for our products. If we are unable to keep up with demand for our products, our revenue could be impaired, market acceptance for our products could be adversely affected and our customers might instead purchase our competitors’ products. Our inability to successfully manufacture our products would have a material adverse effect on our operating results.

We rely on a limited number of suppliers or, in some cases, one supplier, for some of our materials and components used in our consumable products, and may not be able to find replacements or immediately transition to alternative suppliers, which could have a material adverse effect on our business, financial condition, results of operations and reputation.

We rely on limited or sole suppliers for certain reagents and other materials and components that are used in our consumable products. While we periodically forecast our needs for such materials and enter into standard purchase orders with them, we do not have long-term contracts with many of these suppliers. If we were to lose such suppliers, there can be no assurance that we will be able to identify or enter into agreements with alternative suppliers on a timely basis on acceptable terms, if at all. An interruption in our operations could occur if we encounter delays or difficulties in securing these materials, or if the quality of the materials supplied do not meet our requirements, or if we cannot then obtain an acceptable substitute. The time and effort required to qualify a new supplier and ensure that the new materials provide the same or better quality results could result in significant additional costs. Any such interruption could significantly affect our business, financial condition, results of operations and reputation.

In addition, certain of the components used in our instruments are sourced from limited or sole suppliers. If we were to lose such suppliers, there can be no assurance that we will be able to identify or enter into agreements with alternative suppliers on a timely basis on acceptable terms, if at all. An interruption in our ability to sell and deliver instruments to customers could occur if we encounter delays or difficulties in securing these components, or if the quality of the components supplied do not meet specifications, or if we cannot then obtain an acceptable substitute. If any of these events occur, our business and operating results could be harmed.

If we cannot provide quality technical and applications support, we could lose customers and our business and prospects will suffer.

The placement of our products at new customer sites, the introduction of our technology into our customers' existing laboratory workflows and ongoing customer support can be complex. Accordingly, we need highly trained technical support personnel. Hiring technical support personnel is very competitive in our industry due to the limited number of people available with the necessary scientific and technical backgrounds and ability to understand our technology at a technical level. To effectively support potential new customers and the expanding needs of current customers, we will need to substantially expand our technical support staff. If we are unable to attract, train or retain the number of highly qualified technical services personnel that our business needs, our business and prospects will suffer.

Our business could be negatively impacted by cyber security threats.

In the ordinary course of our business, we collect and store sensitive data, intellectual property and proprietary business information owned or controlled by ourselves or our customers. We face various cyber security threats, including cyber security attacks to our information technology infrastructure and attempts by others to gain access to our proprietary or sensitive information. This information encompasses a wide variety of business-critical information including research and development information, commercial information, and business and financial information. The procedures and controls we use to monitor these threats and mitigate our exposure may not be sufficient to prevent cyber security incidents. The result of these incidents could include disrupted operations, lost opportunities, misstated financial data, liability for stolen assets or information, increased costs arising from the implementation of additional security protective measures, litigation and reputational damage. Any remedial costs or other liabilities related to cyber security incidents may not be fully insured or indemnified by other means.

The life sciences research and diagnostic markets are highly competitive. If we fail to effectively compete, our business, financial condition and operating results will suffer.

We face significant competition in the life sciences research and diagnostic markets. We currently compete with both established and early stage companies that design, manufacture and market systems and consumable

supplies. We believe our principal competitors in the life sciences research and genome mapping markets include Pacific Biosciences of California, Oxford Nanopore Technologies, 10x Genomics, Genomic Vision and Dovetail Genomics. In addition, there are a number of new market entrants in the process of developing novel technologies for the life sciences research, diagnostic and screening markets.

Many of our current competitors are either publicly traded, or are divisions of publicly-traded companies, and may enjoy a number of competitive advantages over us, including:

- greater name and brand recognition;
- substantially greater financial and human resources;
- broader product lines;
- larger sales forces and more established distributor networks;
- substantial intellectual property portfolios;
- larger and more established customer bases and relationships; and
- better established, larger scale, and lower cost manufacturing capabilities.

We believe that the principal competitive factors in all of our target markets include:

- cost of instruments and consumables;
- accuracy, including sensitivity and specificity, and reproducibility of results;
- reputation among customers;
- innovation in product offerings;
- flexibility and ease of use; and
- compatibility with existing laboratory processes, tools and methods.

We cannot assure investors that our products will compete favorably or that we will be successful in the face of increasing competition from new products and technologies introduced by our existing competitors or new companies entering our markets. In addition, we cannot assure investors that our competitors do not have or will not develop products or technologies that currently or in the future will enable them to produce competitive products with greater capabilities or at lower costs than ours. Any failure to compete effectively could materially and adversely affect our business, financial condition and operating results.

Acquisitions or joint ventures could disrupt our business, cause dilution to our stockholders and otherwise harm our business.

We may acquire other businesses, products or technologies as well as pursue strategic alliances, joint ventures, technology licenses or investments in complementary businesses. We have not made any acquisitions to date, and our ability to do so successfully is unproven. Any of these transactions could be material to our financial condition and operating results and expose us to many risks, including:

- disruption in our relationships with customers, distributors or suppliers as a result of such a transaction;
- unanticipated liabilities related to acquired companies;
- difficulties integrating acquired personnel, technologies and operations into our existing business;
- diversion of management time and focus from operating our business to acquisition integration challenges;

- increases in our expenses and reductions in our cash available for operations and other uses; and
- possible write-offs or impairment charges relating to acquired businesses.

Foreign acquisitions involve unique risks in addition to those mentioned above, including those related to integration of operations across different cultures and languages, currency risks and the particular economic, political and regulatory risks associated with specific countries.

Also, the anticipated benefit of any acquisition may not materialize. Future acquisitions or dispositions could result in potentially dilutive issuances of our equity securities, the incurrence of debt, contingent liabilities or amortization expenses or write-offs of goodwill, any of which could harm our financial condition. We cannot predict the number, timing or size of future joint ventures or acquisitions, or the effect that any such transactions might have on our operating results.

Risks related to government regulation and diagnostic product reimbursement

If the FDA determines that our products are medical devices or if we seek to market our products for clinical diagnostic or health screening use, we will be required to obtain regulatory clearance(s) or approval(s), and may be required to cease or limit sales of our then marketed products, which could materially and adversely affect our business, financial condition and results of operations. Any such regulatory process would be expensive, time-consuming and uncertain both in timing and in outcome.

We have focused initially on the life sciences research market. This includes laboratories associated with academic and governmental research institutions, as well as pharmaceutical, biotechnology and contract research companies. Accordingly, our products are labeled as “Research Use Only,” or RUO, and are not intended for diagnostic use. While we have focused initially on the life sciences research market and RUO products only, our strategy is to expand our product line to encompass products that are intended to be used for the diagnosis of disease, either alone or in collaboration with third parties (such as our collaboration with Berry Genomics). Such in-vitro diagnostic, or IVD, products will be subject to regulation by the FDA as medical devices, or comparable international agencies, including requirements for regulatory clearance or approval of such products before they can be marketed. If the FDA were to determine that our products are intended for clinical use or if we decided to market our products for such use, we would be required to obtain FDA 510(k) clearance or premarket approval in order to sell our products in a manner consistent with FDA laws and regulations. Such regulatory approval processes or clearances are expensive, time-consuming and uncertain; our efforts may never result in any approved premarket approval application, or PMA, or 510(k) clearance for our products; and failure by us or a collaborator to obtain or comply with such approvals and clearances could have an adverse effect on our business, financial condition or operating results.

IVD products may be regulated as medical devices by the FDA and comparable international agencies and may require either clearance from the FDA following the 510(k) pre-market notification process or PMA from the FDA, in each case prior to marketing. If we or our collaborators are required to obtain a PMA or 510(k) clearance for products based on our technology, we or they would be subject to a substantial number of additional requirements for medical devices, including establishment registration, device listing, Quality Systems Regulations which cover the design, testing, production, control, quality assurance, labeling, packaging, servicing, sterilization (if required), and storage and shipping of medical devices (among other activities), product labeling, advertising, recordkeeping, post-market surveillance, post-approval studies, adverse event reporting, and correction and removal (recall) regulations. One or more of the products we or a collaborator may develop using our technology may also require clinical trials in order to generate the data required for PMA approval. Complying with these requirements may be time-consuming and expensive. We or our collaborators may be required to expend significant resources to ensure ongoing compliance with the FDA regulations and/or take satisfactory corrective action in response to enforcement action, which may have a material adverse effect on the ability to design, develop, and commercialize products using our technology as planned. Failure to comply

with these requirements may subject us or a collaborator to a range of enforcement actions, such as warning letters, injunctions, civil monetary penalties, criminal prosecution, recall and/or seizure of products, and revocation of marketing authorization, as well as significant adverse publicity. If we or our collaborators fail to obtain, or experience significant delays in obtaining, regulatory approvals for IVD products, such products may not be able to be launched or successfully commercialized in a timely manner, or at all.

Laboratory developed tests, or LDTs, are a subset of IVD tests that are designed, manufactured and used within a single laboratory. The FDA maintains that LDTs are medical devices and has for the most part exercised enforcement discretion for most LDTs. A significant change in the way that the FDA regulates any LDTs that we, our collaborators or our customers develop using our technology could affect our business. If the FDA requires laboratories to undergo premarket review and comply with other applicable FDA requirements in the future, the cost and time required to commercialize an LDT will increase substantially, and may reduce the financial incentive for laboratories to develop LDTs, which could reduce demand for our instruments and our other products. In addition, if the FDA were to change the way that it regulates LDTs to require that we undergo pre-market review or comply with other applicable FDA requirements before we can sell our instruments or our other products to clinical cytogenics laboratories, our ability to sell our instruments and other products to this addressable market would be delayed, thereby impeding our ability to penetrate this market and generate revenue from sales of our instruments and our other products.

Failure to comply with applicable FDA requirements could subject us to misbranding or adulteration allegations under the Federal Food, Drug, and Cosmetic Act. We could be subject to a range of enforcement actions, including warning letters, injunctions, civil monetary penalties, criminal prosecution, and recall and/or seizure of products, as well as significant adverse publicity. In addition, changes to the current regulatory framework, including the imposition of additional or new regulations, could arise at any time during the development or marketing of our products, which may negatively affect our ability to obtain or maintain FDA or comparable regulatory approval of our products, if required.

Foreign jurisdictions have laws and regulations similar to those described above, which may adversely affect our ability to market our products as planned in such countries. The number and scope of these requirements are increasing. As in the U.S., the cost and time required to comply with regulatory requirements may be substantial, and there is no guarantee that we will obtain the necessary authorization(s) required to make our products commercially viable. As a result, the imposition of foreign requirements may also have a material adverse effect on the commercial viability of our operations.

We expect to rely on third parties in conducting any required future studies of diagnostic products that may be required by the FDA or other regulatory authorities, and those third parties may not perform satisfactorily.

We do not have the ability to independently conduct clinical trials or other studies that may be required to obtain FDA and other regulatory clearance or approval for future diagnostic products. Accordingly, we expect that we would rely on third parties, such as clinical investigators, consultants, and collaborators to conduct such studies if needed. Our reliance on these third parties for clinical and other development activities would reduce our control over these activities. If these third parties do not successfully carry out their contractual duties or regulatory obligations or meet expected deadlines, if the third parties need to be replaced or if the quality or accuracy of the data they obtain is compromised, we may not be able to obtain regulatory clearance or approval.

If diagnostic procedures that are enabled by our technology are subject to unfavorable pricing regulations or third-party coverage and reimbursement policies, our business could be harmed.

Currently, our product is for research use only, but clinical laboratories may acquire our instrumentation through a capital purchase or capital lease and use the Saphyr and direct label stain chemistry to create their own potentially reimbursable products, such as laboratory developed tests for in vitro diagnostics. Our customers may generate revenue for these testing services by seeking the necessary approval of their product from the FDA or

the Center for Medicare and Medicaid Services, or CMS, along with coverage and reimbursement from third-party payors, including government health programs and private health plans. The ability of our customers to commercialize diagnostic tests based on our technology will depend in part on the extent to which coverage and reimbursement for these test will be available from such third-party payors.

In the U.S., molecular testing laboratories have multiple options for reimbursement coding, but we expect that the primary codes used will be the genomic sequencing procedure codes, or GSPs. The American Medical Association, or AMA, added GSPs to its clinical laboratory fee schedule in 2015. In addition, CMS recently issued a coverage determination providing for the reimbursement of next-generation sequencing for certain cancer diagnostics using an FDA-approved in vitro diagnostic test. Private health plans often follow CMS to a substantial degree, and it is difficult to predict what CMS will decide with respect to reimbursement of any products our customers try to commercialize.

In Europe, coverage for molecular diagnostic testing is varied. Countries with statutory health insurance (e.g., Germany, France, The Netherlands) tend to be more progressive in technology adoption with favorable reimbursement for molecular diagnostic testing. In countries such as the United Kingdom with tax-based insurance, adoption and reimbursement for molecular diagnostic testing is not uniform and is influenced by local budgets.

Ultimately, coverage and reimbursement of new products is uncertain, and whether laboratories that use our instruments to develop their own products will attain coverage and adequate reimbursement is unknown. In the U.S., there is no uniform policy for determining coverage and reimbursement. Coverage can differ from payor to payor, and the process for determining whether a payor will provide coverage may be separate from the process for setting the reimbursement rate, In addition, the U.S. government, state legislatures and foreign governments have shown significant interest in implementing cost containment programs to limit the growth of government-paid health care costs, including price controls and restrictions on reimbursement. We cannot be sure that coverage will be available for any diagnostic tests based on our technology, and, if coverage is available, the level of payments. Reimbursement may impact the demand for those tests. If reimbursement is not available or is available only to limited levels, our customers may not be able to successfully commercialize any tests for which they receive marketing authorization.

Current and future legislation may increase the difficulty and cost to obtain marketing approval of and commercialize any products based on our technology and affect the prices that may be obtained.

In March 2010, the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Affordability Reconciliation Act, collectively, the ACA, became law. The ACA is a sweeping law intended to broaden access to health insurance, reduce or constrain the growth of healthcare spending, enhance remedies against fraud and abuse, add new transparency requirements for the healthcare and health insurance industries, impose new taxes and fees on the health industry and impose additional health policy reforms. The ACA's provisions of importance to our business include, but are not limited to, a 2.3% excise tax on certain entities that manufacture or import medical devices offered for sale in the U.S., with limited exceptions, which has been suspended, but due to subsequent legislative amendments, will be automatically reinstated for medical device sales beginning January 1, 2020, unless Congress takes additional action to delay the implementation of the tax.

Some of the provisions of the ACA have yet to be implemented, and there have been judicial and Congressional challenges to certain aspects of the ACA, as well as efforts by the Trump administration to repeal or replace certain aspects of the ACA. Since January 2017, President Trump has signed two Executive Orders and other directives designed to delay the implementation of certain provisions of the ACA or otherwise circumvent some of the requirements for health insurance mandated by the ACA. Concurrently, Congress has considered legislation that would repeal or repeal and replace all or part of the ACA. While Congress has not passed comprehensive repeal legislation, two bills affecting the implementation of certain taxes under the ACA

have been signed into law. The 2017 U.S. Tax Cuts and Jobs Act, includes a provision repealing, effective January 1, 2019, the tax-based shared responsibility payment imposed by the ACA on certain individuals who fail to maintain qualifying health coverage for all or part of a year that is commonly referred to as the "individual mandate". Additionally, a 2018 continuing resolution on appropriations delays the implementation of certain ACA-mandated fees, including, without limitation, the medical device excise tax.

In addition, other legislative changes have been proposed and adopted since the ACA was enacted. For example, on April 1, 2014, the Protecting Access to Medicare Act of 2014, or PAMA, was signed into law, which, among other things, significantly altered the payment methodology under the Medicare Clinical Laboratory Fee Schedule, or CLFS. PAMA requires certain laboratories performing clinical diagnostic laboratory tests to report to CMS the amounts paid by private payors for laboratory tests. Beginning January 1, 2018, CMS will use reported private payor pricing to periodically revise payment rates under the CLFS.

We expect that the ACA, as well as other healthcare reform measures that may be adopted in the future, may result in more rigorous coverage criteria and additional downward pressure on the price that we or our collaborators will receive for any cleared or approved product. Any reduction in payments from Medicare or other government programs may result in a similar reduction in payments from private payors. The implementation of cost containment measures or other healthcare reforms may prevent our customers from successfully commercializing any tests for which they receive approval, which could prevent us from being able to generate revenue and attain profitability.

In addition, sales of our instruments outside of the U.S. will subject us to foreign regulatory requirements, which may also change over time.

We cannot predict whether future healthcare initiatives will be implemented at the federal or state level or in countries outside of the U.S. in which we may do business, or the effect any future legislation or regulation will have on us. The expansion in government's effect on the U.S. healthcare industry may result in decreased profits to us, lower reimbursements by payors for our products or reduced medical procedure volumes, all of which may adversely affect our business, financial condition and results of operations.

We may be subject, directly or indirectly, to federal and state healthcare fraud and abuse laws and other federal and state laws applicable to our marketing practices. If we are unable to comply, or have not complied, with such laws, we could face substantial penalties.

Our operations are directly or indirectly, through our customers, subject to various federal and state fraud and abuse laws, including, without limitation, the federal and state anti-kickback statutes and false claims laws. These laws may impact, among other things, our sales and marketing and education programs, and our financial and business relationships with researchers who use our instruments to develop marketed products. By way of example: the federal Anti-Kickback Statute prohibits, among other things, any person or entity from, among other things, knowingly and willfully soliciting, receiving, offering or paying any remuneration, directly or indirectly, to induce, or in return for, purchasing, leasing, ordering, or arranging for or recommending the purchase, lease, or order of any good, facility, item, or service reimbursable, in whole or in part, under a federal healthcare program; and the federal false claims laws, including, without limitation the federal civil False Claims Act, prohibit, among other things, anyone from knowingly and willingly presenting, or causing to be presented for payment, to the federal government (including Medicare and Medicaid) claims for reimbursement for, among other things, drugs or services that are false or fraudulent, claims for items or services not provided as claimed, or claims for medically unnecessary items or services. The ACA, among other things, amended the intent requirement of the federal Anti-Kickback Statute to clarify that a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a crime. In addition, the ACA clarifies that the government may assert that a claim that includes items or service resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the federal civil False Claims Act.

In addition, we may be subject to the Health Insurance Portability and Accountability Act of 1996, or HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act and its implementing regulations, which imposes certain requirements relating to the privacy, security and transmission of individually identifiable health information without appropriate authorization by entities subject to the rule, such as health plans, health care clearinghouses and certain health care providers and their business associates who create, use or disclose HIPAA protected health information on their behalf. We may also be subject to state and foreign laws that govern the privacy and security of health information in some circumstances, many of which differ from each other in significant ways and often are not preempted by HIPAA, thus complicating compliance efforts.

If our operations are found to be in violation of any of these laws, we may be subject to penalties, including, without limitation, civil, criminal, and administrative penalties, damages, fines, disgorgement, the curtailment or restructuring of our operations, exclusion from participation in federal and state healthcare programs, additional integrity oversight and reporting obligations, individual imprisonment, contractual damages, and reputational harm, any of which could adversely affect our ability to operate our business and our results of operations.

Risks Related to Intellectual Property

If we are unable to protect our intellectual property, it may reduce our ability to maintain any technological or competitive advantage over our competitors and potential competitors, and our business may be harmed.

We rely on patent protection as well as trademark, copyright, trade secret and other intellectual property rights protection and contractual restrictions to protect our proprietary technologies, all of which provide limited protection and may not adequately protect our rights or permit us to gain or keep any competitive advantage. As of April 13, 2018, we were the assignee or assignee-applicant of 10 granted U.S. patents and approximately 12 pending U.S. patent applications. We also were the assignee-applicant of approximately 79 pending patent applications and granted patents in particular jurisdictions outside the U.S. If we fail to protect and/or maintain our intellectual property, third parties may be able to compete more effectively against us, we may lose our technological or competitive advantage, and/or we may incur substantial litigation costs in our attempts to recover or restrict use of our intellectual property.

We cannot assure investors that any of our currently pending or future patent applications will result in granted patents, and we cannot predict how long it will take for such patents to issue, if at all. It is possible that, for any of our patents that have issued or that may issue in the future, our competitors may design their products around our patented technologies. Further, we cannot assure investors that other parties will not challenge any patents granted to us, or that courts or regulatory agencies will hold our patents to be valid, enforceable, and/or infringed. We cannot guarantee investors that we will be successful in defending challenges made against our patents and patent applications. Any successful third-party challenge or challenges to our patents could result in the unenforceability or invalidity of such patents, or such patents being interpreted narrowly and/or in a manner adverse to our interests. Our ability to establish or maintain a technological or competitive advantage over our competitors and/or market entrants may be diminished because of these uncertainties. For these and other reasons, our intellectual property may not provide us with any competitive advantage. For example:

- we or our licensors might not have been the first to make the inventions claimed or disclosed by our pending patent applications or issued patents;
- we or our licensors might not have been the first to file patent applications for these inventions. To determine the priority of these inventions, we may have to participate in interference proceedings or derivation proceedings declared by the U.S. Patent and Trademark Office, or the USPTO, which could result in substantial cost to us, and could possibly result in a loss or narrowing of patent rights. No assurance can be given that our patent applications or granted patents (or those of our licensors) will have priority over any other patent or patent application involved in such a proceeding, or will be held valid as an outcome of the proceeding;

- other parties may independently develop similar or alternative products and technologies or duplicate any of our products and technologies, which can potentially impact our market share, revenue, and goodwill, regardless of whether intellectual property rights are successfully enforced against these other parties;
- it is possible that our owned or licensed pending patent applications will not result in granted patents, and even if such pending patent applications issue as patents, they may not provide intellectual property protection of commercially viable products or product features, may not provide us with any competitive advantages, or may be challenged and invalidated by third parties, patent offices, and/or the courts;
- we may be unaware of or unfamiliar with prior art and/or interpretations of prior art that could potentially impact the validity or scope of our patents or pending patent applications, or patent applications that we intend to file;
- we take efforts and enter into agreements with employees, consultants, collaborators, and advisors to confirm ownership and chain of title in intellectual property rights. However, an inventorship or ownership dispute could arise that may permit one or more third parties to practice or enforce our intellectual property rights, including possible efforts to enforce rights against us;
- we may elect not to maintain or pursue intellectual property rights that, at some point in time, may be considered relevant to or enforceable against a competitor;
- we may not develop additional proprietary products and technologies that are patentable, or we may develop additional proprietary products and technologies that are not patentable ;
- the patents or other intellectual property rights of others may have an adverse effect on our business; and
- we apply for patents relating to our products and technologies and uses thereof, as we deem appropriate. However, we or our representatives or their agents may fail to apply for patents on important products and technologies in a timely fashion or at all, or we or our representatives or their agents may fail to apply for patents in potentially relevant jurisdictions.

To the extent our intellectual property offers inadequate protection, or is found to be invalid or unenforceable, we would be exposed to a greater risk of direct or indirect competition. If our intellectual property does not provide adequate coverage of our competitors’ products, our competitive position could be adversely affected, as could our business.

Software is an important component of at least some of our products and services. To the extent such software is not protected by our patents, our dependence on trade secret protection may not provide adequate protection. In addition, the Supreme Court’s ruling *Alice Corporation Pty. Ltd. v. CLS Bank International*, has narrowed the scope of patent protection available for software in certain circumstances.

The measures that we use to protect the security of our intellectual property and other proprietary rights may not be adequate, which could result in the loss of legal protection for, and thereby diminish the value of, such intellectual property and other rights.

In addition to pursuing patents on our technology, we also rely upon trademarks, trade secrets, copyrights and unfair competition laws, as well as license agreements and other contractual provisions, to protect our intellectual property and other proprietary rights. Despite these measures, any of our intellectual property rights could be challenged, invalidated, circumvented or misappropriated. In addition, we take steps to protect our intellectual property and proprietary technology by entering into confidentiality agreements and intellectual property assignment agreements with our employees, consultants, corporate partners and, when needed, our advisors. Such agreements may not be enforceable or may not provide meaningful protection for our trade secrets

and/or other proprietary information in the event of unauthorized use or disclosure or other breaches of the agreements, and we may not be able to prevent such unauthorized disclosure. Moreover, if a party having an agreement with us has an overlapping or conflicting obligation to a third party, our rights in and to certain intellectual property could be undermined. Monitoring unauthorized and inadvertent disclosure is difficult, and we do not know whether the steps we have taken to prevent such disclosure are, or will be, adequate. If we were to enforce a claim that a third party had illegally obtained and was using our trade secrets, it would be expensive and time consuming, the outcome would be unpredictable, and any remedy may be inadequate. In addition, courts outside the U.S. may be less willing to protect trade secrets.

In addition, competitors could purchase our products and attempt to replicate and/or improve some or all of the competitive advantages we derive from our development efforts, willfully infringe our intellectual property rights, design their products around our protected technology or develop their own competitive technologies that fall outside of our intellectual property rights. If our intellectual property does not adequately protect our market share against competitors' products and methods, our competitive position could be adversely affected, as could our business.

We have rights in some intellectual property that has been discovered through government funded programs and thus is subject to federal regulations such as "march-in" rights, certain reporting requirements, and a preference for U.S. industry. Compliance with such regulations may limit our exclusive rights, subject us to expenditure of resources with respect to reporting requirements, and limit our ability to contract with non-U.S. manufacturers.

Some of the intellectual property rights assigned to us and/or in-licensed to us have been generated through the use of U.S. government funding and are therefore subject to certain federal regulations. For example, all of the intellectual property rights licensed to us under our license agreement with Princeton University have been generated using U.S. government funds. As a result, the U.S. government has certain rights to intellectual property embodied in our current or future products pursuant to the Bayh-Dole Act of 1980. These U.S. government rights in certain inventions developed under a government-funded program include a non-exclusive, non-transferable, irrevocable worldwide license to use inventions for any governmental purpose. In addition, the U.S. government has the right to require us to grant exclusive, partially exclusive, or non-exclusive licenses to any of these inventions to a third party if the government determines that: (i) adequate steps have not been taken to commercialize the invention; (ii) government action is necessary to meet public health or safety needs; or (iii) government action is necessary to meet requirements for public use under federal regulations (also referred to as "march-in rights"). The U.S. government also has the right to take title to these inventions if we fail, or the applicable licensor fails, to disclose the invention to the government, elect title, and file an application to register the intellectual property within specified time limits. In addition, the U.S. government may acquire title to these inventions in any country in which a patent application is not filed within specified time limits. Intellectual property generated under a government funded program is also subject to certain reporting requirements, compliance with which may require us, or the applicable licensor, to expend substantial resources. In addition, the U.S. government requires that any products embodying the subject invention or produced through the use of the subject invention be manufactured substantially in the U.S. The manufacturing preference requirement can be waived if the owner of the intellectual property can show that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in the U.S. or that, under the circumstances, domestic manufacture is not commercially feasible. This preference for U.S. manufacturing may limit our ability to license the applicable patent rights on an exclusive basis under certain circumstances.

If we enter into future arrangements involving government funding, and we make inventions as a result of such funding, intellectual property rights to such discoveries may be subject to the applicable provisions of the Bayh-Dole Act. To the extent any of our current or future intellectual property is generated through the use of U.S. government funding, the provisions of the Bayh-Dole Act may similarly apply. Any exercise by the government of certain of its rights could harm our competitive position, business, financial condition, results of operations and prospects.

We depend on technology that is licensed to us by Princeton University. Any loss of our rights to this technology could prevent us from selling our products.

Some technology that relates to analysis of nucleic acids is licensed exclusively to us from Princeton University, or Princeton. We do not own the patents that underlie this license. Our rights to use this technology and employ the inventions claimed in the licensed patents are subject to the continuation of and compliance with the terms of the license. Our principal obligations under our license agreement with Princeton are as follows:

- royalty payments;
- annual maintenance fees;
- using commercially reasonable efforts to develop and sell a product using the licensed technology and developing a market for such product;
- paying and/or reimbursing fees related to prosecution, maintenance and enforcement of patent rights; and
- providing certain reports.

If we breach any of these obligations, Princeton may have the right to terminate or modify the license, which could result in our being unable to develop, manufacture and sell our products or a competitor gaining access to the relevant technology. Termination or certain modifications of our license agreement with Princeton would have a material adverse effect on our business.

In addition, we are a party to a number of other agreements that include licenses to intellectual property, including non-exclusive licenses. We may need to enter into additional license agreements in the future. Our business could suffer, for example, if any current or future licenses terminate, if the licensors fail to abide by the terms of the license, if the licensed patents or other rights are found to be invalid or unenforceable, or if we are unable to enter into necessary licenses on acceptable terms.

As we have done previously, we may need or may choose to obtain licenses and/or acquire intellectual property rights from third parties to advance our research or begin commercialization of our current or future products, and

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

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

- the scope of rights granted under the license agreement and other interpretation-related issues;
- whether and the extent to which our technology and processes infringe any intellectual property of the licensor that is not subject to the licensing agreement;
- whether to take action to enforce any intellectual property rights against an allegedly infringing product or process of a third party;

- our right to sublicense patent and other rights to third parties;
- our diligence obligations with respect to the use of licensed technology in relation to our development and commercialization of our products, and what activities satisfy those diligence obligations; and
- the ownership of inventions and know-how, such as intellectual property resulting from the joint creation or use of intellectual property by our licensors and us and our partners.

If disputes over intellectual property that we have licensed prevent or impair our ability to maintain our current licensing arrangements on acceptable terms, we may be unable to successfully develop and commercialize the affected product, or the dispute may have an adverse affect on our results of operation.

In addition to agreements pursuant to which we in-license intellectual property, we may in the future grant licenses under our intellectual property, or sell certain intellectual property. Like in-licenses, out-licenses can be complex and disputes may arise between us and our licensees, such as the types of disputes described above. Moreover, licensees may breach their obligations, or we may be exposed to liability due to our failure or alleged failure to satisfy our obligations. Any such occurrence could have an adverse affect on our business.

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

Our success also depends on our ability to develop, manufacture, market and sell our products and perform our services without infringing the proprietary rights of third parties. Numerous U.S. and foreign-issued patents and pending patent applications owned by third parties exist in the fields in which we are developing products and services. As part of a business strategy to impede our successful commercialization and entry into new markets, competitors may allege that our products and/or services infringe their intellectual property rights.

We could incur substantial costs and divert the attention of our management and technical personnel in defending ourselves against claims of infringement made by third parties. Any adverse ruling by a court or administrative body, or perception of an adverse ruling, may have a material adverse impact on our ability to conduct our business and our finances. Moreover, third parties making claims against us may be able to obtain injunctive relief against us, which could block our ability to offer one or more products or services and could result in a substantial award of damages against us. In addition, since we sometimes indemnify customers, collaborators or licensees, we may have additional liability in connection with any infringement or alleged infringement of third party intellectual property. Intellectual property litigation can be very expensive, and we may not have the financial means to defend ourselves or our customers, collaborators and licensees.

Because patent applications can take many years to issue, there may be pending applications, some of which are unknown to us, that may result in issued patents upon which our products or proprietary technologies may infringe. Moreover, we may fail to identify issued patents of relevance or incorrectly conclude that an issued patent is invalid or not infringed by our technology or any of our products. There is a substantial amount of litigation involving patents and other intellectual property rights in our industry. If a third-party claims that we or any of our licensors, customers or collaboration partners infringe upon a third-party's intellectual property rights, we may have to:

- seek to obtain licenses that may not be available on commercially reasonable terms, if at all;
- abandon any product alleged or held to infringe, or redesign our products or processes to avoid potential assertion of infringement;
- pay substantial damages including, in exceptional cases, treble damages and attorneys' fees, which we may have to pay if a court decides that the product or proprietary technology at issue infringes upon or violates the third-party's rights;

- pay substantial royalties or fees or grant cross-licenses to our technology; or
- defend litigation or administrative proceedings that may be costly whether we win or lose, and which could result in a substantial diversion of our financial and management resources.

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

Competitors may infringe our patents or the patents we license in. In the event of infringement or unauthorized use, we may file one or more infringement lawsuits, which can be expensive and time-consuming. An adverse result in any such litigation proceedings could put one or more of our patents at risk of being invalidated, being found to be unenforceable, and/or being interpreted narrowly and could put our patent applications at risk of not issuing and/or could impact the validity or enforceability positions of our other patents or those we license. Furthermore, because of the substantial amount of discovery required in connection with intellectual property litigation, there is a risk that some of our confidential information could be compromised by disclosure during this type of litigation.

Most of our competitors are larger than we are and have substantially greater resources. They are, therefore, likely to be able to sustain the costs of complex patent litigation longer than we could. In addition, the uncertainties associated with litigation could have a material adverse effect on our ability to raise the funds necessary to continue our operations, continue our internal research programs, in-license needed technology, pursue, obtain or maintain intellectual property rights, or enter into development partnerships that would help us bring our products to market.

In addition, patent litigation can be very costly and time-consuming. An adverse outcome in such litigation or proceedings may expose us or any of our future development partners to loss of our proprietary position, expose us to significant liabilities, or require us to seek licenses that may not be available on commercially acceptable terms, if at all.

Our issued patents could be found invalid or unenforceable if challenged in court or at the Patent Office or other administrative agency, which could have a material adverse impact on our business.

If we or any of our partners were to initiate legal proceedings against a third party to enforce a patent related to one of our products or services, the defendant in such litigation could counterclaim that our patent is invalid and/or unenforceable. In patent litigation in the U.S., defendant counterclaims alleging invalidity and/or unenforceability are commonplace, as are validity challenges by the defendant against the subject patent or other patents before the USPTO. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, including lack of novelty, obviousness or non-enablement, failure to meet the written description requirement, indefiniteness, and/or failure to disclose the best mode or to claim patent eligible subject matter. Grounds for an unenforceability assertion could be an allegation that someone connected with prosecution of the patent intentionally withheld material information from the USPTO, or made a misleading statement, during prosecution. Additional grounds for an unenforceability assertion include an allegation of misuse or anticompetitive use of patent rights, and an allegation of incorrect inventorship with deceptive intent. Third parties may also raise similar claims before the USPTO even outside the context of litigation. The outcome is unpredictable following legal assertions of invalidity and unenforceability. With respect to the validity question, for example, we cannot be certain that no invalidating prior art existed of which we and the patent examiner were unaware during prosecution. These assertions may also be based on information known to us or the Patent Office. If a defendant or third party were to prevail on a legal assertion of invalidity and/or unenforceability, we would lose at least part, and perhaps all, of the claims of the challenged patent. Such a loss of patent protection would or could have a material adverse impact on our business.

We may be subject to claims that our employees, consultants or independent contractors have wrongfully used or disclosed alleged trade secrets of their other clients or former employers to us, and/or that their other clients or former employers allegedly have rights in our intellectual property, which could subject us to costly litigation.

As is common in the life sciences industry, we engage the services of consultants and independent contractors to assist us in the development of our products. Many of these consultants and independent contractors were previously employed at, or may have previously or may be currently providing consulting or other services to, universities or other technology, biotechnology or pharmaceutical companies, including our competitors or potential competitors. We may become subject to claims that our company, a consultant or an independent contractor inadvertently or otherwise used or disclosed trade secrets or other information proprietary to their former employers or their former or current clients. We may similarly be subject to claims stemming from similar actions of an employee, such as one who was previously employed by another company, including a competitor or potential competitor. We may become subject to claims that one or more current or former employees, consultants, advisors, or independent contractors of ours owns rights in our intellectual property and/or has assigned or is under an obligation to assign rights in our intellectual property to another party. This may include a competitor of ours. If a competitor has rights in our patents, the competitor or a licensee or related entity may be able to make, use, sell, import, and/or export the patented technology without liability to us under our patents or the patents we license. Litigation may be necessary to defend against these claims. Even if we are successful in defending against these claims, litigation could result in substantial costs and be a distraction to our management team. If we were not successful we could lose valuable intellectual property rights.

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

We generally enter into confidentiality and intellectual property assignment agreements with our employees, consultants, and contractors. These agreements generally provide that inventions conceived by the party in the course of rendering services to us will be our exclusive property. However, those agreements may not be honored and may not effectively assign or may be alleged to ineffectively assign intellectual property rights to us. For example, even if we have a consulting agreement in place with an academic advisor pursuant to which such academic advisor is required to assign any inventions developed in connection with providing services to us, such academic advisor may not have the right to assign such inventions to us, as it may conflict with his or her obligations to assign all such intellectual property to his or her employing institution.

In addition, we sometimes enter into agreements where we provide services to third parties, such as customers. Under such circumstances, our agreements may provide that certain intellectual property that we conceive in the course of providing those services is assigned to the customer. In those cases, we may not be able to use that particular intellectual property in, for example, our work for other customers without a license.

We may not be able to protect our intellectual property rights throughout the world, which could materially and negatively affect our business.

Filing, prosecuting, maintaining, and defending patents on current and future products in all countries throughout the world would be prohibitively expensive, and our intellectual property rights in some countries outside the U.S. can be less extensive than those in the U.S. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as federal and state laws in the U.S. Consequently, regardless of whether we are able to prevent third parties from practicing our inventions in the U.S., we may not be able to prevent third parties from practicing our inventions in all countries outside the U.S., or from selling or importing products made using our inventions in and into the U.S. or other jurisdictions. Competitors may use our technologies in jurisdictions where we have not pursued and obtained patent protection to develop their own products, and further, may export otherwise infringing products to territories where we have patent protection, but enforcement is not as strong as it is in the U.S. These products may compete with our products and our

patents or other intellectual property rights may not be effective or sufficient to prevent them from competing. Even if we pursue and obtain issued patents in particular jurisdictions, our patent claims or other intellectual property rights may not be effective or sufficient to prevent third parties from so competing. Patent protection must ultimately be sought on a country-by-country basis, which is an expensive and time-consuming process with uncertain outcomes. Accordingly, we may choose not to seek patent protection in certain countries, and we will not have the benefit of patent protection in such countries.

Many companies have encountered significant problems in protecting and defending intellectual property rights in foreign jurisdictions. The legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents and other intellectual property protection, particularly those relating to biotechnology, which could make it difficult for us to stop the infringement of our patents or marketing of competing products in violation of our proprietary rights generally. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business, could put our patents at risk of being invalidated or interpreted narrowly and our patent applications at risk of not issuing, and could provoke third parties to assert claims against us. We may not prevail in any lawsuits that we initiate and the damages or other remedies awarded, if any, may not be commercially meaningful. Accordingly, our efforts to enforce our intellectual property rights around the world may be inadequate to obtain a significant commercial advantage from the intellectual property that we develop or license and may adversely impact our business.

In addition, we and our partners also face the risk that our products or components thereof are imported, reimported, or exported into markets with relatively higher prices from markets with relatively lower prices, which would result in a decrease of sales and any payments we receive from the affected market. Recent developments in U.S. patent law have made it more difficult to stop these and related practices based on theories of patent infringement.

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

As is the case with other life science industry companies, our success is heavily dependent on intellectual property, particularly patents. Obtaining and enforcing patents involve both technological complexity and legal complexity. Therefore, obtaining and enforcing patents is costly, time-consuming and inherently uncertain. In addition, the America Invents Act, or the AIA, became effective on March 16, 2013.

An important change introduced by the AIA is that the U.S. transitioned to a “first-to-file” system for deciding which party should be granted a patent when two or more patent applications are filed by different parties claiming the same invention. A third party that files a patent application in the USPTO after that date but before us could therefore be awarded a patent claiming or disclosing an invention of ours even if we had made the invention before it was made by the third party. This will require us to be cognizant going forward of the time from invention to filing of a patent application, but circumstances could prevent us from promptly filing patent applications on our inventions. Additionally, there can be a trade-off between obtaining an earlier filing date, and waiting to obtain additional data and/or further refine a patent application. In some circumstances, the effects of a decision to pursue an earlier filing or a later filing will not be known until prior art or third party activities are subsequently discovered, such as by the USPTO or by a third party seeking to challenge patent rights. These circumstances may apply, for example, to patent applications prepared and filed around the time of the implementation of the AIA, or with a priority application that preceded the implementation of the AIA.

Among some of the other changes introduced by the AIA are changes that limit where a patent holder may file a patent infringement suit and providing additional opportunities for third parties to challenge an issued patent in the USPTO. This applies to all of our owned and in-licensed U.S. patents, even those issued before March 16, 2013. Because of a lower standard for evidence in USPTO proceedings compared to the standard for evidence in U.S. federal courts necessary to invalidate a patent claim, a third party could potentially provide

evidence in a USPTO proceeding sufficient for the USPTO to hold a claim invalid even though the same evidence would be insufficient to invalidate the claim if first presented in a court action. Accordingly, a third party may try to use the USPTO procedures to invalidate our patent claims that would not have been invalidated if first challenged by the third party in court. The AIA and its implementation could increase the uncertainties and costs surrounding the prosecution of our patent applications and the enforcement or defense of our issued patents. In addition, the contours of the laws under the AIA are subject to further judicial interpretation and/or legislative changes.

Additionally, the U.S. Supreme Court has ruled on several patent cases in recent years, such as *Impression Products, Inc. v. Lexmark International, Inc., Association for Molecular Pathology v. Myriad Genetics, Inc*., *Mayo Collaborative Services v. Prometheus Laboratories, Inc.* and *Alice Corporation Pty. Ltd. v. CLS Bank International*, either narrowing the scope of patent protection available in certain circumstances or weakening the rights of patent owners in certain situations. In addition to increasing uncertainty with our ability to obtain patents in the future, this combination of events has created uncertainty as to the value of patents, once obtained, including patents in the molecular biology analysis and diagnostic space in particular. Depending on decisions by the U.S. Congress, the federal courts, and the USPTO, the laws and regulations governing patents could change in unpredictable ways that could weaken our ability to obtain new patents or to enforce our existing patents and patents that we might obtain in the future.

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

The USPTO and various foreign governmental patent agencies require compliance with a number of procedural, documentary, fee payment and other provisions during the patent process. There are situations in which noncompliance can result in abandonment or lapse of a patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, competitors might be able to enter the market earlier than would otherwise have been the case. In some cases, our licensors may be responsible for these payments, thereby decreasing our control over compliance with these requirements.

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

Our registered or unregistered trademarks or trade names may be challenged, infringed, circumvented or declared generic or determined to be infringing other marks. We may not be able to protect our rights to these trademarks and trade names, which we need to build name recognition by potential partners or customers in our markets of interest. At times, competitors may adopt trade names or trademarks similar to ours, thereby impeding our ability to build brand identity and possibly leading to market confusion. In addition, there could be potential trade name or trademark infringement claims brought by owners of other registered trademarks. Over the long term, if we are unable to establish name recognition based on our trademarks and trade names, then we may not be able to compete effectively and our business may be adversely affected.

We may use third-party open source software components in future products, and failure to comply with the terms of the underlying open source software licenses could restrict our ability to sell such products.

While our current products do not contain any software tools licensed by third-party authors under “open source” licenses, we may choose to use open source software in future products. Use and distribution of open source software may entail greater risks than use of third-party commercial software, as open source licensors generally do not provide warranties or other contractual protections regarding infringement claims or the quality of the code. Some open source licenses may contain requirements that we make available source code for modifications or derivative works we create based upon the type of open source software we use. If we combine our proprietary software with open source software in a certain manner, we could, under certain open source

licenses, be required to release the source code of our proprietary software to the public. This would allow our competitors to create similar products with less development effort and time, and ultimately could result in a loss of product sales.

Although we intend to monitor any use of open source software to avoid subjecting our products to conditions we do not intend, the terms of many open source licenses have not been interpreted by U.S. courts, and there is a risk that any such licenses could be construed in a way that could impose unanticipated conditions or restrictions on our ability to commercialize our products. Moreover, we cannot assure investors that our processes for controlling our use of open source software in our products will be effective. If we are held to have breached the terms of an open source software license, we could be required to seek licenses from third parties to continue offering our products on terms that are not economically feasible, to re-engineer our products, to discontinue the sale of our products if re-engineering could not be accomplished on a timely basis, or to make generally available, in source code form, our proprietary code, any of which could adversely affect our business, operating results, and financial condition.

We use third-party software that may be difficult to replace or cause errors or failures of our products that could lead to lost customers or harm to our reputation.

We use software licensed from third parties in our products. In the future, this software may not be available to us on commercially reasonable terms, or at all. Any loss of the right to use any of this software could result in delays in the production of our products until equivalent technology is either developed by us, or, if available, is identified, obtained and integrated, which could harm our business. In addition, any errors or defects in third-party software or other third-party software failures could result in errors or defects or cause our products to fail, which could harm our business and be costly to correct. Many of these providers attempt to impose limitations on their liability for such errors, defects or failures, and, if enforceable, we may have additional liability to our customers or third-party providers that could harm our reputation and increase our operating costs.

We intend to maintain our relationships with third-party software providers and to seek software from such providers that does not contain any errors or defects. Any failure to do so could adversely impact our ability to deliver reliable products to our customers and could harm our results of operations.

Numerous factors may limit any potential competitive advantage provided by our intellectual property rights.

The degree of future protection afforded by our intellectual property rights is uncertain because intellectual property rights have limitations, and may not adequately protect our business, provide a barrier to entry against our competitors or potential competitors, or permit us to maintain our competitive advantage. Moreover, if a third party has intellectual property rights that cover or impact our use of our technology, we may not be able to fully use or extract value from our intellectual property rights. For example:

- others may be able to develop and/or use technology that is similar to our technology or aspects of our technology but that does not cover the claims of any our patents or patents that may issue from our patent applications or those we license;
- we or the licensor of our licensed-in patents might not have been the first to make the inventions disclosed and/or claimed in a pending patent application that we own or license;
- we or the licensor of our licensed-in patents might not have been the first to file patent applications disclosing and/or claiming an invention;
- others may independently develop similar or alternative technologies without infringing our or our licensors’ intellectual property rights;
- pending patent applications that we own or license may not lead to issued patents or may not result in the claims that we want (for example, as to the scope of issued claims, if any);

- patents, if issued, that we own or license may not provide us with any competitive advantages, or may be held invalid or unenforceable, as a result of legal challenges by our competitors or other third parties;
- third parties may compete with us in jurisdictions where we do not pursue and obtain patent protection;
- we may not be able to obtain and/or maintain necessary or useful licenses on reasonable terms or at all;
- third parties may assert an ownership interest in our intellectual property and, if successful, such disputes may preclude us from exercising exclusive rights over that intellectual property;
- we may not be able to maintain the confidentiality of our trade secrets or other proprietary information;
- we may not develop or in-license additional proprietary technologies that are patentable; and
- the patents or other intellectual property of others may have an adverse effect on our business.

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

Risks Related to This Offering and Ownership of our Common Stock

We do not know whether an active, liquid and orderly trading market will develop for our common stock or what the market price of our common stock will be and as a result it may be difficult for you to sell your shares of our common stock.

Prior to this offering there has been no public market for shares of our common stock. Although our common stock has been approved for listing on The Nasdaq Stock Market LLC, or Nasdaq, an active trading market for our shares may never develop or be sustained following this offering. You may not be able to sell your shares quickly or at the market price if trading in shares of our common stock is not active. The initial public offering price for our common stock will be determined through negotiations with the underwriters, and the negotiated price may not be indicative of the market price of the common stock after the offering. As a result of these and other factors, you may be unable to resell your shares of our common stock at or above the initial public offering price. Further, an inactive market may also impair our ability to raise capital by selling shares of our common stock and may impair our ability to enter into strategic partnerships or acquire companies or products by using our shares of common stock as consideration.

The price of our stock may be volatile, and you could lose all or part of your investment.

The trading price of our common stock following this offering is likely to be highly volatile and could be subject to wide fluctuations in response to various factors, some of which are beyond our control, including limited trading volume. In addition to the factors discussed in this “Risk Factors” section and elsewhere in this prospectus, these factors include:

- our commercial progress in marketing and selling our systems, including sales and revenue trends;
- changes in laws or regulations applicable our systems;
- adverse developments related to our laboratory facilities;
- increased competition in the diagnostics services industry;
- the failure to obtain and/or maintain adequate reimbursement of our systems;
- adverse developments concerning our manufacturers and suppliers;
- our inability to establish future collaborations;
- additions or departures of key scientific or management personnel;

- introduction of new testing services offered by us or our competitors;
- announcements of significant acquisitions, strategic partnerships, joint ventures or capital commitments by us or our competitors;
- our ability to effectively manage our growth;
- the size and growth, if any, of our targeted markets;
- actual or anticipated variations in quarterly operating results;
- our cash position;
- our failure to meet the estimates and projections of the investment community or that we may otherwise provide to the public;
- publication of research reports about us or our industry or positive or negative recommendations or withdrawal of research coverage by securities analysts;
- changes in the market valuations of similar companies;
- overall performance of the equity markets;
- issuances of debt or equity securities;
- sales of our common stock by us or our stockholders in the future;
- trading volume of our common stock;
- changes in accounting practices;
- ineffectiveness of our internal controls;
- disputes or other developments relating to proprietary rights, including our ability to adequately protect our technologies;
- significant lawsuits, including patent or stockholder litigation;
- general political and economic conditions; and
- other events or factors, many of which are beyond our control.

In addition, the stock market in general, and diagnostic and biotechnology companies in particular, have experienced extreme price and volume fluctuations that have often been unrelated or disproportionate to the operating performance of these companies. Broad market and industry factors may negatively affect the market price of our common stock, regardless of our actual operating performance. If the market price of our common stock after this offering does not exceed the initial public offering price, you may not realize any return on your investment in us and may lose some or all of your investment. In the past, securities class action litigation has often been instituted against companies following periods of volatility in the market price of a company's securities. This type of litigation, if instituted, could result in substantial costs and a diversion of management's attention and resources, which would harm our business, operating results or financial condition.

We have never paid dividends and we do not intend to pay dividends on our common stock, so any returns on your investment in our common stock will be limited to appreciation in the value of our stock.

We have never declared or paid any cash dividend on our common stock. We currently anticipate that we will retain future earnings for the development, operation and expansion of our business and do not anticipate declaring or paying any cash dividends for the foreseeable future. Any determination to pay dividends in the future will be at the discretion of our board of directors and will depend upon results of operations, financial condition, contractual restrictions, restrictions imposed by applicable law and other factors our board of directors deems relevant. Accordingly, if you purchase shares in this offering, realization of a gain on your investment will

depend on the appreciation of the price of our common stock, which may never occur. In addition, our loan and security agreement with Midcap contains a negative covenant which prohibits us from paying dividends without the prior written consent of Midcap.

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

Our executive officers, directors, 5% stockholders and their affiliates held approximately 79.3% of our voting stock as of June 30, 2018, and, upon the closing of this offering, that same group will hold approximately 47.1% of our outstanding voting stock (assuming no exercise of the underwriters' over-allotment option), based upon the number of shares of our common stock outstanding as of June 30, 2018. Therefore, even after this offering, these stockholders will have the ability to influence us through this ownership position. These stockholders may be able to determine all matters requiring stockholder approval. For example, these stockholders may be able to control elections of directors, amendments of our organizational documents, or approval of any merger, sale of assets or other major corporate transaction. This may prevent or discourage unsolicited acquisition proposals or offers for our common stock that you may feel are in your best interest as one of our stockholders.

Purchasers in this offering will experience immediate and substantial dilution in the book value of their investment.

The initial public offering price of our common stock will be substantially higher than the pro forma net tangible book value per share of our common stock. Therefore, if you purchase shares of our common stock in this offering at an assumed initial public offering price of $5.50 per share, you will experience immediate dilution of $3.67 per share, the difference between the price per share you pay for our common stock and its pro forma net tangible book value per share as of June 30, 2018, after giving effect to the issuance of shares of our common stock in this offering. This dilution is due in large part to the fact that our earlier investors paid substantially less than the initial public offering price when they purchased their shares of common stock.

In addition, we have issued options and warrants to acquire our capital stock at prices significantly below the initial public offering price. To the extent outstanding options and warrants are ultimately exercised, there will be further dilution to investors purchasing our common stock in this offering. In addition, if the underwriters exercise their option to purchase additional shares from us or if we issue additional equity securities, you will experience additional dilution.

We are an emerging growth company, and the reduced reporting requirements applicable to emerging growth companies could make our common stock less attractive to investors.

We are an emerging growth company, as defined in the Jumpstart Our Business Startups Act of 2012, or the JOBS Act. For as long as we continue to be an emerging growth company, we may take advantage of exemptions from various reporting requirements that are applicable to other public companies that are not emerging growth companies, including not being required to comply with the auditor attestation requirements of Section 404 of the Sarbanes-Oxley Act of 2002, or the Sarbanes-Oxley Act, reduced disclosure obligations regarding executive compensation in this prospectus and our periodic reports and proxy statements and exemptions from the requirements of holding nonbinding advisory votes on executive compensation and stockholder approval of any golden parachute payments not previously approved. We could be an emerging growth company for up to five years following the year in which we complete this offering, although circumstances could cause us to lose that status earlier, including if the market value of our common stock held by non-affiliates exceeds $700.0 million as of any June 30 before that time or if we have total annual gross revenue of $1.07 billion or more during any fiscal year before that time, in which cases we would no longer be an emerging growth company as of the following December 31 or, if we issue more than $1.0 billion in non-convertible debt during any three year period before

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

Under the JOBS Act, emerging growth companies can also delay adopting new or revised accounting standards that have different effective dates for public and private companies until those standards apply to private companies. We have elected to use this extended transition period. As a result of this election, our timeline to comply with these standards will in many cases be delayed as compared to other public companies that are not eligible to take advantage of this election or have not made this election. Therefore, our financial statements may not be comparable to those of companies that comply with the public company effective dates for these standards.

In addition, if we cease to be an emerging growth company, we will no longer be able to use the extended transition period for complying with new or revised accounting standards. As a result, changes in rules of U.S. generally accepted accounting principles or their interpretation, the adoption of new guidance or the application of existing guidance to changes in our business could significantly affect our financial position and results of operations.

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

After the closing of this offering, we will be subject to the reporting requirements of the Securities Exchange Act of 1934, as amended, the Sarbanes-Oxley Act and the rules and regulations of Nasdaq. The Sarbanes-Oxley Act requires, among other things, that we maintain effective disclosure controls and procedures and internal controls over financial reporting. Internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements in accordance with accounting principles generally accepted in the U.S.. Commencing with our fiscal year ending December 31, 2018, we must perform system and process evaluation and testing of our internal controls over financial reporting to allow management to report on the effectiveness of our internal controls over financial reporting in our Form 10-K filing for that year, as required by Section 404 of the Sarbanes-Oxley Act. This will require that we incur substantial additional professional fees and internal costs to expand our accounting and finance functions and that we expend significant management efforts. Prior to this offering, we have never been required to test our internal controls within a specified period, and, as a result, we may experience difficulty in meeting these reporting requirements in a timely manner.

During the evaluation and testing process of our internal controls, if we identify one or more material weaknesses in our internal control over financial reporting, we will be unable to assert that our internal control over financial reporting is effective. We cannot assure you that there will not be material weaknesses or significant deficiencies in our internal control over financial reporting in the future. Any failure to maintain internal control over financial reporting could severely inhibit our ability to accurately report our financial condition or results of operations. If we are unable to conclude that our internal control over financial reporting is effective, or if our independent registered public accounting firm determines we have a material weakness or significant deficiency in our internal control over financial reporting, we could lose investor confidence in the accuracy and completeness of our financial reports, the market price of our common stock could decline, and we could be subject to sanctions or investigations by Nasdaq, the Securities and Exchange Commission, or the SEC, or other regulatory authorities. Failure to remedy any material weakness in our internal control over financial reporting, or to implement or maintain other effective control systems required of public companies, could also restrict our future access to the capital markets.

We will incur significant increased costs as a result of operating as a public company, and our management will be required to devote substantial time to new compliance initiatives.

As a public company, we will incur significant legal, accounting and other expenses that we did not incur as a private company. We will be subject to the reporting requirements of the Securities Exchange Act of 1934, as amended, which will require, among other things, that we file with the SEC annual, quarterly and current reports with respect to our business and financial condition. In addition, the Sarbanes-Oxley Act, as well as rules subsequently adopted by the SEC and Nasdaq to implement provisions of the Sarbanes-Oxley Act, impose significant requirements on public companies, including requiring establishment and maintenance of effective disclosure and financial controls and changes in corporate governance practices. Further, in July 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act, or the Dodd-Frank Act, was enacted. There are significant corporate governance and executive-compensation-related provisions in the Dodd-Frank Act that require the SEC to adopt additional rules and regulations in these areas. Recent legislation permits emerging growth companies to implement many of these requirements over a longer period and up to five years from the pricing of this offering. We intend to take advantage of this new legislation, but cannot assure you that we will not be required to implement these requirements sooner than planned and thereby incur unexpected expenses. Stockholder activism, the current political environment and the current high level of government intervention and regulatory reform may lead to substantial new regulations and disclosure obligations, which may lead to additional compliance costs and impact the manner in which we operate our business in ways we cannot currently anticipate.

We expect the rules and regulations applicable to public companies to substantially increase our legal and financial compliance costs and to make some activities more time-consuming and costly. If these requirements divert the attention of our management and personnel from other business concerns, they could have a material adverse effect on our business, financial condition and results of operations. The increased costs will decrease our net income or increase our consolidated net loss, and may require us to reduce costs in other areas of our business or increase the prices of our products or services. For example, we expect these rules and regulations to make it more difficult and more expensive for us to obtain director and officer liability insurance and we may be required to incur substantial costs to maintain the same or similar coverage. We cannot predict or estimate the amount or timing of additional costs we may incur to respond to these requirements. The impact of these requirements could also make it more difficult for us to attract and retain qualified persons to serve on our board of directors, our board committees or as executive officers.

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

If our existing stockholders sell, or indicate an intention to sell, substantial amounts of our common stock in the public market after the lock-up and other legal restrictions on resale discussed in this prospectus lapse, the trading price of our common stock could decline. Based on shares of common stock outstanding as of June 30, 2018, upon the closing of this offering we will have outstanding a total of 14,923,797 shares of common stock. Of these shares, only the shares of common stock sold in this offering by us, plus any shares sold upon exercise of the underwriters' over-allotment option, will be freely tradable without restriction in the public market immediately following this offering (except for any shares purchased by our affiliates, if any, and shares purchased through the directed share program). Roth Capital Partners, however, may, in its discretion, permit our officers, directors and other stockholders who are subject to these lock-up agreements to sell shares prior to the expiration of the lock-up agreements.

We expect that the lock-up agreements pertaining to this offering will expire 180 days from the date of this prospectus. After the lock-up agreements expire, up to an additional 9,423,797 shares of common stock will be eligible for sale in the public market, though such shares held by directors, executive officers and other affiliates and may be subject to volume limitations under Rule 144 under the Securities Act. In addition, shares of common stock that are either subject to outstanding options or reserved for future issuance under our employee benefit

plans will become eligible for sale in the public market to the extent permitted by the provisions of various vesting schedules, the lock-up agreements and Rule 144 and Rule 701 under the Securities Act. If these additional shares of common stock are sold, or if it is perceived that they will be sold, in the public market, the trading price of our common stock could decline.

After this offering, the holders of 4,315,190 shares of our common stock will be entitled to rights with respect to the registration of their shares under the Securities Act, subject to the lock-up agreements described above. See "Description of Capital Stock—Registration Rights." Registration of these shares under the Securities Act would result in the shares becoming freely tradable without restriction under the Securities Act. Any sales of securities by these stockholders could have a material adverse effect on the trading price of our common stock.

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

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

All of our executive officers, senior management and directors and all of the holders of our capital stock are subject to lock-up agreements that restrict their ability to transfer shares of our capital stock for 180 days from the date of this prospectus. Subject to certain exceptions, the lock-up agreements limit the number of shares of capital stock that may be sold immediately following this initial public offering. We expect that the lock-up agreements pertaining to this offering will expire 180 days from the date of this prospectus. After the lock-up agreements expire, up to an additional 9,423,797 shares of common stock will be eligible for sale in the public market, of which 4,315,190 shares are held by directors, executive officers and other affiliates and will be subject to volume limitations under Rule 144 under the Securities Act of 1933, as amended, or the Securities Act. In addition, shares of common stock that are either subject to outstanding options or reserved for future issuance under our employee benefit plans will become eligible for sale in the public market to the extent permitted by the provisions of various vesting schedules, the lock-up agreements and Rule 144 and Rule 701 under the Securities Act. If these additional shares of common stock are sold, or if it is perceived that they will be sold, in the public market, the trading price of our common stock could decline. The underwriters of this offering may, in their sole discretion, permit our stockholders who are subject to these lock-up agreements to sell shares of common stock prior to the expiration of the lock-up agreements.

We have broad discretion in the use of the net proceeds from this offering and may not use them effectively.

Our management will have broad discretion in the application of the net proceeds from this offering, including for any of the purposes described in the section entitled "Use of Proceeds," and you will not have the opportunity as part of your investment decision to assess whether the net proceeds will be used appropriately. Because of the number and variability of factors that will determine our use of the net proceeds from this offering, their ultimate use may vary substantially from their currently intended use. Our management might not apply our net proceeds in ways that ultimately increase the value of your investment. We intend to use the net proceeds from this offering to expand our commercial capabilities in selling and marketing related to our products, to fund our ongoing research and development activities, and for general corporate purposes, including working capital, operating expenses and capital expenditures.

Our expected use of net proceeds from this offering represents our current intentions based upon our present plans and business condition. As of the date of this prospectus, we cannot predict with certainty all of the particular uses for the net proceeds to be received upon the completion of this offering, or the amounts that we will actually spend on the uses set forth above. The amounts and timing of our actual use of the net proceeds will

vary depending on numerous factors, including the commercial success of our systems and the costs of our research and development activities, as well as the amount of cash used in our operations. The costs and timing of research and development activities and the build out of our commercial selling and marketing capabilities, particularly as related to expansion of our systems, are highly uncertain, subject to substantial risks and can often change. Depending on the outcome of these activities, our plans and priorities may change, and we may apply the net proceeds from this offering differently than we currently anticipate. For example, in the event we identify other opportunities that we believe are in the best interests of our stockholders, we may use a portion of the net proceeds from this offering for the acquisition of, or investment in, technologies, products or companies that complement our business, although we have no current intentions, commitments or agreements to do so. As a result, our management will have broad discretion in the application of the net proceeds, and investors will be relying on our judgment regarding the application of the net proceeds of this offering. In addition, we might decide to postpone or not pursue expansion of our systems if the net proceeds from this offering and other sources of cash are less than expected.

The failure by our management to apply these funds effectively could harm our business. Pending their use, we may invest the net proceeds from this offering in short-term, investment-grade, interest-bearing securities. These investments may not yield a favorable return to our stockholders. If we do not invest or apply the net proceeds from this offering in ways that enhance stockholder value, we may fail to achieve expected financial results, which could cause our stock price to decline.

Anti-takeover provisions under our charter documents and Delaware law could delay or prevent a change of control which could limit the market price of our common stock and may prevent or frustrate attempts by our stockholders to replace or remove our current management.

Our amended and restated certificate of incorporation and amended and restated bylaws, which are to become effective immediately prior to the closing of this offering, contain provisions that could delay or prevent a change of control of our company or changes in our board of directors that our stockholders might consider favorable. Some of these provisions include:

- a board of directors divided into three classes serving staggered three-year terms, such that not all members of the board will be elected at one time;
- a prohibition on stockholder action through written consent, which requires that all stockholder actions be taken at a meeting of our stockholders;
- a requirement that special meetings of stockholders be called only by the chairman of the board of directors, the chief executive officer, the president or by a majority of the total number of authorized directors;
- advance notice requirements for stockholder proposals and nominations for election to our board of directors;
- a requirement that no member of our board of directors may be removed from office by our stockholders except for cause and, in addition to any other vote required by law, upon the approval of not less than two-thirds of all outstanding shares of our voting stock then entitled to vote in the election of directors;
- a requirement of approval of not less than two-thirds of all outstanding shares of our voting stock to amend any bylaws by stockholder action or to amend specific provisions of our certificate of incorporation; and
- the authority of the board of directors to issue preferred stock on terms determined by the board of directors without stockholder approval and which preferred stock may include rights superior to the rights of the holders of common stock.

In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporate Law, which may prohibit certain business combinations with stockholders

owning 15% or more of our outstanding voting stock. These anti-takeover provisions and other provisions in our amended and restated certificate of incorporation and amended and restated bylaws could make it more difficult for stockholders or potential acquirers to obtain control of our board of directors or initiate actions that are opposed by the then-current board of directors and could also delay or impede a merger, tender offer or proxy contest involving our company. These provisions could also discourage proxy contests and make it more difficult for you and other stockholders to elect directors of your choosing or cause us to take other corporate actions you desire. Any delay or prevention of a change of control transaction or changes in our board of directors could cause the market price of our common stock to decline.

If securities or industry analysts do not publish research or publish inaccurate or unfavorable research about our business, our stock price and trading volume could decline.

The trading market for our common stock will depend in part on the research and reports that securities or industry analysts publish about us or our business. Securities and industry analysts do not currently, and may never, publish research on our company. If no securities or industry analysts commence coverage of our company, the trading price for our stock would likely be negatively impacted. In the event securities or industry analysts initiate coverage, if one or more of the analysts who covers us downgrades our stock or publishes inaccurate or unfavorable research about our business, our stock price may decline. If one or more of these analysts ceases coverage of our company or fails to publish reports on us regularly, demand for our stock could decrease, which might cause our stock price and trading volume to decline.

Our recurring losses and negative cash flows have raised substantial doubt regarding our ability to continue as a going concern.

Since inception, we have experienced recurring operating losses and negative cash flows, and we expect to continue to generate operating losses and consume significant cash resources for the foreseeable future. Without additional financing, these conditions raise substantial doubt about our ability to continue as a going concern, meaning that we may be unable to continue operations for the foreseeable future or realize assets and discharge liabilities in the ordinary course of operations. As a result, our financial statements include an explanatory paragraph expressing substantial doubt about our ability to continue as a going concern. If we are unable to obtain sufficient funding, our business, prospects, financial condition and results of operations will be materially and adversely affected and we may be unable to continue as a going concern. If we are unable to continue as a going concern, we may have to liquidate our assets and may receive less than the value at which those assets are carried on our consolidated financial statements, and it is likely that investors will lose all or a part of their investment. Future reports from our independent registered public accounting firm may also contain statements expressing doubt about our ability to continue as a going concern. If we seek additional financing to fund our business activities in the future and there remains doubt about our ability to continue as a going concern, investors or other financing sources may be unwilling to provide additional funding on commercially reasonable terms or at all.

Our amended and restated certificate of incorporation to be effective in connection with the closing of this offering will provide that the Court of Chancery of the State of Delaware or the U.S. federal district courts will be the exclusive forums for substantially all disputes between us and our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers or other employees.

Our amended and restated certificate of incorporation to be effective in connection with the closing of this offering provides that the Court of Chancery of the State of Delaware is the sole and exclusive forum for any derivative action or proceeding brought on our behalf, any action asserting a breach of fiduciary duty, any action asserting a claim against us arising under the Delaware General Corporation Law, our amended and restated certificate of incorporation or our amended and restated bylaws, or any action asserting a claim against us that is governed by the internal affairs doctrine. Our amended and restated certificate of incorporation further provides

that the U.S. federal district courts will be the exclusive forum for resolving any complaint asserting a cause of action arising under the Securities Act. These choice of forum provisions may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for disputes with us or our directors, officers or other employees, which may discourage such lawsuits. If a court were to find either choice of forum provision contained in our amended and restated certificate of incorporation to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could adversely affect our results of operations and financial condition.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This prospectus contains forward-looking statements about us and our industry that involve substantial risks and uncertainties. All statements other than statements of historical facts contained in this prospectus, including statements regarding our future results of operations or financial condition, business strategy and plans, and objectives of management for future operations, are forward-looking statements. In some cases, you can identify forward-looking statements because they contain words such as "anticipate," "believe," "contemplate," "continue," "could," "estimate," "expect," "intend," "may," "plan," "potential," "predict," "project," "should," "target," "will" or "would" or the negative of these words or other similar terms or expressions.

We have based these forward-looking statements largely on our current expectations and projections about future events and financial trends that we believe may affect our financial condition, results of operations, business strategy and financial needs. These forward-looking statements are subject to known and unknown risks, uncertainties and assumptions, including risks described in "Risk Factors" and elsewhere in this prospectus, regarding, among other things:

- the size and growth potential of the markets for our products, and our ability to serve those markets;
- the rate and degree of market acceptance of our products;
- ability to expand our sales organization to address effectively existing and new markets that we intend to target;
- impact from future regulatory, judicial, and legislative changes or developments in the U.S. and foreign countries;
- ability to compete effectively in a competitive industry;
- the success of competing technologies that are or may become available;
- the performance of our third-party contract sales organizations, suppliers and manufacturers;
- our ability to attract and retain key scientific or management personnel;
- the accuracy of our estimates regarding expenses, future revenues, reimbursement rates, capital requirements and needs for additional financing;
- our ability to obtain funding for our operations;
- our ability to attract collaborators and strategic partnerships; and
- our use of the proceeds from this offering.

You should not rely on forward-looking statements as predictions of future events. We have based the forward-looking statements contained in this prospectus primarily on our current expectations and projections about future events and trends that we believe may affect our business, financial condition, results of operations and prospects. The outcome of the events described in these forward-looking statements is subject to risks, uncertainties and other factors described in "Risk Factors" and elsewhere in this prospectus. Moreover, we operate in a very competitive and rapidly changing environment. New risks and uncertainties emerge from time to time, and it is not possible for us to predict all risks and uncertainties that could have an impact on the forward-looking statements contained in this prospectus.

The results, events and circumstances reflected in the forward-looking statements may not be achieved or occur, and actual results, events or circumstances could differ materially from those described in the forward-looking statements.

In addition, statements that "we believe" and similar statements reflect our beliefs and opinions on the relevant subject. These statements are based on information available to us as of the date of this prospectus. And while we believe that information provides a reasonable basis for these statements, that information may be

limited or incomplete. Our statements should not be read to indicate that we have conducted an exhaustive inquiry into, or review of, all relevant information. These statements are inherently uncertain, and investors are cautioned not to unduly rely on these statements.

The forward-looking statements made in this prospectus relate only to events as of the date on which the statements are made. We undertake no obligation to update any forward-looking statements made in this prospectus to reflect events or circumstances after the date of this prospectus or to reflect new information or the occurrence of unanticipated events, except as required by law. We may not actually achieve the plans, intentions, or expectations disclosed in our forward-looking statements, and you should not place undue reliance on our forward-looking statements. Our forward-looking statements do not reflect the potential impact of any future acquisitions, mergers, dispositions, joint ventures or investments.

MARKET, INDUSTRY AND OTHER DATA

This prospectus contains estimates and information concerning our industry, including market size and growth rates of the markets in which we participate, that are based on industry publications and reports. This information involves many assumptions and limitations, and you are cautioned not to give undue weight to these estimates. We have not independently verified the accuracy or completeness of the data contained in these industry publications and reports. The industry in which we operate is subject to a high degree of uncertainty and risk due to a variety of factors, including those described in “Risk Factors,” that could cause results to differ materially from those expressed in these publications and reports.

USE OF PROCEEDS

We estimate that we will receive net proceeds from this offering of approximately $25.7 million (or approximately $29.6 million if the underwriters' option to purchase additional shares of our common stock from us is exercised in full) based on the assumed initial public offering price of $5.50 per share, after deducting estimated underwriting discounts and commissions and estimated offering expenses payable by us.

A $1.00 increase (decrease) in the assumed initial public offering price of $5.50 per share would increase (decrease) cash and cash equivalents, working capital, total assets, total liabilities, additional paid-in capital and total stockholders' (deficit) equity by $4.7 million, assuming that the number of shares offered by us, as set forth on the cover page of this prospectus, remains the same, after deducting the estimated underwriting discounts and commissions. Similarly, each increase (decrease) of 1.0 million shares in the number of shares of common stock offered by us would increase (decrease) each of cash and cash equivalents, working capital, total assets, additional paid-in capital and total stockholders' (deficit) equity by $4.7 million, assuming the assumed initial public offering price of $5.50 per share remains the same, and after deducting the estimated underwriting discounts and commissions.

We intend to use the net proceeds from the offering as follows: (1) $12 million to expand our commercial operations to grow and support the installed base of our products among life sciences basic research, translational research and clinical-related customers in the U.S. and internationally; (2) $9 million to improve and update our technology and instruments and to develop additional labeling reagents; (3) $1 million to potentially establish a direct commercialization presence in China; (4) $1 million to assist existing and future partners in pursuing regulatory approvals or clearances to develop instruments and consumables in areas outside of life science research, including potentially LDTs; and (5) the remainder to fund working capital and other general corporate purposes.

We also may use a portion of the net proceeds from the offering to fund acquisitions or other business development opportunities. However, we have no current commitments or obligations with respect to any such acquisitions or business development opportunities at this time.

The expected use of net proceeds from this offering represents our intentions based upon our present plans and business conditions. We cannot predict with certainty all of the particular uses for the proceeds of this offering or the amounts that we will actually spend on the uses set forth above. Accordingly, we will have significant flexibility in applying the net proceeds of this offering. The timing and amount of our actual expenditures will be based on many factors, including cash flows from operations and the anticipated growth of our business. Pending their use, we intend to invest the net proceeds of this offering in a variety of capital-preservation investments, including short-and intermediate-term, interest-bearing, investment-grade securities and government securities.

DIVIDEND POLICY

We do not anticipate declaring or paying, in the foreseeable future, any cash dividends on our capital stock. We intend to retain all available funds and future earnings, if any, to fund the development and expansion of our business, and we do not anticipate paying any cash dividends in the foreseeable future. Any future determination regarding the declaration and payment of dividends, if any, will be at the discretion of our board of directors and will depend on then-existing conditions, including our financial condition, operating results, contractual restrictions, capital requirements, business prospects and other factors our board of directors may deem relevant. In addition, we are currently prohibited from paying dividends on our common stock without the prior written consent of Midcap, our senior lender.

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CAPITALIZATION

The following table sets forth our cash and cash equivalents and capitalization as of June 30, 2018:

- on an actual basis;
- on a pro forma basis, giving effect to (i) the automatic conversion of all of our outstanding shares of convertible preferred stock into an aggregate of 5,700,572 shares of common stock, (ii) the conversion of approximately $14.4 million aggregate principal amount of outstanding convertible promissory notes plus accrued interest thereon into 3,567,099 shares of common stock (based on an assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus) and a conversion date of June 30, 2018); and
- on a pro forma as adjusted basis, giving effect to (i) the pro forma adjustments set forth above and (ii) our receipt of estimated net proceeds from the sale of 5,500,000 shares of common stock in the offering at the assumed initial public offering price of $5.50 per share, after deducting the estimated underwriting discounts and commissions and estimated offering expenses payable by us.

You should read this table together with "Management's Discussion and Analysis of Financial Condition and Results of Operations" and our financial statements and related notes included elsewhere in this prospectus.

	As of June 30, 2018		
	Actual	Pro Forma (unaudited)	Pro Forma As Adjusted
Cash and cash equivalents	$ 7,624,289	$ 7,624,289	$ 33,336,789
Long-term debt	8,956,143	8,956,143	8,956,143
Convertible note	14,329,843	—	—
Preferred stock warrant liability	1,604,836	—	—
Convertible preferred stock, $0.0001 par value; 218,982,477 shares authorized, 121,992,497 shares issued and outstanding, actual, and no shares authorized, issued and outstanding, pro forma and pro forma as adjusted	43,010,137	—	—
Stockholders' deficit:			
Common stock, $0.0001 par value; 244,097,620 shares authorized, actual, 156,126 shares issued and outstanding, actual; shares authorized, pro forma; shares issued and outstanding, pro forma; shares authorized, pro forma as adjusted; shares issued and outstanding, pro forma as adjusted	16	942	1,492
Additional paid-in capital	4,146,927	63,090,817	88,802,767
Accumulated deficit	(61,424,874)	(61,424,874)	(61,424,874)
Total stockholders' (deficit) equity	(57,277,611)	1,666,885	27,379,385
Total capitalization	$ 10,623,348	$ 10,623,028	$ 36,177,023

A $1.00 increase (decrease) in the assumed initial public offering price of $5.50 per share would increase (decrease) cash and cash equivalents, working capital, total assets, total liabilities, additional paid-in capital and total stockholders' (deficit) equity by $4.7 million, assuming that the number of shares offered by us, as set forth on the cover page of this prospectus, remains the same, after deducting the estimated underwriting discounts and commissions. Similarly, each increase (decrease) of 1.0 million shares in the number of shares of common stock offered by us would increase (decrease) each of cash and cash equivalents, working capital, total assets, additional paid-in capital and total stockholders' (deficit) equity by $4.7 million, assuming the assumed initial

public offering price of $5.50 per share remains the same, and after deducting the estimated underwriting discounts and commissions.

If the underwriters' option to purchase additional shares of our common stock from us is exercised in full, pro forma as adjusted cash and cash equivalents, additional paid-in capital, total stockholders' (deficit) equity, total capitalization and shares of common stock outstanding as of June 30, 2018 would be $37.2M, $92.7M, $31.2M, $40.2M and 15.7M, respectively.

The number of shares of our common stock to be outstanding after this offering is based on 5,856,698 shares of our common stock as of June 30, 2018, after giving effect to the conversion of shares of our convertible preferred stock outstanding as of June 30, 2018 into an aggregate of 5,700,572 shares of our common stock immediately prior to the closing of this offering, and excludes:

- 833,960 shares of our common stock issuable upon the exercise of stock options outstanding as of June 30, 2018 under our Amended and Restated 2006 Equity Compensation Plan, as amended, or 2006 Plan, with a weighted-average exercise price of $2.53 per share;
- 2,098,909 shares of our common stock reserved for future issuance under our 2018 Equity Incentive Plan, or 2018 Plan, which will become effective once the registration statement of which this prospectus forms a part is declared effective, with such shares including 1,100,000 new shares plus the number of shares (not to exceed 998,909 shares) (i) that remain available for the issuance of awards under our 2006 Plan at the time our 2018 Plan becomes effective, and (ii) any shares underlying outstanding stock awards granted under our 2006 Plan that expire or are repurchased, forfeited, cancelled or withheld, as more fully described in the section titled "Executive Compensation – Equity Incentive Plans";
- 240,000 shares of our common stock reserved for issuance under our 2018 Employee Stock Purchase Plan, or ESPP, which will become effective once the registration statement of which this prospectus forms a part is declared effective, and any automatic increases in the number of shares of common stock reserved for future issuance under our ESPP;
- 2,003 shares of our common stock issuable upon the exercise of an outstanding warrant which, prior to the completion of this offering, is exercisable for 42,872 shares of our Series B convertible preferred stock;
- 3,505 shares of our common stock issuable upon the exercise of outstanding warrants which, prior to the completion of this offering, are exercisable for 75,027 shares of our Series B-1 convertible preferred stock;
- 23,851 shares of our common stock issuable upon the exercise of an outstanding warrant which, prior to the completion of this offering, is exercisable for 510,417 shares of our Series D convertible preferred stock;
- 42,834 shares of our common stock issuable upon the exercise of an outstanding warrants which, prior to the completion of this offering, are exercisable for 916,667 shares of our Series D-1 convertible preferred stock; and
- up to 189,750 shares of common stock issuable upon exercise of warrants to be issued to the Underwriters in connection with this offering, which will have an exercise price equal to 150% of the initial public offering price per share in this offering.

Unless we specifically state otherwise, the information in this prospectus assumes or gives effect to:

- the filing of our amended and restated certificate of incorporation, which will be in effect upon the completion of this offering;
- the conversion of all of our outstanding shares of convertible preferred stock into an aggregate of 5,700,572 shares of common stock upon the closing of this offering;

- the conversion of outstanding convertible promissory notes into 3,567,099 shares of common stock (based on an assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus) and a conversion date of June 30, 2018);
- that the initial public offering price of our shares of common stock is $5.50 per share, which is the midpoint of the price range set forth on the cover page of this prospectus;
- no exercise of the outstanding options described above;
- no exercise of the underwriters' option to purchase up to an additional 825,000 shares of common stock from us in this offering; and
- a 1-for-21.4 reverse stock split of our common stock effected on July 16, 2018.

DILUTION

If you invest in our common stock in this offering, your interest will be diluted to the extent of the difference between the initial public offering price per share of common stock and the pro forma as adjusted net tangible book value per share immediately after this offering.

Our pro forma net tangible book value as of June 30, 2018 was $1.7 million, or $0.18 per share. Pro forma net tangible book value per share represents the amount of our total tangible assets less our total liabilities, divided by the number of our shares of common stock outstanding as of June 30, 2018, after giving effect to (i) the automatic conversion of all of our outstanding shares of convertible preferred stock into an aggregate of 5,700,572 shares of common stock, and (ii) the conversion of approximately $14.4 million aggregate principal amount of outstanding convertible promissory notes plus accrued interest thereon into 3,567,099 shares of common stock (based on an assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus) and a conversion date of June 30, 2018).

After giving effect to the sale by us of 5,500,000 shares of common stock in this offering at the assumed initial public offering price of $5.50 per share (the mid-point of the price range set forth on the cover page of this prospectus), and after deducting estimated underwriting discounts, commissions and estimated offering expenses payable by us, our pro forma as adjusted net tangible book value as of June 30, 2018 would have been $27.4 million, or $1.83 per share. This amount represents an immediate increase in pro forma as adjusted net tangible book value of $1.65 per share to our existing stockholders and an immediate dilution in pro forma as adjusted net tangible book value of $3.67 per share to investors purchasing common stock in this offering. We determine dilution by subtracting the pro forma as adjusted net tangible book value per share after this offering from the amount of cash paid by an investor for a share of common stock in this offering. The following table illustrates this dilution on a per share basis:

Assumed initial public offering price per share		$5.50
Historical net tangible book value (deficit) per share as of June 30, 2018	$(366.87)	
Increase in historical net tangible book value (deficit) per share attributable to pro forma adjustments described above	$ 367.04	
Pro forma net tangible book value (deficit) per share as of June 30, 2018	$ 0.18	
Increase in pro forma as adjusted net tangible book value per share attributable to new investors purchasing shares in this offering	$ 1.65	
Pro forma as adjusted net tangible book value per share after this offering		$1.83
Dilution per share to new investors purchasing shares in this offering		$3.67

The dilution information discussed above is illustrative only and may change based on the actual initial public offering price and other terms of this offering. A $1.00 increase (decrease) in the assumed initial public offering price of $5.50 per share would increase (decrease) our pro forma as adjusted net tangible book value per share after this offering by $0.31 per share and increase (decrease) the dilution to investors purchasing shares in this offering by $0.69 per share, in each case assuming the number of shares of common stock offered by us, as set forth on the cover page of this prospectus, remains the same, and after deducting estimated underwriting discounts and commissions payable by us. Similarly, each increase or decrease of 1.0 million shares in the number of shares of common stock offered by us would increase (decrease) our pro forma as adjusted net tangible book value by approximately $0.18 per share and decrease (increase) the dilution to investors purchasing shares in this offering by approximately $0.18 per share, in each case assuming the assumed initial public offering price of $5.50 per share remains the same, and after deducting estimated underwriting discounts and commissions.

If the underwriters exercise their option to purchase additional shares of common stock in full, the pro forma net tangible book value per share, as adjusted to give effect to this offering, would be $0.15 per share, and the dilution in pro forma net tangible book value per share to investors in this offering would be $0.15 per share.

The number of shares of our common stock to be outstanding after this offering is based on 5,856,698 shares of our common stock as of June 30, 2018, after giving effect to the conversion of shares of our convertible preferred stock outstanding as of June 30, 2018 into an aggregate of 5,700,572 shares of our common stock immediately prior to the closing of this offering, and excludes:

- 833,960 shares of our common stock issuable upon the exercise of stock options outstanding as of June 30, 2018 under our 2006 Plan with a weighted-average exercise price of $2.53 per share;
- 2,098,909 shares of our common stock reserved for future issuance under the 2018 Plan, which will become effective once the registration statement of which this prospectus forms a part is declared effective, with such shares including 1,100,000 new shares plus the number of shares (not to exceed 998,909 shares) (i) that remain available for the issuance of awards under our 2006 Plan at the time our 2018 Plan becomes effective, and (ii) any shares underlying outstanding stock awards granted under our 2006 Plan that expire or are repurchased, forfeited, cancelled or withheld, as more fully described in the section titled "Executive Compensation – Equity Incentive Plans";
- 240,000 shares of our common stock reserved for issuance under the ESPP, which will become effective once the registration statement of which this prospectus forms a part is declared effective, and any automatic increases in the number of shares of common stock reserved for future issuance under our ESPP;
- 2,003 shares of our common stock issuable upon the exercise of an outstanding warrant which, prior to the completion of this offering, is exercisable for 42,872 shares of our Series B convertible preferred stock;
- 3,505 shares of our common stock issuable upon the exercise of outstanding warrants which, prior to the completion of this offering, are exercisable for 75,027 shares of our Series B-1 convertible preferred stock;
- 23,851 shares of our common stock issuable upon the exercise of an outstanding warrant which, prior to the completion of this offering, is exercisable for 510,417 shares of our Series D convertible preferred stock;
- 42,834 shares of our common stock issuable upon the exercise of an outstanding warrants which, prior to the completion of this offering, are exercisable for 916,667 shares of our Series D-1 convertible preferred stock; and
- up to 189,750 shares of common stock issuable upon exercise of warrants to be issued to the Underwriters in connection with this offering, which will have an exercise price equal to 150% of the initial public offering price per share in this offering.

To the extent that any outstanding options or warrants are exercised or new options are issued under our stock-based compensation plans, or we issue additional shares of common stock in the future, there will be further dilution to investors participating in this offering. In addition, we may choose to raise additional capital because of market conditions or strategic considerations, even if we believe that we have sufficient funds for our current or future operating plans. If we raise additional capital through the sale of equity or convertible debt securities, the issuance of these securities could result in further dilution to our stockholders.

Certain of our existing stockholders, including entities affiliated with certain of our directors, have indicated an interest in purchasing an aggregate of approximately $6.35 million in shares of our common stock in this offering at the initial public offering price per share. Based on an assumed initial public offering price of $5.50 per share, these persons and entities would purchase an aggregate of approximately 1,154,545 of the 5,500,000 shares in this offering based on these indications of interest. However, because indications of interest are not binding agreements or commitments to purchase, the underwriters may determine to sell more, less or no shares in this offering to any of these persons or entities, or any of these persons or entities may determine to purchase more, less or no shares in this offering. The foregoing discussion and tables do not reflect any potential purchases by these persons or entities or their affiliated entities.

SELECTED FINANCIAL DATA

The selected statements of operations data for the years ended December 31, 2016 and 2017 and the balance sheet data as of December 31, 2016 and 2017 are derived from our audited financial statements that are included elsewhere in this prospectus. The selected statements of operations data for the six months ended June 30, 2017 and 2018 and the balance sheet data as of June 30, 2018 are derived from our unaudited financial statements that are included elsewhere in this prospectus. Our historical results are not necessarily indicative of our results in any future period and results from our interim period may not necessarily be indicative of the results of the entire year.

You should read the following selected financial data together with "Management's Discussion and Analysis of Financial Condition and Results of Operations" and our financial statements and the related notes included elsewhere in this prospectus. The selected financial data in this section are not intended to replace our financial statements and the related notes and are qualified in their entirety by the financial statements and related notes included elsewhere in this prospectus.

	Year ended December 31,		Six Months Ended June 30,	
	2016	2017	2017	2018
			(unaudited)	
Total revenue	$ 6,792,789	$ 9,505,043	$ 3,916,864	$ 5,158,494
Operating expenses				
Cost of revenue	3,578,692	6,030,512	2,844,117	2,654,879
Research and development	11,431,941	12,009,170	6,584,614	4,465,919
Selling, general and administrative	12,950,572	14,079,658	7,436,426	6,385,378
Impairment of property and equipment	—	604,511	—	—
Total operating expenses	27,961,205	32,723,851	16,865,157	13,506,176
Interest expense	(470,072)	(590,927)	(286,095)	(709,616)
Other income	2,802,797	462,923	896,758	1,907,742
Provision for income taxes	(12,924)	(18,552)	(22,358)	(9,282)
Net loss	$ (18,848,615)	$ (23,365,364)	$ (12,359,988)	$ (7,158,838)
Net loss per share(1):				
Basic and diluted	$ (156.20)	$ (163.86)	$ (88.04)	$ (46.10)
Pro forma net loss per share(1):				
Basic and diluted		$ (4.33)		$ (0.85)

(1) See Note 2 of the notes to our financial statements included elsewhere in this prospectus for a description of how we compute basic and diluted net income per share attributable to common stockholders and preferred stockholders and pro forma basic and diluted net loss per share attributable to common stockholders.

	Year Ended December 31		As of June 30
	2016	2017	2018
			(unaudited)
Balance Sheet Data:			
Cash and cash equivalents	$ 5,249,620	$ 1,021,897	$ 7,624,289
Working capital	1,371,819	(9,512,886)	(6,773,417)
Total assets	14,787,737	10,145,153	18,094,156
Convertible note	—	—	14,329,843
Long-term debt	6,633,176	6,729,752	8,956,143
Total liabilities	16,630,182	17,362,227	32,361,630
Convertible preferred stock	25,416,527	43,010,137	43,010,137
Accumulated deficit	(30,900,672)	(54,266,036)	(61,424,874)
Total stockholders' (deficit) equity	(27,258,972)	(50,227,211)	(57,277,611)

MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

The following discussion should be read in conjunction with the "Selected Financial Data" and our financial statements and related notes thereto included elsewhere in this prospectus. In addition to historical information, this discussion contains forward- looking statements that involve risks, uncertainties and assumptions that could cause actual results to differ materially from management's expectations. Factors that could cause such differences are discussed in the sections entitled "Special Note Regarding Forward-Looking Statements" and "Risk Factors." We are not undertaking any obligation to update any forward-looking statements or other statements we may make in the following discussion or elsewhere in this document even though these statements may be affected by events or circumstances occurring after the forward-looking statements or other statements were made. Therefore, no reader of this document should rely on these statements being current as of any time other than the time at which this document is declared effective by the U.S. Securities and Exchange Commission.

Overview

We are a life sciences instrumentation company in the genome analysis space. We develop and market the Saphyr system, a platform for ultra-sensitive and ultra-specific structural variation detection that enables researchers and clinicians to accelerate the search for new diagnostics and therapeutic targets and to streamline the study of changes in chromosomes, which is known as cytogenetics. Our Saphyr system comprises an instrument, chip consumables, reagents and a suite of data analysis tools.

Structural variation refers to large-scale structural differences in the genomic DNA of one individual compared to another. Each structural variation involves the rearrangement or repetition of as few as hundreds to as many as tens of millions of DNA base pairs. Those rearrangements may be insertions, deletions, duplications, inversions or translocations of segments of one or more chromosomes. Structural variations may be inherited or arise spontaneously and many cause genetic disorders and diseases. Until our commercial launch of the Saphyr system in February 2017, and since, we believe no products existed or exist that could more comprehensively and cost and time-efficiently detect structural variation.

Our Saphyr system comprises an instrument, chip consumables, reagents and a suite of data analysis tools. Our customers include researchers and clinicians who seek to uncover and understand the biological or clinical impact of genome variation to improve the diagnosis and treatment of patients with better clinical tests and new medicines or to replace existing cytogenetic tests that are expensive, slow and labor-intense, with a modern solution that simplifies workflow and reduces costs and that has the potential to significantly increase diagnostic yields across the industry. Our customers also include researchers in non-human segments such as agricultural genomics where they seek to advance their understanding of how structural variation impacts industrial applications of plants and animals.

To date, we have financed our operations principally through private placements of our convertible preferred stock, convertible promissory notes, borrowings from credit facilities and revenue from our commercial operations.

Since our inception, we have raised net equity proceeds of $129.3 million to fund our operations from the issuance of convertible preferred stock and convertible promissory notes. We have incurred losses in each year since our inception. Our net losses were $18.8 million and $23.4 million for the years ended December 31, 2016 and 2017, respectively, and $12.4 million and $7.2 million for the six months ended June 30, 2017 and 2018, respectively. As of June 30, 2018, we had an accumulated deficit of $61.4 million.

We expect to continue to incur significant expenses and operating losses as we:

- expand our sales and marketing efforts to further commercialize our products;

- continue research and development efforts to improve our existing products;
- hire additional personnel;
- enter into collaboration arrangements, if any;
- add operational, financial and management information systems; and
- incur increased costs as a result of operating as a public company.

Financial Overview

Revenue

We generate product revenue from sales of our instruments and consumables. We currently sell our products for research use only applications and our customers are primarily laboratories associated with academic and governmental research institutions, as well as pharmaceutical, biotechnology and contract research companies. Sales of our consumables have consistently increased due to an increasing number of our instruments being installed in the field, all of which require certain of our consumables to run customers' specific tests. Consumable revenue consists of sales of complete assays which are developed internally by us, plus sales of kits which contain all the elements necessary to run tests.

Other revenue consists of warranty and other service-based revenue.

The following table presents our revenue for the periods indicated:

	Year Ended December 31,		Six Months Ended June 30,	
	2016	2017	2017	2018
			(unaudited)	
Product revenue	$ 6,153,355	$ 8,769,704	$ 3,609,281	$ 4,918,245
Other revenue	639,434	735,339	307,583	240,249
Total	$ 6,792,789	$ 9,505,043	$ 3,916,864	$ 5,158,494

The following table reflects total revenue by geography and as a percentage of total revenue, based on the billing address of our customers. North America consists of the United States and Canada. EMEIA consists of Europe, Middle East, India and Africa. Asia Pacific includes China, Japan, South Korea, Singapore and Australia.

	Year Ended December 31,				Six Months Ended June 30,			
	2016		2017		2017		2018	
	$	%	$	%	$	%	$	%
					(unaudited)			
North America	$2,078,987	31%	$3,801,481	40%	$1,794,728	47%	$2,553,428	49%
EMEIA	1,666,188	24%	1,282,897	13%	819,464	21%	1,128,510	21%
Asia Pacific	3,047,614	45%	4,420,665	47%	1,302,672	32%	1,476,556	30%
Total	$6,792,789	100%	$9,505,043	100%	$3,916,864	100%	$5,158,494	100%

Subsequent to the issuance of the June 30, 2018 unaudited condensed consolidated financial statements, we discovered an error in the disclosure of revenue amounts for the six months ended June 30, 2018 within the North America, EMEIA and Asia Pacific reportable segments. Accordingly, the table above has been restated to correct the June 30, 2018 disclosures of revenue for the North America, EMEIA and Asia Pacific reportable segments, resulting in increases (decreases) from amounts previously reported of $837,451, $239,421, and $(1,076,872), respectively.

Cost of Revenue

Cost of revenue for our instruments and consumables includes cost from the manufacturer, raw material parts costs and associated freight, shipping and handling costs, contract manufacturer costs, salaries and other personnel costs, overhead and other direct costs related to those sales recognized as product revenue in the period.

Cost of other revenue consists of salaries and other personnel costs and costs related to warranties and other costs of servicing equipment at customer sites.

Research and Development Expenses

Research and development expenses consist of salaries and other personnel costs, stock-based compensation, research supplies, third-party development costs for new products, materials for prototypes, and allocated overhead costs that include facility and other overhead costs. We have made substantial investments in research and development since our inception, and plan to continue to make investments in the future. Our research and development efforts have focused primarily on the tasks required to support development and commercialization of new and existing products. We believe that our continued investment in research and development is essential to our long-term competitive position.

Selling, General and Administrative Expenses

Selling, general and administrative expenses consist primarily of salaries and other personnel costs, and stock-based compensation for our sales and marketing, finance, legal, human resources and general management, as well as professional services, such as legal and accounting services.

Results of Operations

Comparison of the Six Months Ended June 30, 2017 and 2018

The following table sets forth our results of operations for the six months ended June 30, 2017 and 2018:

	Six Months Ended June 30,		Period-to-Period Change	
	2017	2018	$	%
	(unaudited)			
Product revenue	$ 3,609,281	$ 4,918,245	$ 1,308,964	36.3%
Other revenue	307,583	240,249	(67,334)	-21.9%
Total revenue	3,916,864	5,158,494	1,241,630	31.7%
Cost of product revenue	2,818,861	2,644,043	(174,818)	-6.2%
Cost of other revenue	25,256	10,836	(14,420)	-57.1%
Research and development	6,584,614	4,465,919	(2,118,695)	-32.2%
Selling, general and administrative	7,436,426	6,385,378	(1,051,048)	-14.1%
Total operating expenses	16,865,157	13,506,176	(3,358,981)	-19.9%
Loss from operations	(12,948,293)	(8,347,682)	4,600,611	-35.5%
Interest expense	(286,095)	(709,616)	(423,521)	-148.0%
Change in fair value of preferred stock warrants and expirations	953,893	2,470,921	1,517,028	159.0%
Other expense	(57,135)	(563,179)	(506,044)	-885.7%
Loss before income taxes	(12,337,630)	(7,149,556)	5,188,074	-42.1%
Provision for income taxes	(22,358)	(9,282)	13,076	-58.5%
Net loss	$ (12,359,988)	$ (7,158,838)	$ (5,201,150)	-42.1%

Revenue

Revenue increased by $1.2 million, or 31.7%, to $5.2 million for the six months ended June 30, 2018, as compared to $3.9 million for the same period in 2017. Average sales prices, or ASPs, of instruments decreased by 7% while consumables increased by 37%, respectively in the six months ended June 30, 2018, as compared with the six months ended June 30, 2017. We began selling our new Saphyr system in February 2017 which includes higher priced consumables than those sold under our previously marketed, first generation system Irys. In addition, sales volumes of instruments and consumables increased by 17% and 160%, respectively in the six months ended June 30, 2018, as compared with the six months ended June 30, 2017.

Cost of Revenue

Cost of product revenue decreased by $0.2 million, or 6.2%, to $2.6 million for the six months ended June 30, 2018, as compared to $2.8 million for the same period in 2017. The decrease was primarily due to the increase in consumable revenue relative to instrument revenue for the six months ended June 30, 2018, as compared to the same period in 2017. Cost of revenues could adversely be affected if we are unable to sell our remaining Irys instruments at the current carrying amount of $1.3 million.

Research and Development Expenses

Research and development expenses decreased $2.1 million, or $32.2%, to $4.5 million for the six months ended June 30, 2018 compared to $6.6 million for the same period in 2017. The decrease in research and development expenses during this period was primarily related to decreases in compensation and benefit expense as a result in a reduction in headcount during the second half of 2017.

Selling, General and Administrative Expenses

Selling, general and administrative expenses were $7.4 million and $6.4 million for the six months ended June 30, 2017 and 2018, respectively. The decrease in selling, general and administrative expenses during this period of $1.0 million was primarily related to decreases in compensation and benefit expense as a result of a reduction in headcount during the second half of 2017. We expect selling, general and administrative expenses to increase in future periods as the number of sales, technical support and marketing and administrative personnel grows and we continue to broaden our customer base and grow our business. We also expect to incur additional expenses as a public company, including expenses related to compliance with the rules and regulations of the SEC and Nasdaq, additional insurance expenses, and expenses related to investor relations activities and other administrative and professional services.

Interest Expense

Interest expense increased from $0.3 million to $0.7 million for the six months ended June 30, 2017 and 2018, respectively. The increase in interest expense is related to additional borrowing of convertible notes entered into during the six months ended June 30, 2018.

Change in Fair Value of Preferred Stock Warrants

Change in fair value of preferred stock warrants was $1.0 million and $2.5 million for the six months ended June 30, 2017 and 2018, respectively. The preferred stock warrants are subject to remeasurement at each reporting period, with changes in fair value recorded in the statement of operations.

Other Expense

Other expense was $0.1 million and $0.6 million for the six months ended June 30, 2017 and 2018, respectively. The increase is related to financing expenses incurred to extinguish the Western Alliance LSA during the six months ended June 30, 2018.

Comparison of the Years Ended December 31, 2016 and 2017

The following table sets forth our results of operations for the years ended December 31, 2016 and 2017:

	Year Ended December 31,		Period-to-Period Change	
	2016	2017	$	%
Product revenue	$ 6,153,355	$ 8,769,704	$ 2,616,349	42.5%
Other revenue	639,434	735,339	95,905	15.0%
Total revenue	6,792,789	9,505,043	2,712,254	39.9%
Cost of product revenue	3,459,771	5,958,537	2,498,766	72.2%
Cost of other revenue	118,921	71,975	(46,946)	-39.5%
Research and development	11,431,941	12,009,170	577,229	5.0%
Selling, general and administrative	12,950,572	14,079,658	1,129,086	8.7%
Impairment of property and equipment	—	604,511	604,511	N/A
Total operating expenses	27,961,205	32,723,851	4,762,646	17.0%
Loss from operations	(21,168,416)	(23,218,808)	(2,050,392)	9.7%
Interest expense	(470,072)	(590,927)	(120,855)	-25.7%
Change in fair value of preferred stock warrants and expirations	3,006,082	751,933	(2,254,149)	-75.0%
Other expense	(203,285)	(289,010)	(85,725)	-42.2%
Loss before income taxes	(18,835,691)	(23,346,812)	(4,511,121)	23.9%
Provision for income taxes	(12,924)	(18,552)	(5,628)	43.5%
Net loss	$(18,848,615)	$(23,365,364)	$ 4,516,749	24.0%

Revenue

Revenue increased by $2.7 million, or 39.9% to $9.5 million for the year ended December 31, 2017, as compared to $6.8 million for the same period in 2016. ASPs of instruments and consumables increased in the year ended December 31, 2017, as compared with the year ended December 31, 2016 as we began selling our new Saphyr system, which includes higher priced instruments and consumables, in February 2017. The vast majority of the increase in product revenue of $2.6 million was due to a 37% increase in instrument unit sales and a 4% increase in consumable unit sales in the year ended December 31, 2017, as compared to 2016; higher priced instruments (instrument ASP increased 6%) and consumables (consumable ASP increased 18%) also contributed to the increase in product revenue, but to a much lesser extent than the increase in sales volume. The increase in other revenue of $0.1 million was due to increased warranty revenues.

Cost of Revenue

Cost of product revenue increased by $2.5 million, or 72.2%, to $6.0 million for the year ended December 31, 2017, as compared to $3.5 million for the same period in 2016. The increase was primarily due to increased sales of instruments and consumables and write-downs of Irys instruments (the predecessor to our Saphyr instrument) of $0.4 million included in inventory to net realizable value during 2017. During the year ended December 31, 2017, we also incurred higher costs related to the manufacturing of our instruments due to purchase quantities at lower volumes on a per-batch basis. In order to manage working capital, instruments were ordered as needed, limiting volume based purchase discounts. We expect the cost of product revenue per instrument to decrease in future periods as we benefit from economies of scale and modifications to the components and assembly over time. Cost of revenues could adversely be affected if we are unable to sell our remaining Irys instruments at the current carrying amount of $1.3 million.

Research and Development Expenses

Research and development expenses were relatively consistent at $11.4 million and $12.0 million for the year ended December 31, 2016 and 2017, respectively. During 2017, we began to transition our efforts from research and development to the commercialization of our products. As part of commercialization effort we reduced headcount related to research and development personnel during the second half of 2017. We expect our research and development expenses will be lower in the near term due to this transition.

Selling, General and Administrative Expenses

Selling, general and administrative expenses were $13.0 million and $14.1 million for the years ended December 31, 2016 and 2017, respectively. The increase in selling, general and administrative expenses during this period of $1.1 million was primarily related to increases in marketing expense due to the launch of Saphyr, our new product platform, in February 2017 and increased headcount for customer support services. We expect selling, general and administrative expenses to increase in future periods as the number of sales, technical support and marketing and administrative personnel grows and we continue to broaden our customer base and grow our business. We also expect to incur additional expenses as a public company, including expenses related to compliance with the rules and regulations of the SEC and Nasdaq, additional insurance expenses, and expenses related to investor relations activities and other administrative and professional services.

Impairment of Property and Equipment

We did not recognize any impairment losses during the year ended December 31, 2016. During the year ended December 31, 2017, we recognized an impairment loss of $0.6 million related to our Irys instruments at customer sites as the carrying amount of the assets were determined to be in excess of the assets fair value.

Interest Expense

Interest expense was relatively consistent with $0.5 million and $0.6 million for the year ended December 31, 2016 and 2017, respectively.

Change in Fair Value of Preferred Stock Warrants

Change in fair value of preferred stock warrants was $3.0 million and $0.8 million for the year ended December 31, 2016 and 2017, respectively. The preferred stock warrants are subject to remeasurement at each reporting period, with changes in fair value recorded in the statement of operations.

Other Expense

Other expense was relatively consistent with $0.2 million and $0.3 million for the year ended December 31, 2016 and 2017, respectively.

Liquidity and Capital Resources

Since our inception, we have incurred net losses and negative cash flows from operations. We incurred net losses of $18.8 million, $23.4 million, and $7.2 million, and used $23.5 million, $20.8 million and $9.8 million of cash from our operating activities for the years ended December 31, 2016 and 2017 and the six months ended June 30, 2018, respectively. As of June 30, 2018, we had an accumulated deficit of $61.4 million and cash and cash equivalents of $7.6 million.

Sources of Liquidity

To date, we have financed our operations principally through private placements of our convertible preferred stock, borrowings from credit facilities and revenue from our commercial operations.

Preferred stock financings

As of December 31, 2017, we had raised approximately $129.3 million in net equity proceeds through sales of our preferred stock, including the sale of 49,819,157 shares of our Series D and D-1 convertible preferred stock and warrants to purchase 31,672,817 shares of our Series D convertible preferred stock, during the year ended December 31, 2016 at a purchase price of $0.48 per share for net proceeds of $23.5 million.

During the year ended December 31, 2017, we also issued 36,974,586 shares of Series D-1 Preferred Stock at a purchase price of $0.48 per share for net proceeds of $17.6 million.

See Note 8 to our consolidated financial statements for a discussion of the terms and provisions of our Series D and Series D-1 Preferred Stock issued in 2016 and 2017.

Loan facility

On March 8, 2016, we entered into a new term Loan and Security Agreement with Western Alliance Bank, or the Western Alliance LSA, for $7.0 million. The loan proceeds were used to repay the outstanding $5.0 million loan with Square 1 Bank, as required by the amended Loan and Security agreement between Square 1 Bank and us.

We received a notice of default from Western Alliance Bank notifying us that we were in default as of December 31, 2017, as we had failed to secure at least $15.0 million from the sale or issuance of our equity securities or subordinated debt as set forth in the amended Western Alliance LSA. Based on the loan default notice we determined to reclassify the total loan balance of approximately $6.7 million to current liabilities on the consolidated balance sheet as of December 31, 2017, as the loan could be called at any time by Western Alliance Bank.

In February 2018, the Western Alliance LSA was amended requiring the Company to secure $21.0 million in funding prior to June 30, 2018. As part of the amendment, Western Alliance Bank agreed to forbear from exercising any of its default remedies set forth in the LSA as a result of our loan default.

On June 13, 2018, the Western Alliance LSA was amended, replacing previously amended funding requirements and requiring the Company to secure $5.0 million in funding prior to August 3, 2018. Additionally, the amendment restricted the Company’s use of all cash collected from customers, received on and after the amendment date, until a total of $2.5 million of collections. As part of the amendment, Western Alliance Bank waived the existing default.

On June 29, 2018, we entered into a new Credit and Security Agreement with Midcap Financial Trust which provides for a five year $15 million term loan facility. The Credit and Security Agreement is secured by a lien covering substantially all of our assets, including intellectual property. Upon executing the agreement, we drew down a $10.0 million term loan from the credit facility. The loan proceeds were used to repay the outstanding $7.0 million balance on the Western Alliance LSA.

See Note 7 to our consolidated financial statements for a discussion of terms and provisions to the Western Alliance LSA and Midcap Financial CSA.

Note purchase agreement

On February 9, 2018, we entered into a Note Purchase Agreement with various investors, which included related parties, or the Investors, pursuant to which we agreed to sell the Investors 8% Convertible Promissory Notes, or the Convertible Notes, in the original principal amount up to approximately $16.0 million. On April 2, 2018, we amended the Note Purchase Agreement to, among other things, increase the principal amount available for issuance under the Note Purchase Agreement to approximately $18.4 million. In addition, in connection with the Midcap Financial CSA, we again amended the Note Purchase Agreement to increase the amount available for

issuance under the Note Purchase Agreement to approximately $19.4 million. The Convertible Notes have a maturity date of September 30, 2018 and are convertible either into our common stock or preferred stock, dependent on the conversion events as described in Note 12 to our consolidated financial statements.

As of June 30, 2018, the Company had received proceeds of approximately $14.4 million from the issuance of the Convertible Notes.

Cash Flows

The following table sets forth the cash flow from operating, investing and financing activities for the periods presented:

	Year Ended December 31,		Six Months Ended June 30,	
	2016	2017	2017	2018
Net cash provided by (used in):			(unaudited)	
Operating activities	$ (23,496,358)	$ (20,817,798)	$ (12,353,518)	$ (9,753,922)
Investing activities	(1,349,853)	(1,017,830)	(461,939)	(189,401)
Financing activities	25,431,061	17,607,905	13,232,128	16,545,714

Operating Activities

We derive cash flows from operations primarily from the sale of our products and services. Our cash flows from operating activities are also significantly influenced by our use of cash for operating expenses to support the growth of our business. We have historically experienced negative cash flows from operating activities as we have developed our technology, expanded our business and built our infrastructure and this may continue in the future.

Net cash used in operating activities was $12.4 million during the six months ended June 30, 2017 as compared to $9.8 million during the six months ended June 30, 2018. The decrease in cash used in operating activities of $2.6 million was the result of lower operating losses during the six months ended June 30, 2018 as compared to the six months ended June 30, 2017.

Net cash used in operating activities was $23.5 million during the year ended December 31, 2016 as compared to $20.8 million during the year ended December 31, 2017. The decrease in cash used in operating activities of $2.7 million was primarily the result of increased revenues.

Investing Activities

Historically, our primary investing activities have consisted of capital expenditures for the purchase of capital equipment to support our expanding infrastructure. We expect to continue to incur additional costs for capital expenditures related to these efforts in future periods.

Net cash used in investing activities was $0.5 million during the six months ended June 30, 2017 as compared to $0.2 million during the six months ended June 30, 2018.

Net cash used in investing activities was $1.4 million during the year ended December 31, 2016 as compared to $1.0 million during the year ended December 31, 2017. The decrease in cash used in investing activities of $0.4 million was the result of a decrease in the purchase of property and equipment in 2017.

Financing Activities

Historically, we have financed our operations principally through private placements of our convertible preferred stock and promissory notes and borrowings from credit facilities, as well as gross profits from our commercial operations.

Net cash provided by financing activities was $13.2 million during the six months ended June 30, 2017 as compared to $16.5 million during the six months ended June 30, 2018. The increase in cash provided by financing activities of $3.3 million was the result of proceeds from the issuance of convertible notes of approximately $14.4 million during the six months ended June 30, 2018, compared to proceeds from the issuance (and in advance of issuance) of convertible preferred stock of $13.2 million during the six months ended June 30, 2017. In addition, a new debt financing deal that closed in June 2018 produced net proceeds of approximately $2.5 million.

Net cash provided by financing activities was $25.4 million during the year ended December 31, 2016 as compared to $17.6 million during the year ended December 31, 2017. The decrease in cash provided by financing activities of $7.8 million was the result of the issuance of a smaller aggregate amount of convertible preferred stock in 2017 as compared to 2016.

Capital Resources

We have not achieved profitability since our inception, and we expect to continue to incur net losses in the future. We also expect that our operating expenses will increase as we continue to increase our marketing efforts to drive adoption of our commercial products. Additionally, as a public company, we will incur significant audit, legal and other expenses that we did not incur as a private company. Our liquidity requirements have historically consisted, and we expect that they will continue to consist, of sales and marketing expenses, research and development expenses, working capital, debt service and general corporate expenses.

We believe that the net proceeds from this offering, together with our cash generated from commercial sales and our current cash and cash equivalents, including the proceeds from our recent financings, will be sufficient to meet our anticipated operating cash requirements for at least the next 18 months. In the future, we expect our operating and capital expenditures to increase as we increase headcount, expand our sales and marketing activities and grow our customer base. Our estimates of the period of time through which our financial resources will be adequate to support our operations and the costs to support research and development and our sales and marketing activities are forward-looking statements and involve risks and uncertainties and actual results could vary materially and negatively as a result of a number of factors, including the factors discussed in the section “Risk Factors” of this prospectus. We have based our estimates on assumptions that may prove to be wrong and we could utilize our available capital resources sooner than we currently expect. Our future funding requirements will depend on many factors, including:

- market acceptance of our products;
- the cost and timing of establishing additional sales, marketing and distribution capabilities;
- the cost of our research and development activities; and
- the effect of competing technological and market developments.

We cannot assure you that we will be able to obtain additional funds on acceptable terms, or at all. If we raise additional funds by issuing equity or equity-linked securities, our stockholders may experience dilution. Future debt financing, if available, may involve covenants restricting our operations or our ability to incur additional debt. Any debt or equity financing that we raise may contain terms that are not favorable to us or our stockholders. If we do not have or are not able to obtain sufficient funds, we may have to reduce our commercialization efforts or delay our development of new products. We also may have to reduce marketing, customer support or other resources devoted to our products or cease operations

Contractual Obligations

The following summarizes our significant contractual obligations as of December 31, 2017:

	Payment Due by Period				
Contractual Obligations	Total	Less than 1 year	1-3 years	3-5 years	After 5 years
Operating leases	$ 2,591,952	$ 826,884	$1,765,068	$ —	$ —
Principal payments, interest and end of term fees on loan	8,426,862	8,426,862	—	—	—
	$11,018,814	$9,253,746	$1,765,068	$ —	$ —

Our operating lease obligations primarily relate to leases for our current headquarters in San Diego, California.

We also have ongoing obligations related to license agreements which contain immaterial minimum annual payments that are credited against the actual royalty expense, which are not included in the table above.

Purchase orders or contracts for the purchase of supplies and other goods and services are not included in the table above. We have a contractual commitment with a supplier to purchase $0.1 million of products each quarter until the first quarter of 2019. We are not able to determine the aggregate amount of other such purchase orders that represent contractual obligations, as purchase orders may represent authorizations to purchase rather than binding agreements. Our purchase orders are based on our current procurement or development needs and are fulfilled by our vendors within short time horizons.

Off-Balance Sheet Arrangements

We did not have during the periods presented, and we do not currently have, any off-balance sheet arrangements, as defined under SEC rules, and similarly did not and do not have any holdings in variable interest entities.

Critical Accounting Policies and Estimates

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

While our significant accounting policies are more fully described in Note 2 to our consolidated financial statements appearing elsewhere in this prospectus, we believe that the following accounting policies are the most critical for fully understanding and evaluating our financial condition and results of operations.

Revenue Recognition

Product Revenue

Product revenue represents the sale of our instruments and consumables to third parties. Timing of revenue recognition on instrument sales is based upon when delivery has occurred, the price is fixed or determinable, and collectability is reasonably assured.

The majority of our instruments contain embedded operating systems and other software which is included in the purchase price of the instrument. The software is deemed incidental to the system as a whole as it is not sold or marketed separately and its production costs are minor compared to those of the hardware system. Hardware and software elements are both delivered when ownership is transferred to the customer.

Installation services for direct sale customers are performed at the same time or shortly after the product is delivered and require only a minimal effort to complete. We believe installation is a perfunctory service and is not material to our obligations in the contract.

Other Revenue

Other revenue includes revenue from extended service contracts and other services that may be performed. Revenue for extended warranty contracts is recognized ratably over the service period. Revenue for other services is generally recognized based on proportional performance of the contract, when the Company's ability to complete project requirements is reasonably assured. Deferred revenue represents amounts received in advance for on-going service arrangements. Most of these services are completed in a short period of time from the receipt of the customer's order. When significant risk exists in the Company's ability to fulfill project requirements, revenue is recognized upon completion of the contract.

Multiple Element Arrangements

We regularly enter into contracts where revenue is derived from multiple deliverables, including products or services. These contracts typically include an instrument, consumables, and extended service contracts. Revenue recognition for contracts with multiple deliverables is based on the individual units of accounting determined to exist in the contract. A delivered item is considered a separate unit of accounting when the delivered item has value to the customer on a stand-alone basis. Items are considered to have stand-alone value when they are sold separately by any vendor or when the customer could resell the item on a stand-alone basis.

For transactions with multiple deliverables, consideration is allocated at the inception of the contract to all deliverables based on their relative selling price. The relative selling price for each deliverable is determined using vendor-specific objective evidence, or VSOE, of selling price or third-party evidence of selling price if VSOE does not exist. If neither VSOE nor third-party evidence exists, we use our best estimate of the selling price using average selling prices over an appropriate period coupled with an assessment of current market conditions. If the product or service has no history of sales or if the sales volume is not sufficient, we consider our approved standard prices adjusted for applicable discounts.

In order to establish VSOE of selling price, we must regularly sell the product or service on a standalone basis with a substantial majority priced within a relatively narrow range. In cases where there is not a sufficient number of standalone sales and VSOE of selling price cannot be determined, then we utilize third-party evidence to establish selling price.

Distributor Transactions

In certain markets, we sell products and provides services to customers through distributors that specialize in life sciences products. In cases where the product is delivered to a distributor, revenue recognition generally occurs when title transfers to the distributor. The terms of sales transactions through distributors are generally consistent with the terms of direct sales to customers, except the distributors do not require our services to install the instrument at the end customer and perform the services for the customer that are beyond our standard warranty in the first year following the sale. These transactions are accounted for in accordance with our revenue recognition policy described herein.

Stock-Based Compensation Expense

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

The Black-Scholes option-pricing model requires the use of subjective assumptions, including the risk- free interest rate, the expected stock price volatility, the expected term of stock options, the expected dividend yield and the fair value of the underlying common stock on the date of grant. See Note 8 to our consolidated financial statements included elsewhere in this prospectus for information concerning certain of the specific assumptions we used in applying the Black-Scholes option pricing model to determine the estimated fair value of our stock options granted in the years ended December 31, 2016 and 2017 and the six months ended June 30, 2017 and 2018.

Determination of the Fair Value of Common Stock

We are required to estimate the fair value of the common stock underlying our stock-based awards when performing the fair value calculations using the Black-Scholes option pricing model. Because our common stock is not currently publicly traded, the fair value of the common stock underlying our stock-based awards has been determined on each grant date by our board of directors, with input from management, considering our most recently available third-party valuation of common shares. All options to purchase shares of our common stock are intended to be granted with an exercise price per share no less than the fair value per share of our common stock underlying those options on the date of grant, based on the information known to us on the date of grant.

The third-party valuations of our common stock were performed using methodologies, approaches and assumptions consistent with the American Institute of Certified Public Accountants Audit and Accounting Practice Aid Series: *Valuation of Privately Held Company Equity Securities Issued as Compensation*. In addition, our board of directors considered various objective and subjective factors to determine the fair value of our common stock, including:

- the prices of our convertible preferred stock sold to investors in arm’s length transactions;
- the rights, preferences and privileges of our convertible preferred stock as compared to those of our common stock, including the liquidation preferences of our convertible preferred stock;
- our results of operations and financial position;
- the composition of, and changes to, our management team and board of directors;
- the lack of liquidity of our common stock as a private company;
- the material risks related to our business and industry;
- external market conditions affecting the life sciences and biotechnology industry sectors;
- U.S. and global economic conditions;
- the likelihood of achieving a liquidity event for the holders of our common stock, such as an initial public offering, or IPO, or a sale of our company, given prevailing market conditions; and
- the market value and volatility of comparable companies.

Following the closing of this offering, the fair value of our common stock will be the closing price of our common stock on the date of the grant.

The fair value of the underlying preferred stock was determined using an Option Pricing Method, or OPM. Under the OPM, once the fair market value of the enterprise is established, shares are valued by creating a series

of call options with exercise prices based on the liquidation preference and conversion behavior of the different classes of equity. Accordingly, the aggregate equity value is allocated to each of the classes of equity shares outstanding. The Company utilizes both the market and income approach to establish the fair market value of the enterprise.

Based on the assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus), the intrinsic value of stock options outstanding as of December 31, 2017 would have been $4.0 million, of which $1.7 million and $2.3 million would relate to stock options that were vested and unvested, respectively, at that date.

Preferred Stock Warrant Liability

As of December 31, 2016, and 2017 and June 30, 2018, we had outstanding warrants to purchase 36,676,737, 36,603,557 and 37,228,557 shares of preferred stock, respectively. As of June 30, 2018, we had outstanding warrants to purchase 42,872 shares of Series B convertible preferred stock, 4,085,784 shares of Series B-1 convertible preferred stock, 32,183,234 shares of Series D convertible preferred stock and 916,667 shares of Series D-1 convertible preferred stock. See Note 8 to our consolidated financial statements included elsewhere in this prospectus for information concerning preferred stock warrant issuances during the years ended December 31, 2016 and 2017.

The warrants to purchase preferred stock are valued at each reporting period using the Black-Scholes-Merton model. This valuation includes observable inputs such as risk-free rate, as well as unobservable inputs for assumed volatility, the expected life of the warrants, and the fair value of the underlying preferred stock. See Note 3 to our consolidated financial statements included elsewhere in this prospectus for information concerning certain of the specific assumptions we used in applying the Black-Scholes option pricing model to determine the estimated fair value of our preferred stock warrants as of December 31, 2016 and 2017 and June 30, 2018. Following the closing of this offering, warrants to purchase an aggregate of 35,683,574 shares of preferred stock will be subject to automatic termination and warrants to purchase an aggregate of 1,544,983 shares of preferred stock will adjust into common stock warrants.

JOBS Act

We are an "emerging growth company," as defined in the Jumpstart Our Business Startups Act, or JOBS Act. Under the JOBS Act, an emerging growth company can take advantage of an extended transition period for complying with new or revised accounting standards. This provision allows an emerging growth company to delay the adoption of new or revised accounting standards that have different transition dates for public and private companies until those standards would otherwise apply to private companies. We have elected to use this extended transition period. As a result of this election, our timeline to comply with these standards will in many cases be delayed as compared to other public companies that are not eligible to take advantage of this election or have not made this election. Therefore, our financial statements may not be comparable to those of companies that comply with the public company effective dates for these standards.

For so long as we are an emerging growth company we expect that:

- we will present only two years of audited consolidated financial statements, plus unaudited consolidated condensed financial statements for any interim period, and related management's discussion and analysis of financial condition and results of operations in our initial registration statement;
- we will avail ourselves of the exemption from the requirement to obtain an attestation and report from our auditors on the assessment of our internal control over financial reporting pursuant to the Sarbanes-Oxley Act;

- we will avail ourselves of the extended transition periods available to emerging growth companies under the JOBS Act for complying with new or revised accounting standards; and
- we will provide less extensive disclosure about our executive compensation arrangements.

We will remain an emerging growth company for up to five years, although we will cease to be an "emerging growth company" upon the earliest of: (1) the last day of the fiscal year following the fifth anniversary of this offering, (2) the last day of the first fiscal year in which our annual revenues are $1.07 billion or more, (3) the date on which we have, during the previous rolling three-year period, issued more than $1.0 billion in non-convertible debt securities, and (4) the date on which we are deemed to be a "large accelerated filer" as defined in the Exchange Act.

Recent Accounting Pronouncements

See Note 2 to our consolidated financial statements included elsewhere in this prospectus for information concerning recent accounting pronouncements.

Quantitative and Qualitative Disclosures about Market Risk

The market risk inherent in our financial instruments and in our financial position represents the potential loss arising from adverse changes in interest rates. As of June 30, 2018, we had $7.6 million in cash and cash equivalents, consisting of non-interest and interest-bearing bank accounts. Our primary exposure to market risk is interest rate sensitivity, which is affected by changes in the general level of U.S. interest rates. Due to the short-term, low-risk profile of our bank accounts, an immediate 100 basis point change in interest rates would not have a material effect on the fair market value of our cash equivalents.

Internal Control Over Financial Reporting

Pursuant to Section 404(a) of the Sarbanes-Oxley Act, commencing the year following our first annual report required to be filed with the SEC, our management will be required to report on the effectiveness of our internal control over financial reporting. To comply with the requirements of being a reporting company under the Exchange Act, we will need to implement additional financial and management controls, reporting systems and procedures and hire additional accounting and finance staff, as well as potentially upgrade our information technology systems.

BUSINESS

Overview

We are a life sciences instrumentation company in the genome analysis space. We develop and market the Saphyr system, a platform for ultra-sensitive and ultra-specific structural variation detection that enables researchers and clinicians to accelerate the search for new diagnostics and therapeutic targets and to streamline the study of changes in chromosomes, which is known as cytogenetics. Our Saphyr system comprises an instrument, chip consumables, reagents and a suite of data analysis tools.

Structural variation refers to large-scale structural differences in the genomic DNA of one individual compared to another. Each structural variation involves the rearrangement or repetition of as few as hundreds to as many as tens of millions of DNA base pairs. Those rearrangements may be insertions, deletions, duplications, inversions or translocations of segments of one or more chromosomes. Structural variations may be inherited or arise spontaneously, and many cause genetic disorders and diseases. Until our commercial launch of the Saphyr system in February 2017, and since, we believe no products existed or exist that could more comprehensively and cost and time-efficiently detect structural variation.

Our Saphyr system comprises an instrument, chip consumables, reagents and a suite of data analysis tools. Our customers include researchers and clinicians who seek to uncover and understand the biological or clinical impact of genome variation to improve the diagnosis and treatment of patients with better clinical tests and new medicines or to replace existing cytogenetic tests that are expensive, slow and labor-intense, with a modern solution that simplifies workflow and reduces costs and that has the potential to significantly increase diagnostic yields across the industry. Our customers also include researchers in non-human segments such as agricultural genomics where they seek to advance their understanding of how structural variation impacts industrial applications of plants and animals. We have established relationships with key opinion leaders in genomics research and clinical applications, including rare diseases and oncology, and our installed base of over 90 systems made up of Saphyr and its predecessor system includes some of the world's most prominent clinical, translational research, basic research, academic and government institutions as well as leading pharmaceutical and diagnostic companies. Examples include Children's National Health System, DuPont Pioneer, Garvan Institute of Medical Research, Genentech, Icahn School of Medicine at Mount Sinai, McDonnell Genome Institute at Washington University, National Institutes of Health, Pennsylvania State University and Salk Institute for Biological Studies. Our revenues in 2017 were \$9.5 million, representing approximately 40% growth over the prior year, and for the first half of 2018 our revenues were \$5.2 million, representing approximately 32% growth over the prior year comparable period. Our cumulative revenues for the period from January 1, 2016 through June 30, 2018 from each of the customers listed above were, respectively, \$0.5M, \$0.5M, \$0.3M, \$0.3M, \$0.1M, \$0.4M, \$0.1M, \$0.3M, and \$0.1M.

Approximately 6,000 research use only, or RUO, high throughput sequencers are currently installed worldwide. These sequencers are developed and sold almost entirely by Illumina and are owned by an estimated 3,000 unique customers. Sequencing is very good at detecting genome differences involving just a few base pairs or single-nucleotide variations, which Saphyr cannot detect, but sequencing including next-generation sequencing, or NGS, cannot reliably detect the larger structural variations that our Saphyr system can detect. Therefore, Saphyr is being adopted alongside this installed base of sequencers as a complement that gives users the ability to see a much wider scope of genome variation than ever before.

The Saphyr system, which is for RUO, is also beginning to be adopted by cytogenetics labs that seek to use it in commercial clinical tests of its patients as an LDT. These labs currently rely on existing methods such as karyotyping, fluorescence in situ hybridization, or FISH, and microarrays for clinical tests and research that look at chromosomal structure, location and function in cells. Major guidelines for oncology and genetic disease clinical diagnostics recommend first-line structural variation testing by these existing methods. The organizations issuing these guidelines include, among many others, World Health Organization (WHO), National

Comprehensive Cancer Network (NCCN), American College of Medical Genetics (ACMG) and American College of Obstetricians & Gynecologists (ACOG).

Saphyr and its predecessor system, which we collectively refer to as our system in this prospectus, have been cited by researchers and clinicians in approximately 130 publications covering structural variations in areas of high unmet medical need and research interest, such as rare and undiagnosed pediatric diseases, muscular diseases, developmental delays and disorders, prostate cancer and leukemia. Importantly, Saphyr can be used alone to provide comprehensive detection of structural variations and enable diagnostic calls without the need for any sequencing or cytogenetic technology.

Industry Background

Genome analysis is the process of extracting biological information from DNA. DNA is the code that is found in all living cells and determines the characteristics and health of all living organisms. Although each organism's DNA order is unique, all DNA is composed of the same four nucleotides that come in pairs, which are referred to as base pairs. The human genome is composed of six billion of these base pairs (three billion of which are the maternal copy and three billion of which are the paternal copy of the genome), distributed across 23 pairs of chromosomes ranging in size from approximately 50 million to approximately 250 million base pairs. Genome variation is defined as at least one base pair differing in a comparison of sequence against a reference standard and can be as large as tens of millions of base pairs.

It had long been believed by the scientific community that all problems in genome analysis could be addressed by DNA sequencing, which is a method of determining the precise order of the bases adenine (A), guanine (G), cytosine (C) and thymine (T) in a genome. Many in the industry felt that the only bottlenecks for sequencing companies to address were the cost per genome and the throughput of the sequencers. If these issues could be addressed, it was generally believed that sequencing would usher in a new wave of medical-grade genome analysis that would give rise to an abundance of highly impactful discoveries in medicine. These discoveries would lead to novel therapies and patient management pathways driven by exquisitely specific and sensitive diagnostic tests.

In recent years, however, it has become evident that sequencing is not completely fulfilling the needs of researchers and clinicians. For example, after 10 years with next-generation sequencing in use, the diagnostic yields of the leading genetic testing laboratories in the world continue to hover around only 50%, which is where they have been for at least two decades, meaning that only half of patients receive a confirmed pathogenic diagnosis. Researchers and clinicians now agree that despite major advances in the speed and cost-effectiveness of sequencing, it fails to reliably detect structural variations, which represent an entire class of genome variation.

Structural variation is one of the most biologically important aspects of the human genome. It is the underlying driver of many known human diseases, including numerous genetic disorders, inherited diseases and cancer. Structural variations occur when relatively large groups of base pairs change their existence or position in the genome relative to a normal standard. Structural variations can be as small as a few hundred base pairs or as large as tens of millions of base pairs and can be confined to one chromosome or can unfold between chromosomes. The changes can be rearrangements in location, order or orientation, and they can involve the insertion, deletion or duplication of entire blocks of base pairs. As an example of the importance of structural variations, thousands of base pairs can be rearranged and result in the ABL gene from one chromosome joining the BCR gene on an entirely different chromosome to form BCR-ABL, an oncogenic fusion gene which causes certain leukemias.

We believe the available methods to detect structural variations for research and clinical applications, other than Saphyr, are antiquated and cumbersome and can only detect a small proportion of the structural variations across an entire genome. These methods therefore have very limited utility in population research studies that seek to discover new structural variations to explain pathology. Without additional tools, researchers and

clinicians cannot comprehensively study the genome, which will ultimately result in the failure of genomics to deliver on its full promise of new therapies and diagnostics.

The Saphyr system provides a solution for comprehensive structural variation analysis. The Saphyr system is a proprietary, sample-to-result platform based on physical mapping of the genome, which is the process of assigning the chromosomal location, order and orientation of the functional elements of the genome. We believe that Saphyr is the only product capable of detecting structural variations at high sensitivity and specificity with a workflow that is cost-effective and time-efficient. A complete and accurate physical map of the genome enables the user to much more readily and systematically detect the structural variations that sequencing and cytogenetics technologies miss. Our mapping makes it possible for researchers and clinicians to more comprehensively detect structural variations and measure the complete scope of genome variation present in their study populations.

Market Opportunity

According to Research and Markets, the worldwide market for genomics products and services is expected to reach approximately $23.9 billion by 2022, up from approximately $14.7 billion in 2017, representing a compound annual growth rate of 10.2%. We believe that the market opportunity is predominantly split among three regions: North America, Europe and Asia. Within Asia, one of the fastest growing genomics markets is China, where adoption of genome analysis technology has been growing at approximately 20% per year.

The two segments of the genomics market that are driving the uptake of our product are:

- ***Sequencing for Discovery Research.*** In discovery research across patient cohorts, sequencing is primarily used to find single nucleotide variations responsible for disease or therapeutic response. Sequencing alone, however, is significantly limited due to its inability to reveal structural variations. Our Saphyr system has been expanding this market segment by complementing sequencing to expand the scope of genome variation that can be analyzed in a study and achieve a more comprehensive view of the genome.
- ***Cytogenetics.*** To provide a clinical diagnosis, cytogenetic tests detect known variations that are linked to specific diseases or therapeutic responses. The technologies used for detecting structural variations are expensive and involve cumbersome workflows with relatively limited ability to scale to higher volumes or more complex testing panels. Sequencers tend not to be used for cytogenetics due to their inability to reliably detect structural variations. Cytogenetics laboratories are beginning to adopt Saphyr as a more effective and efficient approach to finding the structural variations relevant to cytogenetics. For this segment, Saphyr is used alone to provide comprehensive detection of structural variations and enable diagnostic calls without the need for any sequencing or cytogenetic technology.

We believe that the discovery research and cytogenetics segments together comprise an addressable opportunity for us to sell up to approximately 8,500 Saphyr systems, representing a current total instrument market opportunity of approximately $2.1 billion. Importantly, we expect this market opportunity to expand at the rate of adoption of new RUO high throughput sequencers which we estimate is over 15% per year. While we do not expect the number of cytogenetics labs to increase significantly, we do expect our growth in this market to be driven by conversion of traditional cytogenetics methodologies to our Saphyr system.

In addition to the instrument sales opportunity, Saphyr instruments generate recurring revenue from chip consumables that are used on a per-sample basis. We believe each Saphyr instrument has the potential to create recurring revenue in a range of approximately $75,000 to approximately $150,000 per year, suggesting a potential annual recurring revenue opportunity of approximately $0.6 billion to approximately $1.3 billion.

Therefore, we believe that our currently addressable portion of the genome analysis market is estimated to be between $2.7 billion and $3.4 billion.

Existing Technologies and Their Limitations

Existing technologies fail to adequately address the need for structural variation detection because they do not overcome the inherent complexity of the genome or they are not capable of providing a cost-effective, scalable solution to meet the increasing demands of genomics research and clinical applications.

The Genome Is Complex

Genome composition itself makes the measurement of genome structure and structural variation inherently difficult. Genome sequence is built from combinations of only the A, G, C and T nucleotides. The nucleotides have a natural pairing system in which A pairs with T and G pairs with C. Each pair of nucleotides is referred to as a base pair. In humans, the approximately six billion base pairs are distributed across 23 pairs of chromosomes. A chromosome is an organizational unit that biology has evolved to compartmentalize genomic information. One set of 23 chromosomes (three billion base pairs) is inherited from each parent. Within each chromosome, the base pairs are organized into functional elements such as genes, which code for protein production, and other elements that regulate how and when the genes are expressed for protein production.

The six billion base pairs that make up the human genome cannot be read by any existing technology in a simple linear, contiguous fashion. Due in part to only four unique nucleotides being available to write the entire genetic code, it is very common for stretches of sequence to be identical either within the same chromosome or between chromosomes. As much as two-thirds of the human genome is made up of repetitive DNA sequences. This repetition tends to cause structural variations to be flanked by sequences that are identical to sequences in other parts of the genome which further complicates structural variation detection.

The Genome Orchestrates Life and Genome Structure Is Key

Genome structure is the way in which the functional elements are organized. Namely, the location on each chromosome where the gene or functional regulatory elements are found, what order and orientation they are in and how many of each element are present. This organization is an essential part of the instructions that the organism uses in every one of its cells to develop and differentiate and to react and respond to its environment over its lifetime. When this critical location, order, orientation or quantity vary, it is termed structural variation.

Even though both single nucleotide variation and structural variation are each very common, a much larger number of variant nucleotides in the average human genome are found in structural variations as compared to single nucleotide variations. A recent study showed that 30 million base pairs, on average, in the human genome are part of structural variations while only 10 million are single nucleotide variations. Most variations are inconsequential and make up the background variation responsible for the diversity of life. Over time, these variations can randomly affect genes and proteins which, through natural selection, drive diversity and evolution across species and diversity within them. Variations can also cause disease.

Relative to single nucleotide variations, structural variations are much more apt to be profoundly disruptive. They often cause a tectonic shift in the genome. These genomic shifts can have devastating effects on the health of a human. Examples where structural variations caused a disruption of genes resulting in disease include:

- dystrophin gene variation – structural variation disrupting dystrophin production that is found in Duchenne Muscular Dystrophy;
- 9pminus variation – deletion found in a rare developmental syndrome in children;
- TMPRSS2-ERG fusion – gene fusion found in prostate cancer;
- EML4-ALK fusion – gene fusion found in lung cancer; and
- BCR-ABL fusion (Philadelphia chromosome) – gene fusion found in leukemias such as chronic myelogenous leukemia, acute lymphoblastic leukemia and acute myelogenous leukemia.

It is important to detect these structural variations and the potentially thousands of other structural variations in each individual. Sequencing and cytogenetics simply do not elucidate comprehensive structural variations in a systematic and cost- and time-efficient manner. Most structural variations found to date that have been implicated in disease, such as those listed above, were discovered through laborious, expensive, unindustrialized and non-comprehensive methods over the course of many years. Thousands of additional important structural variations are believed to exist and are expected to be found with a systematic structural variation detection tool such as our Saphyr.

The Limitations of Sequencing

As the first complete draft of the human genome was being assembled in 2000, the belief arose that most questions in genome analysis could be addressed by sequencing. Over the course of over 15 years, sequencing proliferated across the entire genome analysis community with Illumina becoming the clear sequencing industry leader. As more sequencing data emerged, it became apparent that sequencing alone would not adequately elucidate the causes of human disease. The promise of sequencing was not fully delivered due to sequencing's inability to address the complexities of genome composition.

Nearly all genome sequencing, including next-generation sequencing, uses a method called sequencing by synthesis. Sequencing by synthesis is an in-vitro process for synthesizing a copy of DNA, one base at a time in a way that makes it possible to measure the identity of each base as it is incorporated into the growing DNA copy. Sequencing by synthesis involves cutting genomic DNA into small pieces of a few hundred base pairs each, amplifying these pieces many times and anchoring them to a solid support where they are copied by a polymerase using fluorescently labeled bases. These copies are called sequencing reads. Illumina, which is the world leader in next-generation sequencing technology, markets systems that provide average read lengths that are 100 to 300 base pairs long. These short reads are matched by computer programs to a reference genome in a process called alignment. The reference is meant to represent the "standard" human genome in a normal, non-diseased state. It is the result of billions of dollars spent on the Human Genome Project and other initiatives begun in the late 1990s and early 2000s to put together the first complete set of human DNA code. When a patient's genome is sequenced today, the short reads are compared against the reference as a template. Using this approach, sequencing attempts to reconstruct, or "resequence," the genome and infer genome variations.

The read lengths typical for next-generation sequencing are often too short to determine the right location and orientation of a reading frame in the genome because many of the reads from one chromosome are identical to reads from either another chromosome or even another location on the same chromosome. When reads are indistinguishable from one another, computations cannot be performed to place the reads in the correct location in the genome.

The other significant limitation with next-generation sequencing is that the genome fragments used as templates in the copying process are also very short. This fragmentation is a result of the methods used for DNA isolation from the cell and the use of polymerase chain reaction, or PCR. These short lengths disconnect and destroy most of the structural information of the original genome and make next-generation sequencing unable to reliably detect genomic variations larger than a few hundred base pairs.

If the sequencing reads were accurate, on the order of hundreds of thousands of base pairs long and from templates that were even longer, they would overcome the redundancy of genome composition and every read would have a unique position in the genome. It would then be possible to assemble a structurally accurate picture of the genome. Accurate structural variation would be revealed upon comparing structurally accurate assemblies of genomes across a population to determine the structural changes that are driving the observed pathology or physiology.

The recognition of the need for greater lengths of sequence reads to determine genome structure, birthed the so-called long-read sequencing submarket. Because of the need for long-read sequencing, Pacific Biosciences of

California developed a system that uses another alternative form of sequencing by synthesis, while Oxford Nanopore Technologies developed a system that uses nanopore technology. These systems provide users with average read lengths in the tens of thousands of base pairs. However, these read lengths have proven not to be long enough to reliably and comprehensively detect structural variations. Pacific Biosciences' polymerases cannot regularly produce reads that are the necessary hundreds of thousands of base pairs in length. In addition, Oxford Nanopore's system has difficulty reliably feeding molecules that are, on average, hundreds of thousands of base pairs in length through each nanopore. The time and cost of providing a comprehensive whole genome analysis of a patient in a clinical setting is prohibitive when using these longer-read technologies.

In summary, all existing sequencing technologies, whether short or long, do no provide a solution for integrating structural variation into patient diagnosis and management.

The Limitations of Cytogenetics

Cytogenetics is the study of chromosomal structure and how structural variations impact health. The field has historically relied on karyotyping, FISH and more recently, microarrays. These methods each can detect some structural variations, but they are all inadequate solutions for high volume and low cost genetic testing for structural variations and none is an approach that can comprehensively detect structural variations with the ultra-high sensitivity and ultra-high specificity of the Saphyr system.

Karyotyping

Karyotyping is the gross optical examination of the chromosomes using a microscope. It is a laboratory technique, modernized in the 1960s, whereby the chromosomes from one cell are stained and visualized by a pathologist or technician to investigate the total number and structure of chromosomes.

Karyotyping has many limitations. It is cell culture dependent and therefore requires live and actively dividing cells. Karyotyping has extremely low resolution and is therefore only sensitive for very large structural variations that are unambiguous to identify. Given that chromosomes are being directly viewed on a slide by a pathologist with a microscope, resolution tends to be limited to structural events that are larger than five million base pairs. When karyotyping is used to diagnose unknown genetic disease, only about 5% of karyotyping tests result in a confirmed pathogenic finding. The test is costly, and its results are subject to each pathologist's interpretation which introduces variability in diagnostic calls and makes the methodology not amenable to automation.

FISH

FISH is a molecular cytogenetic technique that is used to detect chromosomal aberrations. FISH is based on the idea of using a specifically developed probe to detect a particular gene abnormality that is suspected to be in the genome. When the probe finds targeted variation, it binds to it and generates a fluorescent signal which is observed with a fluorescence microscope.

Several characteristics of FISH limit its productivity and efficiency for use in structural variation detection. Like karyotyping, it is cell culture dependent and therefore requires live and actively dividing cells. Also, FISH is limited to known targets and cannot be used for discovery. Every FISH test performed needs to be chosen to look for a specific genetic marker that the clinician anticipates may be found based on the clinical symptoms of the patient. In addition, the test results can be ambiguous and inconclusive, and reproducibility and variability among users can be a significant issue. Like karyotyping, FISH's diagnostic yield is very low when used to diagnose unknown genetic disease with only an estimated 7% of FISH providing a confirmed pathogenic finding. In addition, FISH is expensive, especially for the limited amount of information that it provides.

Microarrays

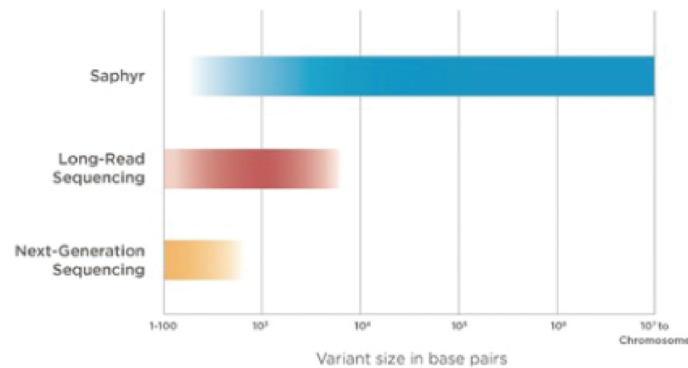
Chromosomal microarrays and SNP (single nucleotide polymorphism) arrays are tests consisting of slides that contain thousands of spots of DNA fragments that bind to the DNA of the sample. Microarrays detect gains and losses of specifically chosen DNA sequence and can also infer gene expression levels. Microarrays interrogate thousands of genes simultaneously that are known to be associated with presumed genetic disorders of interest to the user. Probe coverage is typically highly focused in regions of known clinical significance.

Microarrays have limited utility as a diagnostic tool as they are only useful when there are gains and losses of base pairs within the sample's genome that are specific to the probes that are populated on the array. Microarrays are also limited in their ability to provide specific locations of gains or losses on a chromosome, or even identify on which chromosome that the gains or losses occur. In addition, microarrays have low resolution as they cannot reliably detect structural variants smaller than 50,000 base pairs. Also, the diagnostic yield of microarrays is low. Only an estimated 20% of microarray tests provide a confirmed pathogenic finding when used to diagnose unknown genetic disease.

Our Solution

Our approach to measuring genome structure and structural variation is novel and highly differentiated. Most efforts in the genomic industry to address structural variation have been based on taking sequencing by synthesis as the starting point and attempting to overcome its deficiencies to make it applicable to structural variation analysis. In contrast, the Saphyr system directly observes extremely long genomic DNA without any amplification to construct a physical map that accurately assigns the chromosomal location, order, orientation and quantity of all the genome's functional elements. Our solution is built upon four key elements:

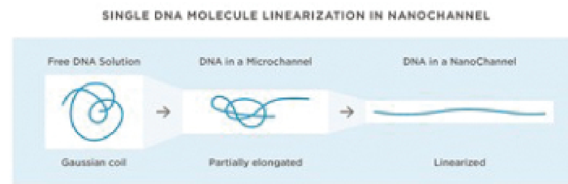
- **Extremely long molecules for analysis.** Structural accuracy can only come from analysis of extremely long chromosomal fragments. The Saphyr system is capable of analyzing single molecules that are on average approximately 250,000 base pairs long. Such fragments will contain enough unique sequence information that they are distinguishable from other fragments. These lengths are over 1,000 times longer than the average read length with Illumina systems and approximately 10 times longer than the average read lengths with Pacific Biosciences and Oxford Nanopore systems. Building a picture of the genome with massive building blocks overcomes the inherent challenge of genome complexity and is the key to Saphyr's unprecedented sensitivity and specificity.



- **Proprietary nanotechnology for massively parallel linearization and analysis of long molecules with single molecule imaging.** Analyzing these extremely long chromosomal fragments required invention. Molecules of this size are more like balls of yarn in a test tube and must be unraveled for meaningful analysis. We invented, patented, developed and commercialized nanochannel arrays to

capture them from solution and unwind and linearize them for structural variation analysis. Each molecule is imaged separately, making it possible to deconvolute complex mixtures including haplotypes and heterogeneous tumors, as shown in the graphic below.

SINGLE DNA MOLECULE LINEARIZATION IN NANOCHANNEL



- **DNA labeling chemistry specifically for physical mapping.** The detailed analysis of sequence we use is also highly unique and novel. Instead of identifying the sequence of every base pair in these long fragments, we label and detect specific sequence patterns or motifs that occur universally across every genome with an average frequency of approximately one site for every few thousand base pairs. The key to our method entails introducing fluorescent tags at the sequence-specific site using highly specific and robust enzymatic chemistry along the extremely long fragments. These fragments, stretched out in nanochannels, are then directly imaged allowing us to measure the distance between labels with high accuracy. The pattern of labels detected on all these fragments can then be related to the pattern of sequence motif sites in a reference genome for comparison. Changes in the pattern indicate structural variation.
- **Bioinformatic tools for structural variation analysis.** Finally, our approach includes a novel bioinformatics platform that we developed from the ground-up to take advantage of the unique benefits of our solution. It comprises proprietary algorithms for the construction of a structurally accurate physical map of the genome without using a reference genome in assignment of structure. Physical maps of a test subject are then compared in cross-mapping analysis that allows our system to detect genome wide structural variation, including the most complex balanced events. Our system can do so by comparing one physical map against a common reference, or against the maps of a mother and father in the case of an afflicted child with an undiagnosed disease for example, or against maps of normal blood when studying solid tumor cancers. This comparative approach uses our proprietary database of healthy individuals to filter out the non-disease causing structural variants found in the general healthy population.

Our Focus Areas

Our Saphyr system serves many segments of the genomics market seeking to find and understand structural variation. We have identified focus areas where we concentrate our resources to ensure robust adoption of our system and frequent utilization of consumables. We have selected these segments because of their urgent need to detect structural variations and the significant economic opportunity they represent. Our current focus areas are human genetic diseases, including rare diseases and oncology. Our Saphyr system, which is for RUO, is being used for basic and translational research and also beginning to be adopted by cytogenetics labs that seek to use it in commercial clinical tests of its patients as an LDT.

Rare Diseases

In genetic disease, existing tools have reached a plateau where almost half of patients with genetic disease who are tested in clinical laboratories fail to receive a molecular diagnosis. In order to increase diagnostic yield, a massive increase in the understanding of the complete structure and variation of the genome is essential. We believe the various studies presented below illustrate how Saphyr is essential to achieving this objective.

Example: Undiagnosed Diseases Network Patient

The National Institutes of Health funded Undiagnosed Diseases Network, or UDN, brings together top clinical and genomics teams from several key institutes in the U.S. to study the most difficult to diagnose genetic disease patients. Through a collaboration with UCLA, Dr. Eric Vilain of Children's National Medical Center runs all UDN patients of the UCLA cohort on Saphyr to identify pathogenic variants that go undetected using sequencing or cytogenetics in known or novel genes.

While data collection and a full analysis of the cohort is ongoing, at the American Society of Human Genetics, or ASHG, annual meeting, Dr. Vilain's team presented preliminary results on the first 12 UDN patients and their parents analyzed with Saphyr. In each family, Saphyr detected thousands of variants of which more than 100 were rare, and typically three to seven structural variations that were new to the patient, referred to as de novo structural variations, were identified. In one case presented at ASHG, whole genome sequencing and chromosomal microarray on the DNA of a girl with developmental delay, autism, poor sleep and self-mutilation failed to identify pathogenic variants. Saphyr was able to detect a 2,500-base pair insertion inherited from the father in a gene where whole genome sequencing had picked up a random mutation inherited from the mother. Together, the two variants create a compound heterozygous mutation in a gene with a known phenotype that includes poor sleep, developmental delay and autism with self-mutilation. Large heterozygous insertions like the one presented here are seldomly detected by next-generation sequencing and are too small for microarrays. The diagnosis of this patient was only possible by the combination of next-generation sequencing and Saphyr.

Based on Dr. Vilain's results, including a study on patients with Duchenne Muscular Dystrophy published in Genome Medicine, Saphyr targets the 40% to 70% of genetics patients who cannot be diagnosed with exome or whole genome sequencing. Saphyr has the power to replace multiple tests for genetic disorders, including microarrays, PCR tests and chromosomal cytogenetic tests. Each existing test requires a patient to visit a clinician and most often provides an inconclusive result. Dr. Vilain showed evidence that integration of Saphyr into existing diagnostic regimens can help to change the way that medicine is practiced.

Example: Rare Familial Cancer

A rare cancer, occurring in approximately one in one million people, was found in four members of a single extended family. A team at MD Anderson Cancer Center had used all standard clinical tools and whole genome sequencing on the affected family members but failed to identify any causative variants. Using Saphyr data, a 38,000-base pair sequence was found in these patients in six tandem copies, while unaffected family members had a single copy of this sequence. The duplication was found to be upstream of an important gene in the pathway known to be upregulated in this rare cancer. The identification of this mutation could be useful for pre-implantation embryo analysis and targeted treatments.

Example: Repeat Expansion Disorder

In a study by Dr. Eric Wang of the University of Florida, Saphyr was able to precisely count the number of times that a sequence segment was repeated in muscle cells derived from a patient with Myotonic Dystrophy. This devastating disease is a repeat expansion disorder, caused by the extreme lengthening of short repeat array in the genome. Other diseases in this category include ALS, Huntington's Disease, and Fragile-X disease. Current methods that do not utilize our Saphyr system cannot measure the length of such repeat arrays accurately. Saphyr's ability to measure the normal and expanded repeat with unprecedented accuracy and detail on single molecules could help allow the development of better targeted tests and medicines.

Example: Greenwood Genetic Center

Greenwood Genetic Center, based in South Carolina, has acquired Saphyr as part of a project to increase the diagnostic yield for patients with genetic disorders and cancer. As one of the first centers in the world to

introduce next-generation sequencing in a diagnostic setting, Greenwood Genetic Center aims to introduce a lab developed test, or LDT, based on Saphyr. As such, a number of patients with a variety of birth defects and developmental disorders are being analyzed on Saphyr.

In genetic disease, the standard of care consists usually of a combination of both phenotype-dependent targeted tests, and whole-genome analysis approaches. Targeted tests can consist of Multiple Ligation Probe Amplification, or MLPA, to test for the presence or absence of specific exons, PCR amplification and Sanger sequencing of candidate genes and multiple FISH probes to pick up specific structural variants common to the expected disease. For whole genome approaches, first tier diagnostic tools include karyotyping techniques like metaphase chromosome spreads and in some cases microarrays. More recently, whole exome sequencing or whole genome sequencing are increasingly being introduced.

A future workflow in which Saphyr replaces the large majority of FISH and MLPA tests for a genetics clinic such as Greenwood Genetic Center would rely on Saphyr to detect all structural variants larger than 500 base pairs, and on next-generation sequencing to detect all single nucleotide variants and other variants smaller than 500 base pairs. Since up to numerous FISH and MLPA tests are often performed, Saphyr's single whole genome analysis provides a cost effective solution that saves significant amounts of time, labor and analysis in lieu of such tests.

Oncology

In cancer, each patient has a unique disease with a complex pattern of genome changes. Traditional and recently-developed treatments do not attack the individual changes in each patient's tumor. Recent personalized medicine programs aim to provide clinicians with individual treatments specifically targeting the mutations found in each patient's cancer. For personalized cancer medicine to be successful, all variants in the cancer genome need to be detected, which is not feasible with cytogenetic or whole genome sequencing approaches. The studies presented below demonstrate that Saphyr is critical for a complete understanding of a cancer genome, which is essential to enable truly targeted treatments.

Example: Hematologic Malignancies

In a study to be published in Nature Genetics, Dr. James Broach, Director of the Penn State Institute for Personalized Medicine, presented system's ability to detect large rearrangements in leukemia, with a strong focus on translocations. In his research, our system detected all known translocations identified with standard clinical tools and, importantly, many structural variations never before identified in cancer, plus hundreds of structural variations that could not be seen by other methodologies.

Attempts by Dr. Broach to detect translocations using next-generation sequencing were unsuccessful because of the large number of false positive translocation calls. Because of the highly repetitive nature of the human genome, many remote genomic regions have high sequence homology, and short-read sequencing often fails to correctly map reads to the correct genomic origin, leading to excessive false positive calls. The extremely long molecules that our system analyzes span long repetitive segments of sequence and can anchor sequences into the correct genomic context, leading to extremely few false positive calls.

Given the high speed, low cost, industry-leading sensitivity and high reliability of our system displayed in this study, Dr. Broach showed evidence that our system is well positioned to eventually become the primary tool for clinical detection of genomic structural variation.

Example: Prostate Cancer

In a study published in Oncotarget, Dr. Vanessa Hayes at the Garvan Institute of Medical Research in Australia presented a complete tumor-normal comparison from a primary prostate cancer. Dr. Hayes' team

identified 85 large somatic deletions and insertions, of which half directly impact potentially oncogenic genes or regions. Only 11% of these large structural variations were detected using high-coverage, short-read next-generation sequencing and bioinformatics analyses using a combination of the leading structural variation calling algorithms for next-generation sequencing data. Many structural variations detected with our system were flanked by repetitive sequences, making them undetectable to short-read sequencing.

In subsequent studies presented at the Advances in Genome Biology and Technology annual meeting, Dr. Hayes detected several oncogenic driver mutations in metastasized prostate cancer samples. Several of the reported mutations were variants previously found in other cancer types but never before reported in prostate cancer, and for which effective treatments are available. Existing gene panels or FISH tests performed on cancer samples only test for expected variants. Our system's whole genome analysis approach is the only molecular method that is capable of identifying all major structural variants in a cancer genome with sufficiently high sensitivity. To make existing targeted cancer therapies more effective and to discover new ones, a complete characterization of the genome is important, making our system valuable in personalized cancer medicine.

Our Products

We develop and market the Saphyr system, a complete sample-to-result solution for structural variation analysis that empowers comprehensive genome analysis and facilitates a deeper understanding of genetic variation and function. We believe it is the only solution capable of addressing the needs for structural variation analysis because it is:

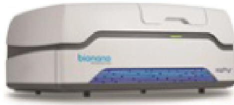
- **Highly sensitive.** We believe Saphyr is the most sensitive structural variation detector currently on the market in that it can identify structural variations that no other system can.
- **Highly specific.** The structural variations found by Saphyr are found by direct observation rather than inference. Saphyr has a very low false positive rate, typically less than 2%.
- **Cost effective.** We anticipate that the Saphyr users' cost per sample will reach $500 in 2018, which would represent one-tenth of what it was in 2014. We expect this cost per sample to continue to decline to less than $300 per sample in 2019 and less than $100 per sample in 2020.
- **Fast.** Saphyr generates greater than 640 giga base pairs of information per day, on par with some of the faster short-read sequencers in the market. For highly sensitive structural variation detection, this allows Saphyr to process two human samples per day. We expect Saphyr's throughput to increase to six per day by the middle of 2019 and 12 per day by the end of 2020. Over this same period, we expect to continuously improve the automation of sample prep and bioinformatics to help drive efficiencies of workflow.

Saphyr is being adopted across an extensive base of customers in world-class clinical, translational research, basic research, academic and governmental institutions as well as pharmaceutical and biotechnology companies.

We began marketing the Saphyr system in February 2017 after previously marketing Irys, our first-generation system, which was a slower system. We sell through a direct sales force and support organizations in North America and Europe, and through distribution partners in the Asia-Pacific and other regions of the world. We have sold more than 90 of our systems to over 80 customers globally. We continually seek to expand our product offerings to meet the needs of our customers.

When customers adopt the Saphyr system, they acquire one or more instruments, chips, reagents for DNA isolation and labeling and a suite of bioinformatics tools. The chips and reagents are used on a recurring basis. We also sell them ancillary solutions such as servers, reagents and other non-proprietary components used with the system. We designed Saphyr to accommodate performance upgrades without the need for replacement of the entire instrument. We intend for these performance enhancements to be delivered through software upgrades, purchased hardware upgrades and new chips and reagents.

The Saphyr Instrument



The Saphyr instrument is a single-molecule imager that includes high performance optics, automated sample loading based on machine learning algorithms and computational hardware and control software. The instrument’s high-performance optics simultaneously image DNA linearized in hundreds of thousands of nanochannels. The instrument’s control interface is the user’s primary control center to design and monitor experiments as they occur in real time. The computational hardware is responsible for the secondary processing of the image data being produced on the Saphyr.

The Saphyr instrument currently analyzes one Saphyr chip, containing up to two samples, per day with statistically relevant depth of coverage across each whole genome. An upgrade of the capability of the Saphyr instrument to process two chips, instead of one, per run is planned for the middle of 2019. This instrument upgrade along with the planned improvements to the chip mentioned below will enable Saphyr to process up to six human samples per day by the middle of 2019 and 12 per day by the end of 2020.

The Saphyr Chip

The Saphyr chip is the consumable that packages the nanochannel arrays for use in genome analysis. In its current form, each Saphyr chip has two flow cells. Each flow cell contains approximately 120,000 nanochannels that are roughly 50 nanometers wide and can hold a unique sample, which enables a researcher to analyze two samples per chip per day. We plan to offer a new chip to our customers in the middle of 2019 that will have three flow cells which, combined with the instrument upgrade mentioned above, will allow Saphyr to process six human samples per day. In 2020, we expect to offer a 12-flow cell version of the chip. The instrument at that time will be able to run two chips per run; however, given the increased processing load of the 12-flow cell chip relative to the three-flow cell chip, Saphyr is expected to take two days to process two 12-flow cell chips, thereby enabling a throughput of 12 samples per day in 2020.

To manufacture the arrays, we use photolithography in a semiconductor fabrication facility to print hundreds of thousands of tiny grooves on silicon wafers and then dice the wafers into individual chips. Our chips are inexpensive to manufacture and highly scalable. The fluidic environment in each channel allows individual molecules to move swiftly utilizing only the charge of DNA. Our nanochannels allow only a single linearized molecule at a time to enter a given channel while preventing the molecule from tangling or folding back on itself. Importantly, hundreds of thousands of molecules can move through hundreds of thousands of parallel nanochannels simultaneously, enabling extremely high-throughput processing on a single-molecule basis.

Saphyr Sample Prep and Labeling Kits

Our Bionano Prep Kits™ and labeling kits provide the critical reagents and protocols needed to extract and label high molecular weight, or HMW, DNA for use with the Saphyr™ system. These kits are optimized for performing our genome mapping applications on a variety of sample types.

Our workflow begins with the isolation of ultra-high molecular weight DNA. Our sample prep kits are optimized for isolating and purifying ultra-high molecular weight DNA in a process that is gentler than existing DNA extraction methods. The resulting purified DNA is millions of base pairs long and optimal for use with our systems. Each Bionano Prep Kit allows customers to perform five to 10 HMW DNA preps. Our kits and protocols enable the extraction of HMW DNA from a variety of sample types including soft or fibrous animal tissue, plant tissue, cell lines and human blood.

Our labeling reagents are optimized for applications on our genome mapping systems. Starting with HMW DNA purified using the appropriate Bionano Prep Kit, fluorescent labels are attached to specific sequence motifs. The result is uniquely identifiable genome-specific label patterns that enable de novo map assembly, anchoring sequencing contigs and discovery of structural variations as small as 500 base pairs to up to chromosome arm lengths.

Our newest and most powerful kit for DNA labeling, the Direct Label and Stain, or DLS, Kit is a proprietary, nondestructive chemistry for sequence motif labeling of genomic DNA that improves every aspect of our genome mapping. DLS uses a single direct-labeling enzymatic reaction to attach a fluorophore to the DNA at a specific 6-base pair sequence motif, yielding approximately 16 labels per 100,000 base pairs in the human genome. After labeling, the molecules are linearized in the Saphyr chip on the Saphyr instrument and imaged. Through the isolation, labeling and linearization steps, the molecules maintain an average length of around 250,000 base pairs. The label patterns on each molecule allow them to be uniquely identified and aligned in a pair-wise comparison against all other molecules imaged from the same sample.

Data Solutions

Our data solutions offering includes a complete suite of hardware and software for end-to-end experiment management, algorithms for assembling genome maps and algorithms and databases for bioinformatics processing, all of which is driven through convenient web-based management and monitoring tools.

Bionano Access is our web-based hub for Saphyr operations. It provides all the software that our customers need for experiment management and our structural variation analysis in one place. With Bionano Access our customers can:

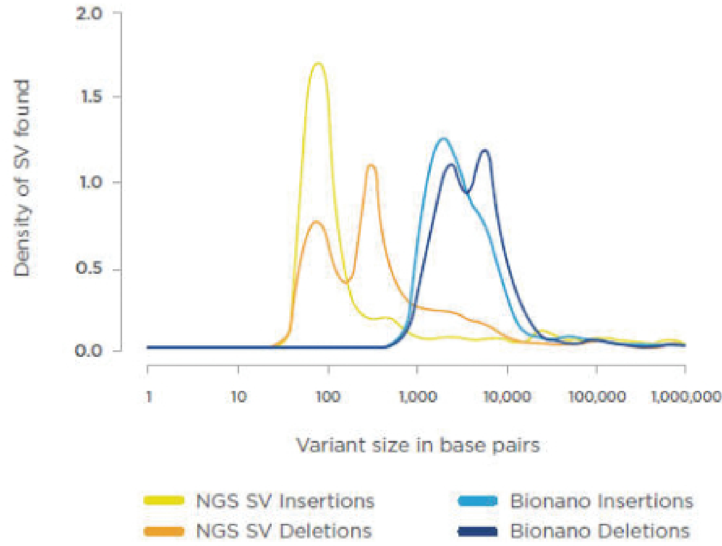
- set up runs and monitor real-time data quality metrics remotely to flag potential sample quality issues early;
- automatically start de novo assemblies and structural variation analysis when the desired amount of data has been collected;
- visualize and manipulate maps and structural variants; and
- analyze trios and clinical samples by filtering through uncommon variants to identify inherited and de novo variants, and export in a file format that is used consistently throughout the industry.

We have a suite of proprietary algorithms and databases that fully enable our proprietary bioinformatic and structural variation analysis pipelines. Using pairwise alignment of the single molecule images, consensus genome maps are constructed, refined, extended and merged. Molecules are then clustered into two alleles, and a diploid assembly is created to allow for heterozygous structural variation detection. Genome maps typically span entire chromosome arms in single, contiguous maps. Comparative analysis of maps reveals structural variation. Our customers use our variant annotation workflow to specifically uncover rare and sample-specific mutations. For example, to help a customer determine genomic variant frequency in a tumor, Saphyr compares the cancer sample structural calls against over 600,000 structural variations from over 160 humans with no evidence of diseases. To identify somatic mutations, the workflow can run comparisons of the tumor specimen against a control sample to determine whether the cancer mutations are present in low abundance among the control’s genome. Using this high through-put pipeline approach we can efficiently focus on dozens of clinically significant structural candidates for further analysis.

Our hardware solution includes the Saphyr Compute Server, which provides offers cluster-like performance in an affordable, compact solution and the Bionano Compute Server, which expands the analytical capacity of the suite of tools. With these solutions, our customers are capable of performing multiple simultaneous analyses and sustaining continuous throughput, which allows them to spend less time waiting for data, so they can focus on investigating results. We also offer a cloud-based solution for data analysis through a third party provider and expect to launch our own cloud-based solution by the fourth quarter of 2018.

The Saphyr System's Industry-Leading Sensitivity and Specificity

Our Saphyr system detects structural variations that Illumina's systems miss. As shown in the graphic below, the Garvan Institute of Medical Research generated data that we expect to be published which shows the density of structural variations found relative to the size of the structural variation found for our system (blue lines) against next-generation sequencing (Illumina; orange lines). Next-generation sequencing has a very significant deficiency in detecting structural variations. Given our system's ability to detect structural variations, it picks up essentially where next-generation sequencing drops off, as shown below.



Retaining long-range contiguity throughout the genome mapping process is critical for any comprehensive study of genome structure and function, particularly for the analysis of structural variation in complex genomes. Saphyr offers unmatched sensitivity for the detection of large structural variations greater than 500 base pairs. Saphyr's specific sensitivity percentages from recent studies are shown below:

- 99% sensitivity for homozygous insertions/deletions larger than 500 base pairs;
- 95% sensitivity for heterozygous insertions/deletions larger than 500 base pairs;
- 95% sensitivity for balanced and unbalanced translocations larger than 50,000 base pairs;
- 99% sensitivity for inversions larger than 30,000 base pairs;
- 97% sensitivity for duplications larger than 30,000 base pairs; and
- 97% sensitivity for copy number variants larger than 500,000 base pairs.

A study of Pacific Biosciences' long-read sequencing's ability to detect homozygous and heterozygous insertions and deletions was published recently. The sensitivity to detect homozygous structural variations using Pacific Biosciences was 87%, compared to 99% using Saphyr. The sensitivity to detect heterozygous structural variations using Pacific Biosciences was only 41%, which is less than half the 84% sensitivity for heterozygous structural variation detection using Saphyr. Even when the Pacific Biosciences structural variation calls were limited to insertions and deletions larger than 500 base pairs, the sensitivity for homozygous structural variations was only 81%, and for heterozygous structural variations was only 49%.

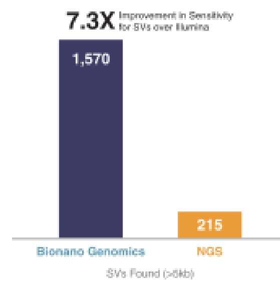
SV Sensitivity[1]

	Bionano Genomics	Pacific Biosciences
Insertions		
Homozygous	99.3%	80.4%
Heterozygous	81.2%	39.7%
Deletions		
Homozygous	98.8%	82.4%
Heterozygous	87.9%	62.0%

[1]Sensitivity for variations >500 base pairs

Saphyr detects duplications over 30,000 base pairs, in direct or inverse orientation, with a sensitivity of 97%. Saphyr detects 99% of inversions of that same size range. Inversions are the invisible variants and have traditionally been the hardest to detect structural events. They are balanced, without gain or loss of sequence, and unlike translocations they do not create easily visible changes in genomic context. Inversions often escape detection by traditional cytogenetic techniques. Chromosomal microarrays cannot identify balanced events, and metaphase chromosome spreads can only visualize some megabase-size inversions. Next-generation sequencing approaches tend to miss inversions because reads from inside the inversion tend to map back to the reference without any indication that the orientation of the sequence has changed. Detection of the breakpoints often fails, especially if the inversion is flanked by segmental duplications, repeat sequences or other non-unique sequences. Saphyr's imaging of extremely long molecules overcomes these obstacles to identifying inversions.

In a separate study, our system detected seven times more structural variations larger than 5,000 base pairs compared to next-generation sequencing. Dr. Pui-Yan Kwok at the University of California, San Francisco, demonstrated the robustness of our system for genome-wide discovery of structural variations in a trio from the 1000 Genomes Project. Using our system, hundreds of insertions, deletions, and inversions greater than 5,000 base pairs were uncovered amounting to 7.3 times more than the large structural variation events detected by next-generation sequencing. Importantly, many of the structural variations that were found were in regions believed to contain functional elements leading to disruption of gene function or regulation.



Our Strengths

We have established ourselves as one of the leaders in the field of genome analysis, and we believe we are the industry's performance leader in structural variation detection. Below are our strengths that we believe will enable us to capture a significant portion of the genome analysis market and retain our leadership position in structural variation:

- ***Highly differentiated technology platform enables researchers and clinicians to obtain information that cannot be had systematically and cost efficiently from traditional technologies.*** Saphyr's unique ability to systematically and cost efficiently see structural variations across the genome from 500 base pairs to tens of millions of base pairs is unique in the industry. We believe this greater insight will facilitate a paradigm shift in healthcare from an emphasis on treatment with relatively untargeted therapies to a focus on earlier detection, more precise diagnosis and treatment with better targeted therapies.
- ***Validated solution recognized industry-wide.*** We have deep and expanding scientific validation. Our system has been cited in approximately 130 publications, and we believe our technology is becoming a vital tool in cutting-edge life sciences research.
- ***Strong installed base of premier customers.*** We have sold more than 90 of our systems to over 80 customers globally. Our customers include some of the world's most prominent clinical, translational research, basic research, academic and government institutions as well as leading pharmaceutical and diagnostic companies. Examples include Examples include Children's National Health System, DuPont Pioneer, Garvan Institute of Medical Research, Genentech, Icahn School of Medicine at Mount Sinai, McDonnell Genome Institute at Washington University, National Cancer Institute, National Institutes of Health, Pennsylvania State University and Salk Institute for Biological Studies.
- ***Attractive business model with a growing, high-margin recurring revenue component.*** As we continue to grow our installed base of Saphyr systems, optimize workflows and expand our structural variation detection capabilities, we expect to rapidly increase our high-margin revenues derived from consumables. The successful integration of our technology into our customers' projects provides ongoing sales of assays and consumables.
- ***Industry-leading intellectual property portfolio.*** We have developed a global patent portfolio that includes 43 issued patents across 14 patent families and an exclusively licensed portfolio of patents and applications from Princeton University, which includes 22 patents across two families. This global patent portfolio has filing dates ranging from 2001 to 2017. We have robust intellectual property protection surrounding our devices, systems, and methods for macromolecular analysis. Our ideation stems from our highly active research programs and results in our patent portfolio continually expanding at a significant pace.
- ***Highly experienced senior management team.*** We are led by a dedicated and highly experienced senior management team with significant industry experience and proven ability to develop novel solutions. Each of the members of our senior management has more than 20 years of relevant experience.

Our Strategy

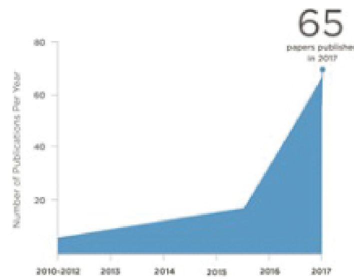
Our goal is to enable new research in genomics to allow greater insight into their role in human health in ways that have not been possible with any other current research and diagnostic technologies.

Our strategy to achieve this includes:

- ***Drive adoption of Saphyr in discovery research and cytogenetics markets.*** Saphyr has the potential to significantly expand the life science research market and genomics-based diagnostics market because of its unrivaled sensitivity, by enabling researchers to perform studies on structural variations that they

were previously unable to perform. We believe Saphyr has the capability to enable the development of a new category of diagnostic tests and tools.

- ***Support the publication of findings with Saphyr by our customers beyond the over 130 papers published to date.*** The chart below shows the annual number of publications released since 2010 which featured data generated by Saphyr and its predecessor system. Recently, the overall number of these publications has grown significantly. For example, of the over 130 papers published to date, approximately half were published in 2017 alone. We will continue to support and foster our customer base to help grow the number of publications featuring our systems' data. We believe that these publications are impactful as our customers' studies cover structural variations in areas of high unmet medical need, such as rare and undiagnosed pediatric diseases, muscular diseases, developmental delays and disorders, prostate cancer and leukemia.



- ***Expand gross margins through economies of scale and growing sales of consumables.*** Our overall gross margin has historically been driven by our instrument gross margin as the sales of our instruments have constituted the vast majority of our total revenues to date. Our instrument gross margin is significantly lower than our consumables gross margin. We expect our overall gross margin to expand in 2018 and beyond as:
  - We further negotiate with silicon fabrication manufacturers for better contract pricing of our consumables. As our manufacturing lot volumes increase, we expect to have lower costs of goods sold. This is driven by the pass along of some of the economies of scale of contract manufacturers that mainly operate in the ultra-high-volume silicon computer chip industry.
  - Consumables sales continue to represent the fastest growing component of overall revenues. As consumables growth continues to outpace instrument growth, we expect the proportion of our product mix which is higher gross margin to increase, thereby expanding our overall gross margin.
- ***Continue to innovate our products and technologies.*** We designed Saphyr to accommodate performance enhancements without the need for replacement of the entire instrument. For example, hardware upgrades and new consumables are made available to purchase by customers. We intend for these performance enhancements to be delivered on a regular basis. In addition, we periodically make available software upgrades to customers through download at no charge. We will continue to develop and refine our technologies to improve the ease of use of our Saphyr system and enable our existing installed systems to meaningfully increase sample throughput and sensitivity and specificity of structural variation detection.
- ***Partner with industry-leading companies and laboratories to accelerate adoption in clinical markets.*** Establish additional collaborations with customers to help drive validating studies. Expand partnership efforts with clinical diagnostic companies to commercialize LDTs in the U.S. as well as LDTs and approved tests outside the U.S.

Sales and Marketing

Our commercial team includes 16 individuals, including seven salespeople, two marketing personnel, and seven sales support personnel, including customer solutions personnel, field specialists and application specialists.

This commercial staff is primarily located in North America and Europe. Most of our sales support team is located at our headquarters in San Diego and some work remotely throughout the U.S., Europe and China.

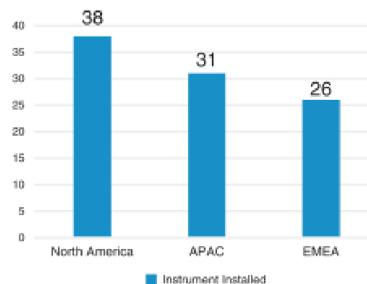
We sell our products through a direct sales force in North America and Europe. Our sales strategy involves the use of a combination of sales managers, sales representatives and field application specialists. Our direct sales force includes four salespeople located in the U.S. and three located in Europe. We expect to increase our sales force as we expand our business.

We sell our products through a network of distributors in the Asia-Pacific region and select other markets outside of North America and Europe. Specifically, we distribute our instruments and reagents via third-party distributors in markets such as China, Japan, South Korea, Singapore, Australia, India and South Africa. Four of our distributors are in China, one in Australia, one in Japan and one in South Korea.

The role of our sales managers and sales representatives is to educate customers on the advantages of Saphyr and the applications that our system makes possible. The role of our field application specialists is to provide on-site training and scientific technical support to prospective and existing customers. Our field application specialists are technical experts with advanced degrees, including four with Ph.D.s, and generally have extensive experience in academic research and core sequencing lab experience.

In addition, we maintain an applications lab team in San Diego, California composed of scientific experts who can transfer knowledge from the research and development team to the field application specialists. The applications lab team also runs foundational scientific collaborations and proof of principle studies, which help demonstrate the value of our product offering to prospective customers.

Our domestic and international sales force informs our current and potential customers of current product offerings, new product and new assay introductions, and technological advances in Saphyr systems, workflows, and notable research being performed by our customers or ourselves. As our primary point of contact in the marketplace, our sales force focuses on delivering a consistent marketing message and high level of customer service, while also attempting to help us better understand evolving market and customer needs.



We intend to significantly expand our sales, support, and marketing efforts in the future by expanding our direct footprint in North America and Europe as well as developing a more comprehensive support network in China where significant market opportunities exist. Additionally, we believe that there is significant opportunity in other European, South American, Asia-Pacific and Middle Eastern regions. We plan to expand into these regions via initial penetration with distributors.

Our sales and marketing efforts are targeted at key opinion leaders, laboratory directors and principal investigators at leading translational research, clinical institutions, governmental research institutions and pharmaceutical companies. In addition to our selling activities, we align with key opinion leaders at leading institutions and clinical research laboratories to help increase scientific and commercial awareness of our technology, demonstrate its benefits relative to existing technologies and accelerate its adoption. We also seek to increase awareness of our products through participation at trade shows, academic conferences, online webinars and dedicated scientific events attended by prominent users and prospective customers.

Our systems are relatively new to the life science marketplace and require a capital investment by our customers. The sales process typically involves numerous interactions and demonstrations with multiple people within an organization. Some potential customers conduct in-depth evaluations of the system including having us run experiments on in-house Saphyr systems. In addition, in most countries, sales to academic or governmental institutions require participation in a tender process involving preparation of extensive documentation and a lengthy review process. Because of these factors and the budget cycles of our customers, our sales cycle, the time from initial contact with a customer to our receipt of a purchase order, can often be nine to 12 months.

Manufacturing and Supply

Our manufacturing strategy is to outsource instrument and chip manufacturing and internally develop and assemble reagent kits in our own facility.

Instruments

Our Saphyr instrument is manufactured by a third party medical device manufacturer. Nearly complete Saphyr instruments are shipped by the manufacturer to us for final assembly and quality control testing. Upon completion, we ship directly to our customers' locations globally, or distributors' locations in the case of certain systems sold in the Asia-Pacific region. Installation of, and training on, our products is provided by our employees in the markets where we conduct direct sales, and by distributors in those markets where we operate with distributors.

We believe this manufacturing strategy is efficient and conserves capital. However, in the event it becomes necessary to utilize a different contract manufacturer for Saphyr, we would experience additional costs, delays and difficulties in doing so, and our business could be harmed.

This manufacturer actively manages obsolescence of all components in our system. This is done through their supply management process where we get notified of any parts that will become obsolete with enough lead time to identify alternatives.

Consumables

All of our chip consumables are produced by a third party manufacturer at its facility; however, we have established procedures for a replacement manufacturer if required. We complete final assembly and quality control assessments of our chips at our headquarters in San Diego.

Our reagents are sourced from a limited number of suppliers, including certain single source suppliers. Reagents include all components required to run a sample on Saphyr, such as capture and detector reagents, enzyme reagents and enzyme substrate. Although we believe that alternatives would be available, it would take time to identify and validate replacement reagents for our assay kits, which could negatively affect our ability to supply assay kits on a timely basis. Reagents are supplied through a single source supplier. This supplier requires a sufficient notification period to allow for supply continuity and the identification and technology transfer to a new supplier in the event either party wishes to terminate the relationship.

We actively manage component obsolescence by subscribing to our vendors' end-of-life notifications. If a vendor is unable to provide sufficient notification, we keep safety stock of the component to minimize disruption to operations.

Key Agreements

License Agreement with Princeton University

In January 2004, we entered into a license agreement, or the License Agreement, with Princeton University, or Princeton. Pursuant to the License Agreement, we received a worldwide, exclusive right and license to, among other things, manufacture and market products or services utilizing patents and inventions related to our sample preparation, DNA imaging and genomic data analysis platform and other key technology.

We are obligated to pay Princeton an annual license maintenance fee in the mid-four digits, which can be reduced by royalties paid to Princeton during the preceding 12 month period. We are also obligated to make royalty payments to Princeton equal to (i) a percentage in the mid-single digits of our and any of our sub-licensees' net sales of products covered by the License Agreement and (ii) a percentage in the low-single digits of our and any of our sub-licensees' revenue from services covered by the License Agreement. Our royalty obligations continue on a licensed product-by-licensed product and licensed service-by-licensed service basis, in every country of the world, until the later of the last sale of a licensed product or service or the expiration of all Princeton patent rights.

The term of the License Agreement will continue until all of our royalty payment obligations have expired, unless terminated earlier. Princeton may terminate the License Agreement upon written notice in the event of our material breach of the License Agreement if such breach remains uncured for 60 days. We may terminate the License Agreement without cause upon 60 days' advance written notice to Princeton.

Agreement for the Manufacture of Our Instruments

We have engaged a single third party manufacturer to produce and test our instruments on an as-ordered basis. The manufacturer of our instruments has no obligation to manufacture our instruments without a purchase order. In addition, this manufacturer has no obligation to maintain inventory in excess of any open purchase orders or materials in excess of the amount it reasonably determines will be consumed within 90 days. We are obligated to purchase any material deemed in excess pursuant to the agreement. The price we pay is determined according to a mutually agreed-upon pricing formula. We may terminate a purchase order by giving the manufacturer at least 30 days' written notice.

Agreement for the Manufacture of Our Chip Consumables

We have engaged a single third party manufacturer to manufacture our chip consumables used in our Saphyr system and provide engineering services to us. This third party has no obligation to manufacture our chip consumables without a purchase order. The prices and fees we pay are established in our agreement with this manufacturer or determined by the manufacturer pursuant if supported by appropriate information. Our agreement with this manufacturer automatically renews for successive one year terms unless a party notifies the other party in writing at least 30 days prior to the expiration of the then-current term. We may terminate an order of the agreement at any time upon 30 days' written notice.

Berry Genomics Agreement

We have entered into a collaboration agreement, or the Berry Agreement, with Berry Genomics Co., Ltd, or Berry. Under the terms of the Berry Agreement, Berry agreed to develop, market and commercialize a Berry-branded in-vitro diagnostic, or IVD, system (which is comprised of both kits and instruments) in the People's

Republic of China, or the PRC, in certain specified fields, as well as for clinical use by its partners. Pursuant to the Berry Agreement, Berry agreed to purchase certain of our components for use exclusively within the kits and instruments that make up the IVD system. Berry is then responsible for manufacturing the finished system, as well as for obtaining regulatory approvals for the sale of our components in the PRC. Per the Berry Agreement, we are obligated to provide the necessary support and documentation for the components, as well as provide training to enable Berry's after-sales installation and support for the IVD system.

Pursuant to the terms of the Berry Agreement, we granted to Berry and its affiliates, an irrevocable, exclusive, sublicensable, fully paid-up, royalty-free, license during the term of the agreement, solely to seek and obtain CFDA registration, manufacture, market, distribute and sell IVD kits and IVD instruments. We also have the right to all IVD system improvements. We have the first right, but not obligation, to take any measures we deem appropriate to enforce our intellectual property rights. We also agree to provide reasonable assistance related to such enforcement actions as Berry may request at the cost and expenses of Berry.

The Berry Agreement may be renewed by either party upon 90 days written notice and subject to the negotiation of an agreement facilitating such renewal. Either party may terminate the agreement for a material breach if such breach remains uncured for 30 days, or immediately if the breach is not curable. We may also immediately terminate the Berry Agreement if Berry fails to fulfill its minimum quantity purchase requirements.

Intellectual Property

Our core technology for nucleic acid research is related to methods and devices for non-sequencing based analysis of macromolecules such as nucleic acids. Using this technology, long (high-molecular weight) nucleic acids can be suitably labeled and elongated in order to ascertain structural information such as scaffold organization, copy number, and de novo analysis of genomic repeats that is not readily obtained with current sequencing-based approaches. We have secured and continue to pursue intellectual property rights globally, including rights related to analysis of nucleic acid molecules, as well as innovations in the molecular biology and bioinformatics spaces.

We have developed a global patent portfolio that includes 43 issued patents across 14 patent families and an exclusively licensed portfolio of patents and applications from Princeton University, which includes 22 patents across two families. This global patent portfolio has filing dates ranging from 2001 to 2017. The owned and licensed families contain issued patents and pending applications that relate to devices, systems, and methods for macromolecular analysis, and reflect our active and ongoing research programs. The commercial foci of these patent families are discussed below.

Commercial Focus	Number of Issued and Pending Patents
Nanochannel devices and systems	70
Methods of macromolecule analysis using nanochannel arrays	62
Methods of genetic detection and copy number analysis	28
Method of genomic sequence and epigenomic analysis.	48
Biomolecule isolation and processing for use in nanochannel analysis	3
Method of optimizing nanochannel analysis	6
Next-generation products	11

In addition to pursuing patents, we have taken steps to protect our intellectual property and proprietary technology by entering into confidentiality agreements and intellectual property assignment agreements with our employees, consultants, corporate partners and, as applicable, our advisors.

Government Regulation

Our products are currently intended for research use only, or RUO, applications, although our customers may use our products to develop their own products that are subject to regulation by the FDA. Although most products intended for RUO are not currently subject to clearance or approval by the FDA, RUO products fall under the FDA's jurisdiction if they are used for clinical rather than research purposes. Consequently, our products are labeled "For Research Use Only."

The FDA's 2013 Guidance for Industry and Food and Drug Administration Staff on "Distribution of In Vitro Diagnostic Products Labeled for Research Use Only or Investigational Use Only," or, the RUO/IUO Guidance, provides the FDA's thinking on when IVD products are properly labeled for RUO or for IUO. The RUO/IUO Guidance explains that the FDA will review the totality of the circumstances when evaluating whether equipment and testing components are properly labeled as RUO. Merely including a labeling statement that a product is intended for research use only will not necessarily exempt the device from the FDA's 510(k) clearance, premarket approval, or other requirements, if the circumstances surrounding the distribution of the product indicate that the manufacturer intends its product to be used for clinical diagnostic use. These circumstances may include written or verbal marketing claims or links to articles regarding a product's performance in clinical applications, a manufacturer's provision of technical support for clinical validation or clinical applications, or solicitation of business from clinical laboratories, all of which could be considered evidence of intended uses that conflict with RUO labeling.

When marketed for clinical diagnostic use, our products will be regulated by the FDA as medical devices. The FDA defines a medical device in part as an instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article which is intended for the diagnosis of disease or other conditions or in the cure, mitigation, treatment, or prevention of disease in man. FDA regulates the development, testing, manufacturing, marketing, post-market surveillance, distribution, advertising and labeling of medical devices requires them to be register by the medical device manufacturer and listed as marketed products.

The FDA classifies medical devices into one of three classes on the basis of the intended use of the device, the risk associated with the use of the device for that indication, as determined by the FDA, and on the controls deemed by the FDA to be necessary to reasonably ensure their safety and effectiveness. Class I devices, which have the lowest level of risk associated with them, are subject to general controls. Class II devices are subject to general controls and special controls, including performance standards. Class III devices, which have the highest level of risk associated with them, are subject to general controls and premarket approval. Most Class I devices and some Class II devices are exempt from a requirement that the manufacturer submit a premarket notification, or 510(k), and receive clearance from the FDA which is otherwise a premarketing requirement for a Class II device. Class III devices may not be commercialized until a premarket approval application, or PMA, is submitted to and approved by the FDA.

510(k) Clearance Pathway

To obtain 510(k) clearance, a sponsor must submit to the FDA a premarket notification demonstrating that the device is substantially equivalent, or SE, to a device legally marketed in the U.S. for which a PMA was not required. The FDA is supposed to make a SE determination within 90 days of FDA's receipt of the 510(k), but it often takes longer if the FDA requests additional information. Most 510(k)s do not require supporting data from clinical trials, but the FDA may request such data.

Premarket Approval Pathway

A PMA must be submitted if a new device cannot be cleared through the 510(k) process. The PMA process is generally more complex, costly and time consuming than the 510(k) process. A PMA must be supported by extensive data including, but not limited to, technical, preclinical, clinical trials, manufacturing and labeling to

demonstrate to the FDA's satisfaction the safety and effectiveness of the device for its intended use. After a PMA is sufficiently complete, the FDA will accept the application for filing and begin an in-depth review of the submitted information. By statute, the FDA has 180 days to review the accepted application, although, review of the application generally can take between one and three years. During this review period, the FDA may request additional information or clarification of information already provided. Also during the review period, an advisory panel of experts from outside the FDA may be convened to review and evaluate the application and provide recommendations to the FDA as to the approvability of the device. In addition, the FDA will conduct a preapproval inspection of the manufacturing facility to ensure compliance with its quality system regulations, or QSRs. New premarket approval applications or premarket approval application supplements are also required for product modifications that affect the safety and efficacy of the device.

Clinical Trials

Clinical trials are usually required to support a PMA and are sometimes required for a 510(k). In the U.S., if the device is determined to present a "significant risk," the manufacturer may not begin a clinical trial until it submits an investigational device exemption application, or IDE, and obtains approval of the IDE from the FDA. These clinical trials are also subject to the review, approval and oversight of an institutional review board, or IRB, at each clinical trial site. The clinical trials must be conducted in accordance with the FDA's IDE regulations and good clinical practices. A clinical trial may be suspended by FDA, the sponsor or an IRB at its institution at any time for various reasons, including a belief that the risks to the study participants outweigh the benefits of participation in the trial. Even if a clinical trial is completed, the results may not demonstrate the safety and efficacy of a device to the satisfaction of the FDA, or may be equivocal or otherwise not be sufficient to obtain approval of a device.

After a medical device is placed on the market, numerous regulatory requirements apply. These include among other things:

- compliance with QSRs, which require manufacturers to follow stringent design, testing, control, documentation, record maintenance, including maintenance of complaint and related investigation files, and other quality assurance controls during the manufacturing process;
- reporting of device malfunctions, serious injuries or deaths;
- registration of the establishments where the devices are produced;
- labeling regulations, which prohibit the promotion of products for uncleared or unapproved uses; and
- medical device reporting obligations, which require that manufacturers investigate and report to the FDA adverse events, including deaths, or serious injuries that may have been or were caused by a medical device and malfunctions in the device that would likely cause or contribute to a death or serious injury if it were to recur.

Failure to comply with applicable regulatory requirements can result in enforcement action by the FDA, which may include sanctions, including but not limited to, warning letters; fines, injunctions, and civil penalties; recall or seizure of the device; operating restrictions, partial suspension or total shutdown of production; refusal to grant 510(k) clearance or PMA approvals of new devices; withdrawal of 510(k) clearance or PMA approvals; and civil or criminal prosecution. To ensure compliance with regulatory requirements, medical device manufacturers are subject to market surveillance and periodic, pre-scheduled and unannounced inspections by the FDA.

Laboratories that purchase certain of our products and perform clinical diagnostic testing are also subject to extensive regulation under the Clinical Laboratory Improvement Amendments of 1988, or CLIA, requiring clinical laboratories to meet specified standards in areas such as personnel qualifications, administration, participation in proficiency testing, patient test management, quality control, quality assurance and inspections.

Adverse interpretations of current CLIA regulations or future changes in CLIA regulations could have an adverse effect on sales of any affected products. Moreover, if we decide to operate our own clinical testing laboratory, we will be required to comply with CLIA. If, in the future, we operate our own clinical laboratory to perform clinical diagnostic testing, we would become subject to the Health Insurance Portability and Accountability Act of 1996, or HIPAA, as well as additional federal and state laws that impose a variety of fraud and abuse prohibitions on healthcare providers, including clinical laboratories.

Laboratory Developed Tests

Although the FDA has statutory authority to regulate medical devices, the FDA has historically exercised its enforcement discretion and not enforced applicable provisions of the FDC Act and FDA regulations with respect to laboratory developed tests, or LDTs, which are a subset of in vitro diagnostic tests that are intended for clinical use and designed, manufactured and used entirely within a single laboratory. The FDA does not consider devices to be LDTs if they are designed or manufactured completely, or partly, outside of the laboratory that offers and uses them. We sell our Saphyr system on an RUO basis to CLIA certified cytogenetics laboratories, which may use the system to develop LDTs.

At various times since 2006, the FDA has issued documents outlining its intent to require varying levels of FDA oversight of many types of LDTs. In October 2014, the FDA issued draft guidance that sets forth a proposed risk-based regulatory framework that would apply such oversight to LDTs. The FDA has indicated that it does not intend to implement its proposed framework until the draft guidance documents are finalized. It is unclear at this time if or when the FDA will finalize its plans to end enforcement discretion for LDTs, and even then, whether the new regulatory requirements are expected to be phased-in over time. However, the FDA may decide to regulate certain LDTs on a case-by-case basis at any time. A significant change in the way that the FDA regulates any LDTs that we, our collaborators or our customers develop using our technology could affect our business. If the FDA requires laboratories to undergo premarket review and comply with other applicable FDA requirements in the future, the cost and time required to commercialize an LDT will increase substantially, and may reduce the financial incentive for laboratories to develop LDTs, which could reduce demand for our instruments and our other products. In addition, if the FDA were to change the way that it regulates LDTs to require that we undergo pre-market review or comply with other applicable FDA requirements before we can sell our instruments or our other products to clinical cytogenics laboratories, our ability to sell our instruments and other products to this addressable market would be delayed, thereby impeding our ability to penetrate this market and generate revenue from sales of our instruments and our other products.

Europe/Rest of World Government Regulation

Whether or not we obtain FDA approval for a product, we must obtain the requisite approvals from regulatory authorities in non-U.S. countries prior to the commencement of clinical trials or marketing of our product for clinical diagnostic use in those countries. The regulations in other jurisdictions vary from those in the U.S. and may be easier or more difficult to satisfy and are subject to change. For example, the European Union recently published new regulations that will result in greater regulation of medical devices and IVDs. The IVD Regulation is significantly different from the IVD Directive that it replaces in that it will ensure that the new requirements apply uniformly and on the same schedule across the member states, include a risk-based classification system and increase the requirements for conformity assessment. The conformity assessment process results in the receipt of a CE designation which has been sufficient to begin marketing many types of IVDs. That process will become more difficult and costly to complete.

Other Governmental Regulation

We are subject to laws and regulations related to the protection of the environment, the health and safety of employees and the handling, transportation and disposal of medical specimens, infectious and hazardous waste and radioactive materials. For example, the U.S. Occupational Safety and Health Administration, has established

extensive requirements relating specifically to workplace safety for healthcare employers in the U.S. This includes requirements to develop and implement multi-faceted programs to protect workers from exposure to blood-borne pathogens, including preventing or minimizing any exposure through needle stick injuries. For purposes of transportation, some biological materials and laboratory supplies are classified as hazardous materials and are subject to regulation by one or more of the following agencies: the U.S. Department of Transportation, the U.S. Public Health Service, the U.S. Postal Service and the International Air Transport Association. We generally use third-party vendors to dispose of regulated medical waste, hazardous waste and radioactive materials that we may use during our research.

Coverage and Reimbursement

Currently, our product is for research use only, but clinical laboratories may acquire our instrumentation through a capital purchase or capital lease and use the Saphyr and direct label stain chemistry to create their own potentially reimbursable products, such as laboratory developed tests for in vitro diagnostics, Our customers may generate revenue for these testing services by seeking the necessary approval of their product from the FDA or the Center for Medicare and Medicaid Services, or CMS, along with coverage and reimbursement from third-party payors, including government health programs and private health plans. The ability of our customers to commercialize diagnostic tests based on our technology will depend in part on the extent to which coverage and reimbursement for these tests will be available from such third-party payors.

In the U.S., molecular testing laboratories have multiple options for reimbursement coding, but we expect that the primary codes used will be the genomic sequencing procedure codes, or GSPs. The American Medical Association, or AMA, added GSPs to its clinical laboratory fee schedule in 2015. In addition, CMS recently issued a coverage determination providing for the reimbursement of next-generation sequencing for certain cancer diagnostics using an FDA-approved in vitro diagnostic test. Private health plans often follow CMS to a substantial degree, and it is difficult to predict what CMS will decide with respect to reimbursement of any products our customers try to commercialize.

In Europe, coverage for molecular diagnostic testing is varied. Countries with statutory health insurance (e.g., Germany, France, The Netherlands) tend to be more progressive in technology adoption with favorable reimbursement for molecular diagnostic testing. In countries such as the United Kingdom with tax-based insurance, adoption and reimbursement for molecular diagnostic testing is not uniform and is influenced by local budgets.

Ultimately, coverage and reimbursement of new products is uncertain, and whether laboratories that use our instruments to develop their own products will attain coverage and adequate reimbursement is unknown. In the U.S., there is no uniform policy for determining coverage and reimbursement. Coverage can differ from payor to payor, and the process for determining whether a payor will provide coverage may be separate from the process for setting the reimbursement rate, In addition, the U.S. government, state legislatures and foreign governments have shown significant interest in implementing cost containment programs to limit the growth of government-paid health care costs, including price controls and restrictions on reimbursement.

Healthcare Reform

In the U.S. and abroad, there have been and continue to be a number of legislative initiatives to contain healthcare costs and change the way healthcare is financed. By way of example, in March 2010, the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Affordability Reconciliation Act, collectively, the ACA, became law. The ACA is a sweeping law intended to broaden access to health insurance, reduce or constrain the growth of healthcare spending, enhance remedies against fraud and abuse, add new transparency requirements for the healthcare and health insurance industries, impose new taxes and fees on the health industry and impose additional health policy reforms. The ACA’s provisions of importance to our business include, but are not limited to, a 2.3% excise tax on certain entities that manufactures or imports

medical devices offered for sale in the U.S., which has been suspended, but due to subsequent legislative amendments, will be automatically reinstated for medical device sales beginning January 1, 2020, unless Congress takes additional action to delay the implementation of the tax.

Some of the provisions of the ACA have yet to be implemented, and there have been judicial and Congressional challenges to certain aspects of the ACA, as well as efforts by the Trump administration to repeal or replace certain aspects of the ACA. Since January 2017, President Trump has signed two Executive Orders and other directives designed to delay the implementation of certain provisions of the ACA or otherwise circumvent some of the requirements for health insurance mandated by the ACA. Concurrently, Congress has considered legislation that would repeal or repeal and replace all or part of the ACA. While Congress has not passed comprehensive repeal legislation, two bills affecting the implementation of certain taxes under the ACA have been signed into law. The 2017 U.S. Tax Cuts and Jobs Act includes a provision repealing, effective January 1, 2019, the tax-based shared responsibility payment imposed by the ACA on certain individuals who fail to maintain qualifying health coverage for all or part of a year that is commonly referred to as the "individual mandate". Additionally, a 2018 continuing resolution on appropriations delays the implementation of certain ACA-mandated fees, including, without limitation, the medical device excise tax.

Further, other legislative changes have been proposed and adopted since the ACA was enacted. For example, on April 1, 2014, the Protecting Access to Medicare Act of 2014, or PAMA, was signed into law, which, among other things, significantly altered the payment methodology under the Medicare Clinical Laboratory Fee Schedule, or CLFS. PAMA requires certain laboratories performing clinical diagnostic laboratory tests to report to CMS the amounts paid by private payors for laboratory tests. Beginning on January 1, 2018, CMS has begun using reported private payor pricing to periodically revise payment rates under the CLFS.

We expect that additional state and federal healthcare reform measures will be adopted in the future, any of which could limit the amounts that federal and state governments will pay for healthcare products and services. In addition, sales of our tests outside of the U.S. will subject us to foreign regulatory requirements, which may also change over time.

Other Healthcare Laws

Our operations are directly or indirectly, through our customers, subject to various federal and state fraud and abuse laws, including, without limitation, the federal and state anti-kickback statutes and false claims laws. These laws may impact, among other things, our sales and marketing and education programs, and our financial and business relationships with researchers who use our instruments to develop marketed products. By way of example: the federal Anti-Kickback Statute prohibits, among other things, any person or entity from, among other things, knowingly and willfully soliciting, receiving, offering or paying any remuneration, directly or indirectly, to induce, or in return for, purchasing, leasing, ordering, or arranging for or recommending the purchase, lease, or order of any good, facility, item, or service reimbursable, in whole or in part, under a federal healthcare program; and the federal false claims laws, including, without limitation the federal civil False Claims Act, prohibit, among other things, anyone from knowingly and willingly presenting, or causing to be presented for payment, to the federal government (including Medicare and Medicaid) claims for reimbursement for, among other things, drugs or services that are false or fraudulent, claims for items or services not provided as claimed, or claims for medically unnecessary items or services. The ACA, among other things, amended the intent requirement of the federal Anti-Kickback Statute to clarify that a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a crime. In addition, the ACA clarifies that the government may assert that a claim that includes items or service resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the federal civil False Claims Act.

In addition, we may be subject to HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act and its implementing regulations, which imposes certain requirements relating to the

privacy, security and transmission of individually identifiable health information without appropriate authorization by entities subject to the rule, such as health plans, health care clearinghouses and certain health care providers and their business associates who create, use or disclose HIPAA protected health information on their behalf. We may also be subject to state and foreign laws that govern the privacy and security of health information in some circumstances, many of which differ from each other in significant ways and often are not preempted by HIPAA, thus complicating compliance efforts.

If our operations are found to be in violation of any of these laws, we may be subject to penalties, including, without limitation, civil, criminal, and administrative penalties, damages, fines, disgorgement, the curtailment or restructuring of our operations, exclusion from participation in federal and state healthcare programs, additional integrity oversight and reporting obligations, individual imprisonment, contractual damages, and reputational harm, any of which could adversely affect our ability to operate our business and our results of operations.

Employees

As of June 30, 2018, we had 65 employees, of which 28 work in sales, sales support and marketing, 28 work in research and development, four work in manufacturing and operations and five work in general and administrative. As of June 30, 2018, of our 65 employees, 57 were located in the U.S. and eight were employed outside the U.S. None of our employees is represented by a labor union or is subject to a collective bargaining agreement.

Facilities

We lease approximately 33,128 square feet of office, laboratory, and manufacturing space at our headquarters in San Diego, California, under a lease that expires on December 31, 2020. We believe that we will need additional space as we grow our operations, but believe that suitable additional or substitute space will be available to accommodate future growth of our business. We believe that our existing office, laboratory and manufacturing space will be sufficient to meet our needs in the interim.

MANAGEMENT

Executive Officers and Directors

The following table sets forth information regarding our directors and executive officers as of July 31, 2018.

Name	Age	Position
Executive Officers:		
R. Erik Holmlin, Ph.D.	50	President, Chief Executive Officer and Director
Mike Ward	47	Chief Financial Officer
Han Cao, Ph.D.	50	Chief Scientific Officer
Warren Robinson	49	Chief Commercial Officer
Mark Borodkin	44	Chief Operating Officer
Non-Employee Directors:		
David L. Barker, Ph.D.(1)(2)	77	Chairman, Director
Darren Cai, Ph.D.(1)	53	Director
Albert Luderer, Ph.D.(2)(3)	70	Director
Junfeng Wang(1)(3)	44	Director
Christopher Twomey(2)	58	Director
Quan Zhou(3)	43	Director

(1) Member of the compensation committee.
(2) Member of the audit committee.
(3) Member of the nominating and corporate governance committee.

Executive Officers

R. Erik Holmlin, Ph.D. Dr. Holmlin has served as our President and Chief Executive Officer and as a member of our board of directors since January 2011. From June 2010 to February 2011, Dr. Holmlin served as president and Chief Executive Officer of GenVault Corporation, a private biosample management solutions company. Previously, Dr. Holmlin held positions as an entrepreneur in residence at Domain Associates, a dedicated life sciences venture capital firm; Chief Commercial Officer of Exiqon A/S, a publicly traded RNA research solutions company; founder and executive at GeneOhm Sciences, which was acquired by Becton Dickinson and Company; and a National Institutes of Health postdoctoral fellow at Harvard University. Until June 2016, Dr. Holmlin served as a director of Nanosphere, Inc., a publicly traded molecular diagnostic company, which was subsequently acquired by Luminex Corporation, a publicly traded biological testing company. Dr. Holmlin received his bachelor's degree in chemistry from Occidental College, his Ph.D. in chemistry from the California Institute of Technology and MBAs from University of California, Berkeley and Columbia University. Our board of directors believes that Dr. Holmlin's over 17 years of experience in the life sciences and health care industries, which includes the areas of technology development, product commercialization and venture financing, qualifies him to serve on our board of directors.

Mike Ward. Mr. Ward has served as our Chief Financial Officer since May 2018, and previously served as our Chief Business Officer from July 2017 and as our Vice President, Corporate Development since April 2014. From September 2009 to September 2013, Mr. Ward served as a Director and Vice President of the Private Equity and Venture Capital Investment team of Lurie Investment Fund. In addition, Mr. Ward previously served in investment banking positions at Leerink Partners, BMO Capital Markets, Dresdner Kleinwort Wasserstein, Prudential Securities and Credit Suisse. Mr. Ward has previously served on the boards of directors of public and private companies, including Nanosphere, Inc., CytoPherx, Inc., Aperion Biologics, Inc. and Impact Health, Inc. Mr. Ward has over 20 years of experience in the areas of investment banking, private equity and venture capital in the life sciences industry. Mr. Ward received his bachelor's degree in finance from the University of Illinois.

Han Cao, Ph.D. Dr. Cao founded Bionano in 2003 and has served as our Chief Scientific Officer since July 18, 2011. From January 2000 to October 2003, Dr. Cao worked as a Research Fellow in the Nanostructure lab in the Department of Engineering at Princeton University. Dr. Cao was a postdoctoral fellow from October 2000 to December 2003 at the Institute for Human Gene Therapy, in the Department of Molecular and Cellular Biology at the University of Pennsylvania Medical Center. Dr. Cao received his bachelor's degree in molecular and cellular biology from the University of Science and Technology of China and his Ph.D. in molecular biology from the University of Delaware.

Warren Robinson. Mr. Robinson has served as our Chief Commercial Officer since November 2017 and previously served as a Vice President with us in various sales and marketing functions from October 2015 to November 2017, including most recently as our Vice President of Global Sales and Marketing. From June 2013 to October 2015, Mr. Robinson served as Division Vice President of Aegis Chemical Solutions, LLC, a private oil production services company. Previously, Mr. Robinson held various leadership roles in sales-focused positions with Life Technologies Corporation, a publicly traded research tools development company acquired by Thermo Fisher Scientific Inc. in February 2014, and Invitrogen Corporation, a publicly traded research tools development company acquired by Life Technologies in January 2008. Mr. Robinson received his bachelor's degree in biochemistry from The University of Lethbridge, a research university located in Canada.

Mark Borodkin. Mr. Borodkin has served as our Chief Operating Officer since November 2017 and previously served as our Vice President, Product Development and Operations since October 2014. From December 2011 to August 2014, Mr. Borodkin served as the Senior Director of Engineering and Chief Product Officer at Brooks Life Science Systems, a provider of automation and cryogenic solutions for the life science industry, and from April 2009 to October 2011 as a Director of Engineering at Affymetrix, Inc., a private life science systems company that was acquired by Thermo Fisher Scientific in March 2016. From December 2007 to April 2009, Mr. Borodkin served as a Senior Manager and Core Team Leader of R&D for Siemens Healthcare Diagnostics, and for the prior 13 years, he developed sequencing and real-time PCR systems at Applied Biosystems, now a part of Thermo Fisher Scientific. Mr. Borodkin received both his bachelor's degree in electrical engineering and his master's degree in computer and systems engineering from Rensselaer Polytechnic Institute.

Non-Employee Directors

David L. Barker, Ph.D. Dr. Barker has served on our board of directors since May 2010, and as Chairman of our board of directors since August 2016. Dr. Barker also serves as a member of the board of directors of AmideBio, LLC, a private biotechnology company, Singular Genomics Systems, Inc., a private biotechnology company, and Integrated Diagnostics Inc., a private molecular diagnostics company. In addition, Dr. Barker is a scientific advisor to MiNDERA Corp., a private molecular dermatology company, and Luna DNA Inc., a private medical research database company. From January 2000 to January 2007, Dr. Barker served as Vice President and Chief Scientific Officer of Illumina, Inc., a public DNA sequencing technology company, and until May 2016 served as a member of the scientific advisory board of Illumina. Dr. Barker previously served as a member of the board of directors of IntegenX, Inc., a private Rapid human DNA identification technology company acquired by Thermo Fisher Scientific in May 2018, Zephyrus Biosciences, Inc., a private protein analysis research platform company acquired by Bio-Techne Corporation, a public life sciences company, in March 2016, ProteinSimple, a private protein analysis platform development company acquired by BioTechne in June 2014, and NextBio, a private genomic data analysis company acquired by Illumina in October 2013. Dr. Barker received his bachelor's degree in chemistry from the California Institute of Technology and a Ph.D. in biochemistry from Brandeis University. Our board of directors believes Dr. Barker's extensive experience in managing and leading early stage and established companies within the clinical diagnostic and biotechnology industries qualifies him to serve on our board of directors.

Darren Cai, Ph.D. Dr. Cai has served on our board of directors since September 2014. From April 2015 to April 2018, Dr. Cai served as a Managing Director of Legend Capital, a Chinese early stage and expansion stage

venture capital firm, and held a previous position as a Director of Legend Capital from October 2012. Dr. Cai also served as Chief Financial Officer of Beijing Genomics Institute, a genome sequencing company, from 2014 to 2016. During his tenure at Legend Capital, Dr. Cai focused on investment opportunities in the healthcare sector and led investment in more than 20 companies located in the U.S. and China. In addition, Dr. Cai previously served on the board of directors of Beijing Genomics Institute. Dr. Cai received his bachelor's degree in biophysics from the University of Science and Technology of China, MBA from Yale University and Ph.D. in vision science from the University of California, Berkeley. Our board of directors believes Dr. Cai's extensive experience in managing and developing investment and business opportunities within the health care sector qualifies him to serve on our board of directors.

Albert Luderer, Ph.D. Dr. Luderer has served on our board of directors since October 2011. Since March 2010, Dr. Luderer has served as Chief Executive Officer and a member of the board of directors of Integrated Diagnostics Inc., a private molecular diagnostics company. In addition, Dr. Luderer currently serves as the Chief Executive Officer and a member of the board of directors of Indi Molecular, Inc., synthetic antibody technology company, and as a the Executive Chairman of the board of directors of Prostate Management Diagnostics Inc. Dr. Luderer has over 30 years of experience in executive leadership roles in the areas of technology development, operations and business development. Dr. Luderer received his bachelor's degree in zoology from Drew University and his MS in immunochemistry and Ph.D. in immunogenics from Rutgers University. Our board of directors believes Dr. Luderer's experience in the biotechnology sector, with special focuses on technology, business development and commercialization, qualifies him to serve on our board of directors.

Junfeng Wang. Mr. Wang has served on our board of directors since February 2018. Since October 2009, Mr. Wang has served as a Managing Director of Legend Capital, and held previous positions with Legend Capital as Executive Director from October 2007, Senior Vice President from October 2006 and Vice President from October 2005. Through his tenure at Legend Capital, Mr. Wang has worked in the healthcare and chemical industries, developing research and investment expertise in growth capital investment. Mr. Wang received his bachelor's degree in polymer chemistry from Lanzhou University, a research university located in China, and his MBA from McMaster University, a research university located in Canada. Our board of directors believes Mr. Wang's extensive experience as a venture capital investor in the healthcare and chemical industries qualifies him to serve on our board of directors.

Christopher J. Twomey has served on our board of directors since July 2018. Since March 2006, Mr. Twomey has served as a director of Senomyx, Inc., a taste technologies company. Since August 2013, Mr. Twomey has served as a director and Chairman of the Audit Committee of Tandem Diabetes Care, Inc., a medical device company. From March 1990 to June 2007, Mr. Twomey served in various roles, including as Senior Vice President, Finance and Chief Financial Officer, at Biosite Incorporated, a medical diagnostics company. From October 1981 to March 1990, Mr. Twomey served as an audit manager for Ernst & Young, LLP. From July 2006 to March 2014, Mr. Twomey also served as a director and Chairman of the Audit Committee of Cadence Pharmaceuticals, Inc., a specialty pharmaceutical company that was acquired by Mallinckrodt plc in 2014. Mr. Twomey received his bachelors degree in Business Economics from the University of California at Santa Barbara. Mr. Twomey contributes substantial leadership skills and expertise in accounting and financial reporting that are especially valuable in his role as Chairman of our Audit Committee.

Quan Zhou. Mr. Zhou has served on our board of directors since February 2018. Since April 2016, Mr. Zhou has served as an Executive Director at Legend Capital, and held previous positions as Director from April 2015 and Vice President from October 2012. During his tenure at Legend Capital, Mr. Zhou has focused on the Medtech and diagnostics industries. Mr. Zhou received his bachelor's degree in Biology from the University of Science and Technology in China, his Masters in Neuroscience from the National University of Singapore, and his MBA from the China Europe International Business School. Our board of directors believes Mr. Zhou's extensive experience in investment in the healthcare sector qualifies him to serve on our board of directors.

There are no family relationships among any of our directors or executive officers.

Composition of Our Board of Directors

Our business and affairs are managed under the direction of our board of directors. Each of our current directors was elected to serve as a member of our board of directors pursuant to a stockholders agreement dated August 5, 2016, as amended, by and among us and certain of our stockholders. Pursuant to the stockholders agreement: (1) Dr. Holmlin was designated to serve on our board of directors as the then serving chief executive officer; (2) Mr. Zhou was designated by LC Fund VI, L.P., LC Parallel Fund VI, L.P. and LC HealthCare Fund I, and their affiliates, collectively referred to as LC, to serve on our board of directors as a representative of the holders of our Series C convertible preferred stock; (3) Mr. Wang was designated by LC to serve on our board of directors as a representative of the holders of our Series D-1 convertible preferred stock stockholders; and (4) Dr. Luderer, Dr. Barker, Dr. Cai and Mr. Twomey were designated to serve on our board of directors as independent directors. The stockholders agreement will terminate upon the closing of this offering, and thereafter no stockholder will have any special rights regarding the election or designation of the members of our board of directors.

We currently have seven directors, and our board of directors may establish the authorized number of directors from time to time by resolution.

In accordance with our amended and restated certificate of incorporation to be filed in connection with this offering, immediately after this offering, our board of directors will be divided into three classes with staggered three-year terms. At each annual general meeting of stockholders, the successors to directors whose terms then expire will be elected to serve from the time of election and qualification until the third annual meeting following election. Our directors will be divided among the three classes as follows:

- the Class I directors will be Dr. Holmlin and Dr. Barker, and their terms will expire at the annual general meeting of stockholders to be held in 2019;
- the Class II directors will be Dr. Luderer and Mr. Zhou, and their terms will expire at the annual general meeting of stockholders to be held in 2020; and
- the Class III director will be Dr. Cai, Mr. Twomey and Mr. Wang, and their terms will expire at the annual general meeting of stockholders to be held in 2021.

Board Leadership Structure

Our board of directors is currently chaired by Dr. Barker, who has authority, among other things, to call and preside over board of directors meetings, to set meeting agendas and to determine materials to be distributed to the board of directors. Accordingly, the chairperson of our board of directors has substantial ability to shape the work of the board of directors. We believe that separation of the positions of chairperson and chief executive officer reinforces the independence of our board of directors in its oversight of our business and affairs. In addition, we have a separate chair for each committee of our board of directors. The chair of each committee is expected to report annually to our board of directors on the activities of their committee in fulfilling their responsibilities as detailed in their respective charters or specify any shortcomings should that be the case.

Role of the Board in Risk Oversight

The audit committee of our board of directors is primarily responsible for overseeing our risk management processes on behalf of our board of directors. Going forward, we expect that the audit committee will receive reports from management at least quarterly regarding our assessment of risks. In addition, the audit committee reports regularly to our board of directors, which also considers our risk profile. The audit committee and our board of directors focus on the most significant risks we face and our general risk management strategies. While our board of directors oversees our risk management, management is responsible for day-to-day risk management processes. Our board of directors expects management to consider risk and risk management in each business decision, to proactively develop and monitor risk management strategies and processes for

day-to-day activities and to effectively implement risk management strategies adopted by the audit committee and our board of directors. We believe this division of responsibilities is the most effective approach for addressing the risks we face and that our board of directors' leadership structure, which also emphasizes the independence of our board of directors in its oversight of its business and affairs, supports this approach.

Director Independence

Under the listing requirements and rules of Nasdaq, independent directors must comprise a majority of our board of directors as a listed company within one year of the listing date. Our board of directors has undertaken a review of the independence of each director. Based on information provided by each director concerning her or his background, employment and affiliations, our board of directors has determined that all of our directors, except Dr. Holmlin, are independent directors, as defined by Rule 5605(a)(2) of the Nasdaq Listing Rules.

Committees of Our Board of Directors

Our board of directors has established an Audit Committee, a Compensation Committee, and a Nominating and Corporate Governance Committee. The composition and responsibilities of each of the committees of our board of directors are described below. Members serve on these committees until their resignation or until otherwise determined by our board of directors. Our board of directors may establish other committees as it deems necessary or appropriate from time to time.

Audit Committee

Our audit committee consists of Mr. Twomey, Dr. Luderer and Dr. Barker, each of whom our board of directors has determined satisfies the independence requirements under the Nasdaq listing standards and Rule 10A-3(b)(1) of the Exchange Act. The chair of our audit committee is Mr. Twomey, who our board of directors has determined is an "audit committee financial expert" within the meaning of SEC regulations. Each member of our audit committee can read and understand fundamental financial statements in accordance with applicable requirements. In arriving at these determinations, the board of directors has examined each audit committee member's scope of experience and the nature of their employment in the corporate finance sector.

The primary purpose of the audit committee is to discharge the responsibilities of our board of directors with respect to our corporate accounting and financial reporting processes, systems of internal control and financial-statement audits, and to oversee our independent registered accounting firm. Specific responsibilities of our audit committee include:

- helping our board of directors oversee our corporate accounting and financial reporting processes;
- managing the selection, engagement, qualifications, independence and performance of a qualified firm to serve as the independent registered public accounting firm to audit our financial statements;
- discussing the scope and results of the audit with the independent registered public accounting firm, and reviewing, with management and the independent accountants, our interim and year-end operating results;
- developing procedures for employees to submit concerns anonymously about questionable accounting or audit matters;
- reviewing related person transactions;
- obtaining and reviewing a report by the independent registered public accounting firm at least annually, that describes our internal quality control procedures, any material issues with such procedures, and any steps taken to deal with such issues when required by applicable law; and
- approving, or, as permitted, pre-approving, audit and permissible non-audit services to be performed by the independent registered public accounting firm.

Compensation Committee

Our compensation committee consists of Dr. Barker, Dr. Cai and Mr. Wang. The chair of our compensation committee is Dr. Barker. Our board of directors has determined that each member of the compensation committee is independent under the Nasdaq listing standards, a "non-employee director" as defined in Rule 16b-3 promulgated under the Exchange Act and an "outside director" as that term is defined in Section 162(m) of the Code.

The primary purpose of our compensation committee is to discharge the responsibilities of our board of directors in overseeing our compensation policies, plans and programs and to review and determine the compensation to be paid to our executive officers, directors and other senior management, as appropriate. Specific responsibilities of our compensation committee include:

- reviewing and approving the compensation of our chief executive officer, other executive officers and senior management;
- reviewing and recommending to our board of directors the compensation paid to our directors;
- reviewing and approving the compensation arrangements with our executive officers and other senior management;
- administering our equity incentive plans and other benefit programs;
- reviewing, adopting, amending and terminating, incentive compensation and equity plans, severance agreements, profit sharing plans, bonus plans, change-of-control protections and any other compensatory arrangements for our executive officers and other senior management;
- reviewing, evaluating and recommending to our board of directors succession plans for our executive officers; and
- reviewing and establishing general policies relating to compensation and benefits of our employees, including our overall compensation philosophy.

Nominating and Corporate Governance Committee

Our nominating and corporate governance committee consists of Dr. Luderer, Mr. Wang and Mr. Zhou. The chair of our nominating and corporate governance committee is Dr. Luderer. Our board of directors has determined that each member of the nominating and corporate governance committee is independent under the Nasdaq listing standards, a non-employee director, and free from any relationship that would interfere with the exercise of his or her independent judgment.

Specific responsibilities of our nominating and corporate governance committee include:

- identifying and evaluating candidates, including the nomination of incumbent directors for reelection and nominees recommended by stockholders, to serve on our board of directors;
- considering and making recommendations to our board of directors regarding the composition and chairmanship of the committees of our board of directors;
- instituting plans or programs for the continuing education of our board of directors and orientation of new directors;
- developing and making recommendations to our board of directors regarding corporate governance guidelines and matters; and
- overseeing periodic evaluations of the board of directors' performance, including committees of the board of directors and management.

Code of Business Conduct and Ethics

Effective upon the completion of this offering, we will adopt a code of business conduct and ethics that applies to all our employees, officers and directors. This includes our principal executive officer, principal financial officer and principal accounting officer or controller, or persons performing similar functions. The full text of our code of business conduct and ethics will be posted on our website at www.bionanogenomics.com. We intend to disclose on our website any future amendments to our code of business conduct and ethics or waivers that exempt any principal executive officer, principal financial officer, principal accounting officer or controller, persons performing similar functions or our directors from provisions in our code of business conduct and ethics. Information contained in, or that can be accessed through, our website is not incorporated by reference into this prospectus, and you should not consider information on our website to be part of this prospectus.

Compensation Committee Interlocks and Insider Participation

None of the members of the compensation committee is currently, or has been at any time, one of our officers or employees. None of our executive officers currently serves, or has served during the last calendar year, as a member of the board of directors or compensation committee of any entity that has one or more executive officers serving as a member of our board of directors or compensation committee.

Director Compensation

Our board of directors adopted a non-employee director compensation policy in July 2018 that will become effective upon the execution and delivery of the underwriting agreement related to this offering and will be applicable to each member of our board of directors who is not also serving as an employee or consultant to the Company. This compensation policy provides that each such non-employee director will receive the following compensation for service on our board of directors:

- an annual cash retainer of $30,000;
- an additional annual cash retainer of $20,000 for service as chairman of the board of directors;
- an additional annual cash retainer of $15,000, $10,000 and $10,000 for service as chair of the audit committee, compensation committee and the nominating and corporate governance committee, respectively;
- an additional annual cash retainer of $7,500, $5,000 and $5,000 for service as a member of the audit committee, compensation committee and the nominating and corporate governance committee, respectively (not applicable to committee chairs);
- an initial option grant to purchase common stock with an aggregate Black-Scholes option value of $50,000 on the date of each such non-employee director’s appointment to our board of directors; and
- an annual option grant to purchase common stock with an aggregate Black-Scholes option value of $35,000 on the date of each of our annual stockholder meetings.

Each of the option grants described above will be granted under our 2018 Plan, the terms of which are described in more detail below under “— Equity Benefit Plans — 2018 Equity Incentive Plan.” Each such option grant will vest and become exercisable subject to the director’s continuous service to us, provided that each option will vest in full upon a change in control (as defined in the 2018 Plan). The term of each option will be 10 years, subject to earlier termination as provided in the 2018 Plan, provided that upon a termination of service other than for death, disability or cause, the post-termination exercise period will be 12 months from the date of termination. An eligible director may decline all or any portion of his or her compensation by giving notice to the Company prior to the date cash may be paid or equity awards are to be granted, as the case may be.

We have reimbursed and will continue to reimburse all of our non-employee directors for their reasonable out-of-pocket expenses incurred in attending board of directors and committee meetings. Dr. Holmlin, our President and Chief Executive Officer, is also a director but did not receive any additional compensation for his service as a director. See the section titled "Executive Compensation" for more information regarding the compensation earned by Dr. Holmlin.

The following table sets forth in summary form information concerning the compensation that was earned by each of our non-employee directors during the year ended December 31, 2017:

NAME	FEES EARNED OR PAID IN CASH	OPTION AWARDS ($)(1)	TOTAL ($)
David L. Barker, Ph.D.	$ 30,000	$ 8,066	$ 38,066
Darren Cai, Ph.D.	$ —	$ —	$ —
Brian K. Halak, Ph.D.(2)	$ —	$ 5,500	$ 5,500
Albert Luderer, Ph.D.	$ 10,000	$ 5,500	$ 15,500
Junfeng Wang	$ —	$ —	$ —
Christopher Twomey(3)	$ —	$ —	$ —
Quan Zhou(4)	$ —	$ —	$ —

(1) The amounts reported reflect the aggregate grant date fair value of each equity award granted to our non-employee directors during the fiscal year ended December 31, 2017, as computed in accordance with Financial Accounting Standard Board Accounting Standards Codification Topic 718 for stock-based compensation transactions (ASC 718). Assumptions used in the calculation of these amounts are included in Note 2 to our financial statements for the fiscal year ended December 31, 2017. As required by SEC rules, the amounts shown exclude the impact of estimated forfeitures related to service-based vesting conditions. These amounts do not reflect the actual economic value that will be realized by our non-employee directors upon the vesting of the stock options, the exercise of the stock options, or the sale of the common stock underlying such stock options. As of December 31, 2017, the aggregate number of shares outstanding under all options to purchase our common stock held by our non-employee directors were: Dr. Barker, 573,200; Dr. Halak, 387,000; and Dr. Luderer, 393,000. None of our non-employee directors held unvested stock awards as of December 31, 2017.

(2) Dr. Halak resigned from our Board of Directors in May 2018.

(3) Mr. Twomey was appointed to our Board of Directors in July 2018.

(4) Mr. Zhou was appointed to our Board of Directors in July 2018.

EXECUTIVE COMPENSATION

Our named executive officers for the year ended December 31, 2017, consisting of our principal executive officer and the next two most highly compensated executive officers, were:

- R. Erik Holmlin, Ph.D., our Chief Executive Officer;
- Mike Ward, our Chief Financial Officer; and
- Han Cao, Ph.D., our Chief Scientific Officer.

Summary Compensation Table

The following table presents all of the compensation awarded to or earned by or paid to our named executive officers during the fiscal year ended December 31, 2017.

Name and Principal Position	Year	Salary ($)	Bonus ($)	Option Awards(1) ($)	Non-Equity Incentive Plan Compensation(2) ($)	All Other Compensation(3) ($)	Total ($)
R. Erik Holmlin, Ph.D. *Chief Executive Officer*	2017	378,628	—	93,786	118,132	14,784	605,330
Mike Ward *Chief Financial Officer*	2017	289,380	—	20,841	72,056	14,198	396,475
Han Cao, Ph.D. *Chief Scientific Officer*	2017	300,451	—	31,262	45,518	14,468	391,699

(1) In accordance with SEC rules, this column reflects the aggregate grant date fair value of stock options granted to our named executive officers during fiscal year ended December 31, 2017 under our 2006 Plan, computed in accordance with ASC 718. The valuation assumptions used in calculating the fair value of the stock options are included in Note 2 to our financial statements included elsewhere in this prospectus. These amounts do not reflect the actual economic value that may be realized by the named executive officer upon the vesting of the stock options, the exercise of the stock options, or the sale of the common stock underlying such stock options.

(2) Amounts reported represent bonuses earned for 2017 and paid in 2018 at the discretion of our board of directors.

(3) Amounts reflect the following: for Mr. Holmlin, $14,424 for 401(k) matching contributions and $360 for life insurance premiums; for Mr. Ward, $13,838 for 401(k) matching contributions and $360 for life insurance premiums; for Mr. Cao, $14,108 for 401(k) matching contributions and $360 for life insurance premiums.

Annual Base Salary

The compensation of our named executive officers is generally determined and approved by our board of directors, based on the recommendation of the compensation committee of our board of directors. The 2017 base salaries that became effective as of February 7, 2017 were as follows:

NAME	2017 BASE SALARY ($)
R. Erik Holmlin, Ph.D.	378,628
Mike Ward	289,380
Han Cao, Ph.D.	300,451

Bonus Opportunity

In addition to base salaries, our named executive officers are eligible to receive annual performance-based cash bonuses, which are designed to provide appropriate incentives to our executives to achieve defined annual

performance goals and to reward our executives for individual achievement towards these goals. The annual performance-based bonus each named executive officer is eligible to receive is generally based on the extent to which we achieve the corporate goals that our compensation committee establishes each year and, for all except Dr. Holmlin, the individual's contributions to such achievements. Dr. Holmlin's payout is based entirely on Company performance, Dr. Cao's payout is based on Company performance (25% weighting) and his individual performance (75% weighting), and Mr. Ward's payout is based on Company performance (50% weighting) and his individual performance (50% weighting). At the end of the year, our board of directors reviews each executive's performance and determines the actual bonus payout to be awarded to each of our named executive officers.

For 2017, the target bonus for Dr. Holmlin was 40% of base salary, for Dr. Cao was 20% of base salary and for Mr. Ward was 30% of base salary. Our corporate performance objectives for 2017, as established by our compensation committee, included achievement of our 2017 operating plan, launch of our Saphyr instrument, accomplishment of product development milestones, entry into product development and marketing arrangements and securing additional financing. In March 2018, our board of directors approved a 78% overall achievement level of our corporate goals and awarded bonuses to our named executive officers based on Company achievements and, except for Dr. Holmlin, on individual performance in 2017.

Equity-Based Incentive Awards

We believe that our ability to grant equity-based awards is a valuable and necessary compensation tool that aligns the long-term financial interests of our employees, consultants and directors with the financial interests of our stockholders. In addition, we believe that our ability to grant equity-based awards helps us to attract, retain and motivate employees, consultants and directors, and encourages them to devote their best efforts to our business and financial success. Our board of directors is responsible for approving equity grants. Vesting of equity awards is generally tied to continuous service with us and serves as an additional retention measure. Our executives generally are awarded an initial new hire grant upon commencement of employment. Additional grants may occur periodically in order to specifically incentivize executives with respect to achieving certain corporate goals or to reward executives for exceptional performance.

Prior to this offering, we have granted all equity awards pursuant to the 2006 Plan, the terms of which are described below under "—Equity Benefit Plans." All options are granted with a per share exercise price equal to no less than the fair market value of a share of our common stock on the date of the grant of such award. Generally our stock option awards vest over a three-year period subject to the holder's continuous service to us.

In February 2017, our board of directors granted options to purchase 307,975 shares to Dr. Holmlin, 102,658 shares to Dr. Cao and 68,439 shares to Mr. Ward. Each option has an exercise price of $0.64 per share and vests as follows: 25% of the shares subject to the option are fully vested and 6.25% of the shares subject to the option vest at the end of each three month anniversary of vesting commencement date, subject to single trigger acceleration of vesting in connection with a change of control, provided in each case that the holder is then providing services to us in accordance with the terms of the 2006 Plan. For additional information, please see below under "—Outstanding Equity Awards at Fiscal Year-End."

Agreements with Our Named Executive Officers

Below are descriptions of our employment agreements with our named executive officers. For a discussion of the severance pay and other benefits to be provided in connection with a termination of employment and/or a change in control under the arrangements with our named executive officers, please see "—Potential Payments upon Termination or Change in Control" below.

Dr. Holmlin. We entered into an employment agreement with Dr. Holmlin in January 2011, as amended in March 2011 and in November 2017, which governs the current terms of his employment with us. Pursuant to the

agreement, as amended, Dr. Holmlin was entitled to an initial annual base salary of $315,000 and is eligible to receive an annual performance bonus with a target of 40% of his base salary, with a higher amount possible if goals exceeding target are achieved, as determined by our compensation committee and subject to approval by our board of directors. In addition, Dr. Holmlin was eligible to receive an option to purchase shares of the Company's common stock representing 5.0% of the fully-diluted equity shares immediately subsequent to the closing of a Series B transaction, which were equal to 5,984 shares of our common stock and were granted in 2011. In addition, Dr. Holmlin's agreement provided for additional options to be granted in connection with specified events in order to maintain Dr. Holmlin's ownership percentage, pursuant to which Dr. Holmlin was granted additional options to purchase 2,231 shares in 2012 and 5,093 shares in 2015. No obligations to make additional grants to maintain Dr. Holmlin's ownership percentage remain under his employment agreement. Dr. Holmlin's employment is at will.

Mr. Ward. We entered into an employment agreement with Mr. Ward in July 2016, which governs the current terms of his employment with us. Pursuant to the agreement, Mr. Ward was entitled to an initial annual base salary of $278,250 and is eligible to receive an annual performance bonus with a target amount of up to 30% of his base salary, as determined by our board of directors. Mr. Ward's employment is at will.

Dr. Cao. We entered into an employment agreement with Dr. Cao in July 2011, as amended in November 2017, which governs the current terms of his employment with us. Pursuant to the agreement, Dr. Cao was entitled to an initial annual base salary of $250,000 and a one-time signing bonus of $40,000 in cash. Dr. Cao received certain benefits in connection with his relocation, which were paid in 2012. Dr. Cao is eligible to receive an annual performance bonus with a target amount of 20% of his base salary based on the Company's performance (25% weighting) and Dr. Cao's individual performance (75% weighting), as determined by our board of directors. In addition, Dr. Cao was eligible to receive an option to purchase a number of shares of the Company's common stock that, together with shares and/or options then owned by Dr. Cao and the shares of Series B preferred stock of the Company that was to be issued to Dr. Cao as described in his employment agreement, represented no less than 7.5% of the total outstanding shares of the common stock of the Company on a fully diluted basis, which was equal to 4,689 shares of our common stock and was granted in 2011. No obligations to make additional grants to maintain Dr. Cao's ownership percentage remain under his employment agreement. Dr. Cao was also entitled to a bonus consisting of 240,800 shares of Series B preferred stock of the Company pursuant to the terms of a restricted stock purchase agreement entered into in August 2011. Dr. Cao's employment is at will.

Potential Payments upon Termination or Change in Control

Regardless of the manner in which a named executive officer's service terminates, each named executive officer is entitled to receive amounts earned during his term of service, including unpaid salary and unused vacation. In addition, each of our named executive officers is eligible to receive certain benefits pursuant to his employment agreement with us, as described below. For the definitions of "cause," "good reason" and "disability" referenced below, please refer to the individual employment agreements with each of our named executive officers.

Dr. Holmlin. Upon Dr. Holmlin's termination for any reason other than death, disability, cause or resignation without good reason, and subject to Dr. Holmlin's execution of a release, Dr. Holmlin shall be eligible to receive (i) a lump sum amount equal to nine months of base salary, (ii) accelerated vesting of any options or restricted shares that would have vested within 18 months after the date of termination and (iii) premiums for continued health coverage for nine months following the date of termination, or until Dr. Holmlin is no longer eligible for continuation coverage, whichever is earlier. In the event of termination due to disability, and subject to Dr. Holmlin's execution of a release, Dr. Holmlin shall be eligible to receive accelerated vesting in full for any unvested portion of the options granted pursuant to his agreement. In the event of a deemed liquidation event (as defined in Dr. Holmlin's employment agreement), the options granted to Dr. Holmlin pursuant to his agreement shall vest in full.

Mr. Ward. Upon termination without cause, and subject to Mr. Ward's execution of a release, Mr. Ward will be eligible to receive (i) six months of continued base salary payments at the rate in effect at the time of termination and (ii) premiums for continued health coverage for six months following the date of termination or until Mr. Ward is no longer eligible for continuation coverage or he becomes eligible for new healthcare eligibility available through new employment, whichever is earlier.

Dr. Cao. Upon Dr. Cao's termination without cause or resignation for good reason, and subject to Dr. Cao's execution of a release, Dr. Cao will be eligible to receive (i) six months of continued base salary, to be paid on the Company's normal pay days commencing with the first regular payroll date of the Company following the effective date of the release, and (ii) premiums for continued health coverage for a period of six months following the date of termination or until Dr. Cao is no longer eligible for such coverage, whichever is earlier. In addition, Dr. Cao's unvested options shall immediately vest as if Dr. Cao had been employed for an additional six months from the date of termination, since more than two years has passed from start of Dr. Cao's employment. Upon Dr. Cao's termination by death or disability, Dr. Cao's unvested options shall immediately vest as if Dr. Cao had been employed for an additional six months from the date of termination, since more than two years has passed from the start of Dr. Cao's employment.

Each of our named executive officers holds stock options under the 2006 Plan that were granted subject to the general terms of the 2006 Plan and the form of stock option agreement. A description of the termination and change of control provisions in the 2006 Plan and stock options granted thereunder is provided below under "—Equity Benefit Plans" and the specific vesting terms of each named executive officer's stock options are described below under "—Outstanding Equity Awards at Fiscal Year-End."

Outstanding Equity Awards at Fiscal Year-End

The following table presents information regarding outstanding equity awards held by our named executive officers as of December 31, 2017.

		Option Awards(1)			
Name	**Grant Date**	**Number of Securities Underlying Unexercised Options Exercisable**	**Number of Securities Underlying Unexercised Options Unexercisable**	**Option Exercise Price Per Share(2)**	**Option Expiration Date**
R. Erik Holmlin, Ph.D.	2/7/2017(3)	134,739	173,236	$ 0.64	2/6/2027
	1/29/2015(4)	6,515	2,961	$ 32.10	1/28/2025
	1/29/2015	5,093	—	$ 32.10	1/28/2025
	6/20/2012	2,231	—	$ 34.24	6/19/2022
	5/16/2011	5,984	—	$ 21.40	5/15/2021
Mike Ward	2/7/2017(3)	29,942	38,497	$ 0.64	2/6/2027
	1/29/2015(4)	1,395	634	$ 32.10	1/28/2025
	4/21/2014(4)	1,071	153	$ 40.66	4/20/2024
Han Cao, Ph.D.	2/7/2017(3)	44,913	57,745	$ 0.64	2/6/2027
	1/29/2015(4)	3,517	1,598	$ 32.10	1/28/2025
	1/29/2015	3,198	—	$ 32.10	1/28/2025
	8/10/2011	4,689	—	$ 21.40	8/9/2021
	4/2/2010	93	—	$ 19.26	4/1/2020
	1/15/2009	93	—	$ 145.52	1/14/2019

(1) All of the option awards were granted under the 2006 Plan, the terms of which plan is described below under "—Equity Benefit Plans."

(2) All of the option awards were granted with a per share exercise price equal to the fair market value of one share of our common stock on the date of grant, as determined in good faith by our board of directors.

(3) Each option award vests as follows: 25% of the shares subject to the option are fully vested and 6.25% of the shares subject to the option vest at the end of each three month anniversary of the vesting commencement date, subject to single trigger acceleration of vesting in connection with a change of control, provided in each case that the holder is then providing services to us in accordance with the terms of the 2006 Plan.

(4) Each option award vests as follows: 25% of the shares subject to the option shall vest at the end of the first anniversary of the vesting commencement date, and 6.25% of the shares subject to the option vest at the end of each three month anniversary of the vesting commencement date, subject to single trigger acceleration of vesting in connection with a change of control, provided in each case that the holder is then providing services to us in accordance with the terms of the 2006 Plan.

Perquisites, Health, Welfare and Retirement Benefits

All of our current named executive officers are eligible to participate in our employee benefit plans, including our medical, dental, vision, life, disability and accidental death and dismemberment insurance plans, in each case on the same basis as all of our other employees. We pay the premiums for the life, disability, accidental death and dismemberment insurance for all of our employees, including our named executive officers. In addition, we provide a 401(k) plan to our employees, including our named executive officers, as discussed in the section below entitled "—401(k) Plan." We generally do not provide perquisites or personal benefits to our named executive officers.

Nonqualified Deferred Compensation

Our named executive officers did not participate in, or earn any benefits under, a nonqualified deferred compensation plan sponsored by us during the fiscal year ended December 31, 2017. Our board of directors may elect to provide our officers and other employees with nonqualified defined contribution or other nonqualified deferred compensation benefits in the future if it determines that doing so is in our best interests.

401(k) Plan

We maintain a defined contribution employee retirement plan, or 401(k) plan, for our employees. Our named executive officers are eligible to participate in the 401(k) plan on the same basis as our other employees. The 401(k) plan is intended to qualify as a tax-qualified plan under Section 401(k) of the Code. The plan permits us to make discretionary contributions, including matching contributions and discretionary profit sharing contributions. The 401(k) plan currently does not offer the ability to invest in our securities.

Equity Benefit Plans

The principal features of our equity plans are summarized below. These summaries are qualified in their entirety by reference to the actual text of the plans, which are filed as exhibits to the registration statement of which this prospectus is a part.

2018 Equity Incentive Plan

Our board of directors adopted our 2018 Plan in July 2018 and our stockholders approved our 2018 Plan in July 2018. Our 2018 Plan provides for the grant of incentive stock options, or ISOs, within the meaning of Section 422 of the Code, to employees, including employees of any parent or subsidiary, and for the grant of nonstatutory stock options, or NSOs, stock appreciation rights, restricted stock awards, restricted stock unit awards, performance stock awards, performance cash awards and other forms of stock awards to employees, directors and consultants, including employees and consultants of our affiliates. Our 2018 Plan is a successor to and continuation of our 2006 Plan. No stock awards may be granted under the 2018 Plan until the date of the underwriting agreement related to this offering.

Authorized Shares. Initially, the maximum number of shares of our common stock that may be issued under our 2018 Plan after it becomes effective will be 2,098,909 shares, which is the sum of (1) 1,100,000 new shares, plus (2) the number of shares (not to exceed 998,909 shares) (i) that remain available for the issuance of awards under our 2006 Plan at the time our 2018 Plan becomes effective, and (ii) any shares subject to outstanding stock options or other stock awards that were granted under our 2006 Plan that are forfeited, terminate, expire, are reacquired, withheld (or not issued) to satisfy a tax withholding obligation or the purchase or exercise price. In addition, the number of shares of our common stock reserved for issuance under our 2018 Plan will automatically increase on January 1 of each calendar year, starting on January 1, 2019 (assuming the 2018 Plan becomes effective in 2018) through January 1, 2028, in an amount equal to 5% of the total number of shares of our capital stock outstanding on the last day of the calendar month before the date of each automatic increase, or a lesser number of shares determined by our board of directors. The maximum number of shares of our common stock that may be issued on the exercise of ISOs under our 2018 Plan is 4,197,818.

Shares subject to stock awards granted under our 2018 Plan that expire or terminate without being exercised in full, or that are paid out in cash rather than in shares, do not reduce the number of shares available for issuance under our 2018 Plan. Additionally, shares become available for future grant under our 2018 Plan if they were issued under stock awards under our 2018 Plan if we repurchase them or they are forfeited. This includes shares used to pay the exercise price of a stock award or to satisfy the tax withholding obligations related to a stock award.

The maximum number of shares of common stock subject to stock awards granted under the 2018 Plan or otherwise during a single calendar year to any non-employee director, taken together with any cash fees paid by us to such non-employee director during such calendar year for service on the board of directors, will not exceed $500,000 in total value (calculating the value of any such stock awards based on the grant date fair value of such stock awards for financial reporting purposes), or, with respect to the calendar year in which a non-employee director is first appointed or elected to the board of directors, $800,000.

Plan Administration. Our board of directors, or a duly authorized committee of our board of directors, will administer our 2018 Plan. Our board of directors may also delegate to one or more of our officers the authority to (1) designate employees (other than officers) to receive specified stock awards and (2) determine the number of shares subject to such stock awards. Under our 2018 Plan, our board of directors has the authority to determine and amend the terms of awards and underlying agreements, including:

- recipients;
- the exercise, purchase or strike price of stock awards, if any;
- the number of shares subject to each stock award;
- the vesting schedule applicable to the awards, together with any vesting acceleration; and
- the form of consideration, if any, payable on exercise or settlement of the award.

Under the 2018 Plan, the board of directors also generally has the authority to effect, with the consent of any adversely affected participant:

- the reduction of the exercise, purchase, or strike price of any outstanding award;
- the cancellation of any outstanding award and the grant in substitution therefore of other awards, cash, or other consideration; or
- any other action that is treated as a repricing under generally accepted accounting principles.

Stock Options. ISOs and NSOs are granted under stock option agreements adopted by the plan administrator. The plan administrator determines the exercise price for stock options, within the terms and conditions of the 2018 Plan, provided that the exercise price of a stock option generally cannot be less than 100% of the fair market value of our common stock on the date of grant. Options granted under the 2018 Plan vest at the rate specified in the stock option agreement as determined by the plan administrator.

Tax Limitations on Incentive Stock Options. The aggregate fair market value, determined at the time of grant, of our common stock with respect to ISOs that are exercisable for the first time by an award holder during any calendar year under all of our stock plans may not exceed $100,000. Options or portions thereof that exceed such limit will generally be treated as NSOs. No ISO may be granted to any person who, at the time of the grant, owns or is deemed to own stock possessing more than 10% of our total combined voting power or that of any of our affiliates unless (1) the option exercise price is at least 110% of the fair market value of the stock subject to the option on the date of grant, and (2) the term of the ISO does not exceed five years from the date of grant.

Restricted Stock Unit Awards. Restricted stock units are granted under restricted stock unit award agreements adopted by the plan administrator. Restricted stock units may be granted in consideration for any form of legal consideration that may be acceptable to our board of directors and permissible under applicable law. A restricted stock unit may be settled by cash, delivery of stock, a combination of cash and stock as deemed appropriate by the plan administrator, or in any other form of consideration set forth in the restricted stock unit agreement. Additionally, dividend equivalents may be credited in respect of shares covered by a restricted stock unit. Except as otherwise provided in the applicable award agreement, restricted stock units that have not vested will be forfeited once the participant's continuous service ends for any reason.

Restricted Stock Awards. Restricted stock awards are granted under restricted stock award agreements adopted by the plan administrator. A restricted stock award may be awarded in consideration for cash, check, bank draft or money order, past or future services to us, or any other form of legal consideration that may be acceptable to our board of directors and permissible under applicable law. The plan administrator determines the terms and conditions of restricted stock awards, including vesting and forfeiture terms. If a participant's service relationship with us ends for any reason, we may receive any or all of the shares of common stock held by the participant that have not vested as of the date the participant terminates service with us through a forfeiture condition or a repurchase right.

Stock Appreciation Rights. Stock appreciation rights are granted under stock appreciation grant agreements adopted by the plan administrator. The plan administrator determines the purchase price or strike price for a stock appreciation right, which generally cannot be less than 100% of the fair market value of our common stock on the date of grant. A stock appreciation right granted under the 2018 Plan vests at the rate specified in the stock appreciation right agreement as determined by the plan administrator.

Performance Awards. The 2018 Plan permits the grant of performance-based stock and cash awards. Our compensation committee may structure awards so that the stock or cash will be issued or paid only following the achievement of certain pre-established performance goals during a designated performance period.

The performance goals that may be selected include one or more of the following: (i) sales; (ii) revenues; (iii) assets; (iv) expenses; (v) market penetration or expansion; (vi) earnings from operations; (vii) earnings before or after deduction for all or any portion of interest, taxes, depreciation, amortization, incentives, service fees or extraordinary or special items, whether or not on a continuing operations or an aggregate or per share basis; (viii) net income or net income per common share (basic or diluted); (ix) return on equity, investment, capital or assets; (x) one or more operating ratios; (xi) borrowing levels, leverage ratios or credit rating; (xii) market share; (xiii) capital expenditures; (xiv) cash flow, free cash flow, cash flow return on investment, or net cash provided by operations; (xv) stock price, dividends or total stockholder return; (xvi) development of new technologies or products; (xvii) sales of particular products or services; (xviii) economic value created or added; (xix) operating margin or profit margin; (xx) customer acquisition or retention; (xxi) raising or refinancing of capital; (xxii) successful hiring of key individuals; (xxiii) resolution of significant litigation; (xxiv) acquisitions and divestitures (in whole or in part); (xxv) joint ventures and strategic alliances; (xxvi) spin-offs, split-ups and the like; (xxvii) reorganizations; (xxviii) recapitalizations, restructurings, financings (issuance of debt or equity) or refinancings; (xxix) or strategic business criteria, consisting of one or more objectives based on the following goals: achievement of timely development, design management or enrollment, meeting specified market penetration or value added, payor acceptance, patient adherence, peer reviewed publications, issuance of new

patents, establishment of or securing of licenses to intellectual property, product development or introduction (including, without limitation, discovery of novel products, maintenance of multiple products in pipeline, product launch or other product development milestones), geographic business expansion, cost targets, cost reductions or savings, customer satisfaction, operating efficiency, acquisition or retention, employee satisfaction, information technology, corporate development (including, without limitation, licenses, innovation, research or establishment of third party collaborations), manufacturing or process development, legal compliance or risk reduction, patent application or issuance goals, or goals relating to acquisitions, divestitures or other business combinations (in whole or in part), joint ventures or strategic alliances; and (xxx) other measures of performance selected by the board of directors.

The performance goals may be based on Company-wide performance or performance of one or more business units, divisions, affiliates, or business segments, and may be either absolute or relative to the performance of one or more comparable companies or the performance of one or more relevant indices. Our board of directors is authorized at any time in its sole discretion, to adjust or modify the calculation of a performance goal for such performance period in order to prevent the dilution or enlargement of the rights of participants, (a) in the event of, or in anticipation of, any unusual or extraordinary corporate item, transaction, event or development; (b) in recognition of, or in anticipation of, any other unusual or nonrecurring events affecting the Company, or the financial statements of the Company in response to, or in anticipation of, changes in applicable laws, regulations, accounting principles, or business conditions; or (c) in view of the board of director's assessment of the business strategy of the Company, performance of comparable organizations, economic and business conditions, and any other circumstances deemed relevant. Specifically, the board of directors is authorized to make adjustment in the method of calculating attainment of performance goals and objectives for a performance period as follows: (i) to exclude the dilutive effects of acquisitions or joint ventures; (ii) to assume that any business divested by the Company achieved performance objectives at targeted levels during the balance of a performance period following such divestiture; and (iii) to exclude the effect of any change in the outstanding shares of common stock of the Company by reason of any stock dividend or split, stock repurchase, reorganization, recapitalization, merger, consolidation, spin-off, combination or exchange of shares or other similar corporate change, or any distributions to common stockholders other than regular cash dividends. In addition, the board of directors is authorized to make adjustment in the method of calculating attainment of performance goals and objectives for a performance period as follows: (i) to exclude restructuring and/or other nonrecurring charges; (ii) to exclude exchange rate effects, as applicable, for non-U.S. dollar denominated net sales and operating earnings; (iii) to exclude the effects of changes to generally accepted accounting standards required by the Financial Accounting Standards Board; (iv) to exclude the effects of any items that are "unusual" in nature or occur "infrequently" as determined under generally accepted accounting principles; (v) to exclude the effects to any statutory adjustments to corporate tax rates; and (vi) to make other appropriate adjustments selected by the board of directors.

Other Stock Awards. The plan administrator may grant other awards based in whole or in part by reference to our common stock. The plan administrator will set the number of shares under the stock award and all other terms and conditions of such awards.

Changes to Capital Structure. In the event there is a specified type of change in our capital structure, such as a stock split, reverse stock split, or recapitalization, appropriate adjustments will be made to (1) the class and maximum number of shares reserved for issuance under the 2018 Plan, (2) the class and maximum number of shares by which the share reserve may increase automatically each year, (3) the class and maximum number of shares that may be issued on the exercise of incentive stock options, (4) the class and maximum number of shares subject to stock awards that may be awarded to any non-employee director under the 2018 Plan, and (5) the class and number of shares and exercise price, strike price, or purchase price, if applicable, of all outstanding stock awards.

Corporate Transactions. Our 2018 Plan provides that in the event of certain specified significant corporate transactions (or a change in control, as defined below), unless otherwise provided in an award agreement or other

written agreement between us and the award holder, the administrator may take one or more of the following actions with respect to such stock awards:

- arrange for the assumption, continuation, or substitution of a stock award by a successor corporation;
- arrange for the assignment of any reacquisition or repurchase rights held by us to a successor corporation;
- accelerate the vesting, in whole or in part, of the stock award and provide for its termination if not exercised (if applicable) at or before the effective time of the transaction;
- arrange for the lapse, in whole or in part, of any reacquisition or repurchase rights held by us;
- cancel or arrange for the cancellation of the stock award, to the extent not vested or not exercised before the effective time of the transaction, in exchange for a cash payment, if any, as determined by the board; or
- make a payment, in the form determined by our board of directors, equal to the excess, if any, of (A) the value of the property the participant would have received on exercise of the award immediately before the effective time of the transaction, over (B) any exercise price payable by the participant in connection with the exercise.

The plan administrator is not obligated to treat all stock awards or portions of stock awards, even those that are of the same type, in the same manner and is not obligated to treat all participants in the same manner.

Under the 2018 Plan, a corporate transaction is generally the consummation of: (1) a sale of all or substantially all of our assets, (2) the sale or disposition of more than 50% of our outstanding securities, (3) a merger or consolidation where we do not survive the transaction, or (4) a merger or consolidation where we do survive the transaction but the shares of our common stock outstanding immediately before such transaction are converted or exchanged into other property by virtue of the transaction.

In the event of a change in control, the board of directors may take any of the above-mentioned actions. Awards granted under the 2018 Plan will not receive automatic acceleration of vesting and exercisability in the event of a change in control, although this treatment may be provided for in an award agreement or other written agreement between the Company and the participant. Under the 2018 Plan, a change in control is generally (1) the acquisition by any person or company of more than 50% of the combined voting power of our then outstanding stock, (2) a merger, consolidation or similar transaction in which our stockholders immediately before the transaction do not own, directly or indirectly, more than 50% of the combined voting power of the surviving entity (or the parent of the surviving entity), (3) a sale, lease, exclusive license or other disposition of all or substantially all of our assets other than to an entity more than 50% of the combined voting power of which is owned by our stockholders, (4) a complete dissolution or liquidation of the Company, or (5) when a majority of our board of directors becomes comprised of individuals who were not serving on our board of directors on the date of the underwriting agreement related to this offering, or the incumbent board, or whose nomination, appointment, or election was not approved by a majority of the incumbent board still in office.

Transferability. Under the 2018 Plan, stock awards are generally not transferable other than by will or the laws of descent and distribution, or as otherwise permitted by our board of directors.

Plan Amendment or Termination. Our board of directors has the authority to amend, suspend, or terminate our 2018 Plan, provided that such action does not materially impair the existing rights of any participant without such participant’s written consent. Certain material amendments also require the approval of our stockholders. No incentive stock options may be granted after the tenth anniversary of the date our board of directors adopted our 2018 Plan. No stock awards may be granted under our 2018 Plan while it is suspended or after it is terminated.

Amended and Restated 2006 Equity Compensation Plan

Our board of directors adopted and our stockholders originally approved our 2006 Plan in September 2006, and it was subsequently amended and restated in September 2008 and most recently amended in March 2016. All references herein to our 2006 Plan shall be deemed to refer to our Amended and Restated 2006 Equity Compensation Plan, as amended, unless the context otherwise requires. Our 2006 Plan allows for the grant of ISOs to employees, including employees of any subsidiary, and for the grant of NSOs, stock appreciation rights, restricted stock awards and restricted stock units and other equity awards to employees, directors and consultants, including employees and consultants of our subsidiaries. As of June 30, 2018, there remained 167,011 shares of common stock available for the grant of awards under the 2006 Plan, and there were options to purchase 833,960 shares of common stock outstanding under the 2006 Plan.

Once our 2018 Plan becomes effective, no further grants will be made under our 2006 Plan. Any outstanding awards granted under our 2006 Plan will remain subject to the terms of our 2006 Plan and applicable award agreements.

Authorized Shares. The maximum number of shares of our common stock that may be issued under our 2006 Plan is 1,022,388 shares. Shares subject to stock awards granted under our 2006 Plan that expire, are forfeited, or terminate without being exercised in full do not reduce the number of shares available for issuance under our 2006 Plan.

Plan Administration. Our board of directors or a duly authorized committee of our board of directors administers our 2006 Plan. Our board of directors shall have the sole authority to (i) determine the individuals to whom grants shall be made under the 2006 Plan, (ii) determine the type, size and terms of the grants to be made to each such individual, (iii) determine the time when the grants will be made and the duration of any applicable exercise or restriction period, including the criteria for exercisability and the acceleration of exercisability, (iv) amend the terms of any previously issued grant, and (v) deal with any other matters arising under the 2006 Plan.

Change of Control. Our 2006 Plan provides that in the event of a change of control, all awards granted under the 2006 Plan shall become fully vested and exercisable (as applicable), unless the board of directors determines otherwise. In the event of a change of control, the administrator may take any of the following actions with respect to any or all outstanding awards: (i) determine that all outstanding options and stock appreciation rights that are not exercised shall be assumed by, or replaced with comparable options by the surviving corporation (or a parent or subsidiary of the surviving corporation), and other outstanding grants that remain in effect after the change of control shall be converted to similar grants of the surviving corporation (or a parent or subsidiary of the surviving corporation), (ii) require that grantees surrender their outstanding options and stock appreciation rights in exchange for one or more payments, in cash or Company stock as determined by the board of directors, in an amount, if any, equal to the amount by which the then fair market value of the shares of Company stock subject to the grantee's unexercised options and stock appreciation rights exceeds the exercise price or base amount of the options and stock appreciation rights, on such terms as the board of directors determines, or (iii) after giving grantees an opportunity to exercise their outstanding options and stock appreciation rights, terminate any or all unexercised options and stock appreciation rights at such time as the board of directors deems appropriate. Such assumption, surrender or termination shall take place as of the date of the change of control or such other date as the board of directors may specify.

Under the 2006 Plan, a change of control is generally (1) the acquisition by any person or company of more than 50% of the combined voting power of our then outstanding stock, (2) the consummation of a merger or consolidation with another corporation where our stockholders, immediately prior to the merger or consolidation, will not beneficially own, immediately after the merger or consolidation, shares entitling such stockholders to more than 50% of all votes to which all stockholders of the surviving corporation would be entitled in the election of directors, (3) the consummation of a sale or other disposition of all or substantially all of our assets, or (4) the consummation of a liquidation or dissolution.

Transferability. Under our 2006 Plan, awards are generally not transferable other than by will or the laws of descent and distribution or as otherwise permitted by the Board.

Plan Amendment or Termination. Our board of directors has the authority to amend, suspend, or terminate our 2006 Plan, although certain material amendments require the approval of our stockholders, and amendments that would materially impair the rights of any participant require the consent of that participant.

2018 Employee Stock Purchase Plan

Our board of directors adopted, and our stockholders approved, our 2018 ESPP in July 2018. The ESPP will become effective immediately prior to and contingent upon the date of the underwriting agreement related to this offering. The purpose of the ESPP is to secure the services of new employees, to retain the services of existing employees, and to provide incentives for such individuals to exert maximum efforts toward our success and that of our affiliates. The ESPP is intended to qualify as an "employee stock purchase plan" within the meaning of Section 423 of the Code for U.S. employees.

Share Reserve. Following this offering, the ESPP authorizes the issuance of 240,000 shares of our common stock under purchase rights granted to our employees or to employees of any of our designated affiliates. The number of shares of our common stock reserved for issuance will automatically increase on January 1 of each calendar year, beginning on January 1, 2019 (assuming the ESPP becomes effective in 2018) through January 1, 2028, by the lesser of (1) 1% of the total number of shares of our common stock outstanding on the last day of the calendar month before the date of the automatic increase, and (2) 300,000 shares; provided that before the date of any such increase, our board of directors may determine that such increase will be less than the amount set forth in clauses (1) and (2). As of the date hereof, no shares of our common stock have been purchased under the ESPP.

Administration. Our board of directors administers the ESPP and may delegate its authority to administer the ESPP to our compensation committee. The ESPP is implemented through a series of offerings under which eligible employees are granted purchase rights to purchase shares of our common stock on specified dates during such offerings. Under the ESPP, we may specify offerings with durations of not more than 27 months, and may specify shorter purchase periods within each offering. Each offering will have one or more purchase dates on which shares of our common stock will be purchased for employees participating in the offering. An offering under the ESPP may be terminated under certain circumstances.

Payroll Deductions. Generally, all regular employees, including executive officers, employed by us or by any of our designated affiliates, may participate in the ESPP and may contribute, normally through payroll deductions, up to 15% of their earnings (as defined in the ESPP) for the purchase of our common stock under the ESPP. Unless otherwise determined by our board of directors, common stock will be purchased for the accounts of employees participating in the ESPP at a price per share that is at least the lesser of (1) 85% of the fair market value of a share of our common stock on the first date of an offering, or (2) 85% of the fair market value of a share of our common stock on the date of purchase. For the initial offering, which we expect will commence on the execution and delivery of the underwriting agreement relating to this offering, the fair market value on the first day of the offering period will be the price at which shares of common stock are first sold to the public.

Limitations. Employees may have to satisfy one or more of the following service requirements before participating in the ESPP, as determined by our board of directors, including: (1) being customarily employed for more than 20 hours per week, (2) being customarily employed for more than five months per calendar year, or (3) continuous employment with us or one of our affiliates for a period of time (not to exceed two years). No employee may purchase shares under the ESPP at a rate in excess of $25,000 worth of our common stock based on the fair market value per share of our common stock at the beginning of an offering for each calendar year such a purchase right is outstanding. Finally, no employee will be eligible for the grant of any purchase rights under the ESPP if immediately after such rights are granted, such employee has voting power over 5% or more of our outstanding capital stock measured by vote or value under Section 424(d) of the Code.

Changes to Capital Structure. In the event that there occurs a change in our capital structure through such actions as a stock split, merger, consolidation, reorganization, recapitalization, reincorporation, stock dividend, dividend in property other than cash, large nonrecurring cash dividend, liquidating dividend, combination of shares, exchange of shares, change in corporate structure, or similar transaction, the board of directors will make appropriate adjustments to: (1) the class(es) and maximum number of shares reserved under the ESPP, (2) the class(es) and maximum number of shares by which the share reserve may increase automatically each year, (3) the class(es) and number of shares subject to and purchase price applicable to outstanding offerings and purchase rights, and (4) the class(es) and number of shares that are subject to purchase limits under ongoing offerings.

Corporate Transactions. In the event of certain significant corporate transactions, any then-outstanding rights to purchase our stock under the ESPP may be assumed, continued or substituted for by any surviving or acquiring entity (or its parent company). If the surviving or acquiring entity (or its parent company) elects not to assume, continue, or substitute for such purchase rights, then the participants' accumulated payroll contributions will be used to purchase shares of our common stock within 10 business days before such corporate transaction, and such purchase rights will terminate immediately.

Under the ESPP, a corporate transaction is generally the consummation of: (1) a sale of all or substantially all of our assets, (2) the sale or disposition of more than 50% of our outstanding securities, (3) a merger or consolidation where we do not survive the transaction, and (4) a merger or consolidation where we do survive the transaction but the shares of our common stock outstanding immediately before such transaction are converted or exchanged into other property by virtue of the transaction,

ESPP Amendment or Termination. Our board of directors has the authority to amend or terminate our ESPP, provided that except in certain circumstances such amendment or termination may not materially impair any outstanding purchase rights without the holder's consent. We will obtain stockholder approval of any amendment to our ESPP as required by applicable law or listing requirements.

Limitations on Liability and Indemnification

On the closing of this offering, our amended and restated certificate of incorporation will contain provisions that limit the liability of our current and former directors for monetary damages to the fullest extent permitted by Delaware law. Delaware law provides that directors of a corporation will not be personally liable for monetary damages for any breach of fiduciary duties as directors, except liability for:

- any breach of the director's duty of loyalty to the corporation or its stockholders;
- any act or omission not in good faith or that involves intentional misconduct or a knowing violation of law;
- unlawful payments of dividends or unlawful stock repurchases or redemptions; or
- any transaction from which the director derived an improper personal benefit.

Such limitation of liability does not apply to liabilities arising under federal securities laws and does not affect the availability of equitable remedies such as injunctive relief or rescission.

Our amended and restated certificate of incorporation will authorize us to indemnify our directors, officers, employees and other agents to the fullest extent permitted by Delaware law. Our amended and restated bylaws will provide that we are required to indemnify our directors and officers to the fullest extent permitted by Delaware law and may indemnify our other employees and agents. Our amended and restated bylaws will also provide that, on satisfaction of certain conditions, we will advance expenses incurred by a director or officer in advance of the final disposition of any action or proceeding, and permit us to secure insurance on behalf of any officer, director, employee, or other agent for any liability arising out of his or her actions in that capacity

regardless of whether we would otherwise be permitted to indemnify him or her under the provisions of Delaware law. We have entered and expect to continue to enter into agreements to indemnify our directors, executive officers and other employees as determined by the board of directors. With certain exceptions, these agreements provide for indemnification for related expenses including attorneys' fees, judgments, fines and settlement amounts incurred by any of these individuals in any action or proceeding.

We believe that these amended and restated certificate of incorporation and amended and restated bylaw provisions and indemnification agreements are necessary to attract and retain qualified persons as directors and officers. We also maintain customary directors' and officers' liability insurance.

The limitation of liability and indemnification provisions in our amended and restated certificate of incorporation and amended and restated bylaws may discourage stockholders from bringing a lawsuit against our directors for breach of their fiduciary duty. They may also reduce the likelihood of derivative litigation against our directors and officers, even though an action, if successful, might benefit us and other stockholders. Further, a stockholder's investment may be adversely affected to the extent that we pay the costs of settlement and damage awards against directors and officers as required by these indemnification provisions.

Insofar as indemnification for liabilities arising under the Securities Act may be permitted for directors, executive officers, or persons controlling us, we have been informed that, in the opinion of the SEC, such indemnification is against public policy as expressed in the Securities Act and is therefore unenforceable.

Rule 10b5-1 Sales Plans

Our directors and officers may adopt written plans, known as Rule 10b5-1 plans, in which they will contract with a broker to buy or sell shares of our common stock on a periodic basis. Under a Rule 10b5-1 plan, a broker executes trades under parameters established by the director or officer when entering into the plan, without further direction from them. The director or officer may amend a Rule 10b5-1 plan in some circumstances and may terminate a plan at any time. Our directors and executive officers may also buy or sell additional shares outside of a Rule 10b5-1 plan when they do not possess of material nonpublic information, subject to compliance with the terms of our insider trading policy. During the first 180 days following this offering, the sale of any shares under such plan would be subject to the lock-up agreement that the director or officer has entered into with the underwriters.

CERTAIN RELATIONSHIPS AND RELATED PARTY TRANSACTIONS

Other than compensation arrangements for our directors and executive officers, which are described elsewhere in this prospectus, below we describe transactions since January 1, 2015 to which we were a party or will be a party, in which:

- the amounts involved exceeded or will exceed $120,000; and
- any of our directors, executive officers or holders of more than 5% of our capital stock, or any member of the immediate family of, or person sharing the household with, the foregoing persons, had or will have a direct or indirect material interest.

Participation in this Offering

Certain of our existing beneficial owners of more than 5% of our voting securities, including entities affiliated with certain of our directors, have indicated an interest in purchasing an aggregate of approximately $6.35 million in shares of our common stock in this offering at the initial public offering price per share. Based on an assumed initial public offering price of $5.50 per share, these persons and entities would purchase an aggregate of approximately 1,154,545 of the 5,500,000 shares in this offering based on these indications of interest. However, because indications of interest are not binding agreements or commitments to purchase, the underwriters may determine to sell more, less or no shares in this offering to any of these persons or entities, or any of these persons or entities may determine to purchase more, less or no shares in this offering.

Convertible Promissory Note Financing

In February 2016, we issued convertible promissory notes in the aggregate principal amount of $1.5 million with an interest rate of 8% per annum. These convertible promissory notes provided for conversion into preferred shares in our next equity financing, at a rate equal to the principal amount of the convertible promissory notes and accrued interest thereon divided by the per share purchase price of the preferred shares in that financing. As further discussed below, on March 4, 2016, these convertible promissory notes converted into an aggregate of 3,138,013 shares of our Series D convertible preferred stock.

The participants in this note financing included the following members of our board of directors and holders of more than 5% of our outstanding capital stock:

Name of Participant	Total Principal Amount
Entities affiliated with LC Fund VI, L.P.(1)	$ 750,000
Entities affiliated with Domain Partners VIII, L.P.(2)	$ 750,000

(1) Includes (i) $715,042 in cash from LC Fund VI, L.P. and (ii) $34,958 in cash from LC Healthcare Fund I, L.P.
(2) Includes (i) $744,476 in cash from Domain Partners VIII, L.P., and (ii) $5,524 in cash from DP VIII Associates, L.P.

Series D Convertible Preferred Stock and Warrant Financing

In March and April 2016, we issued and sold, in a series of closings, an aggregate of 20,652,486 shares of our Series D convertible preferred stock at a purchase price of $0.48 per share for an aggregate purchase price of approximately $9.9 million, and warrants to purchase an aggregate of 31,672,817 shares of our Series D convertible preferred stock for an aggregate purchase price of approximately $31,673. In connection with the first closing of this financing in March 2016, an aggregate of approximately $1.5 million in principal and accrued interest outstanding under the subordinated convertible promissory notes we issued in February 2016 converted into an aggregate of 3,138,013 shares of our Series D convertible preferred stock.

All purchasers of our Series D convertible preferred stock are entitled to specified registration rights. See the section titled “Description of Capital Stock—Registration Rights” for more information regarding these

registration rights. The following table summarizes the Series D convertible preferred stock purchased by affiliates of our executive officers and of members of our board of directors and holders of more than 5% of our outstanding capital stock:

Name of Participant	Shares of Series D Convertible Preferred Stock	Warrants to Purchase Shares of Series D Convertible Preferred Stock	Aggregate Purchase Price
Entities affiliated with LC Fund VI, L.P. (1)	6,443,565	11,263,624	$3,104,175
Entities affiliated with Domain Partners VIII, L.P.(2)	6,443,565	7,412,740	$3,100,324
Han Cao	4,362,062	10,731,083	$2,104,521
Novartis Bioventures Ltd.	1,615,096	—	$ 775,246

(1) Includes: (i) $716,609 of unpaid principal and accrued interest and $2,242,877 in cash from LC Fund VI, L.P., and (ii) $35,035 of unpaid principal and accrued interest and $109,654 in cash from LC Parallel Fund VI, L.P.
(2) Includes: (i) $749,045 of unpaid principal and accrued interest and $2,328,444 in cash from Domain Partners VIII, L.P., and (ii) $5,558 of unpaid principal and accrued interest and $17,277 in cash from DP VIII Associates, L.P.

Series D-1 Convertible Preferred Stock Financing

In August 2016, as well as January, February, March, April, May, July, August and November 2017, we issued and sold, in a series of closings, an aggregate of 66,141,257 shares of our Series D-1 convertible preferred stock at a purchase price of $0.48 per share for an aggregate gross proceeds of approximately $31.7 million. All purchasers of our Series D-1 convertible preferred stock are entitled to certain registration rights. See the section titled “Description of Capital Stock—Registration Rights” for more information regarding these registration rights. The following table summarizes the Series D-1 convertible preferred stock purchased by affiliates of our executive officers and of members of our board of directors and holders of more than 5% of our outstanding capital stock:

Name of Participant	Shares of Series D-1 Convertible Preferred Stock	Aggregate Purchase Price
Entities affiliated with LC Fund VI, L.P.(1)	27,305,708	$13,106,740
Praise Alliance International Limited	12,500,000	$ 6,000,000
Full Succeed International Limited	10,416,667	$ 5,000,000
Entities affiliated with Domain Partners VIII, L.P.(2)	3,710,247	$ 1,780,918
Novartis Bioventures Ltd.	1,070,373	$ 513,779
Han Cao	104,167	$ 50,000

(1) Includes (i) $1,883,867 in cash from LC Fund VI, L.P.; (ii) $11,106,738 in cash from LC Healthcare Fund I, L.P.; and (iii) $116,135 in cash from LC Parallel Fund VI, L.P.
(2) Includes (i) $1,767,801 in cash from Domain Partners VIII, L.P., and (ii) $13,117 in cash from DP VIII Associates, L.P.

Convertible Promissory Note Financing

In February 2018, we issued convertible promissory notes in the aggregate principal amount of approximately $13.4 million with an interest rate of 8% per annum. These convertible promissory notes provide for conversion under the following three circumstances:

Conversion at Qualifying financing – Upon the closing of an equity financing involving the sale by us of convertible preferred stock in which we receive an aggregate of at least $15,000,000 in cumulative gross proceeds, the conversion price will equal 75% of the lowest per share cash purchase price of the convertible

preferred stock sold by us in such qualified financing. The original principal amount and accrued interest under each convertible promissory note shall automatically convert into convertible preferred stock.

Conversion at Initial Public Offering – Prior to the maturity date of the convertible promissory notes, if we complete our initial public offering, the convertible promissory notes will automatically convert into shares of our common stock at an amount equal to the original principal amount and accrued interest under each convertible promissory note divided by 75% of the per share cash purchase price of the common stock offered to the public in the initial public offering.

Optional Conversion at Maturity – Upon maturity, and at the election of the holder, the convertible promissory notes will convert into shares of Series D-2 convertible preferred stock as is equal to the original principal amount and accrued interest under each convertible promissory note divided by the price per share. The price per share is defined as $60,000,000 divided by the aggregate number of outstanding shares of our common stock as of the maturity date.

Accordingly, in connection with the completion of our initial public offering, the principal amount of the convertible promissory notes and accrued interest thereon will automatically convert into 3,339,777 shares of our common stock, assuming an initial public offering price of $5.50 per share and a conversion date of June 30, 2018.

The participants in this note financing included the following members of our board of directors and holders of more than 5% of our outstanding capital stock:

Name of Participant	Total Principal Amount
Entities affiliated with LC Fund VI, L.P. (1)	$ 8,460,000
Entities affiliated with Domain Partners VIII, L.P.(2)	$ 1,500,000

(1) Includes (i) $3,460,000 in cash from LC Healthcare Fund I, L.P.; and (ii) $5,000,000 cash from Rosy Shine Limited.

(2) Includes (i) $1,488,952 in cash from Domain Partners VIII, L.P., and (ii) $11,048 in cash from DP VIII Associates, L.P.

One of our directors, Junfeng Wang, is affiliated with LC Fund VI, L.P. (and its affiliated entities that participated in the financings described above).

Investors' Rights Agreement

In August 2016, we entered into a fifth amended and restated investors' rights agreement, or the IRA, with certain holders of our preferred stock and common stock, including entities affiliated with LC Fund VI, L.P. and Domain Partners VIII, L.P. and including certain members of, and affiliates of, our directors and certain of our executive officers. The IRA provides the holders of our preferred stock with certain registration rights, including the right to demand that we file a registration statement or request that their shares be covered by a registration statement that we are otherwise filing. The Company has obtained a waiver of these rights in connection with the S-1. The IRA also provides these stockholders with information rights, which will terminate on the closing of this offering, and a right of first refusal with regard to certain issuances of our capital stock, which shall terminate immediately prior to, but subject to, the consummation of this firm-commitment underwritten public offering pursuant to the registration statement of which this prospectus forms a part. After 12 months following the closing of this offering, the holders of 4,948,360 shares of our common stock issuable upon conversion of outstanding preferred stock will be entitled to rights with respect to the registration of their shares of common stock under the Securities Act under this agreement. For a description of these registration rights, see "Description of Capital Stock—Registration Rights."

Indemnification Agreements

Our amended and restated certificate of incorporation will contain provisions limiting the liability of directors, and our amended and restated bylaws will provide that we will indemnify each of our directors and officers to the fullest extent permitted under Delaware law. Our amended and restated certificate of incorporation and amended and restated bylaws will also provide our board of directors with discretion to indemnify our employees and other agents when determined appropriate by the board. In addition, we have entered into an indemnification agreement with each of our directors and executive officers, which requires us to indemnify them. For more information regarding these agreements, see “Executive Compensation—Limitations on Liability and Indemnification Matters.”

Policies and Procedures for Transactions with Related Persons

Prior to completion of this offering, we intend to adopt a written policy that our executive officers, directors, nominees for election as a director, beneficial owners of more than 5% of any class of our common stock and any members of the immediate family of any of the foregoing persons are not permitted to enter into a related person transaction with us without the approval or ratification of our board of directors or our audit committee. Any request for us to enter into a transaction with an executive officer, director, nominee for election as a director, beneficial owner of more than 5% of any class of our common stock, or any member of the immediate family of any of the foregoing persons, in which the amount involved exceeds $120,000 and such person would have a direct or indirect interest, must be presented to our board of directors or our audit committee for review, consideration and approval. In approving or rejecting any such proposal, our board of directors or our audit committee is to consider the material facts of the transaction, including whether the transaction is on terms no less favorable than terms generally available to an unaffiliated third party under the same or similar circumstances and the extent of the related person’s interest in the transaction.

PRINCIPAL STOCKHOLDERS

The following table sets forth information regarding beneficial ownership of our capital stock by:

- each person, or group of affiliated persons, known by us to beneficially own more than 5% of our common stock;
- each of our directors;
- each our of named executive officers; and
- all of our current executive officers and directors as a group.

We have determined beneficial ownership in accordance with the rules and regulations of the SEC, and the information is not necessarily indicative of beneficial ownership for any other purpose. Except as indicated by the footnotes below, we believe, based on information furnished to us, that the persons and entities named in the table below have sole voting and sole investment power with respect to all shares that they beneficially own, subject to applicable community property laws.

The percentage ownership information under the column entitled “Before Offering” is based on 5,856,698 shares of our common stock outstanding as of June 30, 2018, assuming the conversion of all outstanding shares of our convertible preferred stock into 5,700,572 shares of common stock.

The percentage ownership information under the column entitled “After Offering” is based on the sale of 5,500,000 shares of common stock in this offering, assuming (i) no exercise of the underwriters’ option to purchase additional shares, and (ii) the conversion of approximately $14.4 million aggregate principal amount of outstanding convertible promissory notes plus accrued interest thereon into 3,567,099 shares of common stock (based on an assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus) and a conversion date of June 30, 2018).

Information with respect to beneficial ownership has been furnished by each director, officer or beneficial owner of more than 5% of our common stock. We have determined beneficial ownership in accordance with the rules of the SEC. These rules generally attribute beneficial ownership of securities to persons who possess sole or shared voting power or investment power with respect to those securities. In addition, the rules include shares of our common stock issuable pursuant to the exercise of stock options or warrants that are either immediately exercisable or exercisable within 60 days after June 30, 2018. These shares are deemed to be outstanding and beneficially owned by the person holding those options or warrants for the purpose of computing the percentage ownership of that person, but they are not treated as outstanding for the purpose of computing the percentage ownership of any other person. Unless otherwise indicated, the persons or entities identified in this table have sole voting and investment power with respect to all shares shown as beneficially owned by them, subject to applicable community property laws.

Certain of our existing stockholders, including entities affiliated with certain of our directors, have indicated an interest in purchasing an aggregate of approximately $6.35 million in shares of our common stock in this offering at the initial public offering price per share. Based on an assumed initial public offering price of $5.50 per share, these persons and entities would purchase an aggregate of approximately 1,154,545 of the 5,500,000 shares in this offering based on these indications of interest. However, because indications of interest are not binding agreements or commitments to purchase, the underwriters may determine to sell more, less or no shares in this offering to any of these persons or entities, or any of these persons or entities may determine to purchase more, less or no shares in this offering. The following table does not reflect any potential purchases by these persons or entities or their affiliated entities, nor does it give effect to any shares that may be acquired by our stockholders, directors or executive officers pursuant to the reserved share program.

Unless otherwise indicated, the address for each beneficial owner listed in the table below is c/o Bionano Genomics, Inc., 9640 Towne Centre Drive, Suite 100, San Diego, California 92121.

Name of Beneficial Owner	Number of Shares Beneficially Owned Before the Offering	Number of Shares Beneficially Owned After the Offering	Percentage of Shares Beneficially Owned	
			Before Offering	After Offering
Greater than 5% Stockholders				
Entities affiliated with LC Fund VI, L.P.(1)	2,502,712	4,089,316	39.2%	27.4%
Entities affiliated with Domain Partners VIII, L.P.(2)	1,613,772	1,566,055	25.7%	10.5%
Directors and Named Executive Officers				
David L. Barker, Ph.D.(3)	17,075	17,075	*	*
Darren Cai, Ph.D.	—	—	*	*
Han Cao, Ph.D.(4)	804,036	302,584	12.5%	2.0%
R. Erik Holmlin, Ph.D.(5)	214,085	214,085	3.5%	1.4%
Albert Luderer, Ph.D.(6)	11,722	11,722	*	*
Christopher Twomey	—	—	*	*
Junfeng Wang(1)	2,502,712	4,089,316	39.2%	27.4%
Mike Ward(7)	45,775	45,775	*	*
Quan Zhou(1)	2,502,712	4,089,316	39.2%	27.4%
All directors and executive officers as a group (11 persons)(8)	3,679,127	4,764,279	50.2%	31.0%

* Represents beneficial ownership of less than 1%.

(1) Consists of (i) 853,800 shares of common stock and 501,804 shares of common stock issuable upon the exercise of warrants held by LC Fund VI, L.P., (ii) 41,312 shares of common stock and 24,533 shares of common stock issuable upon the exercise of warrants held by LC Parallel Fund VI, L.P. and (iii) 1,081,263 shares of common stock held by LC Healthcare Fund I, L.P. The number of shares beneficially owned after the offering includes an aggregate of 2,112,941 shares of our common stock issuable upon the automatic conversion of (a) $3,460,000 of outstanding principal, plus accrued interest thereon, underlying a convertible promissory note held by LC Healthcare Fund I, L.P. and (b) $5,000,000 of outstanding principal, plus accrued interest thereon, underlying a convertible promissory note held by Rosy Shine Limited, upon the completion of this offering at an assumed initial public offering price of $5.50 per share (the midpoint of the range set forth on the cover page of this prospectus), assuming a conversion date of June 30, 2018. Each of LC Fund VI, L.P., LC Parallel Fund VI, L.P., and LC Healthcare Fund I, L.P., collectively referred to as the LC Funds, are ultimately controlled and managed by Legend Capital, a limited liability Chinese company. Legend Capital is ultimately controlled by a management team consisting of three key individuals, Linan Zhu, Hao Chen, and Nengguang Wang. In addition, Junfeng Wang is a Managing Director of Legend Capital. Each of these individual managers of Legend Capital shares voting and investment power over the shares held by the LC Funds and each disclaims beneficial ownership of all shares held by Legend Capital, except to the extent of each such member's actual pecuniary interest therein. Rosy Shine Limited is ultimately controlled and managed by Legend Holdings, a limited liability Chinese joint stock company listed on a Stock Exchange of Hong Kong (3396), which is controlled by its board of directors. The board of directors of Legend Holdings has sole voting and investment power over the shares held by Rosy Shine Limited. None of the members of the board of directors has individual voting or investment power with respect to such shares and each disclaims beneficial ownership of such shares. The address of the each of the above entities is Legend Capital, 10F, Tower A, Raycom Infotech Park, No.2, Kexueyuan South Road, Zhongguancun, Haidian District, Beijing 100190 PRC.

(2) Consists of (i) 1,182,368 shares of common stock and 419,241 shares of common stock issuable upon the exercise of warrants held by Domain Partners VIII, L.P., (ii) 8,773 shares of common stock and 3,110 shares of common stock issuable upon the exercise of the warrants held by DP VIII Associates, L.P. and (iii) 280 shares of common stock held by Domain Associates, L.L.C. The number of shares beneficially owned after the offering includes an aggregate of 374,634 shares of our common stock issuable upon the automatic conversion of $1,500,000 of outstanding principal plus accrued interest underlying convertible notes held by Domain Partners VIII, L.P. and DP VIII Associates, L.P., upon the completion of this offering at an assumed initial public offering price of $5.50 per share (the midpoint of the range set forth on the cover page of this prospectus), and assuming the occurrence of the conversion on June 30, 2018. James C. Blair, Brian H. Dovey, Brian K. Halak, Jesse I. Treu and Nicole Vitullo, the managing members of One Palmer Square VIII, L.L.C., share voting and investment power over the shares held by Domain Partners VIII, L.P. and DP VIII Associates, L.P. James C. Blair, Brian H. Dovey, Brian K. Halak, Nicole Vitullo, and Kim P. Kamdar, the managing members of Domain Associates, L.L.C., share voting and investment power over the shares held by Domain Associates, L.L.C. Each managing member of One Palmer Square VIII, L.L.C. and Domain Associates, L.L.C. disclaims beneficial ownership of all shares held by the Domain Entities, except to the extent of each such managing member's actual pecuniary interest therein. The address for the Domain Entities is One Palmer Square, Suite 515, Princeton, NJ 08542.

(3) Consists of 17,075 shares of common stock subject to options exercisable as of August 29, 2018.

(4) Consists of 225,874 shares of common stock, 501,452 shares of common stock issuable upon the exercise of warrants and 76,710 shares of common stock subject to options exercisable as of August 29, 2018.

(5) Consists of 214,085 shares of common stock subject to options exercisable as of August 29, 2018.

(6) Consists of 11,722 shares of common stock subject to options exercisable as of August 29, 2018.

(7) Consists of 45,775 shares of common stock subject to options exercisable as of August 29, 2018.

(8) Consists of the shares identified in footnotes (1), (3), (4), (5), (6) and (7), and 83,722 shares of common stock subject to options exercisable as of August 29, 2018.

DESCRIPTION OF CAPITAL STOCK

General

Upon filing of our amended and restated certificate of incorporation and the completion of this offering, our authorized capital stock will consist of 200,000,000 shares of common stock, par value $0.0001 per share, and 10,000,000 shares of preferred stock, par value $0.0001 per share. All of our authorized preferred stock upon the completion of this offering will be undesignated. The following is a summary of the rights of our common and preferred stockholders and some of the provisions of our amended and restated certificate of incorporation and amended and restated bylaws, which will become effective immediately prior to and upon the completion of this offering, respectively, and of the Delaware General Corporation Law. This summary is not complete. For more detailed information, please see our amended and restated certificate of incorporation and amended and restated bylaws, which are filed as exhibits to the registration statement of which this prospectus is a part, as well as the relevant provisions of the Delaware General Corporation Law.

Common Stock

Outstanding Shares

As of June 30, 2018, there were 156,126 shares of common stock issued and outstanding held of record by 86 stockholders. This amount excludes our outstanding shares of convertible preferred stock, which will convert into 5,700,572 shares of common stock in connection with the closing of this offering. Based on the number of shares of common stock outstanding as of June 30, 2018, and assuming (i) the automatic conversion of all of our outstanding shares of convertible preferred stock into an aggregate of 5,700,572 shares of common stock, (ii) the conversion of approximately $14.4 million aggregate principal amount of outstanding convertible promissory notes plus accrued interest thereon into 3,567,099 shares of common stock (based on an assumed initial public offering price of $5.50 per share (the midpoint of the price range set forth on the cover page of this prospectus) and a conversion date of June 30, 2018), and (iv) the issuance by us of 5,500,000 shares of common stock in this offering, there will be 14,923,797 shares of common stock outstanding upon the completion of this offering.

Voting Rights

Our common stock is entitled to one vote for each share held of record on all matters submitted to a vote of the stockholders, including the election of directors, and does not have cumulative voting rights. Our amended and restated certificate of incorporation establishes a classified board of directors that is divided into three classes with staggered three-year terms. Only the directors in one class will be subject to election by a plurality of the votes cast at each annual meeting of our stockholders, with the directors in the other classes continuing for the remainder of their respective three-year terms.

Economic Rights

Except as otherwise expressly provided in our eighth amended and restated certificate of incorporation or required by applicable law, all shares of common stock will have the same rights and privileges and rank equally, share ratably, and be identical in all respects for all matters, including those described below.

Dividends. Subject to preferences that may be applicable to any then-outstanding preferred stock, the holders of common stock are entitled to receive dividends, if any, as may be declared from time to time by our board of directors out of legally available funds.

Liquidation Rights. In the event of our liquidation, dissolution or winding-up, holders of our common stock will be entitled to share ratably in the net assets legally available for distribution to stockholders after the

payment of all of our debts and other liabilities, subject to the satisfaction of any liquidation preference granted to the holders of any outstanding shares of preferred stock.

No Preemptive or Similar Rights

The holders of our shares of common stock are not entitled to preemptive rights, and are not subject to conversion, redemption or sinking fund provisions. The rights, preferences and privileges of the holders of our common stock are subject to, and may be adversely affected by, the rights of the holders of shares of any series of our preferred stock that we may designate and issue in the future.

Fully Paid and Non-Assessable

All of our outstanding shares of common stock are, and the shares of common stock to be issued in this offering will be, fully paid and nonassessable.

Convertible Preferred Stock

As of June 30, 2018, there were 121,992,497 shares of our convertible preferred stock outstanding, held of record by 22 holders. Immediately prior to the closing of this offering, each 21.4 outstanding shares of our preferred stock will convert into one share of our common stock. In addition, immediately prior to the completion of this offering, our certificate of incorporation will be amended and restated to delete all references to such shares of convertible preferred stock. Under this amended and restated certificate of incorporation, our board of directors will have the authority, without further action by our stockholders, to issue up to 10,000,000 shares of convertible preferred stock in one or more series, to establish from time to time the number of shares to be included in each such series, to fix the rights, preferences and privileges of the shares of each wholly unissued series and any qualifications, limitations or restrictions thereon and to increase or decrease the number of shares of any such series, but not below the number of shares of such series then outstanding.

Our board of directors may authorize the issuance of preferred stock with voting or conversion rights that could adversely affect the voting power or other rights of the holders of the common stock. The issuance of preferred stock, while providing flexibility in connection with possible acquisitions and other corporate purposes, could, among other things, have the effect of delaying, deferring or preventing a change in our control that may otherwise benefit holders of our common stock and may adversely affect the market price of the common stock and the voting and other rights of the holders of common stock. We have no current plans to issue any shares of preferred stock.

Stock Options

As of June 30, 2018, 833,960 shares of common stock were issuable upon the exercise of outstanding stock options, at a weighted-average exercise price of $2.53 per share.

Warrants

As of June 30, 2018, the following shares of our convertible preferred stock were issuable upon the exercise of outstanding warrants:

- A warrant to purchase 42,872 shares of Series B convertible preferred stock for an exercise price of $1.3995 per share, which we issued to Square 1 Bank.
- Warrants to purchase an aggregate of 75,027 shares of Series B-1 convertible preferred stock for an exercise price of $1.3995 per share, which we issued to Square 1 Bank.
- Warrants to purchase an aggregate of 4,010,757 shares of Series B-1 convertible preferred stock for an exercise price of $1.3995 per share, which we issued to investors in connection with a series of financing transactions.

- A warrant to purchase 510,417 shares of Series D convertible preferred stock for an exercise price of $0.48 per share, which we issued to Western Alliance Bank.
- Warrants to purchase an aggregate of 31,672,817 shares of Series D convertible preferred stock for an exercise price of $0.41 per share, which we issued to investors in connection with a financing transaction.
- A warrant to purchase 291,667 shares of Series D-1 convertible preferred stock for an exercise price of $0.48 per share, which we issued to Western Alliance Bank.
- A warrant to purchase 625,000 shares of Series D-1 convertible preferred stock for an exercise price of $0.48 per share, which we issued to Midcap Financial Trust.

Each of the foregoing warrants provide for the adjustment of the number of shares issuable upon the exercise thereof in the event of stock splits, recapitalizations, reclassifications and consolidations. In addition, the warrants to purchase shares of Series B-1 convertible preferred stock and Series D convertible preferred stock that we issued in connection with our financing transactions contain provisions that provide for the automatic net exercise of such warrants upon the closing of this offering.

Registration Rights

We are party to a fifth amended and restated investors' rights agreement, dated August 5, 2016, pursuant to which certain holders of our capital stock, or their transferees, are entitled to certain registration rights, as set forth below. The registration of shares of our common stock by the exercise of registration rights described below would enable the holders to sell these shares without restriction under the Securities Act when the applicable registration statement is declared effective. We are obligated to pay the registration expenses, other than underwriting discounts and selling commissions, of the shares registered by the demand, piggyback and Form S-3 registrations described below. Generally, in an underwritten offering, the managing underwriter, if any, has the right, subject to specified conditions, to limit the number of shares such holders may include. The demand, piggyback and Form S-3 registration rights described below will expire on the fifth anniversary of the date of a qualified public offering, a deemed liquidation event, or with respect to any particular holder of registrable securities, such time after this offering that the holder can sell all of its registrable securities without restriction under Rule 144 of the Securities Act during any three month period.

Demand Registration Rights

Any time after the earlier of (i) 12 months following the effective date of a qualified public offering and (ii) August 5, 2020, the holders of at least 66-2/3% of the shares of our outstanding preferred stock (or shares of our common stock issued upon conversion of the shares of such preferred stock, or a combination thereof) may request that we file a registration statement covering all or any portion of the registrable securities held by them, subject to the requirement that the registration must cover at least 20% of the registrable securities then held by them, or a lesser percentage if the anticipated gross receipts from the offering would exceed $40,000,000. The holders of our convertible preferred stock may not request more than two registration statements which are declared effective. We are not obligated to effect a demand registration (i) during the period within 90 days after the effective date of a registration statement filed pursuant to a demand registration, (ii) if the registrable securities can be immediately registered on Form S-3, (iii) or during the 12 month period after the effective date of this registration statement.

In addition, the warrants to purchase our Series B and B-1 convertible preferred stock that we issued to Square 1 Bank provide for the same demand registration rights as described above.

Piggyback Registration Rights

If we register any securities for public sale, holders of registration rights have the right to include their shares in the registration statement. As a result, whenever we propose to file a registration statement under the

Securities Act, other than with respect to registration statements on Forms S-4, S-8, or another form not available for registering the registrable securities for sale to the public, the holders of these shares are entitled to notice of the registration and have the right to include their shares in the registration, subject to limitations that the underwriters may impose on the number of shares included in the offering.

In addition, the warrants to purchase our Series B, B-1, D and D-1 convertible preferred stock that we issued to Square 1 Bank, Western Alliance Bank and Midcap Financial Trust provide for the same piggyback registration rights as described above.

Form S-3 Registration Rights

If we are eligible to file a registration statement on Form S-3, holders of registrable securities will have the right to demand that we file a registration statement on Form S-3 so long as the aggregate price to the public of the securities to be sold under the registration statement on Form S-3 is at least $3.0 million, subject to specified exceptions, conditions and limitations. There is no limitation on the number of Form S-3 demand registrations that may be requested.

In addition, the warrants to purchase our Series B and B-1 convertible preferred stock that we issued to Square 1 Bank provide for the same Form S-3 registration rights as described above.

Anti-Takeover Provisions

The provisions of Delaware law, our eighth amended and restated certificate of incorporation and our amended and restated bylaws, which are summarized below, may have the effect of delaying, deferring or discouraging another person from acquiring control of our company. They are also designed, in part, to encourage persons seeking to acquire control of us to negotiate first with our board of directors. We believe that the benefits of increased protection of our potential ability to negotiate with an unfriendly or unsolicited acquirer outweigh the disadvantages of discouraging a proposal to acquire us because negotiation of these proposals could result in an improvement of their terms.

Certificate of Incorporation and Bylaws to be in Effect upon the Closing of this Offering

Because our stockholders do not have cumulative voting rights, stockholders holding a majority of the voting power of our shares of common stock will be able to elect all of our directors. Our amended and restated certificate of incorporation and amended and restated bylaws to be effective upon the closing of this offering will provide for stockholder actions at a duly called meeting of stockholders or, before the date on which all shares of common stock convert into a single class, by written consent. A special meeting of stockholders may be called by a majority of our board of directors, the chair of our board of directors, or our chief executive officer. Our amended and restated bylaws will establish an advance notice procedure for stockholder proposals to be brought before an annual meeting of our stockholders, including proposed nominations of persons for election to our board of directors.

As described above in “Management— Composition of Our Board of Directors,” in accordance with our amended and restated certificate of incorporation to be filed in connection with this offering, immediately after this offering, our board of directors will be divided into three classes with staggered three-year terms.

The foregoing provisions will make it more difficult for another party to obtain control of us by replacing our board of directors. Since our board of directors has the power to retain and discharge our officers, these provisions could also make it more difficult for existing stockholders or another party to effect a change in management. In addition, the authorization of undesignated preferred stock makes it possible for our board of directors to issue preferred stock with voting or other rights or preferences that could impede the success of any attempt to change our control.

These provisions are designed to reduce our vulnerability to an unsolicited acquisition proposal and to discourage certain tactics that may be used in proxy fights. However, such provisions could have the effect of discouraging others from making tender offers for our shares and may have the effect of deterring hostile takeovers or delaying changes in our control or management. As a consequence, these provisions may also inhibit fluctuations in the market price of our stock that could result from actual or rumored takeover attempts.

Section 203 of the Delaware General Corporation Law

When we have a class of voting stock that is either listed on a national securities exchange or held of record by more than 2,000 stockholders, we will be subject to Section 203 of the Delaware General Corporation Law, which prohibits a Delaware corporation from engaging in any business combination with any interested stockholder for a period of three years after the date that such stockholder became an interested stockholder, subject to certain exceptions.

Choice of Forum

Our amended and restated certificate of incorporation provides that the Court of Chancery of the State of Delaware will be the exclusive forum for: (i) any derivative action or proceeding brought on our behalf; (ii) any action asserting a breach of fiduciary duty; (iii) any action asserting a claim against us or any of our directors or officers or other employees arising under the Delaware General Corporation Law, our amended and restated certificate of incorporation or our amended and restated bylaws; or (iv) any action asserting a claim against us that is governed by the internal affairs doctrine. Our amended and restated certificate of incorporation further provides that U.S. federal district courts will be the exclusive forum for resolving any complaint asserting a cause of action arising under the Securities Act.

Limitations on Liability and Indemnification

See "Executive Compensation—Limitations on Liability and Indemnification."

Exchange Listing

Our common stock is currently not listed on any securities exchange. Our common stock has been approved for listing on The Nasdaq Stock Market LLC under the symbol "BNGO."

Transfer Agent and Registrar

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

SHARES ELIGIBLE FOR FUTURE SALE

Before the completion of this offering, there has been no public market for our common stock. Future sales of substantial amounts of our common stock, including shares issued on the exercise of outstanding options, in the public market after this offering, or the possibility of these sales or issuances occurring, could adversely affect the prevailing market price for our common stock or impair our ability to raise equity capital.

Based on our shares outstanding as of June 30, 2018, upon the completion of this offering, a total of 14,923,797 shares of common stock will be outstanding. Of these shares, all of the common stock sold in this offering by us, plus any shares sold by us on exercise of the underwriters' option to purchase additional common stock, will be freely tradable in the public market without restriction or further registration under the Securities Act, unless these shares are held by "affiliates," as that term is defined in Rule 144 under the Securities Act.

The remaining shares of common stock will be, and shares of common stock subject to stock options will be on issuance, "restricted securities," as that term is defined in Rule 144 under the Securities Act. These restricted securities are eligible for public sale only if they are registered under the Securities Act or if they qualify for an exemption from registration under Rules 144 or 701 under the Securities Act, which are summarized below. Restricted securities may also be sold outside of the U.S. to non-U.S. persons in accordance with Rule 904 of Regulation S.

Subject to the lock-up agreements described below and the provisions of Rule 144 or Regulation S under the Securities Act, as well as our insider trading policy, these restricted securities will be available for sale in the public market after the date of this prospectus.

Rule 144

In general, under Rule 144 as currently in effect, once we have been subject to public company reporting requirements of Section 13 or Section 15(d) of the Exchange Act for at least 90 days, an eligible stockholder is entitled to sell such shares without complying with the manner of sale, volume limitation, or notice provisions of Rule 144, subject to compliance with the public information requirements of Rule 144. To be an eligible stockholder under Rule 144, such stockholder must not be deemed to have been one of our affiliates for purposes of the Securities Act at any time during the 90 days preceding a sale and must have beneficially owned the shares proposed to be sold for at least six months, including the holding period of any prior owner other than our affiliates. If such a person has beneficially owned the shares proposed to be sold for at least one year, including the holding period of any prior owner other than our affiliates, then such person is entitled to sell such shares without complying with any of the requirements of Rule 144, subject to the expiration of the lock-up agreements described below.

In general, under Rule 144, as currently in effect, our affiliates or persons selling shares on behalf of our affiliates are entitled to sell shares on expiration of the lock-up agreements described below. Beginning 90 days after the date of this prospectus upon the expiration of such lock-up agreements, within any three-month period, such stockholders may sell a number of shares that does not exceed the greater of:

- 1% of the number of shares of common stock then outstanding, which will equal approximately 149,238 shares immediately after this offering, assuming no exercise of the underwriters' option to purchase additional shares of common stock from us; or
- the average weekly trading volume of our common stock on Nasdaq during the four calendar weeks preceding the filing of a notice on Form 144 with respect to such sale.

Sales under Rule 144 by our affiliates or persons selling shares on behalf of our affiliates are also subject to certain manner of sale provisions and notice requirements and to the availability of current public information about us.

Rule 701

Rule 701 generally allows a stockholder who was issued shares under a written compensatory plan or contract and who is not deemed to have been an affiliate of our company during the immediately preceding 90 days, to sell these shares in reliance on Rule 144, but without being required to comply with the public information, holding period, volume limitation, or notice provisions of Rule 144. Rule 701 also permits affiliates of our company to sell their Rule 701 shares under Rule 144 without complying with the holding period requirements of Rule 144. All holders of Rule 701 shares, however, are required by that rule to wait until 90 days after the date of this prospectus before selling those shares under Rule 701, subject to the expiration of the lock-up agreements described below.

Form S-8 Registration Statements

We intend to file one or more registration statements on Form S-8 under the Securities Act with the SEC to register the offer and sale of shares of our common stock that are issuable under our 2006 Plan, 2018 Plan and ESPP. These registration statements will become effective immediately on filing. Shares covered by these registration statements will then be eligible for sale in the public markets, subject to vesting restrictions, any applicable lock-up agreements described below, and Rule 144 limitations applicable to affiliates.

Lock-up Arrangements

We, and all of our directors, executive officers and the holders of substantially all of our common stock and securities exercisable for or convertible into our common stock outstanding immediately on the closing of this offering, have agreed with the underwriters that, until 180 days (except for our chief executive officer, who has agreed to 18 months) after the date of the underwriting agreement related to this offering, we and they will not, without the prior written consent of Roth Capital Partners, directly or indirectly, offer, pledge, sell, contract to sell, sell any option or contract to purchase, purchase any option or contract to sell, grant any option, right or warrant to purchase or otherwise transfer or dispose of any of our shares of common stock, or any securities convertible into or exercisable or exchangeable for shares of our common stock, or enter into any swap or any other agreement or any transaction that transfers, in whole or in part, directly or indirectly, the economic consequence of ownership of the securities, whether any such swap or transaction is to be settled by delivery of our common stock or other securities, in cash or otherwise. These agreements are described in "Underwriting." Roth Capital Partners may, in its sole discretion, release any of the securities subject to these lock-up agreements at any time.

Registration Rights

Upon the closing of this offering, pursuant to our fifth amended and restated investors' rights agreement, the holders of 4,315,190 shares of our common stock, or their transferees, will be entitled to certain rights with respect to the registration of the offer and sale of their shares under the Securities Act, subject to the terms of the lock-up agreements described under "—Lock-Up Agreements" above. Registration of these shares under the Securities Act would result in the shares becoming freely tradable without restriction under the Securities Act immediately on the effectiveness of the registration. Any sales of securities by these stockholders could have a material adverse effect on the trading price of our common stock. See "Description of Capital Stock—Registration Rights" for additional information.

MATERIAL U.S. FEDERAL INCOME TAX CONSEQUENCES TO NON-U.S. HOLDERS OF THE OWNERSHIP AND DISPOSITION OF OUR COMMON STOCK

The following is a general discussion of the material U.S. federal income tax consequences to Non-U.S. Holders (as defined below) with respect to their ownership and disposition of our common stock purchased in this offering. This discussion is for general information only, is not tax advice and does not purport to be a complete analysis of all the potential tax considerations. This discussion is based upon the provisions of the U.S. Internal Revenue Code existing and proposed U.S. Treasury Regulations promulgated thereunder, current administrative rulings and judicial decisions, in effect as of the date hereof. These authorities may be changed, possibly retroactively, so as to result in U.S. federal income tax consequences different from those set forth below.

This discussion does not address the tax considerations arising under the laws of any non-U.S., state or local jurisdiction, or under U.S. federal gift and estate tax laws, except to the limited extent set forth below. In addition, this discussion does not address tax considerations applicable to a Non-U.S. Holder's particular circumstances or to Non-U.S. Holders that may be subject to special tax rules, including, without limitation:

- banks, insurance companies or other financial institutions;
- tax-exempt organizations or governmental organizations;
- controlled foreign corporations, passive foreign investment companies and corporations that accumulate earnings to avoid U.S. federal income tax;
- brokers or dealers in securities or currencies;
- traders in securities that elect to use a mark-to-market method of accounting for their securities holdings;
- persons that own, or are deemed to own, more than five percent of our capital stock (except to the extent specifically set forth below);
- U.S. expatriates and certain former citizens or long-term residents of the U.S.;
- partnerships or entities classified as partnerships for U.S. federal income tax purposes or other pass-through entities (and investors therein);
- persons who hold our common stock as a position in a hedging transaction, "straddle," "conversion transaction" or other risk reduction transaction or integrated investment;
- persons who hold or receive our common stock pursuant to the exercise of any employee stock option or otherwise as compensation;
- persons who do not hold our common stock as a capital asset within the meaning of Section 1221 of the Internal Revenue Code; or
- persons deemed to sell our common stock under the constructive sale provisions of the Internal Revenue Code.

There can be no assurance that the Internal Revenue Service, or IRS, will not challenge one or more of the tax consequences described herein, and we have not obtained, and do not intend to obtain, an opinion of counsel or ruling from the IRS with respect to the U.S. federal income tax consequences to a Non-U.S. Holder of the purchase, ownership or disposition of our common stock.

You are urged to consult your tax advisor with respect to the application of the U.S. federal income tax laws to your particular situation, as well as any tax consequences of the purchase, ownership and disposition of our common stock arising under the U.S. federal estate or gift tax rules or under the laws of any state, local, non-U.S., or other taxing jurisdiction or under any applicable tax treaty.

Non-U.S. Holder Defined

For purposes of this discussion, you are a "Non-U.S. Holder" if you are a beneficial owner of common stock who has not been excluded from this discussion and who is not a U.S. Holder. A "U.S. Holder" means a beneficial owner of our common stock that is for U.S. federal income tax purposes:

- an individual who is a citizen or resident of the U.S.;
- a corporation or other entity taxable as a corporation created or organized in the U.S. or under the laws of the U.S. or any political subdivision thereof or other entity treated as such for U.S. federal income tax purposes;
- an estate whose income is subject to U.S. federal income tax regardless of its source; or
- a trust (x) whose administration is subject to the primary supervision of a U.S. court and which has one or more U.S. persons who have the authority to control all substantial decisions of the trust or (y) which has made a valid election to be treated as a U.S. person.

Distributions

As described in the section titled "Dividend Policy," we have never declared or paid cash dividends on our capital stock and do not anticipate paying any dividends on our capital stock in the foreseeable future. However, if we do make distributions on our common stock, those payments will constitute dividends for U.S. tax purposes to the extent paid from our current or accumulated earnings and profits, as determined under U.S. federal income tax principles. To the extent those distributions exceed both our current and our accumulated earnings and profits, they will constitute a return of capital and will first reduce your basis in our common stock, but not below zero, and then will be treated as gain from the sale of stock as described below under "—Gain on Disposition of Our Common Stock."

Subject to the discussion below on effectively connected income, backup withholding and foreign accounts, any dividend paid to you generally will be subject to U.S. withholding tax either at a rate of 30% of the gross amount of the dividend or such lower rate as may be specified by an applicable income tax treaty. In order to receive a reduced treaty rate, you must provide us with an IRS Form W-8BEN, IRS Form W-8BEN-E or other appropriate version of IRS Form W-8 certifying qualification for the reduced rate. A Non-U.S. Holder eligible for a reduced rate of U.S. withholding tax pursuant to an income tax treaty may obtain a refund of any excess amounts withheld by timely filing an appropriate claim for refund with the IRS. If the Non-U.S. Holder holds the stock through a financial institution or other agent acting on the Non-U.S. Holder's behalf, the Non-U.S. Holder will be required to provide appropriate documentation to the agent, which then will be required to provide certification to us or our paying agent, either directly or through other intermediaries.

Dividends received by you that are effectively connected with your conduct of a U.S. trade or business (and, if required by an applicable income tax treaty, attributable to a permanent establishment maintained by you in the U.S.) are generally exempt from such withholding tax. In order to obtain this exemption, you must provide us with an IRS Form W-8ECI properly certifying such exemption. Such effectively connected dividends, although not subject to withholding tax, are taxed at the same graduated rates applicable to U.S. persons, net of certain deductions and credits. In addition, if you are a corporate Non-U.S. Holder, dividends you receive that are effectively connected with your conduct of a U.S. trade or business may also be subject to a branch profits tax at a rate of 30% or such lower rate as may be specified by an applicable income tax treaty. You should consult your tax advisor regarding any applicable tax treaties that may provide for different rules.

If you hold our common stock through a financial institution or other agent acting on your behalf, you will be required to provide appropriate documentation to the agent, which then will be required to provide certification to us or our paying agent, either directly or through other intermediaries. You may be eligible to obtain a refund of any excess amounts withheld by timely filing an appropriate claim for refund with the IRS.

Gain on Disposition of Our Common Stock

Subject to the discussion below regarding backup withholding and foreign accounts, you generally will not be required to pay U.S. federal income tax on any gain realized upon the sale or other disposition of our common stock unless:

- the gain is effectively connected with your conduct of a U.S. trade or business (and, if required by an applicable income tax treaty, the gain is attributable to a permanent establishment maintained by you in the U.S.);
- you are a non-resident alien individual who is present in the U.S. for a period or periods aggregating 183 days or more during the calendar year in which the sale or disposition occurs and certain other conditions are met; or
- our common stock constitutes a U.S. real property interest by reason of our status as a "U.S. real property holding corporation," or USRPHC, for U.S. federal income tax purposes at any time within the shorter of the five-year period preceding your disposition of, or your holding period for, our common stock.

We believe that we are not currently and will not become a USRPHC for U.S. federal income tax purposes, and the remainder of this discussion so assumes. However, because the determination of whether we are a USRPHC depends on the fair market value of our U.S. real property relative to the fair market value of our other business assets, there can be no assurance that we will not become a USRPHC in the future. Even if we become a USRPHC, however, as long as our common stock is regularly traded on an established securities market, such common stock will be treated as U.S. real property interests only if you actually or constructively hold more than five percent of such regularly traded common stock at any time during the shorter of the five-year period preceding your disposition of, or your holding period for, our common stock.

If you are a Non-U.S. Holder described in the first bullet above, you will be required to pay tax on the net gain derived from the sale under regular graduated U.S. federal income tax rates, and a corporate Non-U.S. Holder described in the first bullet above also may be subject to the branch profits tax at a 30% rate, or such lower rate as may be specified by an applicable income tax treaty. If you are an individual Non-U.S. Holder described in the second bullet above, you will be required to pay a flat 30% tax (or such lower rate specified by an applicable income tax treaty) on the gain derived from the sale, which tax may be offset by U.S. source capital losses for the year (provided you have timely filed U.S. federal income tax returns with respect to such losses). You should consult any applicable income tax or other treaties that may provide for different rules.

Backup Withholding and Information Reporting

Generally, we must report annually to the IRS the amount of dividends paid to you, your name and address and the amount of tax withheld, if any. A similar report will be sent to you. Pursuant to applicable income tax treaties or other agreements, the IRS may make these reports available to tax authorities in your country of residence.

Payments of dividends or of proceeds on the disposition of stock made to you may be subject to information reporting and backup withholding at a current rate of 24% unless you establish an exemption, for example, by properly certifying your non-U.S. status on an IRS Form W-8BEN, IRS Form W-8BEN-E or another appropriate version of IRS Form W-8. Notwithstanding the foregoing, backup withholding and information reporting may apply if either we or a paying agent has actual knowledge, or reason to know, that such holder is a U.S. person.

Backup withholding is not an additional tax; rather, the U.S. federal income tax liability of persons subject to backup withholding will be reduced by the amount of tax withheld. If withholding results in an overpayment of taxes, a refund or credit may generally be obtained from the IRS, provided that the required information is furnished to the IRS in a timely manner.

Foreign Account Tax Compliance

The Foreign Account Tax Compliance Act, or FATCA, imposes withholding tax at a rate of 30% on dividends on and gross proceeds from the sale or other disposition of our common stock paid to "foreign financial institutions" (as specially defined under these rules), unless such institution enters into an agreement with the U.S. government to withhold on certain payments and to collect and provide to the U.S. tax authorities substantial information regarding the U.S. account holders of such institution (which includes certain equity and debt holders of such institution, as well as certain account holders that are foreign entities with U.S. owners) or otherwise establishes an exemption. FATCA also generally imposes a U.S. federal withholding tax of 30% on dividends on and gross proceeds from the sale or other disposition of our common stock paid to a "non-financial foreign entities" (as specially defined for purposes of these rules) unless such entity provides the withholding agent with a certification identifying certain substantial direct and indirect U.S. owners of the entity, certifies that there are none or otherwise establishes an exemption. The withholding provisions under FATCA generally apply to dividends on our common stock, and under current transition rules, are expected to apply with respect to the gross proceeds from the sale or other disposition of our common stock on or after January 1, 2019. Under certain circumstances, a Non-U.S. Holder might be eligible for refunds or credits of such taxes. An intergovernmental agreement between the U.S. and an applicable foreign country may modify the requirements described in this paragraph. Non-U.S. Holders should consult their tax advisors regarding the possible implications of this legislation on their investment in our common stock.

EACH PROSPECTIVE INVESTOR SHOULD CONSULT ITS TAX ADVISOR REGARDING THE PARTICULAR U.S. FEDERAL, STATE AND LOCAL AND NON-U.S. TAX CONSEQUENCES OF PURCHASING, HOLDING AND DISPOSING OF OUR COMMON STOCK, INCLUDING THE CONSEQUENCES OF ANY PROPOSED CHANGE IN APPLICABLE LAWS.

UNDERWRITING

We have entered into an underwriting agreement with Roth Capital Partners, LLC, acting as the representative of the underwriters named below, with respect to the shares of common stock subject to this offering. Subject to certain conditions, we have agreed to sell to the underwriters, and the underwriters have agreed to purchase, the number of shares of common stock provided below opposite their respective names.

Underwriter	Number of Shares
Roth Capital Partners, LLC	
Maxim Group LLC	
Total	5,500,000

The underwriters are offering the shares of common stock, subject to their acceptance of the shares from us and subject to prior sale. The underwriting agreement provides that the obligations of the several underwriters to pay for and accept delivery of the securities offered by this prospectus are subject to the approval of certain legal matters by their counsel and to certain other conditions. The underwriters are obligated to take and pay for all of the securities if any such securities are taken. However, the underwriters are not required to take or pay for the securities covered by the underwriters' over-allotment option described below.

Over-Allotment Option

We have granted the underwriters an option, exercisable for 30 days from the date of this prospectus, to purchase up to 825,000 additional shares of common stock to cover over-allotments, if any, at the public offering price set forth on the cover page of this prospectus, less underwriting discounts and commissions. The underwriters may exercise this option solely for the purpose of covering over-allotments, if any, made in connection with the offering of the securities offered by this prospectus. If the underwriters exercise this option, each underwriter will be obligated, subject to certain conditions, to purchase a number of additional shares of common stock proportionate to that underwriter's initial purchase commitment as indicated in the table above.

Commission and Expenses

The underwriters have advised us that they propose to offer the shares of common stock to the public at the initial public offering price set forth on the cover page of this prospectus and to certain dealers at that price less a concession not in excess of $ per share. The underwriters may allow, and certain dealers may re-allow, a discount from the concession not in excess of $ per share to certain brokers and dealers. After this offering, the initial public offering price, concession and reallowance to dealers may be reduced by the representatives. No such reduction shall change the amount of proceeds to be received by us as set forth on the cover page of this prospectus. The shares of common stock are offered by the underwriters as stated herein, subject to receipt and acceptance by them and subject to their right to reject any order in whole or in part. The underwriters have informed us that they do not intend to confirm sales to any accounts over which they exercise discretionary authority.

The following table shows the underwriting discounts and commissions payable to the underwriters by us in connection with this offering. Such amounts are shown assuming both no exercise and full exercise of the underwriters' over-allotment option to purchase securities.

	Without Exercise of Over-Allotment(1)	With Full Exercise of Over-Allotment(1)
Public offering price per share	$	$
Total	$	$

(1) The fees do not include the Underwriter's Warrants or expense reimbursement provisions described below.

We have also agreed to issue to Roth Capital Partners, LLC and Maxim Group LLC warrants to purchase shares of common stock collectively equal to an aggregate of 3% of the shares of common stock issued in the offering. The warrants will have an exercise price equal to 150% of the offering price of the shares sold in this offering and may be exercised on a cashless basis. The warrants are exercisable commencing one year after the effective date of the registration statement related to this offering, and will be exercisable for four years thereafter. The warrants are not redeemable by us. The warrants and the shares of common stock underlying the warrants, have been deemed compensation by FINRA and are therefore subject to a 180-day lock-up pursuant to Rule 5110(g)(1) of FINRA. The underwriters (or permitted assignees under the Rule) may not sell, transfer, assign, pledge, or hypothecate the warrants or the shares of common stock underlying the warrants, nor will they engage in any hedging, short sale, derivative, put, or call transaction that would result in the effective economic disposition of the warrants or the underlying shares of common stock for a period of 180 days from the date of this prospectus. Additionally, the warrants may not be sold transferred, assigned, pledged or hypothecated for a 180 day period following the effective date of the registration statement except to any underwriter and selected dealer participating in the offering and their bona fide officers or partners. The warrants will provide for adjustment in the number and price of such warrants and the shares of common stock underlying such warrants in the event of recapitalization, merger or other structural transaction to prevent mechanical dilution.

We have also agreed to reimburse Roth Capital Partners, LLC and Maxim Group LLC for certain out-of-pocket expenses incurred by them, including fees and disbursements of their counsel up to an aggregate of $150,000, with respect to this offering.

We estimate that expenses payable by us in connection with the offering of our common stock, other than the underwriting discounts and commissions and the counsel fees and disbursement reimbursement provisions referred to above, will be approximately $2.5 million.

Indemnification

We have agreed to indemnify the underwriters against certain liabilities, including liabilities under the Securities Act and liabilities arising from breaches of representations and warranties contained in the underwriting agreement, or to contribute to payments that the underwriters may be required to make in respect of those liabilities.

Lock-Up Agreements

Our executive officers, directors and certain of our stockholders, which represent in aggregate 100% of our currently outstanding shares of common stock, have agreed to a 180-day (except for our chief executive officer, who has agreed to 18 months) “lock-up” from the effective date of this prospectus of shares of our common stock that they beneficially own, including the issuance of common stock upon the exercise of currently outstanding convertible securities and options and options which may be issued. This means that, for a period of 180 days following the effective date of this prospectus, such persons may not offer, sell, pledge or otherwise dispose of these securities without the prior written consent of the representative of the underwriters. The lock-up period described in the preceding paragraph will be extended if the Company ceases to be an “emerging growth company” at any time prior to the expiration of the lock-up period and if (1) during the last 17 days of the lock-up period we issue an earnings release or material news or a material event relating to us occurs or (2) prior to the expiration of the lock-up period we announce that we will release earnings results during the 16-day period beginning on the last day of the lock-up period, in which case the lock-up period will be extended until the expiration of the 18-day period beginning on the date of issuance of the earnings release or the occurrence of the material news or material event.

The representative of the underwriters has no present intention to waive or shorten the lock-up period; however, the terms of the lock-up agreements may be waived at its discretion. In determining whether to waive the terms of the lockup agreements, the representative of the underwriters may base its decision on its assessment of the relative strengths of the securities markets and companies similar to ours in general, and the trading pattern of, and demand for, our securities in general.

In addition, the underwriting agreement provides that, subject to certain exceptions, we will not, for a period of 180 days following the effective date of this prospectus, offer, sell or distribute any of our securities or file any registration statement with the commission relating to the offering of any shares of Common Stock or any securities convertible into or exchangeable for Common Stock, without the prior written consent of the representative of the underwriters.

Listing

Our common stock has been approved for listing on The Nasdaq Stock Market LLC, under the symbol "BNGO."

Electronic Distribution

A prospectus in electronic format may be made available on websites or through other online services maintained by one or more of the underwriters of this offering, or by their affiliates. Other than the prospectus in electronic format, the information on any underwriter's website and any information contained in any other website maintained by an underwriter is not part of this prospectus or the registration statement of which this prospectus forms a part, has not been approved and/or endorsed by us or any underwriter in its capacity as underwriter, and should not be relied upon by investors.

Price Stabilization, Short Positions and Penalty Bids

In connection with the offering the underwriters may engage in stabilizing transactions, over-allotment transactions, syndicate covering transactions and penalty bids in accordance with Regulation M under the Exchange Act:

- Stabilizing transactions permit bids to purchase the underlying security so long as the stabilizing bids do not exceed a specified maximum.
- Over-allotment involves sales by the underwriters of shares in excess of the number of shares the underwriters are obligated to purchase, which creates a syndicate short position. The short position may be either a covered short position or a naked short position. In a covered short position, the number of shares over-allotted by the underwriter is not greater than the number of shares that it may purchase in the over-allotment option. In a naked short position, the number of shares involved is greater than the number of shares in the over-allotment option. The underwriter may close out any covered short position by either exercising its over-allotment option and/or purchasing shares in the open market.
- Syndicate covering transactions involve purchases of shares of the common stock in the open market after the distribution has been completed in order to cover syndicate short positions. In determining the source of shares to close out the short position, the underwriters will consider, among other things, the price of shares available for purchase in the open market as compared to the price at which it may purchase shares through the over-allotment option. If the underwriters sell more shares than could be covered by the over-allotment option, a naked short position, the position can only be closed out by buying shares in the open market. A naked short position is more likely to be created if the underwriters are concerned that there could be downward pressure on the price of the shares in the open market after pricing that could adversely affect investors who purchase in the offering.
- Penalty bids permit the representative to reclaim a selling concession from a syndicate member when the common stock originally sold by the syndicate member is purchased in a stabilizing or syndicate covering transaction to cover syndicate short positions.

These stabilizing transactions, syndicate covering transactions and penalty bids may have the effect of raising or maintaining the market price of our securities or preventing or retarding a decline in the market price of our securities. As a result, the price of our securities may be higher than the price that might otherwise exist in

the open market. Neither we nor the underwriters makes any representation or prediction as to the direction or magnitude of any effect that the transactions described above may have on the price of our securities. In addition, neither we nor the underwriters makes any representations that the underwriters will engage in these stabilizing transactions or that any transaction, once commenced, will not be discontinued without notice.

No Public Market

Prior to this offering, there has not been a public market for our securities in the U.S. and the public offering price for our securities will be determined through negotiations between us and the underwriters. Among the factors to be considered in these negotiations will be prevailing market conditions, our financial information, market valuations of other companies that we and the underwriters believe to be comparable to us, estimates of our business potential, the present state of our development and other factors deemed relevant.

We offer no assurances that the initial public offering price will correspond to the price at which our common stock will trade in the public market subsequent to this offering or that an active trading market for our common stock will develop and continue after this offering.

Notice to Prospective Investors in the European Economic Area

In relation to each Member State of the European Economic Area (“EEA”) which has implemented the Prospectus Directive (each, a “Relevant Member State”) an offer to the public of any shares which are the subject of the offering contemplated by this prospectus may not be made in that Relevant Member State, except that an offer to the public in that Relevant Member State of any shares may be made at any time under the following exemptions under the Prospectus Directive, if they have been implemented in that Relevant Member State:

(a) to legal entities which are authorized or regulated to operate in the financial markets or, if not so authorized or regulated, whose corporate purpose is solely to invest in securities;

(b) to any legal entity which has two or more of (1) an average of at least 250 employees during the last financial year; (2) a total balance sheet of more than €43,000,000 and (3) an annual net turnover of more than €50,000,000, as shown in its last annual or consolidated accounts;

(c) by the underwriters to fewer than 100 or, if the Relevant Member State has implemented the relevant provision of the 2010 PD Amending Directive, 150, natural or legal persons (other than “qualified investors” as defined in the Prospectus Directive) subject to obtaining the prior consent of the representatives for any such offer; or

(d) in any other circumstances falling within Article 3(2) of the Prospectus Directive;

provided that no such offer of shares shall result in a requirement for the publication by us or any representative of a prospectus pursuant to Article 3 of the Prospectus Directive.

Any person making or intending to make any offer of shares within the EEA should only do so in circumstances in which no obligation arises for us or any of the underwriters to produce a prospectus for such offer. Neither we nor the underwriters have authorized, nor do they authorize, the making of any offer of shares through any financial intermediary, other than offers made by the underwriters which constitute the final offering of shares contemplated in this prospectus.

For the purposes of this provision, and your representation below, the expression an “offer to the public” in relation to any shares in any Relevant Member State means the communication in any form and by any means of sufficient information on the terms of the offer and any shares to be offered so as to enable an investor to decide to purchase any shares, as the same may be varied in that Relevant Member State by any measure implementing the Prospectus Directive in that Relevant Member State and the expression “Prospectus Directive” means Directive 2003/71/EC and includes any relevant implementing measure in each Relevant Member State, including the 2010 PD Amending Directive, to the extent implemented in the Relevant Member State. The expression “2010 PD Amending Directive” means Directive 2010/73/EU.

Each person in a Relevant Member State who receives any communication in respect of, or who acquires any shares under, the offer of shares contemplated by this prospectus will be deemed to have represented, warranted and agreed to and with us and each underwriter that:

(A) it is a "qualified investor" within the meaning of the law in that Relevant Member State implementing Article 2(1)(e) of the Prospectus Directive; and

(B) in the case of any shares acquired by it as a financial intermediary, as that term is used in Article 3(2) of the Prospectus Directive, (i) the shares acquired by it in the offering have not been acquired on behalf of, nor have they been acquired with a view to their offer or resale to, persons in any Relevant Member State other than "qualified investors", as defined in the Prospectus Directive, or in circumstances in which the prior consent of the representatives has been given to the offer or resale; or (ii) where shares have been acquired by it on behalf of persons in any Relevant Member State other than qualified investors, the offer of those shares to it is not treated under the Prospectus Directive as having been made to such persons.

In addition, in the United Kingdom, this document is being distributed only to, and is directed only at, and any offer subsequently made may only be directed at persons who are "qualified investors", as defined in the Prospectus Directive, (i) who have professional experience in matters relating to investments falling within Article 19 (5) of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005, as amended, or the order, and/or (ii) who are high net worth companies (or persons to whom it may otherwise be lawfully communicated) falling within Article 49(2)(a) to (d) of the Order (all such persons together being referred to as "relevant persons"). This document must not be acted on or relied on in the United Kingdom by persons who are not relevant persons. In the United Kingdom, any investment or investment activity to which this document relates is only available to, and will be engaged in with, relevant persons.

Other Relationships

Some of the underwriters and their affiliates have engaged in, and may in the future engage in, investment banking and other commercial dealings in the ordinary course of business with us or our affiliates. They have received, or may in the future receive, customary fees and commissions for these transactions.

LEGAL MATTERS

Cooley LLP, San Diego, California, which has acted as our counsel in connection with this offering, will pass on certain legal matters with respect to U.S. federal law in connection with this offering. Loeb & Loeb LLP, New York, New York, has acted as counsel to the underwriters in connection with this offering.

EXPERTS

The consolidated financial statements included in this Prospectus have been audited by Deloitte & Touche LLP, an independent registered public accounting firm, as stated in their report appearing herein (which report expresses an unqualified opinion on the consolidated financial statements and includes an explanatory paragraph referring to the Company's ability to continue as a going concern). Such consolidated financial statements have been so included in reliance upon the report of such firm given upon their authority as experts in accounting and auditing.

WHERE YOU CAN FIND ADDITIONAL INFORMATION

We have filed with the SEC a registration statement on Form S-1 under the Securities Act with respect to the shares of common stock offered by this prospectus. This prospectus, which constitutes a part of the registration statement, does not contain all the information set forth in the registration statement, some of which is contained in exhibits to the registration statement as permitted by the rules and regulations of the SEC. For further information with respect to us and our common stock, we refer you to the registration statement, including the exhibits filed as a part of the registration statement. Statements contained in this prospectus concerning the contents of any contract or any other document are not necessarily complete. If a contract or document has been filed as an exhibit to the registration statement, please see the copy of the contract or document that has been filed. Each statement in this prospectus relating to a contract or document filed as an exhibit is qualified in all respects by the filed exhibit. You may obtain copies of this information by mail from the Public Reference Section of the SEC, 100 F Street, N.E., Room 1580, Washington, D.C. 20549, at prescribed rates. You may obtain information on the operation of the public reference rooms by calling the SEC at 1-800-SEC-0330. The SEC also maintains an internet website that contains reports and other information about issuers, like us, that file electronically with the SEC. The address of that website is www.sec.gov.

On the closing of this offering, we will be subject to the information reporting requirements of the Exchange Act, and we will file reports, proxy statements and other information with the SEC. These reports, proxy statements and other information will be available for inspection and copying at the public reference room and website of the SEC referred to above.

We also maintain a website at www.amplyx.com. Information contained in, or accessible through, our website is not a part of this prospectus, and the inclusion of our website address in this prospectus is only as an inactive textual reference.

Bionano Genomics, Inc.

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REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the stockholders and Board of Directors of Bionano Genomics, Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Bionano Genomics, Inc. and its subsidiaries (the "Company"), as of December 31, 2016 and 2017 and the related consolidated statements of operations, consolidated statements of convertible preferred stock and stockholders' deficit, and consolidated statements of cash flows for each of the two years in the period ended December 31, 2017 and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2016 and 2017, and the results of its operations and its cash flows for each of the two years in the period ended December 31, 2017, in conformity with accounting principles generally accepted in the United States of America.

Going Concern

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 suffered recurring losses from operations and has a net capital deficiency that raises substantial doubt about its ability to continue as a going concern. 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.

Basis for Opinion

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

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

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

/s/ Deloitte & Touche, LLP

San Diego, California
May 11, 2018 (July 16, 2018 as to the effects of the reverse stock split as described in Note 12)

We have served as the Company's auditor since 2017.

Bionano Genomics, Inc.

Consolidated Balance Sheets

	December 31, 2016	December 31, 2017	June 30, 2018 (unaudited)	Pro Forma Liabilities, Convertible Preferred Stock, and Stockholders' (Deficit) Equity June 30, 2018 (unaudited)
Assets				
Current assets:				
Cash and cash equivalents	$ 5,249,620	$ 1,021,897	$ 7,624,289	
Accounts receivable, net	1,846,567	3,352,214	2,886,205	
Inventory	1,797,401	1,693,742	1,972,938	
Prepaid expenses and other current assets	1,842,066	1,071,512	3,170,223	
Total current assets	10,735,654	7,139,365	15,653,655	
Property and equipment, net	4,052,083	3,005,788	2,440,501	
Total assets	$ 14,787,737	$ 10,145,153	$ 18,094,156	
Liabilities, convertible preferred stock, and stockholders' deficit				
Current liabilities:				
Accounts payable	$ 792,332	$ 2,302,964	$ 1,752,325	$ 1,752,325
Accrued expenses	2,886,726	3,508,894	4,498,872	4,498,872
Deferred revenue	446,769	211,697	241,196	241,196
Preferred stock warrant liability	4,650,877	3,898,944	1,604,836	—
Current portion of long-term debt	587,131	6,729,752	—	—
Convertible note	—	—	14,329,843	—
Total current liabilities	9,363,835	16,652,251	22,427,072	6,492,393
Long-term debt, net of current portion	6,046,045	—	8,956,143	8,956,143
Long-term deferred revenue	244,884	142,929	144,601	144,601
Other non-current liabilities	975,418	567,047	833,814	833,814
Total liabilities	16,630,182	17,362,227	32,361,630	16,426,951
Commitments and contingencies (Note 9)				
Series A convertible preferred stock, $0.0001 par value; 418,767 shares authorized as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); 345,587 shares issued and outstanding as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); $483,649 liquidation preference at December 31, 2017 and June 30, 2018 (unaudited); no shares authorized, issued or outstanding pro forma at June 30, 2018 (unaudited)	61,847	61,847	61,847	—
Series B convertible preferred stock, $0.0001 par value; 8,101,042 shares authorized as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); 8,058,170 shares issued and outstanding as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); $11,277,409 liquidation preference at December 31, 2017 and June 30, 2018 (unaudited); no shares authorized, issued or outstanding pro forma at June 30, 2018 (unaudited)	842,845	842,845	842,845	—
Series B-1 convertible preferred stock, $0.0001 par value; 7,523,734 shares authorized as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); 3,437,950 shares issued and outstanding as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); $4,811,411 liquidation preference at December 31, 2017 and June 30, 2018 (unaudited); no shares authorized, issued or outstanding pro forma at June 30, 2018 (unaudited)	359,593	359,593	359,593	—

	December 31,		June 30, 2018	Pro Forma Liabilities, Convertible Preferred Stock, and Stockholders' (Deficit) Equity June 30, 2018
	2016	2017	(unaudited)	(unaudited)
Series C convertible preferred stock, $0.0001 par value; 23,357,047 shares authorized as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); 23,357,047 shares issued and outstanding as of December 31, 2016 and 2017 and June 30, 2018 (unaudited); $32,800,301 liquidation preference at December 31, 2017 and June 30, 2018 (unaudited); no shares authorized, issued or outstanding pro forma at June 30, 2018 (unaudited)	5,547,841	5,547,841	5,547,841	—
Series D convertible preferred stock, $0.0001 par value; 52,835,720 shares authorized as of December 31, 2016 and 2017 and June 30, 2018 (unaudited), respectively; 20,652,486 shares issued and outstanding as of December 31, 2016 and 2017 and June 30, 2018 (unaudited), respectively; $9,913,193 liquidation preference at December 31, 2017 and June 30, 2018 (unaudited), respectively; no shares authorized, issued or outstanding pro at June 30, 2018 (unaudited)	4,838,379	4,838,379	4,838,379	—
Series D-1 convertible preferred stock, $0.0001 par value; 73,208,367, 125,808,667 and 25,808,667 shares authorized as of December 31, 2016 and 2017 and June 30, 2018 (unaudited), respectively; 29,166,671, 66,141,257 and 66,141,257 shares issued and outstanding as of December 31, 2016 and 2017, and June 30, 2018 (unaudited) respectively; $31,747,803 liquidation preference at December 31, 2017 and June 30, 2018 (unaudited); no shares authorized, issued or outstanding pro at June 30, 2018 (unaudited)	13,766,022	31,359,632	31,359,632	—
Stockholders' deficit:				
Common stock, $0.0001 par value; 190,559,820, 243,160,120 and 243,160,120 shares authorized at December 31, 2016 and 2017 and June 30, 2018 (unaudited), respectively; 140,385, 154,550 and 156,126 shares issued and outstanding as of December 31, 2016 and 2017 and June 30, 2018 (unaudited), respectively; 9,423,797 shares issued and outstanding proforma at June 30, 2018	14	15	16	942
Additional paid-in capital	3,641,686	4,038,810	4,147,247	63,090,817
Accumulated deficit	(30,900,672)	(54,266,036)	(61,424,874)	(61,424,874)
Total stockholders' (deficit) equity	(27,258,972)	(50,227,211)	(57,277,611)	1,666,885
Total liabilities, convertible preferred stock, and stockholders' deficit	$ 14,787,737	$ 10,145,153	$ 18,094,156	

See accompanying notes

Bionano Genomics, Inc.

Consolidated Statements of Operations

	Year Ended December 31,		Six Months Ended June 30,	
	2016	2017	2017	2018
			(unaudited)	
Revenue:				
Product revenue	$ 6,153,355	$ 8,769,704	$ 3,609,281	$ 4,918,245
Other revenue	639,434	735,339	307,583	240,249
Total revenue	6,792,789	9,505,043	3,916,864	5,158,494
Operating expenses:				
Cost of product revenue	3,459,771	5,958,537	2,818,861	2,644,043
Cost of other revenue	118,921	71,975	25,256	10,836
Research and development	11,431,941	12,009,170	6,584,614	4,465,919
Selling, general and administrative	12,950,572	14,079,658	7,436,426	6,385,378
Impairment of property and equipment	—	604,511	—	—
Total operating expenses	27,961,205	32,723,851	16,865,157	13,506,176
Loss from operations	(21,168,416)	(23,218,808)	(12,948,293)	(8,347,682)
Other income (expense)				
Interest expense	(470,072)	(590,927)	(286,095)	(709,616)
Change in fair value of preferred stock warrants and expirations	3,006,082	751,933	953,893	2,470,921
Other expense	(203,285)	(289,010)	(57,135)	(563,179)
Total other income (expenses)	2,332,725	(128,004)	610,663	1,198,126
Loss before income taxes	(18,835,691)	(23,346,812)	(12,337,630)	(7,149,556)
Provision for income taxes	(12,924)	(18,552)	(22,358)	(9,282)
Net loss	$ (18,848,615)	$ (23,365,364)	$ (12,359,988)	$ (7,158,838)
Net loss per share, basic and diluted:	$ (156.20)	$ (163.86)	$ (88.04)	$ (46.10)
Weighted-average common shares outstanding, basic and diluted	120,673	142,596	140,385	155,273
Pro forma net loss per share, basic and diluted (unaudited)		$ (4.33)		$ (0.85)
Pro forma weighted-average common shares outstanding, basic and diluted (unaudited)		5,402,202		8,427,301

See accompanying notes

Bionano Genomics, Inc.

Consolidated Statements of Convertible Preferred Stock and Stockholders' Deficit

	Series A Convertible Preferred Stock		Series B Convertible Preferred Stock		Series B-1 Convertible Preferred Stock		Series C Convertible Preferred Stock		Series D Convertible Preferred Stock		Series D-1 Convertible Preferred Stock		Common Stock		Additional Paid-in Capital	Accumulated Deficit	Total Stockholders' Deficit
	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount			
Balance at January 1, 2016	1,908,757	$ 4,989,018	17,195,333	$ 23,909,095	7,441,599	$10,359,042	37,752,481	$ 48,930,547					207,483	$ 21	$3,509,178	$ (93,428,106)	$ (89,918,907)
Mandatory conversion of Series A, B and C preferred stock	(1,563,170)	(4,927,171)	(9,137,163)	(23,066,250)	(4,003,649)	(9,999,449)	(14,395,434)	(43,382,706)					1,359,784	136	2,781	81,376,049	81,378,966
10-to-1 reverse stock split	—	—	—	—	—	—	—	—	—	—	—	—	(1,411,180)	(141)	(2,879)	—	(3,020)
Common stock share cancellations	—	—	—	—	—	—	—	—	—	—	—	—	(16,380)	(2)	2	—	—
Issuance of Series D convertible preferred stock, net of issuance cost and warrant fair value of $5,140,463	—	—	—	—	—	—	—	—	20,652,486	4,838,379	—	—	—	—	—	—	—
Issuance of Series D-1 convertible preferred stock, net of issuance cost of $200,002	—	—	—	—	—	—	—	—	—	—	29,166,671	13,766,022	—	—	—	—	—
Issuance of common stock	—	—	—	—	—	—	—	—	—	—	—	—	678	0	1,961	—	1,961
Stock-based compensation expense	—	—	—	—	—	—	—	—	—	—	—	—	—	—	130,643	—	130,643
Net loss	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(18,848,615)	(18,848,615)
Balance at December 31, 2016	345,587	61,847	8,058,170	842,845	3,437,950	359,593	23,357,047	5,547,841	20,652,486	4,838,379	29,166,671	13,766,022	140,385	14	3,641,686	(30,900,672)	(27,258,972)
Issuance of Series D-1 convertible preferred stock, net of issuance cost of $154,191	—	—	—	—	—	—	—	—	—	—	36,974,586	17,593,610	—	—	—	—	—
Issuance of common stock	—	—	—	—	—	—	—	—	—	—	—	—	14,165	1	14,294	—	14,295
Stock-based compensation expense	—	—	—	—	—	—	—	—	—	—	—	—	—	—	382,830	—	382,830
Net loss	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(23,365,364)	(23,365,364)
Balance at December 31, 2017	345,587	$ 61,847	8,058,170	$ 842,845	3,437,950	$ 359,593	23,357,047	$ 5,547,841	20,652,486	$4,838,379	66,141,257	$31,359,632	154,550	$ 15	$4,038,810	$ (54,266,036)	$ (50,227,211)
Issuance of common stock (unaudited)													1,576	1	1,011		1,012
Stock-based compensation expense (unaudited)															107,426		107,426
Net loss (unaudited)																(7,158,838)	(7,158,838)
Balance at June 30, 2018 (unaudited)	345,587	$ 61,847	8,058,170	$ 842,845	3,437,950	$ 359,593	23,357,047	$ 5,547,841	20,652,486	$4,838,379	66,141,257	$31,359,632	156,126	$ 16	$4,147,247	$ (61,424,874)	$ (57,277,611)

See accompanying notes

Bionano Genomics, Inc.

Consolidated Statements of Cash Flows

	Year Ended December 31,		Six Months Ended June 30,	
	2016	2017	2017	2018
			(unaudited)	
Operating activities:				
Net loss	$ (18,848,615)	$ (23,365,364)	$ (12,359,988)	$ (7,158,838)
Adjustments to reconcile net loss to cash used in operating activities:				
Depreciation and amortization expense	1,115,027	1,504,042	724,381	778,555
Change in fair value of preferred stock warrants and expirations	(3,006,082)	(751,933)	(953,893)	(2,470,921)
Stock-based compensation	130,643	382,830	217,846	107,426
Provision for bad debt expense	—	262,000	—	238,000
Inventory write-off	—	364,437	364,437	—
Impairment of property and equipment	—	604,511	—	—
Accretion of debt discount	73,902	96,576	44,682	60,655
Loss on debt extinguishment	—	—	—	342,164
Changes in operating assets and liabilities:				
Accounts receivable	(856,098)	(1,767,647)	469,869	228,009
Inventory	(726,138)	(336,046)	(665,841)	(172,578)
Prepaid expenses and other current assets	(782,217)	770,553	(371,390)	(697,361)
Accounts payable	(608,653)	1,541,472	343,725	(1,058,391)
Accrued expenses and other liabilities	11,873	(123,229)	(167,346)	49,359
Net cash used in operating activities	(23,496,358)	(20,817,798)	(12,353,518)	(9,753,922)
Investing activities:				
Purchases of property and equipment	(1,349,853)	(1,017,830)	(461,939)	(189,401)
Net cash used in investing activities	(1,349,853)	(1,017,830)	(461,939)	(189,401)
Financing activities:				
Repayment of notes payable	(5,000,000)	—	—	(7,447,571)
Proceeds from issuance of long-term debt, net of offering costs	6,886,458	—	—	9,662,430
Proceeds from issuance of convertible note, net of offering costs	—	—	—	14,329,843
Proceeds from issuance of preferred stock and warrants, net of offering costs	23,542,642	17,593,610	8,982,647	—
Proceeds received in advance of issuance of preferred stock and warrants, net of offering costs	—	—	4,249,481	—
Proceeds from option exercises	1,961	14,295	—	1,012
Net cash provided by financing activities	25,431,061	17,607,905	13,232,128	16,545,714
Net increase (decrease) in cash and cash equivalents	584,850	(4,227,723)	416,671	6,602,392
Cash and cash equivalents at beginning of period	4,664,770	5,249,620	5,249,620	1,021,897
Cash and cash equivalents at end of period	$ 5,249,620	$ 1,021,897	$ 5,666,291	$ 7,624,289
Supplementary schedule on non-cash transactions:				
Transfer of instruments to property and equipment from inventory	$ 40,347	$ 75,268	$ —	$ 106,617
Property and equipment costs incurred but not paid included in accounts payable and and accrued expenses	$ 42,670	$ 11,830	$ —	$ 130,484
Leasehold improvements financed by landlord through lease incentives	$ 1,050,244	$ —	$ —	$ —
Fair value of warrants issued with equity classified as a liability	$ 4,938,241	$ —	$ —	$ —
Fair value of warrants issued with debt classified as a liability	$ 99,684	$ —	$ —	$ 176,813
Final payment fee due in connection with the repayment of debt classified within other long-term liabilities	$ 227,500	$ —	$ —	$ 400,000
Deferred equity issuance costs in accounts payable and accrued liabilities	$ —	$ —	$ —	$ 1,401,350
Debt issuance costs incurred but not paid	$ —	$ —	$ —	$ 129,474
Supplementary disclosure of cash flow information				
Interest paid	$ 446,525	$ 534,858	$ 259,953	$ 299,528

See accompanying notes

Bionano Genomics, Inc.

Notes to Consolidated Financial Statements
(Information as of June 30, 2018 and for the six months ended June 30, 2017 and 2018 is unaudited)

1. Organization and Basis of Presentation

Description of Business

Bionano Genomics, Inc. (the "Company") was incorporated in Delaware on August 16, 2007, under the name BioNanomatrix, Inc. On October 11, 2011, the Company changed its name to BioNano Genomics, Inc. Upon the filing of the Company's amended and restated certificate of incorporation immediately prior to the closing of its public offering, the Company's name will be changed to Bionano Genomics, Inc. The Company is developing and commercializing genomic mapping instruments and technology to enable researchers to analyze DNA through unique studies to gain a comprehensive picture of genome biology, including structural variation of DNA and chromosomes.

The accompanying consolidated financial statements (the "financial statements") have been prepared assuming the Company will continue as a going concern, which contemplates continuity of operations, the realization of assets and the satisfaction of liabilities in the normal course of business. The financial statements do not reflect any adjustments that might result if the Company is unable to continue as a going concern. Since inception, the Company has been engaged in organizational activities, including raising capital and research and development activities. The Company has not generated substantial revenues and has not yet achieved profitable operations, nor has it ever generated positive cash flows from operations. There is no assurance that profitable operations, if achieved, could be sustained on a continuing basis. Further, the Company's future operations are dependent on the success of the Company's efforts to raise additional capital and the market acceptance of the Company's products. There can be no assurance that these efforts will be successful.

Going Concern

In accordance with ASU 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*, management is required to perform a two-step analysis over its ability to continue as a going concern. Management must first evaluate whether there are conditions and events that raise substantial doubt about the Company's ability to continue as a going concern and to meet its obligations as they become due within one year after the date that the financial statements are issued (step 1). If management concludes that substantial doubt is raised, management is also required to consider whether its plans alleviate that doubt (step 2).

The Company has experienced net losses and negative cash flows from operating activities since its inception and expects to continue to incur net losses into the foreseeable future. The Company had an accumulated deficit of $54,266,036 and $61,424,874 as of December 31, 2017 and June 30, 2018, respectively. The Company used $20,817,798 cash in operations in 2017 and has used $9,753,922 for the six months ended June 30, 2018. The Company had cash and cash equivalents of $1,021,897 and $7,624,289 as of December 31, 2017 and June 30, 2018, respectively. Management expects operating losses and negative cash flows to continue for at least the next year as the Company continues to incur costs related to research and commercialization efforts. Management has prepared cash flow forecasts which indicate that based on the Company's expected operating losses and negative cash flows, there is substantial doubt about the Company's ability to continue as a going concern within twelve months after the date that the financial statements for the year ended December 31, 2017 and the six months ended June 30, 2018, are issued.

Further, on March 8, 2016, the Company entered into a new term Loan and Security Agreement with Western Alliance Bank (the "Western Alliance LSA"). The provisions of the Western Alliance LSA allow for Western Alliance Bank to exercise a material adverse effect clause should the Company incur a material adverse effect within the meaning provided by the Western Alliance LSA, which could include the going concern matters

described herein. Should Western Alliance Bank invoke the material adverse effect clause, the outstanding loan balance may be declared immediately due and payable. The Company believes that it is a remote probability that the material adverse effect clause associated with the Western Alliance LSA will be exercised.

Management's ability to continue as a going concern is dependent upon its ability to raise additional funding. Management has plans to raise additional capital through equity offerings or debt financings to fulfill its operating and capital requirements for at least 12 months and to maintain compliance with the Western Alliance LSA covenants (see Note 7). The Company's plans include continuing to fund its operating losses and capital funding needs through public or private equity or debt financings, strategic collaborations, licensing arrangements, asset sales, or other arrangements. However, the Company may not be able to secure such financing in a timely manner or on favorable terms, if at all. Furthermore, if the Company issues equity securities to raise additional funds, its existing stockholders may experience dilution, and the new equity securities may have rights, preferences and privileges senior to those of the Company's existing stockholders. If the Company raises additional funds through collaboration, licensing or other similar arrangements, it may be necessary to relinquish valuable rights to its products or proprietary technologies or grant licenses on terms that are not favorable to the Company.

On June 29, 2018, the Company entered into a new Credit and Security Agreement with MidCap Financial Trust (the "Midcap Agreement"). The Midcap Agreement resulted in a $10,000,000 term loan and a $1,000,000 Convertible note. Proceeds from the Midcap Agreement were used to repay the outstanding $7,000,000 balance on the Western Alliance LSA. The provisions of the Midcap Agreement allow for MidCap Financial Trust to exercise a material adverse effect clause should the Company incur a material adverse effect within the meaning provided by the Midcap Agreement, which could include the going concern matters described herein. Should MidCap Financial Trust invoke the material adverse effect clause, the outstanding loan balance may be declared immediately due and payable. The Company believes that it is a remote probability that the material adverse effect clause associated with the Midcap Agreement will be exercised. Management plans to continue raising capital through equity offerings and debt financings to fulfill its operating and capital requirements.

If the Company does not have or is not able to obtain sufficient funds, it may have to reduce commercialization efforts or delay its development of new products. The Company also may have to reduce marketing, customer support or other resources devoted to its products or cease operations.

2. Summary of Significant Accounting Policies

Use of Estimates

The financial statements are prepared in accordance with accounting principles generally accepted in the United States ("GAAP") and all intercompany transactions and balances have been eliminated in consolidation. The preparation of the Company's financial statements require the Company to make estimates and assumptions that impact the reported amounts of assets, liabilities and expenses and the disclosure of contingent assets and liabilities in the financial statements and accompanying notes. Management evaluates its estimates on an ongoing basis. Although estimates are based on the Company's historical experience, knowledge of current events and actions it may undertake in the future, actual results may ultimately materially differ from these estimates and assumptions.

Unaudited Interim Financial Information

The accompanying consolidated balance sheet as of June 30, 2018, the related consolidated statements of operations and consolidated statements of cash flows for the six months ended June 30, 2017 and 2018 and the consolidated statements of convertible preferred stock and stockholders' deficit for the six months ended June 30, 2018 are unaudited. The interim unaudited consolidated financial statements have been prepared on the same basis as the annual audited consolidated financial statements and in the opinion of management, reflect all adjustments, which include only normal recurring adjustments necessary for the fair statement of the Company's financial position as of June 30, 2018 and the results of its operations and its cash flows for the six months ended

June 30, 2017 and 2018. The financial data and other information disclosed in these notes related to the six months ended June 30, 2017 and 2018 are unaudited. The results for the six months ended June 30, 2018 are not necessarily indicative of results to be expected for the year ending December 31, 2018, any other interim periods or any future year or period.

Unaudited Pro Forma Balance Sheet Information

The unaudited pro forma consolidated balance sheet information as of June 30, 2018 assumes the conversion of all outstanding shares of convertible preferred stock into 5,700,572 shares of the Company's common stock and the resulting reclassification of the carrying value of the convertible preferred stock to stockholders' deficit upon the completion of the Company's proposed initial public offering (the "IPO"). The unaudited pro forma consolidated balance sheet information as of June 30, 2018 also assumes the conversion of all convertible notes into 3,567,099 shares of the Company's common stock and the resulting reclassification of the carrying value of the convertible notes to stockholders' deficit upon the completion of the Company's proposed IPO. Lastly, the unaudited pro forma consolidated balance sheet information as of June 30, 2018 assumes the cancellation of the warrant liability and the resulting reclassification of the carrying value of the warrant shares to stockholders' deficit upon the completion of the Company's IPO. The unaudited pro forma consolidated balance sheet assumes that the completion of the IPO had occurred as of June 30, 2018 and excludes shares of common stock issued in the IPO and any related net proceeds.

Reclassifications

Certain amounts presented in the prior year financial statements have been reclassified to conform to current year presentation. Product revenue has been separated into product revenue and other revenue and cost of revenue has been separated into cost of product revenue and cost of other revenue on the consolidated statements of operations. For the year ended December 31, 2016, $631,539 has been reclassified out of product revenue into other revenue and $118,921 has been reclassified out of cost of product revenue into cost of other revenue.

Cash and Cash Equivalents

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

The Company has not experienced any losses in such accounts. The Company believes that it is not exposed to any significant credit risk on cash and cash equivalents. Included in cash and cash equivalents is $201,623, $252,594 and $252,594 in restricted cash as of December 31, 2016 and 2017 and June 30, 2018, respectively, related to amounts held for leases and credit cards.

Fair Value of Financial Instruments

The carrying amounts of all cash equivalents, accounts receivable, prepaid expenses and other current assets, accounts payable and accrued liabilities are reasonable estimates of their fair value because of the short-term nature of these items. Company issued convertible preferred stock warrants are recorded at fair value on a recurring basis.

Concentration of Credit Risk

Financial instruments, which potentially subject the Company to significant concentration of credit risk, consist primarily of cash and cash equivalents and accounts receivable. The Company maintains deposits in federally insured major financial institutions in excess of federally insured limits. The Company has not experienced any losses in such accounts and management believes that the Company is not exposed to significant credit risk due to the financial position of the depository institution in which those deposits are held.

The Company's customers are located throughout the world. The Company generally does not require collateral from its customers, but it performs credit evaluations of their financial condition. More information on accounts receivable is contained in the paragraph titled "Accounts Receivable" below.

Accounts Receivable

The Company extends credit to its customers in the normal course of business based upon an evaluation of each customer's credit history, financial condition, and other factors. Estimates of allowances for doubtful accounts are determined by evaluating individual customer circumstances, historical payment patterns, length of time past due, and economic and other factors. Bad debt expense is recorded as necessary to maintain an appropriate level of allowance for doubtful accounts in selling, general and administrative expense.

The following table reflects the activity related to the Company's allowance for doubtful accounts:

	December 31,		June 30,
	2016	2017	2018 (unaudited)
Accounts receivable	$ 1,846,567	$ 3,614,214	$ 3,386,205
Provision	—	(262,000)	(500,000)
Accounts receivable, net	$ 1,846,567	$ 3,352,214	$ 2,886,205

For the years ended December 31, 2016 and 2017 and the six months ended June 30, 2017 and 2018, Ultravision Technology Ltd. represented 14%, 21%, 0% and 9%, BioStar Company represented 0%, 15%, 0% and 15%, Berry Genomics Corporation represented 11%, 2%, 0% and 1%, Star Research Technology LTD represented 12%, 0%, 1% and 0%, University of Oxford represented 20%, 0%, 0% and 6%, and University of Connecticut represented 12%, 0%, 0% and 0%, respectively, of the Company's accounts receivable balance.

Inventory

Inventory is stated at the lower of cost or net realizable value, on a first-in, first-out basis. Inventory includes raw materials and finished goods that may be used in the research and development process and such items are expensed as consumed or expired. Provisions for slow-moving, excess, and obsolete inventories are estimated based on product life cycles, historical experience, and usage forecasts.

The components of inventories are as follows:

	December 31,		June 30,
	2016	2017	2018 (unaudited)
Materials and supplies	$ 119,329	$ 203,085	$ 242,782
Finished Goods	1,678,072	1,490,657	1,730,155
	$ 1,797,401	$ 1,693,742	$ 1,972,938

Inventories are net of write-downs of approximately $0, $364,437 and $364,437 as of December 31, 2016 and 2017 and June 30, 2018, respectively. During the year ended December 31, 2017, in connection with the market launch of the Company's next generation product, the Saphyr system, the Company determined that its first generation Irys instruments on hand had net realizable values below carrying value. Accordingly, the Company recorded a charge of $364,437 included in cost of revenue to write-down these instruments to net realizable value. As of December 31, 2017, and June 30, 2018, the Company's finished goods inventory included approximately $1,287,000 of Irys instruments.

Property and Equipment

Property and equipment are recorded at cost and depreciated or amortized using the straight-line method over the estimated useful lives of the assets (generally three to five years, or the remaining term of the lease for leasehold improvements, whichever is shorter) and generally consist of laboratory equipment, computer and office equipment, furniture and fixtures, and leasehold improvements. Repairs and maintenance costs are charged to expense as incurred.

Long-Lived Assets

The Company regularly reviews the carrying value and estimated lives of all of its long-lived assets, including property and equipment, to determine whether indicators of impairment may exist which warrant adjustments to carrying values or estimated useful lives. Should an impairment exist, the impairment loss would be measured based on the excess over the carrying amount of the asset's fair value. The Company has not recognized any impairment losses from inception through December 31, 2016. During the year ended December 31, 2017, the Company recognized an impairment loss of $604,511 related to equipment at customer sites. No impairment losses were recognized during the six months ended June 30, 2017 and 2018.

Deferred Rent

Deferred rent consists of the difference between cash payments and the recognition of rent expense on a straight-line basis for the facilities the Company leases. The Company's leases for its facilities provide for fixed increases in minimum annual rental payments. The total amount of rental payments due over the lease terms are being charged to rent expense ratably over the life of the leases. The current portion of deferred rent is included in accrued expenses and the non-current portion in other non-current liabilities on the consolidated balance sheets.

Revenue Recognition

Product Revenue

Product revenue represents the sale of the Company's instruments and consumables to third parties. Timing of revenue recognition on instrument sales is based upon when delivery has occurred, the price is fixed or determinable, and collectability is reasonably assured.

The majority of our instruments contain embedded operating systems and other software which is included in the purchase price of the instrument. The software is deemed incidental to the system as a whole as it is not sold or marketed separately and its production costs are minor compared to those of the hardware system. Hardware and software elements are both delivered when ownership is transferred to the customer. Hardware upgrades, which are made available to customers for purchase, are recognized as revenue when delivered and all revenue recognition criteria noted above have been met.

Installation services for direct sale customers are performed at the same time or shortly after the product is delivered and require only a minimal effort to complete. We believe installation is a perfunctory service and is not material to our obligations in the contract.

Other Revenue

Other revenue includes revenue from extended service contracts and other services that may be performed. Revenue for extended warranty contracts is recognized ratably over the service period. Revenue for other services is generally recognized based on proportional performance of the contract, when the Company's ability to complete project requirements is reasonably assured. Deferred revenue represents amounts received in advance for on-going service arrangements. Most of these services are completed in a short period of time from the receipt of the customer's order. When significant risk exists in the Company's ability to fulfill project requirements, revenue is recognized upon completion of the contract.

Multiple Element Arrangements

The Company regularly enters into contracts where revenue is derived from multiple deliverables, including products or services. These contracts typically include an instrument, consumables, and extended service contracts. Revenue recognition for contracts with multiple deliverables is based on the individual units of accounting determined to exist in the contract. A delivered item is considered a separate unit of accounting when the delivered item has value to the customer on a stand-alone basis. Items are considered to have stand-alone value when they are sold separately by any vendor or when the customer could resell the item on a stand-alone basis.

For transactions with multiple deliverables, consideration is allocated at the inception of the contract to all deliverables based on their relative selling price. The relative selling price for each deliverable is determined using vendor-specific objective evidence ("VSOE") of selling price or third-party evidence of selling price if VSOE does not exist. If neither VSOE nor third-party evidence exists, the Company uses its best estimate of the selling price using average selling prices over an appropriate period coupled with an assessment of current market conditions. If the product or service has no history of sales or if the sales volume is not sufficient, the Company considers its approved standard prices adjusted for applicable discounts.

In order to establish VSOE of selling price, the Company must regularly sell the product or service on a standalone basis with a substantial majority priced within a relatively narrow range. In cases where there is not a sufficient number of standalone sales and VSOE of selling price cannot be determined, then the Company utilizes third-party evidence to establish selling price.

Distributor Transactions

In certain markets, the Company sells products and provides services to customers through distributors that specialize in life sciences products. In cases where the product is delivered to a distributor, revenue recognition generally occurs when title transfers to the distributor. The terms of sales transactions through distributors are generally consistent with the terms of direct sales to customers and do not contain return rights. Distributor sales transactions typically differ from direct customer sales as they do not require the Company's services to install the instrument at the end customer or perform the services for the customer that are beyond the standard warranty in the first year following the sale. These transactions are accounted for in accordance with the Company's revenue recognition policy described herein.

The Company derives a significant portion of product revenue from a limited distributor base. For the years ended December 31, 2016 and 2017, and the six months ended June 30, 2017 and 2018, Berry Genomics Corp. represented 15%, 4%, 8% and 6%, Ultravision Technology Ltd. represented 11%, 15%, 8% and 6%, Gene Company Ltd. represented 0%, 6%, 14% and 13%, and AS One Corp. represented 10%, 0%, 0% and 0%, respectively, of the Company's total revenues. No other distributor represented more than 10% of total Company revenues during these periods.

Cost of Revenue

Cost of revenue for products consists of the Company's instrument cost from the manufacturer, raw material parts costs and associated freight, shipping and handling costs, contract manufacturer costs, royalties due to third parties, salaries and other personnel costs, overhead and other direct costs related to those sales recognized as product revenue in the period.

Cost of other revenue consists of salaries and other personnel costs, and facility costs associated with costs related to warranties and other costs of servicing equipment at customer sites.

Research and Development Costs

Costs incurred for research and product development, including acquired technology and costs incurred for technology in the development stage, are expensed as incurred.

Patent Costs

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

Deferred Offering Costs

Deferred public offering costs primarily consist of legal, accounting and filing fees relating to the IPO. The deferred offering costs will be offset against the IPO proceeds upon the consummation of the offering. In the event the offering is delayed or aborted, incurred offering costs will be expensed. The Company has incurred $1,436,320 of IPO costs as of June 30, 2018.

Stock-Based Compensation

Stock-based compensation expense represents the cost of the grant date fair value of employee stock option grants recognized over the requisite service period of the awards (usually the vesting period) on a straight-line basis, net of actual forfeitures during the period. The Company estimates the fair value of stock option grants using the Black-Scholes option pricing model. The exercise price for all stock options granted was at the estimated fair value of the underlying common stock as determined on the date of grant by the Board of Directors. The Board of Directors determined the value of the underlying stock by considering a number of factors, including historical and projected financial results, the risks the Company faced at the time, the preferences of the Company's convertible preferred stockholders, and the lack of liquidity of the Company's common stock.

Convertible Preferred Stock Warrants

The Company accounts for freestanding warrants to purchase shares of convertible preferred stock as liabilities in the balance sheets under preferred stock warrant liability. The convertible preferred stock warrants are subject to remeasurement at each reporting period, with changes in fair value recorded as change in fair value of warrants and expirations in the consolidated statements of operations.

Income Taxes

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

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

As of December 31, 2016, and 2017, the Company maintained valuation allowances against its deferred tax assets as the Company concluded it had not met the "more likely than not" to be realized threshold. Changes in the valuation allowance when they are recognized in the provision for income taxes may result in a change in the estimated annual effective tax rate.

The Company recognizes the impact of uncertain tax positions at the largest amount that is "more likely than not" to be sustained upon audit by the relevant taxing authority. An uncertain tax position will not be recognized if it has less than a 50% likelihood of being sustained. The Company recognizes interest and penalties related to unrecognized tax benefits within income tax expense. Any accrued interest and penalties are included within the related tax liability.

Comprehensive Loss

Net loss and comprehensive loss were the same for all periods presented; therefore, a separate statement of comprehensive loss is not included in the financial statements.

Segment Reporting

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

The following table reflects total revenue by geography and as a percentage of total revenue, based on the billing address of the Company's customers. North America consists of the United States and Canada. EMEIA consists of Europe, the Middle East, India and Africa. Asia Pacific includes China, Japan, South Korea, Singapore and Australia.

	Year Ended December 31,				Six months ended June 30, (unaudited)			
	2016		2017		2017		2018	
	$	%	$	%	$	%	$	%
North America	$2,078,987	31%	$3,801,481	40%	$1,794,728	47%	$2,553,428	49%
EMEIA	1,666,188	24%	1,282,897	13%	819,464	21%	1,128,510	21%
Asia Pacific	3,047,614	45%	4,420,665	47%	1,302,672	32%	1,476,556	30%
Total	$6,792,789	100%	$9,505,043	100%	$3,916,864	100%	$5,158,494	100%

Subsequent to the issuance of the June 30, 2018 unaudited condensed consolidated financial statements, the Company discovered an error in the disclosure of revenue amounts for the six months ended June 30, 2018 within the North America, EMEIA and Asia Pacific reportable segments. Accordingly, the table above has been restated to correct the June 30, 2018 disclosures of revenue for the North America, EMEIA, and Asia Pacific reportable segments, resulting in increases (decreases) from amounts previously reported of $837,451, $239,421, and $(1,076,872), respectively.

For the years ended December 31, 2016 and 2017, and the six months ended June 30, 2017 and 2018, the United States represented 30%, 37%, 46% and 50% and China represented 34%, 28%, 16% and 23%, respectively of total revenue.

Net Loss Per Share

Basic net loss per share is calculated by dividing the net loss by the weighted-average number of common shares outstanding for the period. Diluted net loss per share is computed by dividing the net loss by the weighted average number of common shares and common share equivalents outstanding for the period. Common stock equivalents are only included when their effect is dilutive. The Company's potentially dilutive securities which include convertible preferred stock and outstanding stock options under the Company's equity incentive plan have been excluded from the computation of diluted net loss per share as they would be anti-dilutive to the net loss per share. For all periods presented, there is no difference in the number of shares used to calculate basic and diluted shares outstanding due to the Company's net loss position.

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

	Year Ended December 31,		Six months ended June 30,	
	2016	2017	2017	2018
			(unaudited)	
Series A convertible preferred stock	16,149	16,149	16,149	16,149
Series B convertible preferred stock	376,550	376,550	376,550	376,550
Series B-1 convertible preferred stock	160,652	160,652	160,652	160,652
Series C convertible preferred stock	1,091,451	1,091,451	1,091,451	1,091,451
Series D convertible preferred stock	965,064	965,064	965,064	965,064
Series D-1 convertible preferred stock	1,362,912	3,090,706	2,657,656	3,090,706
Common stock options	87,287	872,787	895,135	833,960
Preferred warrants	1,713,866	1,710,447	1,713,866	1,739,652
Total	5,773,931	8,283,806	7,876,523	8,274,184

Unaudited Pro Forma Net Loss Per Share

	Year Ended December 31, 2017	Six months ended June 30, 2018
	(unaudited)	
Net loss and pro forma net loss attributable to common stockholders	$ (23,365,364)	$ (7,158,858)
Weighted-average common shares outstanding, basic and diluted	142,596	155,273
Add:		
Pro forma adjustments to reflect assumed conversion of convertible preferred stock	5,259,606	8,272,028
Pro forma weighted-average common shares outstanding, basic and diluted	5,402,202	8,427,301
Pro forma net loss per share attributable to common stockholders, basic and diluted	$ (4.33)	$ (0.85)

Recent Accounting Pronouncements

On April 5, 2012, President Obama signed the Jump-Start Our Business Startups Act (the “JOBS Act”) into law. The JOBS Act contains provisions that, among other things, reduce certain reporting requirements for an emerging growth company. As an emerging growth company, the Company may elect to adopt new or revised accounting standards when they become effective for non-public companies, which typically is later than when public companies must adopt the standards. The Company has elected to take advantage of the extended transition period afforded by the JOBS Act and, as a result, will comply with new or revised accounting standards on the relevant dates on which adoption of such standards is required for emerging growth companies, which are the dates included below.

In May 2014, the FASB issued ASU 2014-09, *Revenue from Contracts with Customers (Topic 606)*. ASU 2014-09 completes the joint effort by the FASB and International Accounting Standards Board to improve financial reporting by creating common revenue recognition guidance for GAAP and International Financial Reporting Standards. ASU 2014-09 applies to all companies that enter into contracts with customers to transfer goods or services. Under the standard, revenue is recognized when a customer obtains control of promised goods or services in an amount that reflects the consideration the entity expects to receive in exchange for those goods or services. In addition, the standard requires disclosure of the nature, amount, timing, and uncertainty of revenue and cash flows arising from contracts with customers. The guidance permits two methods of adoption: retrospectively to each prior reporting period presented (full retrospective method), or retrospectively with the cumulative effect of initially applying the guidance recognized at the date of initial application (modified

retrospective method). The guidance is effective for reporting periods beginning after December 15, 2018, and interim periods beginning after December 15, 2019. The Company has evaluated this new guidance and does not expect the adoption to have a material impact on the financial statements.

In February 2015, the FASB issued ASU 2016-02, *Leases (Topic 842)*, which amends the FASB Accounting Standards Codification and creates Topic 842, "Leases." The new topic supersedes Topic 840, "Leases," and increases transparency and comparability among organizations by recognizing lease assets and lease liabilities on the balance sheet and requires disclosures of key information about leasing arrangements. The guidance is effective for reporting periods beginning after December 15, 2019, and interim periods within fiscal years beginning after December 15, 2020. ASU 2016-02 mandates a modified retrospective transition method. The Company is in the process of evaluating the impact of adoption of the ASU on the financial statements.

In January 2016, the FASB issued ASU No. 2016-01, *Financial Instruments—Overall (Subtopic 825-10): Recognition and Measurement of Financial Assets and Financial Liabilities (ASU 2016-01)*. This guidance changes how entities measure equity investments that do not result in consolidation and are not accounted for under the equity method. Entities will be required to measure these investments at fair value at the end of each reporting period and recognize changes in fair value in net income. A practicability exception will be available for equity investments that do not have readily determinable fair values, however; the exception requires the Company to consider relevant transactions that can be reasonably known to identify any observable price changes that would impact the fair value. This guidance also changes certain disclosure requirements and other aspects of current GAAP. This guidance is effective for the Company for the year ending December 31, 2019 and for interim periods effective the three months ending March 31, 2020. Early adoption is permitted. The Company is currently evaluating the requirements of ASU 2016-01 and has not yet determined whether the adoption of the standard will have a material impact on the financial statements.

In August 2016, the FASB issued ASU 2016-15, *Classification of Certain Cash Receipts and Cash Payments (Topic 230)*. ASU 2016-15 addresses eight specific cash flow issues with the objective of reducing the existing diversity in practice for certain cash receipts and cash payments. The standard is effective for annual reporting periods beginning after December 15, 2018 and interim periods reporting within fiscal years beginning after December 15, 2019, with early adoption permitted. The Company does not believe the adoption of this guidance will have a material impact on the financial statements.

3. Fair Value Measurements

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

Level 1: Unadjusted quoted prices in active markets that are accessible at the measurement date for identical, unrestricted assets or liabilities.

Level 2: Quoted prices for similar assets and liabilities in active markets, quoted prices in markets that are not active, or inputs which are observable, either directly or indirectly, for substantially the full term of the asset or liability.

Level 3: Prices or valuation techniques that require inputs that are both significant to the fair value measurement and unobservable (i.e. supported by little or no market activity).

	December 31, 2016	Fair Value Measurement Using: Quoted Prices in Active Markets for Identical Assets Level 1	Significant Other Observable Inputs Level 2	Significant Unobservable Inputs Level 3
Assets				
Money market funds	$ 5,249,620	$ 5,249,620	$ —	$ —
Total assets	$ 5,249,620	$ 5,249,620	$ —	$ —
Liabilities				
Preferred stock warrant liability	$ 4,650,877	$ —	$ —	$ 4,650,877
Total liabilities	$ 4,650,877	$ —	$ —	$ 4,650,877

	December 31, 2017	Fair Value Measurements Using: Quoted Prices in Active Markets for Identical Assets Level 1	Significant Other Observable Inputs Level 2	Significant Unobservable Inputs Level 3
Assets				
Money market funds	$ 1,021,897	$ 1,021,897	$ —	$ —
Total assets	$ 1,021,897	$ 1,021,897	$ —	$ —
Liabilities				
Preferred stock warrant liability	$ 3,898,944	$ —	$ —	$ 3,898,944
Total liabilities	$ 3,898,944	$ —	$ —	$ 3,898,944

	June 30, 2018	Fair Value Measurements Using: Quoted Prices in Active Markets for Identical Assets Level 1	Significant Other Observable Inputs Level 2	Significant Unobservable Inputs Level 3
	(unaudited)			
Assets				
Money market funds	$ 7,624,289	$ 7,624,289	$ —	$ —
Total assets	$ 7,624,289	$ 7,624,289	$ —	$ —
Liabilities				
Preferred stock warrant liability	$ 1,604,836	$ —	$ —	$ 1,604,836
Total liabilities	$ 1,604,836	$ —	$ —	$ 1,604,836

The following table summarizes the changes in fair value of the Company's Level 3 liabilities for the years ended December 31, 2016 and 2017, and the six months ended June 30, 2018:

	Warrant Liability
Balance at January 1, 2016	$ 2,619,034
Issuance of warrants in connection with debt	99,684
Issuance of warrants in connection with equity	4,938,241
Expiration of Series C warrants	(1,113,633)
Change in fair value of preferred stock warrants	(1,892,449)
Balance at December 31, 2016	4,650,877
Expiration of Series A warrants	(1,424)
Change in fair value of preferred stock warrants	(750,509)
Balance at December 31, 2017	3,898,944
Issuance of warrants in connection with debt (unaudited)	176,813
Change in fair value of preferred stock warrants (unaudited)	$ (2,470,921)
Balance at June 30, 2018 (unaudited)	$ 1,604,836

As of December 31, 2013, the Company classified certain warrants to purchase Series A convertible preferred stock that contain down-round protection provisions as a liability. In connection with the Series C Convertible Participating Preferred Stock and Warrant Purchase Agreement in 2014, the composition of the Company's Board of Directors changed such that the holders of the Series A, B, B-1 and C convertible preferred stock controlled the Board of Directors. Accordingly, upon certain change in control events that are outside of the Company's control, including liquidation, sale, or transfer of control of the Company, holders of the convertible preferred stock can cause its redemption. As such, the then outstanding warrants to purchase shares of Series B and B-1 convertible preferred stock that were previously classified in equity at the time of the Series C Convertible Participating Preferred Stock and Warrant Purchase Agreement were reclassified to a liability at fair value. As of June 30, 2018, holders of the convertible preferred stock continue to control the Board of Directors.

The warrants to purchase shares of Series C convertible preferred stock issued in 2014 expired during the year ending December 31, 2016. In connection with the Series D Convertible Participating Preferred Stock and Warrant Purchase Agreement in 2016 (see Note 8), the Company issued warrants to purchase Series D convertible preferred stock which are classified as a liability. In connection with the Western Alliance LSA and subsequent amendment, the Company issued warrants to purchase Series D and D-1 convertible preferred stock which are classified as a liability (see Note 7).

The warrants to purchase convertible preferred stock are valued at each reporting period using the Black-Scholes-Merton model. This valuation includes observable inputs such as risk-free rate, as well as unobservable inputs for assumed volatility, the expected life of the warrants, and the fair value of the underlying convertible preferred stock. Quantitative information relating to unobservable inputs is disclosed below:

	December 31,		June 30,
	2016	2017	2018 (unaudited)
Risk-free interest rate	0.90%	1.75%	2.32%
Volatility	54.40%	54.60%	47.20%
Expected life (in years)	0.7-1.2	0.6	0.2
Dividend Yield	—	—	—
Fair value of Series A preferred stock	$ 0.67	$ 0.66	$ 0.49
Fair value of Series B-1 preferred stock	$ 0.37	$ 0.36	$ 0.36
Fair value of Series D preferred stock	$ 0.48	$ 0.48	$ 0.42
Fair value of Series D-1 preferred stock	$ 0.48	$ 0.48	$ 0.42

At December 31, 2016 and 2017, the fair value of the underlying convertible preferred stock was determined using an Option Pricing Method (“OPM”). Under the OPM, once the fair market value of the enterprise is established, shares are valued by creating a series of call options with exercise prices based on the liquidation preference and conversion behavior of the different classes of equity. Accordingly, the aggregate equity value is allocated to each of the classes of equity shares outstanding. At June 30, 2018, the fair value of the underlying convertible preferred stock was determined using a probability-weighted expected return model (the “PWERM”) that incorporated two allocation methods: an initial public offering (the “IPO Scenario”) and an OPM to project future outcomes of the Company should the Company remain private in the near term (the “Private Scenario”). In the PWERM IPO Scenario, the probability weighting was 50%, and in the Private Scenario, the probability weighting was 50%. The Company utilizes both the market and income approach to establish the fair market value of the enterprise.

Significant increases or decreases in any of these inputs in isolation (including those inputs utilized in the OPM or those in weighted the scenarios in the PWERM) would result in a significantly different fair value measurement. An increase in the risk-free interest rate, and/or an increase in the remaining contractual term or expected volatility, and/or an increase in the fair value of the convertible preferred stock would result in an increase in the fair value of the warrants.

During the year ended December 31, 2016, the Company modified the provisions of its outstanding Series A, B and C convertible preferred stock resulting in the shares outstanding being remeasured at fair value (see Note 8). The Company utilized the OPM to determine the value of each class of convertible preferred stock at the time of remeasurement.

4. Prepaid Expenses and Other Current Assets

Prepaid expenses and other current assets consist of the following:

	December 31,		June 30,
	2016	2017	2018 (unaudited)
Prepayment to supplier	$ 1,039,565	$ 492,330	$ 1,118,857
Deferred offering costs	—	—	1,436,320
Other current assets	802,501	579,182	615,046
Total	$ 1,842,066	$ 1,071,512	$ 3,170,223

5. Property and Equipment, net

Property and equipment, net consist of the following:

	December 31, 2016	December 31, 2017	June 30, 2018 (unaudited)
Computer and office equipment	$ 476,402	$ 476,402	$ 476,402
Lab equipment	3,252,020	3,995,731	4,156,519
Service equipment placed at customer sites	946,006	594,553	594,553
Leasehold improvements	1,795,178	1,860,667	1,860,667
	6,469,606	6,927,353	7,088,141
Less accumulated depreciation and amortization	(2,417,523)	(3,921,565)	(4,647,640)
	$ 4,052,083	$ 3,005,788	$ 2,440,501

The Company recorded depreciation and amortization expense of $1,115,027, $1,504,042, $724,381 and $778,555 for the years ended December 31, 2016 and 2017 and the six months ended June 30, 2017 and 2018, respectively in operating expenses.

6. Accrued Expenses

Accrued expenses consist of the following:

	December 31, 2016	December 31, 2017	June 30, 2018 (unaudited)
Accrued expenses	$ 2,246,071	$ 2,596,137	$ 3,032,139
Accrued offering costs	—	—	1,059,053
Accrued bonus	640,655	912,757	407,681
	$ 2,886,726	$ 3,508,894	$ 4,498,873

7. Long-Term Debt

Square 1 LSA

In 2012, the Company amended the Loan and Security Agreement with Square 1 Bank (the "Square 1 LSA") for a $5,000,000 term loan in two tranches (Tranche I and Tranche II, up to $2,000,000 and $3,000,000, respectively) with interest at the prime rate plus 2.50%. The Company drew on Tranche I and Tranche II on June 24, 2013, and July 30, 2013, respectively, after which interest-only payments were due through December 11, 2014, as amended in August 2014, followed by principal payments of $277,778 plus interest per month due in 18 installments beginning in January 14, 2015. The Company began to make principal payments, as required, starting January 2015. In March 2016, the Company repaid the Square 1 LSA as part of entering into the Western Alliance LSA as discussed below.

Western Alliance LSA

On March 8, 2016, the Company entered into the Western Alliance LSA for $7,000,000. The loan proceeds were used to repay the outstanding $5,000,000 loan with Square 1 Bank, as required by the 12th amendment to the Square 1 LSA.

The Western Alliance LSA bears a floating interest rate at the 30-day LIBOR Rate plus 6.52% and will amortize in 30 equal monthly installments beginning on the amortization date described below. The Western

Alliance LSA is secured by substantially all assets of the Company and matures on April 1, 2020. The Western Alliance LSA is interest-only until July 8, 2018, which may be extended to October 8, 2018 if the Company is able to secure $21,000,000 in funding prior to June 30, 2018. The Company paid debt issuance costs and a facility fee totaling $113,542 at the inception of the loan, which was recorded as a debt discount and is being recognized as additional interest expense over the term of the loan. Subject to certain limited exceptions, amounts prepaid in relation to the Western Alliance LSA are subject to a prepayment fee based on the then outstanding balance equal to 3% in the first year, 2% in the second year, and 1% thereafter. In addition, upon repayment of the total amounts borrowed, the Company will be required to pay an end of term charge equal to 3.25% of the total amount borrowed. Accordingly, an end of term charge of $227,500 was recorded as debt discount and is included in other long-term liabilities on the balance sheet as of December 31, 2016 and under current liabilities as of December 31, 2017. The end of term charge is being recognized as additional interest expense over the term of the loan.

Additionally, in conjunction with the entry into Western Alliance LSA, the Company issued to Western Alliance Bank a warrant to purchase 510,417 shares of Series D convertible preferred stock at an exercise price of $0.48 per share that was immediately exercisable and expires March 8, 2026. The Company valued the warrant to purchase Series D convertible preferred stock using the Black-Scholes-Merton model, and the initial fair value of the warrant to purchase Series D convertible preferred stock of $65,384 was recorded as a debt discount and is being amortized to interest expense over the term of the loan. The assumptions used in the model were: the fair value of the Series D convertible preferred stock, which was determined using an OPM analysis (see Note 3), an expected life of 2 years, a risk-free interest rate of 0.88% and an expected volatility of 47%.

On December 9, 2016, the Western Alliance LSA was amended, requiring the Company to secure $5,000,000 in funding prior to April 30, 2017 and to secure $15,000,000 in funding between December 1, 2016 and October 8, 2017. In conjunction with this amendment, the Company issued to Western Alliance Bank a warrant to purchase 291,667 shares of Series D-1 convertible preferred stock that were immediately exercisable, expiring December 9, 2026. The Company valued the warrant to purchase Series D-1 convertible preferred stock using the Black-Scholes-Merton model, and the initial fair value of the warrant to purchase Series D-1 convertible preferred stock of $34,300 was recorded as a debt discount and is being amortized to interest expense over the term of the loan. The assumptions used in the model were: the fair value of the Series D-1 convertible preferred stock, which was determined using an OPM analysis (see Note 3), an expected life of 1.2 years, a risk-free interest rate of 0.85% and an expected volatility of 55%.

On November 20, 2017, the Western Alliance LSA was amended requiring the Company to secure $1,500,000 in funding prior to November 20, 2017 and to secure $15,000,000 in funding prior to December 31, 2017. In conjunction with this amendment, the Company agreed to pay an amendment fee of $17,500, which is payable on the earliest to occur of the loan maturity date or the prepayment date. The amount was recorded as a debt discount on the balance sheet and is being recognized as additional interest expense over the remaining term of the loan.

Under the terms of the amended Western Alliance LSA, the Company is subject to operational covenants, including limitations on the Company's ability to incur liens or additional debt, pay dividends, and redeem stock, among other restrictions. The Company is subject to a performance to plan and minimum liquidity financial covenants. The performance to plan restriction requires that the Company's actual trailing six-month revenues, as of any date of determination, shall be no less than seventy-five percent (75%) of projected revenues (the "Revenue Covenant"), as set forth in the Western Alliance LSA. However, the Company is not required to comply with the Revenue Covenant as long as the Company at all times maintains a ratio of its minimum unrestricted cash balance with Western Alliance Bank to its indebtedness with Western Alliance Bank of at least 0.75 to 1.00. As of December 31, 2016, and 2017, the Company was in compliance with its operational covenants.

The Company received a notice of default from Western Alliance Bank notifying the Company that it was in default as of December 31, 2017, as it had failed to secure at least $15,000,000 from the sale or issuance of its

equity securities or subordinated debt as set forth in the amended Western Alliance LSA. Based on the notice of default the Company reclassified the total loan balance of $6,729,752 to current liabilities on the consolidated balance sheet as of December 31, 2017, as the loan could be called at any time by Western Alliance Bank.

In February 2018, the Western Alliance LSA was amended requiring the Company to secure $21,000,000 in funding prior to June 30, 2018. As part of the amendment, Western Alliance Bank agreed to forbear from exercising any of its default remedies set forth in the Western Alliance LSA as a result of the Company's loan default.

On June 13, 2018, the Western Alliance LSA was amended, replacing previously amended funding requirements and requiring the Company to secure $5,000,000 in funding prior to August 3, 2018. Additionally, the amendment restricted Company use of all cash collected from customers, received on and after amendment date, until collecting a total of $2,500,000. As part of the amendment, Western Alliance Back waived the existing default.

MidCap Financial CSA

On June 29, 2018, the Company entered into a Credit and Security Agreement (CSA) with MidCap Financial Trust which provides a $15,000,000 term loan facility available in three tranches, Tranche 1: $10,000,000, Tranche 2: $2,500,000, and Tranche 3: $2,500,000. The Company borrowed $10,000,000 from Tranche 1 immediately upon closing the agreement; Tranches 2 and 3 are available to draw from after achieving $12,500,000 and $16,000,000 in trailing twelve month revenue, respectively. Proceeds from the loan were used to repay the outstanding $7,000,000 due to Western Alliance LSA.

The MidCap Financial CSA bears interest at an annual rate of one month LIBOR plus 7.5%, subject to a LIBOR floor of 1.5%. The loan has a 60-month term, with interest only for the first 18 months and straight-line amortization of principal and interest for the remaining 42 months. The interest only period will be extended by six months following successful completion of an initial public offering that generates not less than $30,000,000 of net proceeds. The CSA is secured by substantially all of the assets of the Company and matures on July 1, 2023.

The Company paid issuance fees of approximately $338,000 at the inception of the loan, which was recorded as a debt discount and is being recognized as additional interest expense over the term of the loan. Subject to certain limited exceptions, amounts prepaid in relation to the MidCap Financial CSA are subject to a prepayment fee determined by multiplying the amount being prepaid by 4% in the first year of the term, 3% in year two, and 2% thereafter. In addition, upon repayment of the total amounts borrowed, the Company will be required to pay an end of term charge equal to 4% of the total amount borrowed. Accordingly, an end of term charge of $400,000 was recorded as debt discount and is included in other long-term liabilities on the balance sheet as of June 30, 2018. The end of term charge is being recognized as additional interest expense over the term of the loan.

In conjunction with entering into the MidCap Financial CSA, the Company issued to MidCap a warrant to purchase 625,000 shares of Series D-1 convertible preferred stock at an exercise price of $0.48 per share that was immediately exercisable and expires June 29, 2028. The Company valued the warrant to purchase Series D convertible preferred stock using the Black-Scholes-Merton model, and the initial fair value of the warrant to purchase Series D-1 convertible preferred stock of $176,813 was recorded as a debt discount and is being amortized to interest expense over the term of the loan. The assumptions used in the model were: the fair value of the Series D-1 convertible preferred stock, which was determined using an OPM analysis (see Note 3), an expected life of 10 years, a risk-free interest rate of 2.83% and an expected volatility of 59%. In addition, MidCap invested $1,000,000 in the convertible note offering at terms identical to other investors described in the Convertible Notes section below.

Convertible Notes

On February 9, 2018, the Company entered into a Note Purchase Agreement (the "Note Purchase Agreement") with various investors, which included related parties (the "Investors"), pursuant to which the Company agreed to sell to the Investors convertible promissory notes (the "Convertible Notes") in the original principal amount of up to $15,960,000. On April 2, 2018, the Company amended the Note Purchase Agreement to, among other things, increase the principal amount available for issuance under the Note Purchase Agreement to $18,372,132. The Convertible Notes have a maturity date of September 30, 2018 and are convertible either into the Company's common stock or convertible preferred stock, dependent on the conversion events as described below.

On June 29, 2018, the Note Purchase Agreement was amended to increase the principal amount available for issuance from $18,372,132 to $19,372,132.

As of June 30, 2018, the Company received proceeds of approximately $14,400,000 from the issuance of the Convertible Notes.

Conversion and Liquidity Events

Conversion at Qualifying financing – Upon the closing of an equity financing following the date of the Note Purchase Agreement involving the sale by the Company of its convertible preferred stock in which the Company receives an aggregate of at least $15,000,000 in cumulative gross proceeds the conversion price will equal (i) for the Convertible Notes issued in February 2018, 75% of the lowest per share cash purchase price of the convertible preferred stock sold by the Company in such qualified financing and (ii) for the Convertible Note issued in June 2018, 80% of the lowest per share cash purchase price of the convertible preferred stock sold by the Company in such qualified financing. The original principal amount and accrued interest under each Convertible Note (the "Conversion Amount") shall automatically convert into convertible preferred stock.

Conversion at Initial Public Offering – Prior to the maturity date if the Company completes an IPO the Conversion Amount will automatically convert into shares of the Company's common stock at an amount equal to the Conversion Amount divided by (i) for the Convertible Notes issued in February 2018, 75% of the per share cash purchase price of the common stock offered to the public in the IPO and (ii) for the Convertible Note issued in June 2018, 80% of the per share cash purchase price of the common stock offered to the public in the IPO.

Optional Conversion at Maturity – Upon maturity, and at the election of the Convertible Note holder, the Conversion Amount will convert into shares of Series D-2 convertible preferred stock as is equal to the Conversion Amount divided by the price per share. The price per share is defined as $60,000,000 divided by the aggregate number of outstanding shares of the Company's common stock as of the maturity date.

Liquidity Event – Upon a liquidation event or deemed liquidation event, the holders of the Convertible Notes will be entitled to receive repayment in an amount equal to (i) for the Convertible Notes issued in February 2018, 250% of the outstanding principal amount underlying the Convertible Notes and any unpaid interest accrued and outstanding and (ii) for the Convertible Note issued in June 2018, 200% of the outstanding principal amount underlying the Convertible Notes and any unpaid interest accrued and outstanding.

The Company evaluated the embedded conversion features within the above convertible notes under ASC 815-10 and ASC 815-15 to determine if they required bifurcation as a derivative instrument. The Company determined the embedded conversion features do not meet the definition of a derivative, and therefore, do not require bifurcation from the host instrument. Since the embedded conversion features were not considered derivatives, the convertible notes were accounted for accordance with ASC 470-20, Debt with Conversion and Other Options.

Debt and unamortized discount balances relating to the Western Alliance LSA are as follows:

	December 31, 2016	December 31, 2017	June 30, 2018 (unaudited)
Term loan face value	$7,000,000	$7,000,000	$ —
Fair value of warrant	(99,684)	(99,684)	
End of term charge	(227,500)	(227,500)	
Capitalized debt issuance costs	(113,542)	(131,042)	
Accretion of debt issuance costs and end of term charge	60,785	148,225	
Accretion of warrant fair value	13,117	39,753	
Balance	6,633,176	6,729,752	
Less current portion	587,131	6,729,752	
Long-term debt	$6,046,045	$ —	$ —

Debt and unamortized discount balances relating to the MidCap Financial CSA are as follows:

	June 30, 2018 (unaudited)
Term loan face value	$ 10,000,000
Fair value of warrant	(176,813)
End of term charge	(400,000)
Capitalized debt issuance costs	(467,044)
Accretion of debt issuance costs and end of term charge	—
Accretion of warrant fair value	—
Balance	8,956,143
Less current portion	—
Long-term debt	$ 8,956,143

Debt and unamortized discount balances relating to the convertible notes are as follows:

	June 30, 2018 (unaudited)
Convertible notes face value	$ 14,372,132
Capitalized debt issuance costs	(42,289)
Balance	14,329,843
Less current portion	14,329,843
Long-term debt	$ —

Non-cash interest expense related to debt discount amortization and accretion of end of term fees was $73,902, $96,576, $44,682 and $69,791 for the years ended December 31, 2016 and 2017 and six months ended June 30, 2017 and 2018, respectively.

Future minimum payments including interest under the loan and security agreement are as follows as of December 31, 2017:

Total minimum loan payments	$ 8,426,862
Unamortized interest	(1,199,362)
End of term charge	(227,500)
Warrant fair value	(59,931)
Capitalized debt issuance costs and end of term charge	(210,317)
Term loan	$ 6,729,752

Future minimum payments including interest under the MidCap Financial CSA are as follows as of June 30, 2018:

	(unaudited)
Years ending December 31,	
2018	$ 479,607
2019	959,213
2020	3,690,745
2021	3,416,684
2022-2023	5,011,162
Total minimum loan payments	$ 13,557,409
Unamortized interest	(3,157,409)
End of term charge	(400,000)
Warrant fair value	(176,813)
Capitalized debt issuance costs and end of term charge	(867,044)
Term loan	8,956,143
Less current portion	—
Long-term debt	$ 8,956,143

8. Convertible Preferred Stock and Stockholders' Deficit

Convertible Preferred Stock

The Company's convertible preferred stock has been classified as temporary equity on the accompanying balance sheets in accordance with authoritative guidance for the classification and measurement of redeemable securities. Upon certain change in control events that are outside of the Company's control, including liquidation, sale or transfer of control of the Company, holders of the convertible preferred stock can cause its redemption. There were 121,992,497 shares of convertible preferred stock outstanding as of December 31, 2017 and June 30, 2018, respectively.

The following sets forth information regarding all convertible preferred stock securities sold since January 1, 2016:

Series D Convertible Preferred Stock Financing

Between March 4, 2016 and April 4, 2016, the Company issued an aggregate of 20,652,486 shares of Series D convertible preferred stock at a purchase price of $0.48 per share, raising approximately $9,700,000, net of share issuance costs of $202,222, excluding the warrant liability discussed below. In conjunction with the Series D convertible preferred stock offering, the Company issued warrants to purchase an aggregate of 31,672,817 of

Series D convertible preferred stock. The Company determined that the warrants met the definition of freestanding financial instruments. Accordingly, the fair value of the warrants was recognized as a liability with an offsetting net deduction to convertible preferred stock. The Company valued the Series D convertible preferred stock warrants using the Black-Scholes-Merton model, and the initial fair value was determined to be $4,938,241. The assumptions used in the model included the fair value of the Series D convertible preferred stock of $0.48, an expected life of 1.9 to 2 years, a risk-free interest rate of 0.74% to 0.88% and an expected volatility of 47%.

Series D-1 Convertible Preferred Stock Financing

Between August 5, 2016 and August 29,2016, the Company issued an aggregate of 29,166,671 shares of Series D-1 convertible preferred stock at $0.48 per share, raising approximately $13,800,000, net of share issuance costs of $200,002.

From February through November 2017, the Company sold and issued 36,974,586 shares of Series D-1 convertible preferred stock at $0.48 per share, raising approximately $17,590,000, net of issuance costs of $154,191. At any time after December 31, 2021, the holders of a majority of the then outstanding Series D-1 convertible preferred stock may redeem any unconverted or unredeemed Series D-1 convertible preferred stock in cash at the greater of the original convertible preferred stock purchase price plus all declared but unpaid dividends or the fair market value. The Company has determined not to adjust the carrying values of the Series D-1 convertible preferred stock to the liquidation preferences of such shares because of the uncertainty over whether or when such an event would occur. The Company has determined that it is not probable that such redemption will occur as a mandatory conversion event, as described below, is expected in advance of the redemption triggers.

Convertible Preferred Stock

The Series A, B, B-1, C, D and D-1 convertible preferred stock (collectively, the “Series Preferred”) have the following rights and privileges:

Voting rights

Series Preferred stockholders are entitled to cast the number of votes equal to the number of whole shares of common stock into which the convertible preferred stock is convertible.

Conversion

Each 21.4 shares of Series Preferred is convertible, at any time, into one share of common stock at the then-applicable Conversion Price (as defined below). The Series Preferred is automatically converted into common stock, at the then-applicable Conversion Price, upon (a) the vote or consent of 66-2/3% of the outstanding shares of Series Preferred or (b) the closing of the sale of shares of common stock to the public (i) in which the price per share paid by the public (prior to the deduction of underwriting discounts and registration expenses) is no less than $5.00 per share (as adjusted for any stock dividends, combinations, splits, recapitalizations and the like with respect to such shares effectuated after July 16, 2018) and (ii) resulting in at least $25,000,000 in gross proceeds to the Company (prior to the deduction of underwriting discounts and registration expenses), in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act of 1933, as amended. The Conversion Price was initially $1.3995 for each share of Series A, B and B-1 convertible preferred stock, $1.4043 for each share of Series C convertible preferred stock and $0.48 for each share of Series D and D-1 convertible preferred stock. The Conversion Price is subject to adjustment in certain circumstances.

Dividends

Holders of the Series Preferred are entitled to receive cash dividends at the rate of 8% of the applicable Original Issue Price (as defined below) per annum, on a non-cumulative basis, on each outstanding share of

Series Preferred. The Company shall not declare any dividends on any shares of Series Preferred other than shares of Series D-1 convertible preferred stock unless the holders of the Series D-1 convertible preferred stock then outstanding first receive, or simultaneously receive, full payment of a dividend. The Original Issue Price is $2.733 per share for the Series A convertible preferred stock, $1.3995 per share for the Series B convertible preferred stock, $1.3995 per share for the Series B-1 convertible preferred stock, $1.4043 per share for the Series C convertible preferred stock, $0.48 per share for the Series D convertible preferred stock and $0.48 per share for the Series D-1 convertible preferred stock, each subject to adjustment in the event of any reorganization, stock split, recapitalization or other similar event involving or affecting a change in the Company's capital structure.

Liquidation Preferences

In the event of liquidation or winding up of the Company, (i) the holders of the Series D and D-1 convertible preferred stock, on a pari passu basis, shall be entitled to receive, prior to and in preference to any payment or distribution to the holders of, Series C convertible preferred stock, Series B and B-1 convertible preferred stock, Series A convertible preferred stock and common stock, a per-share amount equal to the applicable Liquidation Preference (as defined below); (ii) the holders of the Series C convertible preferred stock, on a pari passu basis, shall be entitled to receive, prior to and in preference to any payment or distribution to the holders of Series B and B-1 convertible preferred stock, Series A convertible preferred stock, and common stock, a per-share amount equal to the applicable Liquidation Preference; and (iii) the holders of Series B and B-1 convertible preferred stock and the holders of Series A convertible preferred stock, on a pari passu basis, shall be entitled to receive, prior to and in preference to any payment or distribution to the holders of common stock, a per-share amount equal to the applicable Liquidation Preference. The Liquidation Preference is calculated as follows: (i) when the Company is valued at $91 million or below, the Liquidation Preference is equal to the applicable Original Issue Price for such shares plus the amount of any declared but unpaid dividends and (ii) when the company is valued greater than $91 million, the Liquidation Preference is equal to the applicable Original Issue Price for such shares plus the amount of any declared but unpaid dividends, with the first $10 million of proceeds above $91 million distributed to the holders of the Series D and D-1 convertible preferred stock on a pro rata basis ((i) and (ii) together, "Liquidation Preference").

The authorized shares, purchase price, outstanding shares and Liquidation Preference for each series of convertible preferred stock as of December 31, 2017 and June 30, 2018 (unaudited), are as follows:

	Shares Authorized (December 31, 2017)	Shares Authorized (June 30, 2018)	Purchase Price Per Share	Shares Outstanding	Liquidation Preference
Convertible preferred stock:					
Series A	418,767	418,767	$ 1.39950	345,587	$ 483,649
Series B	8,101,042	8,101,042	$ 1.39950	8,058,170	$ 11,277,409
Series B-1	7,523,734	7,523,734	$ 1.39950	3,437,950	$ 4,811,411
Series C	23,357,047	23,357,047	$ 1.40430	23,357,047	$ 32,800,301
Series D	52,835,720	52,835,720	$ 0.48000	20,652,486	$ 9,913,193
Series D-1	125,808,667	126,746,167	$ 0.48000	66,141,257	$ 31,747,803
Total	218,044,977	218,982,477		121,992,497	$ 91,033,767

Series A, B and C Convertible Preferred Stock Modification

On March 6, 2016 (the "Series A-C Modification Date"), the Company notified existing holders of Series A, B, B-1 and C convertible preferred stock that they would be required to participate in the Series D convertible preferred stock financing at a specified pro rata amount (which equated to their existing applicable ownership percentage of the company).

As of the Series A-C Modification Date, the conversion ratio of Series A, B, B-1 and C convertible preferred stock was adjusted from 1:1 to 1:10 (i.e., 1 share of convertible preferred stock was convertible to 10

shares of common stock) for holders of the Series A, B, B-1 and C convertible preferred stock that elected to participate in the second issuance of the Series D convertible preferred stock financing at or above their pro rata amounts. If the holders of Series A, B, B-1 and C convertible preferred stock did not participate at or above their pro rata amounts, any existing shares of Series A, B, B-1 and C convertible preferred stock were automatically and mandatorily converted into common stock on a 1:1 basis (which represented the existing conversion ratio in effect prior to such modification). Such an automatic conversion would result in the loss of all rights and privileges associated with being a holder of convertible preferred stock (i.e. liquidation preference, board representation and dividend rights).

If the holders of Series A, B, B-1 and C convertible preferred stock elected to participate in the Series D convertible preferred stock financing in excess of their pro rata amount, any additional investment would result in the issuance of warrants to purchase Series D convertible preferred stock. The effective price of the warrants to purchase Series D convertible preferred stock at the date of issuance was a 15% discount from the selling price of the Series D convertible preferred stock.

The Company follows the qualitative approach to assessing changes in terms of convertible preferred stock. Based on its qualitative assessment, the Company determined that the revision of the terms of the Series A, B, B-1 and C convertible preferred stock resulted in both the extinguishment of the Series A, B, B-1 and C convertible preferred stock and the reissuance of the Series A, B, B-1 and C convertible preferred stock. Accordingly, the Company concluded that the difference between the fair value of the post-modification Series A, B, B-1 and C convertible preferred stock and the carrying value of the pre-modification Series A, B, B-1 and C convertible preferred stock should be recognized as an adjustment recorded through accumulated deficit.

The impact of the special mandatory conversion of convertible preferred stock to common stock, as well as the fair value adjustment is as follows:

	Pre-Modification		Post Modification	
	Book Value	Outstanding Shares	Fair Value	Outstanding Shares
Series A preferred stock	$ 4,989,018	1,908,757	$ 61,847	345,587
Series B preferred stock	23,909,095	17,195,333	842,845	8,058,170
Series B-1 preferred stock	10,359,042	7,441,559	359,593	3,437,950
Series C preferred stock	48,930,547	37,752,481	5,547,841	23,357,047
	$ 88,187,702	64,298,130	$ 6,812,126	35,198,754

On August 4, 2016, in connection with the Reverse Stock Split (as defined below), the conversion ratio of the existing Series A, B, B-1 and C convertible preferred stock was adjusted back to 1:1 (i.e., 1 share of convertible preferred stock was convertible to 1 share of common stock).

Warrants

On July 3, 2012, in conjunction with the Square 1 LSA, the Company issued a warrant to purchase 64,309 shares of Series B-1 convertible preferred stock to Square 1 Bank at an exercise price of $1.3995 per-share. The warrant expires in July 2019.

On December 11, 2013, in conjunction with an amendment to the Square 1 LSA, the Company issued a warrant to purchase 10,718 shares of Series B-1 convertible preferred stock to Square 1 Bank at an exercise price of $1.3995 per-share. The warrant expires in December 2020.

On September 17, 2013, in conjunction with the subordinated convertible promissory notes that were issued in connection with the September 2013 Note and Warrant Purchase Agreement, the Company issued warrants to

purchase 1,480,988 shares of Series B-1 convertible preferred stock. Per the terms of the September 2013 Note and Warrant Purchase Agreement, the number of shares of Series B-1 convertible preferred stock purchasable under these warrants was increased to 2,123,528 shares as the Company did not complete a qualified financing prior to January 1, 2014. The warrants allow the investors to purchase Series B-1 convertible preferred stock at an exercise price of $1.3995 per-share. The warrants expire in 2023.

On June 12, 2014, in conjunction with the subordinated convertible promissory notes that were issued in connection with the June 2014 Note and Warrant Purchase Agreement, the Company issued warrants to purchase 715,766 shares of Series B-1 convertible preferred stock at an exercise price of $1.3995 per- share. The warrants expire in 2024.

On September 9, 2014 and November 11, 2014, in conjunction with the issuance of Series C convertible preferred stock, the Company issued warrants to purchase 4,450,616 shares and 6,527,568 shares of Series C convertible preferred stock, respectively, at an exercise price of $1.4043 per-share. On March 31, 2016, all warrants to purchase Series C convertible preferred stock issued in conjunction with the Series C convertible preferred stock offering expired under the terms of their issue with no investor electing to exercise their warrants. As such, these warrants have been retired by the Company.

On March 4, 2016, in conjunction with the Series D convertible preferred stock offering, the Company issued warrants to purchase 31,672,817 shares of Series D convertible preferred stock at an exercise price of $0.41 per-share. The warrants expire in 2026.

On March 8, 2016, in conjunction with the Western Alliance LSA, the Company issued a warrant to purchase 510,417 shares of Series D convertible preferred stock to Western Alliance Bank at an exercise price of $0.48 per-share. Additionally, in conjunction with the first amendment to the Western Alliance LSA, on December 9 2016, the Company issued a warrant to purchase 291,667 shares of Series D-1 convertible preferred stock to Western Alliance Bank at an exercise price of $0.48 per-share. Both of these warrants expire in 2026.

On June 29, 2018, in conjunction with the MidCap Financial CSA, the Company issued a warrant to purchase 625,000 shares of Series D-1 convertible preferred stock to MidCap Financial at an exercise price of $0.48 per-share. This warrant expires in 2028.

All the outstanding warrants to purchase convertible preferred stock are classified as liabilities in the financial statements and are valued at each reporting period using the Black-Scholes-Merton model as discussed in Note 3, “Fair Value Measurements”.

Common Stock

On August 4, 2016, the Company filed a Certificate of Amendment of the Company’s Certificate of Incorporation with the Secretary of State of the State of Delaware to effect a reverse split of common stock at a ratio of one-for-ten, which became effective at the close of business on that day (the “Reverse Stock Split”). As a result, each share of the Company’s common stock outstanding as of August 4, 2016 was automatically changed into one-tenth of a share of common stock, which resulted in a reduction of 1,411,180 shares of common stock issued and outstanding. No fractional shares were issued in connection with the Reverse Stock Split and cash paid to stockholders for potential fractional shares was insignificant. The authorized number of shares and the par value per share of the Company’s common stock were not affected by the Reverse Stock Split.

During 2016, the Company issued 678 shares of common stock in connection with the exercise of stock options, for net proceeds of $1,961.

During 2017, the Company issued 14,165 shares of common stock in connection with the exercise of stock options, for net proceeds of $14,265.

During the six months ended June 30, 2018, the Company issued 1,576 shares of common stock in connection with the exercise of stock options, for net proceeds of $1,012.

Stock Options

The Company's Amended and Restated 2006 Equity Compensation Plan, as amended (the "Plan"), is to provide designated employees of the Company, its subsidiaries, consultants, advisors and non-employee members of the Board with the opportunity to receive grants of incentive stock options and nonqualified stock options. The Company believes that the Plan will encourage the participants to contribute materially to the growth of the Company, thereby benefiting the Company's stockholders, and will align the economic interests of the participants with those of the stockholders. As of December 31, 2016, and 2017, and June 30, 2018, the number of shares reserved under the Plan was 1,022,388.

There were 929,545, 115,672 and 167,083 shares available for grant under the Plan as of December 31, 2016 and 2017, and June 30, 2018, respectively. Options granted under the Plan are exercisable at various dates as determined upon grant and will expire no more than ten years from the date of grant, or in the case of certain non-statutory options, exactly ten years from the date of grant. The exercise price of each option shall be determined by the Board of Directors although generally options have an exercise price equal to the fair market value of the Company's stock on the date of the option grant. In the case of incentive stock options, the exercise price shall not be less than 100% of the fair market value of the Company's common stock at the time the option is granted. For holders of more than 10% of the Company's total combined voting power of all classes of stock, incentive stock options may not be granted at less than 110% of the fair market value of the Company's stock at the date of grant and for a term not to exceed five years. Most option grants generally vest 25% on the first anniversary of the original vesting commencement date, with the balance vesting monthly in equal installments over the remaining three years.

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

	Shares	Weighted-Average Exercise Price	Weighted-Average Remaining Contractual Term	Aggregate Intrinsic Value
Outstanding at December 31, 2016	87,287	$ 21.40	8.0	$ —
Granted	924,016	0.64		—
Exercised	(14,165)	1.07		$ 80,959
Cancelled	(124,351)	1.71		—
Outstanding at December 31, 2017	872,787	$ 2.57	9.0	$ —
Granted (unaudited)	771	0.64		—
Exercised (unaudited)	(1,576)	0.64		$ 1,012
Cancelled/Expired (unaudited)	(38,022)	3.22		—
Outstanding at June 30, 2018 (unaudited)	833,960	$ 2.49	8.5	$ —
Vested and expected to vest at December 31, 2016	78,098	$ 23.11	7.5	$ —
Vested and exercisable at December 31, 2016	38,925	$ 31.46	5.9	$ —
Vested and expected to vest at December 31, 2017	801,023	$ 2.78	9.0	$ —
Vested and exercisable at December 31, 2017	386,972	$ 4.28	8.8	$ —
Vested and expected to vest at June 30, 2018 (unaudited)	792,057	$ 1.63	8.5	$ —
Vested and exercisable at June 30, 2018 (unaudited)	475,691	$ 3.59	8.5	$ —

For the six months ended June 30, 2018, the Company granted to its employee's options to purchase 771 shares of its common stock with an exercise price of $0.64 per share.

From February through May 2017, the Company granted to its employee's options to purchase 809,925 shares of its common stock with an exercise price of $0.64 per share.

For the years ended December 31, 2016 and 2017, the total grant date fair value of vested options was $246,378 and $365,154, respectively. The weighted-average grant date fair value of employee option grants during the years ended December 31, 2016 and 2017 was $0.64.

For the six months ended June 30, 2017 and 2018, the total grant date fair value of vested options was $169,021 and $111,942, respectively. The weighted-average grant date fair value of employee option grants during the six months ended June 30, 2017 and 2018 was $0.64.

Stock-Based Compensation Expense

The Company recognized stock-based compensation expense of $130,643, $382,830, $217,846 and $107,426 for the years ended December 31, 2016 and 2017 and the six months ended June 30, 2017 and 2018, respectively.

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

	Year Ended December 31,		Six months ended June 30,	
	2016	2017	2017	2018
			(unaudited)	
Risk-free interest rate	1.1 - 1.4%	1.8 - 2.0%	1.9%	2.5%
Expected volatility	77 - 83%	58 - 67%	59%	63%
Expected term (in years)	5.3 - 5.4	5.1 - 5.3	5.1	4.0
Expected dividend yield	0%	0%	0%	0%

Risk-free interest rate. The risk-free rate assumption is based on the U.S. Treasury instruments, the terms of which were consistent with the expected term of the Company's stock options.

Expected volatility. Due to the Company's limited operating history and lack of company-specific historical or implied volatility as a private company, the expected volatility assumption was determined by examining the historical volatilities of a group of industry peers whose share prices are publicly available.

Expected term. The expected term of stock options represents the weighted-average period the stock options are expected to be outstanding. The Company uses the simplified method for estimating the expected term as provided by the Securities and Exchange Commission. The simplified method calculates the expected term as the average of the time-to-vesting and the contractual life of the options.

Expected dividend yield. The expected dividend assumption is based on the Company's history and expectation of dividend payouts. The Company has not paid and does not intend to pay dividends.

Forfeitures. The Company reduces stock-based compensation expense for actual forfeitures during the period.

As of December 31, 2016 and 2017 and June 30, 2018, the unrecognized compensation cost related to outstanding employee options was $393,213, $282,642 and $179,526, respectively, and is expected to be recognized as expense over approximately 2.6 years, 1.6 years and 1.2 years, respectively.

Common Stock Reserved for Future Issuance

Common stock reserved for future issuance consist of the following:

	Year Ended December 31,		Six Months Ended June 30, 2018
	2016	2017	(unaudited)
Convertible preferred stock	3,972,778	5,700,572	5,700,572
Stock options issued and outstanding	87,287	872,787	833,960
Authorized for future stock awards or option grants	929,545	115,672	167,083
Preferred warrants	1,713,866	1,710,447	1,739,652
Total	6,703,476	8,399,478	8,441,267

9. Commitments and Contingencies

Leases

The Company leases certain office and lab space in San Diego, California under a non-cancelable operating lease, which was amended July 1, 2015 to add laboratory space and office space and extend its terms through December 2020. Rent expense was $495,475, $590,089, $295,044, and $295,044 for the years ended December 31, 2016 and 2017 and six months ended June 30, 2017 and 2018, respectively, including the offset for amortization of the leasehold incentive obligation of $150,035, $225,052, $112,526 and $112,526 for the years ended December 31, 2016 and 2017 and the six months ended June 30, 2017 and 2018, respectively.

The future minimum lease payments required under non-cancelable leases as of December 31, 2017, are summarized as follows:

Year Ending December 31,	
2018	$ 826,884
2019	862,656
2020	902,412
Total minimum lease payments	$ 2,591,952

Royalty Agreements

The Company has entered into agreements to market and distribute chips and kits used in its instruments. Pursuant to these agreements, the Company is obligated to pay royalties based on sales during each annual license period and is obligated to make minimum payments regardless of the level of sales achieved. The Company has paid $221,688, $233,128, $116,466 and $166,483 for the years ended December 31, 2016 and 2017 and the six months ended June 30, 2017 and 2018, respectively.

Such royalty agreements extend through the life of underlying intellectual property which is affected by patent filing date and jurisdiction. As of December 31, 2017, annual future minimum royalty payments under the Company's royalty agreements total $70,000, on a continuing basis, and extend through November 29, 2026.

Purchase Commitments

The Company has a contractual commitment with a supplier to purchase $100,000 of products each quarter until the first quarter of 2019. The Company is not able to determine the aggregate amount of other such purchase orders that represent contractual obligations, as purchase orders may represent authorizations to purchase rather than binding agreements. The Company's purchase orders are based on its current procurement or development needs and are fulfilled by the Company's vendors within short time horizons.

Litigation

The Company is subject to potential liabilities under various claims and legal actions that are pending or may be asserted. These matters arise in the ordinary course and conduct of the business. The Company intends to continue to defend itself vigorously in such matters. The Company regularly assesses contingencies to determine the degree of probability and range of possible loss for potential accrual in the financial statements. An estimated loss contingency is accrued in the financial statements if it is probable that a liability has been incurred and the amount of the loss can be reasonably estimated. Based on the Company's assessment, it currently does not have any amount accrued as it is not a defendant in any claims or legal actions.

10. Income Taxes

	December 31,	
	2016	2017
Deferred tax assets:		
Net operating loss carryforwards	$ 39,333,135	$ 30,528,420
Research and development credits	3,057,595	4,078,522
Other	884,910	1,163,659
Total gross	43,275,640	35,770,601
Valuation allowance	(43,275,640)	(35,770,601)
Net deferred tax assets	$ —	$ —

The provision for domestic and foreign income taxes is as follows:

	Years Ended December 31,	
	2016	2017
Current:		
Foreign	$ 12,060	$ 16,996
State and local	864	1,556
Income tax provision	$ 12,924	$ 18,552

The domestic and foreign components of income (loss) from continuing operations are as follows:

	Years Ended December 31,	
	2016	2017
Domestic	$ (18,892,417)	$ (23,455,215)
Foreign	56,726	108,403
Loss before provision for income taxes	$ (18,835,691)	$ (23,346,812)

A reconciliation of the income tax computed at the federal statutory tax rate to the expense for income taxes for the years ended December 31, 2016 and 2017 is as follows:

	December 31,	
	2016	2017
Tax at statutory rate	$ (6,404,287)	$ (7,939,075)
State income taxes, net of federal benefits	(195,417)	(376,232)
Change in valuation allowance	7,278,255	(7,523,665)
Tax Cuts and Jobs Act	—	16,552,989
Other permanent differences	394,784	542,487
Credits	(1,060,411)	(1,237,952)
Income tax expense	$ 12,924	$ 18,552

On December 22, 2017, the President of the United States signed into law the Tax Cuts and Jobs Act (the "Act"). The Act amends the Internal Revenue Code to reduce tax rates and modify policies, credits, and deductions for individuals and businesses. For businesses, the Act reduces the corporate tax rate from a maximum of 35% to a flat 21% rate. The rate reduction is effective on January 1, 2018. The Company has calculated its best estimate of the impact of the Act and as a result of the rate reduction, the Company has recorded a reduction to the deferred tax asset balance as of December 31, 2017 by $16.6 million, offset by a full valuation allowance. The Company has reduced its valuation allowance by $7.5 million due to the full valuation allowance position. The reduction in the valuation allowance includes the revaluation of the deferred tax assets, current year losses, and other timing items.

On December 22, 2017, Staff Accounting Bulletin No. 118 ("SAB 118") was issued to address the application of GAAP in situations when a registrant does not have the necessary information available, prepared, or analyzed (including computations) in reasonable detail to complete the accounting for certain income tax effects of the Act. In accordance with SAB 118, the Company's provisional determination is that there is no deferred tax benefit or expense with respect to the remeasurement of certain deferred tax assets and liabilities due to the full valuation allowance against net deferred tax assets. Additional analysis of the law and the impact to the Company will be performed and any impact will be recorded in the respective quarter in 2018. The Company did not record any adjustments to this provisional amount during the six months ended June 30, 2018 and will continue to analyze and refine its calculations related to the remeasurement as the impact of the Act is finalized.

As of December 31, 2017, the Company has federal and state tax net operating loss carryforwards of $128.3 million and $51.0 million, respectively. The federal and state tax loss carryforwards begin to expire in 2027 and 2031, respectively, unless previously utilized. The Company also has federal and California research credit carryforwards of $4.0 million and $3.6 million, respectively. The federal research credit carryforwards and state credit carryforwards begin to expire in 2027 unless previously utilized. The California research credits carry forward indefinitely.

Management assesses all available evidence to estimate if sufficient future taxable income will be generated to use the existing deferred tax assets. The Company has experienced net losses since inception, and the revenue and income potential of the Company's business and market are unproven. Due to the Company's continuing research and development activities, the Company expects to continue to incur net losses into the foreseeable future. As such, the Company cannot conclude that it is more likely than not that its deferred tax assets will be realized. A valuation allowance of $43.3 million and $35.8 million as of December 31, 2016 and 2017, respectively, has been established to offset the deferred tax assets, as realization of such assets is uncertain.

Utilization of the net operating losses and research and development ("R&D") credit carryforwards are subject to annual limitations due to ownership change limitations that have occurred or that could occur in the future, as required by Section 382 of the Internal Revenue Code of 1986, as amended (the "Code"), as well as

similar state and foreign provisions. These ownership changes may limit the amount of net operating losses and R&D credit carryforwards that can be utilized annually to offset future taxable income and tax, respectively. In general, an "ownership change" as defined by Section 382 of the Code results from a transaction or series of transactions over a three-year period resulting in an ownership change of more than 50 percentage points of the outstanding stock of a company by certain stockholders.

During 2013, the Company completed a Section 382/383 analysis, from inception through December 31, 2012, regarding the limitation of the net operating losses and R&D credits. Based upon the analysis, the Company determined that no ownership changes occurred during that period. However, there may have been ownership changes subsequent to December 31, 2012, that could limit the Company's ability to utilize the net operating loss and R&D credit carryforwards. The Company plans to complete an analysis prior to using any of the net operating losses and R&D credits.

The Company is subject to taxation in the United States and the United Kingdom. The Company's tax years from 2007 (inception) are subject to examination by the United States and state authorities due to the carry forward of unutilized net operating losses and R&D credits.

A reconciliation of the beginning and ending amount of unrecognized tax benefits for 2016 and 2017, excluding interest and penalties, is as follows:

	December 31,	
	2016	2017
Balance at beginning of the year	$ 1,903,164	$ 2,451,121
Additions/(reductions) for tax positions - prior year	34,365	—
Increase related to prior year positions - current year	513,592	567,442
Increase related to current year positions	—	—
Balance at the end of the year	$ 2,451,121	$ 3,018,563

The Company recognizes the impact of uncertain tax positions at the largest amount that is "more likely than not" to be sustained upon audit by the relevant taxing authority. An uncertain tax position will not be recognized if it has less than a 50% likelihood of being sustained. Due to the valuation allowance position, none of the unrecognized tax benefits, if recognized, will impact the Company's effective tax rate. The Company does not anticipate a significant change in the unrecognized tax benefits during the next twelve months.

11. Employee Benefits

The Company has a defined contribution 401(k) plan available to eligible employees. Under the terms of the plan, employees may make voluntary contributions as a percent of compensation, limited to the maximum amount allowable under federal tax regulations. The Company, at its discretion, may make certain contributions to the 401(k) plan. The Company made matching contributions of $408,675 and $395,360, and, $237,574 and $133,165, for the years ended December 31, 2016 and 2017 and the six months ended June 30, 2017 and 2018, respectively.

12. Subsequent Events

For the purposes of the financial statements as of December 31, 2017 and the year then ended, the Company identified subsequent events through May 11, 2018, the date on which the financial statements were issued, and, with respect to the reverse stock split described below, through July 16, 2018.

For the purposes of the financial statements as of June 30, 2018 and the six months then ended, the Company has evaluated subsequent events through July 13, 2018, the date on which the financial statements were issued, and, with respect to the reverse stock split described below, through July 16, 2018. No material subsequent events were identified.

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Reverse Stock Split

On July 16, 2018, the Company effected a one-for-21.4 reverse stock split of its issued and outstanding shares of common stock and a proportional adjustment to the existing conversion ratios for each series of the Company's redeemable convertible preferred stock (see Note 8). Accordingly, all share and per share amounts for all periods presented in the accompanying financial statements and notes thereto have been adjusted retroactively, where applicable, to reflect this reverse stock split and adjustment of the preferred stock conversion ratios.

5,500,000 Shares

Common Stock

Sole Book-Running Manager

Roth Capital Partners

Lead Manager

Maxim Group LLC

Through and including , 2018 (the 25th day after the date of this prospectus), all dealers that effect transactions in these securities, whether or not participating in this offering, may be required to deliver a prospectus. This is in addition to a dealer's obligation to deliver a prospectus when acting as an underwriter and with respect to an unsold allotment or subscription.

PART II

INFORMATION NOT REQUIRED IN PROSPECTUS

Unless otherwise indicated, all references to “Bionano,” the “company,” “we,” “our,” “us” or similar terms refer to Bionano Genomics, Inc. and its subsidiaries.

Item 13. Other Expenses of Issuance and Distribution.

The following table sets forth all expenses to be paid by us, other than underwriting discounts and commissions, in connection with this offering. All amounts shown are estimates except for the SEC registration fee, the FINRA filing fee and the exchange listing fee.

SEC registration fee	$ 4,725
FINRA filing fee	5,625
Exchange listing fee	125,000
Printing and engraving expenses	140,000
Legal fees and expenses	1,140,000
Accounting fees and expenses	1,000,000
Custodian transfer agent and registrar fees	25,000
Miscellaneous expenses	89,650
Total	$ 2,530,000

Item 14. Indemnification of Directors and Officers.

Section 145 of the Delaware General Corporation Law authorizes a court to award, or a corporation’s board of directors to grant, indemnity to directors and officers in terms sufficiently broad to permit such indemnification under certain circumstances for liabilities, including reimbursement for expenses incurred, arising under the Securities Act. Our amended and restated certificate of incorporation that will be in effect on the closing of this offering permits indemnification of our directors, officers, employees and other agents to the maximum extent permitted by the Delaware General Corporation Law, and our amended and restated bylaws that will be in effect on the closing of this offering provide that we will indemnify our directors and officers and permit us to indemnify our employees and other agents, in each case to the maximum extent permitted by the Delaware General Corporation Law.

We have entered into indemnification agreements with our directors and officers, whereby we have agreed to indemnify our directors and officers to the fullest extent permitted by law, including indemnification against expenses and liabilities incurred in legal proceedings to which the director or officer was, or is threatened to be made, a party by reason of the fact that such director or officer is or was a director, officer, employee, or agent of Bionano Genomics, Inc., provided that such director or officer acted in good faith and in a manner that the director or officer reasonably believed to be in, or not opposed to, the best interest of Bionano Genomics, Inc.

At present, there is no pending litigation or proceeding involving a director or officer of Bionano Genomics, Inc. regarding which indemnification is sought, nor is the registrant aware of any threatened litigation that may result in claims for indemnification.

We maintain insurance policies that indemnify our directors and officers against various liabilities arising under the Securities Act and the Securities Exchange Act of 1934, as amended, that might be incurred by any director or officer in his capacity as such.

The underwriters are obligated, under certain circumstances, under the underwriting agreement to be filed as Exhibit 1.1 to this Registration Statement, to indemnify us and our officers and directors against liabilities under the Securities Act.

Item 15. Recent Sales of Unregistered Securities.

The following sets forth information regarding all unregistered securities sold since January 1, 2015:

(1) In February 2016, we issued convertible promissory notes in the aggregate principal amount of $1.5 million with an interest rate of 8% per annum. These notes converted into an aggregate of 3,138,013 shares of our Series D convertible preferred stock in March 2016, as described in paragraph (2) below.

(2) In March 2016, we sold and issued an aggregate of 16,224,422 shares of our Series D convertible preferred stock and warrants to purchase an aggregate of 20,941,734 shares of our Series D convertible preferred stock to accredited investors in the first closing of our Series D financing. In this closing, we sold and issued an aggregate of 16,224,422 shares of our Series D convertible preferred stock at a purchase price of $0.48 per share for gross proceeds of approximately $7.8 million, which included the conversion of an aggregate of approximately $1.5 million in principal and accrued interest outstanding under the subordinated convertible promissory notes described in paragraph (1) above into an aggregate of 3,138,013 shares of our Series D convertible preferred stock at a conversion price equal to the purchase price in the financing. The warrants to purchase our Series D convertible preferred stock were sold and issued at a purchase price of $0.001 per share for an aggregate purchase price of approximately $20,941.

(3) In March 2016, we issued a warrant to purchase an aggregate of 510,417 shares of our Series D convertible preferred stock to Western Alliance Bank in connection with the entry into our Loan and Security Agreement with Western Alliance Bank.

(4) In April 2016, we held a second closing of our Series D financing, pursuant to which we sold and issued 4,428,064 shares of our Series D convertible preferred stock to accredited investors at a purchase price of $0.48 per share, for gross proceeds of approximately $2.1 million, and warrants to purchase 10,731,083 shares of our Series D convertible preferred stock at a purchase price of $0.001 per share for an aggregate purchase price of approximately $10,731.

(5) In August 2016, we sold and issued an aggregate of 2,083,335 shares of our Series D-1 convertible preferred stock to accredited investors in the first closing of our Series D-1 financing, at a purchase price of $0.48 per share, for gross proceeds of approximately $1.0 million.

(6) In August 2016, we held a second closing of our Series D-1 financing, pursuant to which we sold and issued 20,833,336 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $10.0 million.

(7) In August 2016, we held a third closing of our Series D-1 financing, pursuant to which we sold and issued 6,250,000 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $3.0 million.

(8) In December 2016, we issued a warrant to purchase 291,667 shares of our Series D-1 convertible preferred stock to Western Alliance Bank in connection with an amendment to our loan facility with Western Alliance Bank.

(9) In February 2017, we held a fourth closing of our Series D-1 financing, pursuant to which we sold and issued 10,416,667 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $5.0 million.

(10) In March 2017, we held a fifth closing of our Series D-1 financing, pursuant to which we sold and issued 2,083,334 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $1.0 million.

(11) In March 2017, we held a sixth closing of our Series D-1 financing, pursuant to which we sold and issued 2,083,334 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $1.0 million.

(12) In April 2017, we held a seventh closing of our Series D-1 financing, pursuant to which we sold and issued 1,041,667 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $0.5 million.

(13) In May 2017, we held an eighth closing of our Series D-1 financing, pursuant to which we sold and issued 1,145,834 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $0.6 million.

(14) In May 2017, we held a ninth closing of our Series D-1 financing, pursuant to which we sold and issued 2,083,334 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $1.0 million.

(15) In July 2017, we held a tenth closing of our Series D-1 financing, pursuant to which we sold and issued 8,745,417 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $4.2 million.

(16) In August 2017, we held an eleventh closing of our Series D-1 financing, pursuant to which we sold and issued 6,250,000 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $3.0 million.

(17) In November 2017, we held a twelfth closing of our Series D-1 financing, pursuant to which we sold and issued 3,125,000 shares of our Series D-1 convertible preferred stock to accredited investors, at a purchase price of $0.48 per share, for gross proceeds of approximately $1.5 million.

(18) In February 2018, we issued convertible promissory notes in the aggregate principal amount of approximately $13.4 million with an interest rate of 8% per annum. In connection with the completion of our initial public offering, the principal amount of the convertible promissory notes and accrued interest thereon will automatically convert into 3,339,777 shares of our common stock, assuming an initial public offering price of $5.50 per share and a conversion date of June 30, 2018.

(19) From January 1, 2015 through April 30, 2018, we granted to our directors, employees, consultants and other service providers options to purchase 982,550 shares of our common stock with per share exercise prices ranging from $0.64 to $32.10 under our Amended and Restated 2006 Equity Compensation Plan, as amended.

(20) In June 2018, we issued a convertible promissory note in for an aggregate principal amount of $1,000,000 with an interest rate of 8% to Midcap Financial Trust with an interest rate of 8% per annum. In connection with the completion of our initial public offering, the principal amount of the convertible promissory note and accrued interest thereon will automatically convert into 227,322 shares of our common stock, assuming an initial public offering price of $5.50 per share and a conversion date of June 30, 2018.

(21) In June 2018, we issued a warrant to purchase an aggregate of 625,000 shares of our Series D-1 convertible preferred stock to Midcap Financial Trust in connection with the entry into our Credit and Security Agreement with MidCap Financial Trust.

None of the foregoing transactions involved any underwriters, underwriting discounts or commissions, or our public offering. Unless otherwise specified above, we believes these transactions were exempt from registration under the Securities Act in reliance on Section 4(a)(2) of the Securities Act (and Regulation D or Regulation S promulgated thereunder), or Rule 701 promulgated under Section 3(b) of the Securities Act as transactions by an issuer not involving any public offering or under benefit plans and contracts relating to compensation as provided under Rule 701. The recipients of the securities in each of these transactions represented their intentions to acquire the securities for investment only and not with a view to or for sale in connection with any distribution thereof, and appropriate legends were placed on the share certificates issued in these transactions. All recipients had adequate access, through their relationships with us, to information about us. The sales of these securities were made without any general solicitation or advertising.

Item 16. Exhibits and Financial Statement Schedules.

(a) Exhibits.

Exhibit Number	Description
1.1#	Form of Underwriting Agreement.
3.1	Eighth Amended and Restated Certificate of Incorporation, as amended.
3.2#	Form of Amended and Restated Certificate of Incorporation, to be in effect upon the closing of the offering.
3.3#	Bylaws, as amended.
3.4#	Form of Amended and Restated Bylaws, to be in effect upon the closing of the offering.
4.1#	Form of Common Stock Certificate.
4.2#	Form of Warrant to Purchase Series B Preferred Stock issued to Square 1 Bank.
4.3#	Form of Warrant to Purchase Series B-1 Preferred Stock issued to Square 1 Bank.
4.4#	Form of Warrant to Purchase Series B-1 Preferred Stock issued to investors.
4.5#	Form of Warrant to Purchase Series D Preferred Stock issued to Western Alliance Bank.
4.6#	Form of Warrant to Purchase Series D Preferred Stock issued to investors.
4.7#	Warrant to Purchase Series D-1 Preferred Stock issued to Western Alliance Bank.
4.8#	Form of Warrant to Purchase Series D-1 Preferred Stock issued to Midcap Financial Trust.
4.9#	Form of Warrant to Purchase Common Stock issued to underwriters (included in Exhibit 1.1).
5.1	Opinion of Cooley LLP.
10.1	Fifth Amended and Restated Investors' Rights Agreement, dated August 5, 2016 as amended.
10.2#	Bionano Genomics, Inc. Amended and Restated 2006 Equity Compensation Plan (the "2006 Plan").
10.3#	Forms of grant notice, stock option agreement and notice of exercise under the 2006 Plan.
10.4#	Bionano Genomics, Inc. 2018 Equity Incentive Plan (the "2018 Plan").
10.5#	Forms of grant notice, stock option agreement and notice of exercise under the 2018 Plan.
10.6#	Bionano Genomics, Inc. 2018 Employee Stock Purchase Plan.
10.7#	Form of Indemnification Agreement by and between the Registrant and each director and executive officer.
10.8#	Bionano Genomics, Inc. Non-Employee Director Compensation Policy.
10.9#	Credit and Security Agreement by and between the Registrant, Midcap Financial Trust and the Lenders listed on the Schedule of Lenders attached thereto, dated June 29, 2018.
10.10#	Employment Agreement by and between the Registrant and R. Erik Holmlin, Ph.D., dated November 7, 2017, as amended.
10.11#	Employment Agreement by and between the Registrant and Han Cao, Ph.D., dated November 7, 2017, as amended.
10.12#	Employment Agreement by and between the Registrant and Mike Ward, dated July 1, 2016.
10.13#	Employment Agreement by and between the Registrant and Warren Robinson, dated November 7, 2017.
10.14#	Employment Agreement by and between the Registrant and Mark Borodkin, dated November 7, 2017.

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Exhibit Number	Description
10.15#	Loan and Security Agreement by and between the Registrant and Western Alliance Bank, dated March 8, 2016.
10.16#	First Amendment to the Loan and Security Agreement by and between the Registrant and Western Alliance Bank, dated December 9, 2016.
10.17#	Second Amendment to the Loan and Security Agreement by and between the Registrant and Western Alliance Bank, dated May 2, 2017.
10.18#	Third Amendment to the Loan and Security Agreement by and between the Registrant and Western Alliance Bank, dated November 20, 2017.
10.19#	Forbearance and Fourth Amendment to the Loan and Security Agreement by and between the Registrant and Western Alliance Bank, dated February 9, 2018.
10.20#	Lease by and between the Registrant and The Irvine Company LLC, dated January 16, 2012.
10.21#	First Amendment to the Lease by and between the Registrant and The Irvine Company LLC, dated September 10, 2013.
10.22#	Second Amendment to the Lease by and between the Registrant and The Irvine Company LLC, dated July 1, 2015.
10.23*#	Master Services Agreement by and between the Registrant and Skorpios Technologies, Inc. (f/k/a Novati Technologies, Inc. and f/k/a SVTC Technologies, LLC), dated March 2, 2009, as amended.
10.24*#	Manufacturing Services Agreement by and between the Registrant and Paramit Corporation, dated February 18, 2015.
10.25*#	License Agreement by and between Princeton University and the Registrant, dated January 7, 2004.
10.26*#	First Amendment to the License Agreement by and between Princeton University and the Registrant, dated December 17, 2004.
10.27*#	Second Amendment to the License Agreement by and between Princeton University and the Registrant, dated February 25, 2010.
10.28#	Third Amendment to the License Agreement by and between Princeton University and the Registrant, dated October 17, 2011.
10.29*#	Fourth Amendment License Agreement by and between Princeton University and the Registrant, dated February 9, 2012.
10.30*#	Agreement by and between the Registrant and Berry Genomics Co., Ltd. dated August 2, 2016.
10.31*#	Sublicense Agreement by and between the Registrant and Industry 3200 dated December 27, 2013.
10.32*#	License Agreement by and between the Registrant and Q Biotechnology CV dated May 1, 2014.
10.33*#	Amendment to Non-Exclusive Patent License Agreement by and between the Registrant and Q Biotechnology CV dated May 1, 2014.
10.34*#	License Agreement by and between the Registrant and New York University dated November 4, 2013.
10.35*#	Option and Sublicense Agreement by and between the Registrant and Pacific Biosciences of California, Inc. dated February 2, 2016.
10.36#	Note Purchase Agreement by and among the Registrant and the Investors listed on Exhibit A thereto, dated February 9, 2018.
10.37#	First Amendment to Note Purchase Agreement by and among the Registrant and the Investors listed on the Schedule of Investors attached thereto, dated April 2, 2018.

Exhibit Number	Description
10.38#	Fifth Amendment to Loan and Security Agreement by and between the Registrant and Western Alliance Bank, dated June 13, 2018.
10.39*#	Amendment to Patent Sublicense Agreement by and between the Registrant and Industry 3200, dated June 28, 2018.
10.40#	Second Amendment to Note Purchase Agreement by and between the Registrant and the Investors listed on the Schedule of Investors attached thereto, dated June 29, 2018.
10.41#	Omnibus Amendment to Convertible Promissory Notes by and among the Registrant and the Holders identified in the signature pages thereto, dated June 29, 2018.
21.1#	Subsidiaries of the Registrant.
23.1	Consent of Deloitte & Touche LLP, independent registered public accounting firm.
23.2	Consent of Cooley LLP (included in Exhibit 5.1).
24.1#	Power of Attorney. Reference is made to the signature page of the registration statement filed by the Registrant on June 28, 2018.
24.2#	Power of Attorney. Reference is made to the signature page of the registration statement filed by the Registrant on July 13, 2018.

* Confidential treatment has been requested with respect to certain portions of this exhibit. Omitted portions have been filed separately with the SEC.
# Previously filed.

(b) Financial Statement Schedules.

All financial statement schedules are omitted because the information required to be set forth therein is not applicable or is shown in the financial statements or the notes thereto.

Item 17. Undertakings.

(a) The undersigned registrant hereby undertakes to provide to the underwriters at the closing specified in the underwriting agreement certificates in such denominations and registered in such names as required by the underwriters to permit prompt delivery to each purchaser.

(b) Insofar as indemnification for liabilities arising under the Securities Act may be permitted to directors, officers and controlling persons of the registrant under the foregoing provisions, or otherwise, the registrant has been advised that in the opinion of the SEC such indemnification is against public policy as expressed in the Securities Act and is, therefore, unenforceable. In the event that a claim for indemnification against such liabilities (other than the payment by the registrant of expenses incurred or paid by a director, officer, or controlling person of the registrant in the successful defense of any action, suit, or proceeding) is asserted by such director, officer, or controlling person in connection with the securities being registered, the registrant will, unless in the opinion of its counsel the matter has been settled by controlling precedent, submit to a court of appropriate jurisdiction the question whether such indemnification by it is against public policy as expressed in the Securities Act and will be governed by the final adjudication of such issue.

(c) The undersigned registrant hereby undertakes that:

(1) For purposes of determining any liability under the Securities Act, the information omitted from the form of prospectus filed as part of this registration statement in reliance on Rule 430A and contained in a form of prospectus filed by the registrant under Rule 424(b)(1) or (4) or 497(h) under the Securities Act will be deemed to be part of this registration statement as of the time it was declared effective.

(2) For the purpose of determining any liability under the Securities Act of 1933, as amended, each post-effective amendment that contains a form of prospectus will be deemed to be a new registration statement relating to the securities offered therein, and the offering of such securities at that time will be deemed to be the initial bona fide offering thereof.

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SIGNATURES

Pursuant to the requirements of the Securities Act, the Registrant has duly caused this Amendment No. 4 to the Registration Statement to be signed on its behalf by the undersigned, thereunto duly authorized, in the City of San Diego, State of California, on the 31st day of July, 2018.

BIONANO GENOMICS, INC.

By: /s/ R. Erik Holmlin, Ph.D.
R. Erik Holmlin, Ph.D.
President and Chief Executive Officer

Pursuant to the requirements of the Securities Act, this Amendment No. 4 to the Registration Statement has been signed by the following persons in the capacities and on the dates indicated.

Signature	Title	Date
/s/ R. Erik Holmlin, Ph.D. R. Erik Holmlin, Ph.D.	Chief Executive Officer and Director *(Principal Executive Officer)*	July 31, 2018
/s/ Mike Ward Mike Ward	Chief Financial Officer *(Principal Financial and Accounting Officer)*	July 31, 2018
/s/ David L. Barker, Ph.D.* David L. Barker, Ph.D.	Director	July 31, 2018
/s/ Darren Cai, Ph.D.* Darren Cai, Ph.D.	Director	July 31, 2018
/s/ Albert A. Luderer, Ph.D.* Albert A. Luderer, Ph.D.	Director	July 31, 2018
/s/ Junfeng Wang* Junfeng Wang	Director	July 31, 2018
/s/ Christopher Twomey* Christopher Twomey	Director	July 31, 2018
/s/ Quan Zhou* Quan Zhou	Director	July 31, 2018

* Pursuant to power of attorney

By: /s/ R. Erik Holmlin, Ph.D.
R. Erik Holmlin, Ph.D.
Attorney-in-Fact

Exhibit 3.1

**EIGHTH AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
BIONANO GENOMICS, INC.**

(Pursuant to Sections 242 and 245 of the
General Corporation Law of the State of Delaware)

BioNano Genomics, Inc., a corporation organized and existing under and by virtue of the provisions of the General Corporation Law of the State of Delaware, as the same may be amended from time to time (the "**General Corporation Law**").

DOES HEREBY CERTIFY:

1. That the original name of this corporation was BioNanomatrix, Inc. and the Certificate of Incorporation of this corporation was originally filed with the Secretary of State of the State of Delaware on August 16, 2007.

2. That the Board of Directors of this corporation (the "**Board**") duly adopted resolutions proposing to amend and restate the Seventh Amended and Restated Certificate of Incorporation of this corporation, as amended (the "**Restated Certificate**"), declaring said amendment and restatement to be advisable and in the best interests of this corporation and its stockholders, and authorizing the appropriate officers of this corporation to solicit the consent of the stockholders therefor, which resolution setting forth the proposed amendment and restatement is as follows:

RESOLVED, that the Restated Certificate be amended and restated in its entirety to read as follows:

FIRST: The name of this corporation is BioNano Genomics, Inc. (the "**Corporation**").

SECOND: The address of the registered office of the Corporation in the State of Delaware is 1209 Orange Street, in the City of Wilmington, County of New Castle, DE 19801. The name of its registered agent at such address is The Corporation Trust Company.

THIRD: The nature of the business or purposes to be conducted or promoted is to engage in any lawful act or activity for which corporations may be organized under the General Corporation Law.

FOURTH: The total number of shares of all classes of stock which the Corporation shall have authority to issue is (i) 190,268,153 shares of Common Stock, $0.0001 par value per share ("**Common Stock**") and (ii) 165,153,010 shares of Preferred Stock, par value $0.0001 per share, 418,767 shares of which are designated "Series A Convertible Participating Preferred Stock" (the "**Series A Preferred Stock**"), 8,101,042 shares of which are designated "Series B Convertible Participating Preferred Stock" (the "**Series B Preferred Stock**"), 7,523,734 shares of which are designated "Series B-1 Convertible Participating Preferred Stock" (the "**Series B-1 Preferred Stock**", and together with the Series B Preferred Stock, the "**Series B/B-1 Preferred Stock**,"), 23,357,047 shares of which are designated "Series C Convertible Participating Preferred Stock"

(the "**Series C Preferred Stock**"), 52,835,720 shares of which are designated "Series D Convertible Participating Preferred Stock" (the "**Series D Preferred Stock**"), and 72,916,700 shares of which are designated "Series D-1 Convertible Participating Preferred Stock" (the "**Series D-1 Preferred Stock**" and, together with the Series A Preferred Stock, the Series B/B-1 Preferred Stock, the Series C Preferred Stock, and the Series D Preferred Stock, the "**Series Preferred**").

Effective at the time of filing of this Certificate of Incorporation with the Secretary of State of the State of Delaware, every ten (10) shares of Common Stock issued and outstanding shall, automatically and without any action on the part of the respective holder thereof, be converted, combined into and shall become one (1) share of Common Stock without increasing or decreasing the par value of each share of Common Stock (the "**Reverse Split**"); provided, however, that the Corporation shall issue no fractional shares of Common Stock as a result of the Reverse Split, but shall instead pay to any stockholder who would be entitled to receive a fractional share as a result of the actions set forth herein a sum in cash equal to the fair market value of the shares constituting such fractional share as determined in good faith by the Board. The Reverse Split shall occur whether or not the certificates representing such shares of Common Stock are surrendered to the Corporation or its transfer agent. The Reverse Split shall be effected on a record holder-by-record holder basis, such that any fractional shares of Common Stock resulting from the Reverse Split and held by a single record holder shall be aggregated. All amounts in this Certificate of Incorporation have been adjusted to reflect the Reverse Split. All certificates representing shares of Common Stock outstanding immediately prior to the filing of this Certificate of Incorporation shall immediately after the filing of this Certificate of Incorporation represent a number of shares of Common Stock as adjusted to reflect the Reverse Split.

The following is a statement of the designations and the powers, privileges and rights, and the qualifications, limitations or restrictions thereof in respect of each class of capital stock of the Corporation.

A. COMMON STOCK

1. General. Except as required by law or as provided in this Eighth Amended and Restated Certificate of Incorporation (this "**Certificate of Incorporation**"), all shares of Common Stock shall be identical in all respects and shall entitle the holders thereof to the same rights and privileges, subject to the same qualifications, limitations and restrictions. The voting, dividend and liquidation rights of the holders of the Common Stock are subject to and qualified by the rights, powers and preferences of the holders of the Series Preferred set forth herein.

2. Dividends and Distributions. Subject to the provisions of this Certificate of Incorporation, including Section B.1 of Article Fourth, the holders of shares of Common Stock shall be entitled to receive such dividends and distributions, payable in cash or otherwise, as may be declared thereon by the Board from time to time out of assets or funds of the Corporation legally available therefor. The holders of shares of Common Stock shall be entitled to share equally, on a per share basis, in such dividends or distributions, subject to the limitations described below.

3. Voting. The holders of shares of Common Stock are entitled to one vote for each share of Common Stock held at all meetings of stockholders (and written actions in lieu of meetings); provided, however, that, except as otherwise required by law, holders of Common Stock, as such, shall not be entitled to vote on any amendment to this Certificate of Incorporation that relates solely to the terms of one or more outstanding series of Series Preferred if the holders of such affected series are entitled, either separately or together with the holders of one or more other such series, to vote thereon pursuant to this Certificate of Incorporation or pursuant to the General Corporation Law. There shall be no cumulative voting. The number of authorized shares of Common Stock may be increased or decreased (but not below the number of shares thereof then outstanding) by (in addition to any vote of the holders of one or more series of Series Preferred that may be required by the terms of this Certificate of Incorporation) the affirmative vote of the holders of shares of capital stock of the Corporation representing a majority of the votes represented by all outstanding shares of capital stock of the Corporation entitled to vote (voting together as a single class) without the approval of the holders of Common Stock voting as a separate class, irrespective of the provisions of Section 242(b)(2) of the General Corporation Law.

4. Liquidation. After the payments to holders of Series Preferred pursuant to Section B.2 of Article Fourth, the holders of Common Stock shall be entitled to liquidation distributions, if any, with holders of Series Preferred on an as converted basis pursuant to Subsection B.2.2 of Article Fourth.

B. PREFERRED STOCK

Unless otherwise indicated, references to "Sections" or "Subsections" in this Part B of this Article Fourth refer to sections and subsections of Part B of this Article Fourth.

1. Dividends.

1.1 Series Preferred Dividends. From the date of the issuance of the Series D-1 Preferred Stock, holders of the Series Preferred shall be entitled to receive, when, as and if declared by the Board, but only out of funds legally available therefor, cash dividends at the rate of eight percent (8%) of the applicable Original Issue Price (as defined below) per annum on each outstanding share of Series Preferred. Such dividends shall be payable only when, as and if declared by the Board and shall be non-cumulative. The Corporation shall not declare, pay or set aside any dividends on shares of any other class or series of capital stock of the Corporation (other than dividends on shares of Common Stock payable in shares of Common Stock) unless (in addition to the obtaining of any consents required elsewhere in this Certificate of Incorporation) the holders of the Series Preferred then outstanding shall first receive, or simultaneously receive, a dividend on each outstanding share of Series Preferred in an amount at least equal to (i) in the case of a dividend on Common Stock or any class or series that is convertible into Common Stock, that dividend per share of Series Preferred as would equal the product of (A) the dividend payable on each share of such class or series determined, if applicable, as if all shares of such class or series had been converted into Common Stock and (B) the number of shares of Common Stock issuable upon conversion of a share of such series of Series Preferred, in each case calculated on the record date for determination of holders entitled to receive such dividend or (ii) in the case of a dividend on any class or series that is not

convertible into Common Stock, at a rate per share of such series of Series Preferred determined by (A) dividing the amount of the dividend payable on each share of such class or series of capital stock by the original issuance price of such class or series of capital stock (subject to appropriate adjustment in the event of any reorganization, stock dividend, stock split, combination or other similar recapitalization affecting such shares) and (B) multiplying such fraction by an amount equal to the applicable Original Issue Price for such series; provided that, if the Corporation declares, pays or sets aside, on the same date, a dividend on shares of more than one class or series of capital stock of the Corporation, the dividend payable to the holders of Series Preferred pursuant to this Section 1 shall be calculated based upon the dividend on the class or series of capital stock that would result in the highest Series Preferred dividend for such series. Notwithstanding the foregoing, the Corporation shall not declare, pay or set aside any dividends on any shares of Series Preferred other than shares of Series D-1 Preferred Stock unless the holders of the Series D-1 Preferred Stock then outstanding shall first receive, or simultaneously receive, full payment of a dividend on each outstanding share of Series D-1 Preferred Stock in an amount equal to the dividend payable pursuant to parts (i) and (ii) above. The "**Original Issue Price**" shall be $0.48 per share for the Series D-1 Preferred Stock, $0.48 per share for the Series D Preferred Stock, $1.4043 per share for the Series C Preferred Stock, $1.3995 per share for the Series B-1 Preferred Stock, $1.3995 per share for the Series B Preferred Stock and $2.733 per share for the Series A Preferred Stock, each subject to appropriate adjustment in the event of any reorganization, stock split, combination, reclassification, recapitalization or other similar event involving or affecting a change in the Corporation's capital structure. For the avoidance of doubt, all previously accrued but unpaid dividends are hereby cancelled upon the filing of this Certificate of Incorporation.

1.2 Adjustments. All numbers relating to the calculation of dividends pursuant to this Section 1 shall be subject to appropriate adjustment whenever there shall occur a reorganization, stock split, combination, reclassification, recapitalization or other similar event involving or affecting a change in the Corporation's capital structure to provide to the holders of Series Preferred the same economic return as they would have received in the absence of such event.

2. Liquidation, Dissolution or Winding Up; Certain Mergers, Consolidations and Asset Sales.

2.1 Preferential Payments to Holders of Series Preferred.

2.1.1 Series Preferred Liquidation Preference. In the event of any voluntary or involuntary liquidation, dissolution or winding up of the Corporation, or in the event of its insolvency, whether under the General Corporation Law, federal bankruptcy laws, or other applicable federal or state laws (each such event, a "**Liquidation Event**"), (i) the holders of shares of Series D Preferred Stock and Series D-1 Preferred Stock (the "**Series D/D-1 Preferred Stock**"), on a *pari pasu* basis, shall be entitled to receive, prior to and in preference to any payment or distribution (or any setting aside of any payment or distribution) to the holders of Series C Preferred Stock, Series B/B-1 Preferred Stock, Series A Preferred Stock, Common Stock or any other class or series of capital stock ranking on liquidation junior to the Series D/D-1 Preferred Stock, by reason of their ownership thereof, an amount per share equal to the applicable Liquidation Preference (as defined below); (ii) the holders of shares of Series C

Preferred Stock, on a *pari pasu* basis, shall be entitled to receive, prior to and in preference to any payment or distribution (or any setting aside of any payment or distribution) to the holders of Series B/B-1 Preferred Stock, Series A Preferred Stock, Common Stock or any other class or series of capital stock ranking on liquidation junior to the Series C Preferred Stock, by reason of their ownership thereof, an amount per share equal to the applicable Liquidation Preference; and (iii) the holders of shares of Series B/B-1 Preferred Stock and Series A Preferred Stock, on a *pari pasu* basis, shall be entitled to receive, prior to and in preference to any payment or distribution (or any setting aside of any payment or distribution) to the holders of Common Stock or any other class or series of capital stock ranking on liquidation junior to the Series B/B-1 Preferred Stock and Series A Preferred Stock, by reason of their ownership thereof, an amount per share equal to the applicable Liquidation Preference. As used herein, "**Liquidation Preference**" means, (I) where the Corporation is valued at $91,000,000 or below pursuant to a Liquidation Event, the sum of (i) the applicable Original Issue Price for such series of Series Preferred, plus (ii) the amount of any declared but unpaid dividends on shares of Series Preferred (the "**Aggregate Dividend Amount**") and (II) where the Corporation is valued at over $91,000,000, (x) with respect to the first $91,000,000 distributed, the sum of (i) the applicable Original Issue Price for such series of Series Preferred, plus (ii) the Aggregate Dividend Amount, and (y) with respect to all amounts remaining following the first distribution of $91,000,000 (the "**Remaining Amount**"), the first $10,000,000 of the Remaining Amount (or such lesser amount if the Remaining Amount is less than $10,000,000) shall be distributed among the holders of Series D/D-1 Preferred Stock, pro rata based on the number of shares held by each such holder. If upon any Liquidation Event, the assets of the Corporation available for distribution to its stockholders shall be insufficient to pay all of the holders of shares of Series Preferred the full amount to which they shall be entitled under this Subsection 2.1, (i) the holders of shares of Series D/D-1 Preferred Stock shall share ratably in any distribution of the assets available for distribution in proportion to the respective amounts which would otherwise be payable in respect of the shares held by them upon such distribution if all amounts payable on or with respect to such shares were paid in full; (ii) if there are any remaining assets of the Corporation available for distribution to the holders of shares of Series C Preferred Stock after the applicable Liquidation Preference has been fully paid to the holders of shares of Series D/D-1 Preferred Stock, the holders of shares of Series C Preferred Stock shall share ratably in any distribution of the assets available for distribution in proportion to the respective amounts which would otherwise be payable in respect of the shares held by them upon such distribution if all amounts payable on or with respect to such shares were paid in full; and (iii) if there are any remaining assets of the Corporation available for distribution to the holders of shares of Series A Preferred Stock and Series B/B-1 Preferred Stock after the applicable Liquidation Preference has been fully paid to the holders of shares of Series C Preferred Stock, and Series D/D-1 Preferred Stock, the holders of shares of Series A Preferred Stock and Series B/B-1 Preferred Stock shall share ratably in any distribution of the assets available for distribution in proportion to the respective amounts which would otherwise be payable in respect of the shares held by them upon such distribution if all amounts payable on or with respect to such shares were paid in full. In no event shall the payment of all or any portion of the Liquidation Preference be deemed to be a payment of dividends on any shares of Series Preferred to the extent permitted by applicable law.

2.2 Distribution of Remaining Assets. Upon a Liquidation Event, after the payment of the full Liquidation Preference as set forth in Subsection 2.1 above to all holders of shares of Series Preferred, the remaining assets of the Corporation available for distribution to its

stockholders shall be distributed among the holders of the shares of Series Preferred and Common Stock, pro rata based on the number of shares held by each such holder, treating for this purpose all such securities as if they had been converted to Common Stock pursuant to the terms of this Certificate of Incorporation immediately prior to such Liquidation Event.

2.3 Deemed Liquidation Events.

2.3.1 Definition. Each of the following events shall be considered a "**Deemed Liquidation Event**" unless the holders of at least 66-2/3% of the Series Preferred (the "**Requisite Holders**"), elect otherwise by written notice sent to the Corporation at least five (5) days prior to the effective date of any such event:

(a) a merger or consolidation in which

(i) the Corporation is a constituent party; or

(ii) a subsidiary of the Corporation is a constituent party and the Corporation issues shares of its capital stock pursuant to such merger or consolidation,

except any such merger or consolidation involving the Corporation or a subsidiary in which the shares of capital stock of the Corporation outstanding immediately prior to such merger or consolidation continue to represent, or are converted into or exchanged for shares of capital stock that represent, immediately following such merger or consolidation, a majority, by voting power, of the capital stock of (1) the surviving or resulting corporation or (2) if the surviving or resulting corporation is a wholly owned subsidiary of another corporation immediately following such merger or consolidation, the parent corporation of such surviving or resulting corporation (provided that, for the purpose of this Subsection 2.3.1, all shares of Common Stock issuable upon exercise of Options (as defined below) outstanding immediately prior to such merger or consolidation or upon conversion of Convertible Securities (as defined below) outstanding immediately prior to such merger or consolidation shall be deemed to be outstanding immediately prior to such merger or consolidation and, if applicable, converted or exchanged in such merger or consolidation on the same terms as the actual outstanding shares of Common Stock are converted or exchanged);

(b) the closing of the transfer in one transaction or a series of related transactions, to a person or group of affiliated persons (other than an underwriter of the Corporation's securities), of the Corporation's outstanding securities if, after such closing, such person or group of affiliated persons would hold 50% or more of the outstanding voting stock of the Corporation (or the surviving or acquiring entity); or

(c) the sale, lease, transfer, exclusive license or other disposition, in a single transaction or series of related transactions, by the Corporation or any subsidiary of the Corporation of all or substantially all the assets of the Corporation and its subsidiaries taken as a whole, or the sale or disposition (whether by merger or otherwise) of one or more subsidiaries of the Corporation if substantially all of the assets of the Corporation and its subsidiaries taken as a whole are held by such subsidiary or subsidiaries, except where such sale,

lease, transfer, exclusive license or other disposition is to a wholly owned subsidiary of the Corporation.

Notwithstanding anything to the contrary herein, the sale of shares of Series D-1 Preferred Stock by the Corporation under that certain Series D-1 Convertible Participating Preferred Stock Purchase Agreement, dated on or about the date hereof, by and among the Corporation and the Purchasers set forth on Exhibit A thereto (the "**Purchase Agreement**") shall not in any circumstances be considered a "Deemed Liquidation Event."

2.3.2 Transaction Payment. At least ten (10) business days prior to the consummation of a Deemed Liquidation Event, the Corporation, or if the Corporation is not a party to such transaction, the holders of shares of capital stock of the Corporation that are parties to such transaction, shall provide the holders of Series Preferred written notice of such event (the "**Event Notice**"). Unless the Requisite Holders deliver a notice to the Corporation within five (5) days after receipt of an Event Notice stating that such Deemed Liquidation Event shall not be treated as a Liquidation Event, a Deemed Liquidation Event shall be deemed to have been elected by such holders to be treated as a Liquidation Event in which case the Corporation shall, and each holder of Series Preferred shall be entitled to require that, prior to or concurrently with consideration from any such Deemed Liquidation Event being paid to the Corporation (if the consideration is to be received by the Corporation in an asset transaction), or by any third party to stockholders of the Corporation other than holders of Series Preferred (if the consideration is to be received directly by such stockholders in a merger, consolidation, stock purchase or similar transaction), a payment (the "**Transaction Payment**") shall be made to the holders of Series Preferred in an amount equal to the amount that such holders would have received had the entire consideration in the transaction (with respect to a Deemed Liquidation Event involving the sale of all or substantially all the assets of the Corporation, net of any liabilities of the Corporation not assumed or otherwise paid by the acquiring entity) been deemed available assets for distribution to the stockholders of the Corporation upon liquidation pursuant to Subsections 2.1 and 2.2. In no event shall the payment of all or any portion of the Transaction Payment be deemed to be a payment of dividends on any shares of Series Preferred to the extent permitted by applicable law. The Corporation shall not have the power to effect a Deemed Liquidation Event unless the agreement or plan of merger or consolidation provides that the consideration payable to the stockholders of the Corporation shall be allocated among the stockholders of the Corporation in accordance with Subsections 2.1 and 2.2.

2.3.3 Payment of Transaction Payment. If securities of the acquiring entity (the "**Acquiring Entity Stock**") or other property are issued to the holders of the Series Preferred and Common Stock in the Deemed Liquidation Event, then, the Transaction Payment shall be paid to the holders of Series Preferred in such portions of cash, property or Acquiring Entity Stock, such that all holders of Series Preferred and Common Stock shall receive the same proportion of cash, property and Acquiring Entity Stock in respect of the amounts to which they are entitled pursuant to Subsections 2.1 and 2.2. The Acquiring Entity Stock utilized to make the Transaction Payment, if any, shall have the same rights, preferences and restrictions (including whether the issuance or sale of such Acquiring Entity Stock is registered or entitled to registration rights) as the Acquiring Entity Stock issued to the holders of Common Stock in the Deemed Liquidation Event. Notwithstanding the foregoing, neither the Corporation nor the acquiring entity shall be obligated to deliver certificates evidencing the Acquiring Entity Stock

or other property deliverable to a holder of Series Preferred as a result of the Liquidation Event unless and until the certificates representing shares of Series Preferred held by such holder are either delivered to the Corporation or the acquiring entity, or their respective transfer agents, as the Corporation and the acquiring entity may require, duly endorsed in blank for transfer, or the holder certifies in writing to the Corporation or the acquiring entity, or their respective transfer agents, as the Corporation and the acquiring entity may require, that such certificates have been lost, stolen or destroyed and executes an agreement satisfactory to the Corporation or such acquiring entity to indemnify the Corporation and/or such acquiring entity from any loss incurred by it in connection with such certificates. The value of the Acquiring Entity Stock or other property determined as follows shall be used for purposes of determining the amount of the entire consideration in the transaction, the Transaction Payment and the payment thereof. If the consideration received by the Corporation or its stockholders ("**Proceeds**") is other than cash or evidences of indebtedness (for which the value thereof shall be deemed to be the principal amount thereof), its value will be deemed its fair market value, determined as follows:

(a) Any securities (including any Acquiring Entity Stock) included in the Proceeds shall be valued as follows:

(i) If traded on a securities exchange or through the Nasdaq National Market, the value shall be deemed to be the average of the closing prices of the securities on such exchange or system over the twenty (20) trading-day period ending three (3) trading days prior to the closing of the Deemed Liquidation Event;

(ii) If actively traded over-the-counter, the value shall be deemed to be the average of the closing bid or sale prices (whichever is applicable) over the twenty (20) trading-day period ending three (3) trading days prior to the closing of the Deemed Liquidation Event; and

(iii) If there is no active public market, the value shall be the fair market value thereof, as determined by an independent appraisal conducted by an independent third party valuation firm (at the expense of the Corporation) and approved by the Board.

(b) Any Proceeds other than cash, evidences of indebtedness, and securities shall have the fair market value of such Proceeds as determined by an independent appraisal conducted by an independent third party valuation firm (at the expense of the Corporation) and approved by the Board.

(c) The foregoing methods for valuing Proceeds to be distributed or delivered in connection with a Deemed Liquidation Event shall, upon approval by the stockholders of the definitive agreements governing the Deemed Liquidation Event, be

superseded by any determination of such value set forth in the definitive agreements governing such Deemed Liquidation Event.

(d) Contingent Consideration. In the event of a Deemed Liquidation Event, if any portion of the consideration payable to the stockholders of the Corporation is placed into escrow or is payable to the stockholders of the Corporation subject to contingencies, then, in such event, the definitive acquisition agreement relating to such Deemed Liquidation Event shall provide that (i) the portion of such consideration that is not placed in escrow and not subject to any contingencies (the "**Initial Consideration**") shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2 as if the Initial Consideration were the only consideration payable in connection with such Deemed Liquidation Event and (ii) any additional consideration which becomes payable to the stockholders of the Corporation upon release from escrow or satisfaction of the applicable contingency shall be allocated among the holders of capital stock of the Corporation in accordance with Subsections 2.1 and 2.2 after taking into account the previous payment of the Initial Consideration and any other amounts previously released from escrow or paid upon satisfaction of any contingency to the stockholders of the Corporation as part of the same transaction.

3. Voting.

3.1 General. On any matter presented to the stockholders of the Corporation for their action or consideration at any meeting of stockholders of the Corporation (or by written consent of stockholders in lieu of meeting), each holder of outstanding shares of Series Preferred shall be entitled to cast the number of votes equal to the number of whole shares of Common Stock into which the shares of Series Preferred held by such holder are convertible as of the record date for determining stockholders entitled to vote on such matter. Except as provided by law or by the other provisions of this Certificate of Incorporation, holders of Series Preferred shall vote together with the holders of Common Stock as a single class. Each holder of Series Preferred shall be entitled to notice of any stockholders' meeting in accordance with the Bylaws of the Corporation at the same time and in the same manner as notice is given to all other stockholders entitled to vote at such meetings.

3.2 Election of Directors. The number of directors constituting the Board shall be seven (7).

3.2.1 Series D-1 Directors. For so long as any shares of Series D-1 Preferred Stock remain outstanding, the holders of Series D-1 Preferred Stock shall be entitled to elect two (2) members of the Board at each meeting or pursuant to each consent of the Corporation's stockholders for the election of directors.

3.2.2 Series C Director. For so long as any shares of Series C Preferred Stock remain outstanding, the holders of Series C Preferred Stock shall be entitled to elect one (1) member of the Board at each meeting or pursuant to each consent of the Corporation's stockholders for the election of directors.

3.2.3 Series B/B-1 Director. For so long as any shares of Series B/B-1 Preferred Stock remain outstanding, the holders of Series B/B-1 Preferred Stock, voting together as a single class, shall be entitled to elect one (1) member of the Board at each meeting or pursuant to each consent of the Corporation's stockholders for the election of directors.

3.2.4 Common Director. The holders of record of the shares of Common Stock, exclusively and as a separate class, shall be entitled to elect one (1) member of the Board at each meeting or pursuant to each consent of the Corporation's stockholders for the election of directors, which will be the Corporation's Chief Executive Officer.

3.2.5 Remaining Directors. The balance of the total number of directors of the Corporation shall be elected by the holders of record of a majority of the shares of Series Preferred and Common Stock, voting together as a single class.

3.2.6 At any meeting held for the purpose of electing a director, the presence in person or by proxy of the holders of a majority of the outstanding shares of the classes or series entitled to elect such director shall constitute a quorum for the purpose of electing such director. Any director elected as provided in this Subsection 3.2 may be removed without cause by, and only by, the affirmative vote of the holders of the shares of the classes or series of capital stock entitled to elect such director or directors, given either at a special meeting of such stockholders duly called for that purpose or pursuant to a written consent of stockholders. A vacancy in any directorship filled by the holders of any classes or series shall be filled only by vote or written consent in lieu of a meeting of the holders of such classes or series or by any remaining director or directors elected by the holders of such class or series pursuant to this Subsection 3.2.

3.2.7 Additional Voting Rights. The Series Preferred shall have the additional voting rights specified in Subsection 3.3.

3.3 Series Preferred Protective Provisions.

3.3.1 At any time when any shares of Series Preferred are outstanding, the Corporation shall not, either directly or indirectly by amendment, merger, consolidation, reorganization, via a subsidiary or otherwise, do any of the following without (in addition to any other vote required by law or this Certificate of Incorporation) the written consent or affirmative vote of the Requisite Holders given in writing or by vote at a meeting, consenting or voting (as the case may be) separately as a class, and any such act or transaction entered into without such consent or vote shall be null and void *ab initio*, and of no force or effect:

(a) alter or change the rights, preferences or privileges of the Series Preferred;

(b) authorize or issue any equity security senior to or on a parity with any series of Series Preferred as to dividend rights or redemption rights or liquidation preferences;

(c) authorize any new issuance of any equity securities of the Corporation, excluding (a) any issuance of Common Stock upon conversion of the Series

Preferred pursuant to this Certificate of Incorporation, and (b) the issuance of Common Stock (or options or warrants therefor) under employee equity incentive plans approved by the Board, provided, that the following items shall require the affirmative consent of at least one (1) LC Director (as such term is defined in that certain Fifth Amended and Restated Stockholders Agreement, dated on or about the date hereof (as the same may be amended from time to time, the "Stockholders Agreement")): (i) any award that does not consist solely of a grant of Options (as each such term is defined in the Corporation's 2006 Equity Compensation Plan, as amended); (ii) any such award that, at the time of grant, the exercise of which involves more than one percent (1%) of the Corporation's then outstanding equity securities; (iii) any such award that deviates from the Vesting Terms (as such term is defined in that certain Fifth Amended and Restated Investors' Rights Agreement, dated on or about the date hereof, as the same may be amended from time to time); and (iv) the settlement of any such awards, on or prior to a Qualified IPO, with grantees who are residents of the People's Republic of China, by way of repurchase, redemption, exchange or similar transactions.

(d) increase the number of shares of the Corporation's capital stock reserved for issuance upon exercise of Options or Convertible Securities or upon the grant or award of stock or stock related rights to employees, officers or directors of, or consultants, advisors or service providers to, the Corporation pursuant to equity compensation or incentive plans or arrangements above the number of shares authorized on the filing date of this Certificate of Incorporation (subject to appropriate adjustment in the event of any reorganization, stock split, combination, reclassification, recapitalization or other similar event involving or affecting a change in the Corporation's capital structure);

(e) amend the Corporation's 2006 Equity Compensation Plan, as amended, or approve any new equity compensation or incentive plan;

(f) amend or waive any provision of the Corporation's Certificate of Incorporation or Bylaws in a manner that would alter or change the rights, preferences or privileges of any Series Preferred;

(g) increase or decrease the authorized number of shares of Common Stock or Series Preferred;

(h) redeem or repurchase any shares of capital stock of the Corporation (other than (i) redemptions of the Series D-1 Preferred Stock as expressly authorized herein or (ii) pursuant to equity incentive agreements with service providers giving the Corporation the right to repurchase shares upon the termination of services);

(i) effect any Liquidation Event or Sale of the Company (as such term is defined in the Stockholders Agreement) or any voluntary recapitalization, reorganization or bankruptcy, or consent to any of the foregoing;

(j) increase or decrease the authorized size of the Board, or create a committee of the Board;

(k) declare or pay any dividends on or make any distribution on, or agree or obligate itself to declare or pay any dividends on or make any distribution on,

Series Preferred, Common Stock or any other capital stock of the Corporation ranking junior to the Series Preferred with respect the payment of dividends;

(l) authorize the extension by the Corporation of any loan or guarantee for indebtedness in excess of $500,000 in the aggregate to any third party (except for trade accounts of the Corporation or any subsidiary arising in the ordinary course of business);

(m) create or incur or authorize the creation or incurrence of any new indebtedness for borrowed money (or any increase of any existing indebtedness for borrowed money as of the filing date of this Certificate of Incorporation) in excess of $1,000,000 in the aggregate;

(n) mortgage or pledge, or create a security interest in, or permit any subsidiary to mortgage, pledge or create a security interest in, the property or assets of the Corporation or such subsidiary;

(o) authorize the acquisition of one or more businesses or assets with a purchase price in excess of $3,000,000 in the aggregate;

(p) authorize the appointment or replacement of the Chief Executive Officer, Chief Financial Officer, Chief Operating Officer, or Chief Scientific Officer of the Corporation;

(q) authorize any transaction involving both the Corporation and any of the Corporation's employees, officers, directors or stockholders or any affiliate thereof, except for (i) arms-length employment agreements, and (ii) any arms-length transaction that is in the ordinary course of business;

(r) authorize appointment and removal of auditors of the Corporation or any material change in the accounting and financial policies of the Corporation;

(s) authorize any increase in compensation of any employee of the Corporation with monthly salary of at least $30,000 by more than 50% in a 12 month period (provided that this clause (r) does not reduce or modify the authority of the Board to generally review and approve executive compensation);

(t) authorize any items of expenditure outside the annual budget in excess of $500,000 per month, individually or in the aggregate;

(u) create or fund any subsidiary, or permit any subsidiary to hold capital stock in any other subsidiary or any other corporation, partnership, limited liability company or other entity;

(v) enter into new lines of business or materially change the nature of the Corporation's existing line of business;

(w) enter into or become a party to any transaction or agreement, or otherwise take any action, which would result in or give rise to the taxation of holders of Series Preferred under Section 305 Internal Revenue Code of 1986, as amended; and

(x) enter into a binding agreement to do any of the foregoing, or effect any of the foregoing, as applicable, with respect to any direct or indirect subsidiary or affiliate of the Corporation.

4. Optional Conversion.

The holders of the Series Preferred shall have conversion rights as follows (the "**Conversion Rights**"):

4.1 Right to Convert.

4.1.1 Series Preferred Conversion Ratio. Each share of Series Preferred shall be convertible, at the option of the holder thereof, at any time and from time to time, and without the payment of additional consideration by the holder thereof, into fully paid and nonassessable shares of Common Stock. The number of shares of Common Stock which a holder of Series Preferred shall be entitled to receive upon conversion shall be equal to the product obtained by multiplying (a) the number of shares of Series Preferred being converted at any time by (b) the applicable Conversion Rate (as defined below) then in effect. The "**Conversion Rate**" in effect at any time shall be equal to the sum of (x) the quotient obtained by dividing the applicable Original Conversion Value (as defined below), by the applicable Conversion Price (as defined below) then in effect plus (y) the quotient obtained by dividing an amount equal to the applicable Aggregate Dividend Amount on each share of Series Preferred by an amount equal to the then current fair market value, as determined in good faith by the Board, of one share of Common Stock at the time of any such conversion. The "**Original Conversion Value**" and the "**Conversion Price**" shall initially be equal to $0.48 per share for each of the Series D-1 Preferred Stock, $0.48 per share for each of the Series D Preferred Stock, $1.4043 per share for each of the Series C Preferred Stock and $1.3995 per share for each of the Series B-1 Preferred Stock, the Series B Preferred Stock and the Series A Preferred Stock (each as adjusted in the event of any reorganization, stock split, combination, reclassification, recapitalization or other similar event involving or affecting a change in the Corporation's capital structure). The initial Conversion Price of each series of Series Preferred, and the rate at which shares of Series Preferred may be converted into shares of Common Stock, shall be subject to adjustment as provided below.

4.1.2 Termination of Conversion Rights. In the event of a Liquidation Event or a Deemed Liquidation Event, the Conversion Rights shall terminate at the close of business on the last full day preceding the date fixed for the payment of any such amounts distributable on such event to the holders of Series Preferred.

4.2 Fractional Shares. No fractional shares of Common Stock shall be issued upon conversion of the Series Preferred. In lieu of any fractional shares to which the holder would otherwise be entitled, the Corporation shall pay cash equal to such fraction multiplied by the fair market value of a share of Common Stock as determined in good faith by the Board.

Whether or not fractional shares would be issuable upon such conversion shall be determined on the basis of the total number of shares of Series Preferred the holder is at the time converting into Common Stock and the aggregate number of shares of Common Stock issuable upon such conversion.

4.3 Mechanics of Conversion.

4.3.1 Notice of Conversion. In order for a holder of Series Preferred to voluntarily convert shares of Series Preferred into shares of Common Stock, such holder shall surrender the certificate or certificates for such shares of Series Preferred (or, if such registered holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate), at the office of the transfer agent for the Series Preferred (or at the principal office of the Corporation if the Corporation serves as its own transfer agent), together with written notice that such holder elects to convert all or any number of the shares of the Series Preferred represented by such certificate or certificates and, if applicable, any event on which such conversion is contingent. Such notice shall state such holder's name or the names of the nominees in which such holder wishes the certificate or certificates for shares of Common Stock to be issued. If required by the Corporation, certificates surrendered for conversion shall be endorsed or accompanied by a written instrument or instruments of transfer, in form reasonably satisfactory to the Corporation, duly executed by the registered holder or his, her or its attorney duly authorized in writing. The close of business on the date of receipt by the transfer agent (or by the Corporation if the Corporation serves as its own transfer agent) of such certificates (or lost certificate affidavit and agreement) and notice shall be the time of conversion (the "**Conversion Time**"), and the shares of Common Stock issuable upon conversion of the shares represented by such certificate shall be deemed to be outstanding of record as of such date. The Corporation shall, as soon as practicable after the Conversion Time, issue and deliver to such holder of Series Preferred, or to his, her or its nominees, a certificate or certificates for the number of full shares of Common Stock issuable upon such conversion in accordance with the provisions hereof, together with cash as provided in Subsection 4.2 in lieu of any fraction of a share of Common Stock otherwise issuable upon such conversion.

4.3.2 Reservation of Shares. The Corporation shall at all times when any shares of Series Preferred are outstanding, reserve and keep available out of its authorized but unissued capital stock, for the purpose of effecting the conversion of the Series Preferred, such number of its duly authorized shares of Common Stock as shall from time to time be sufficient to effect the conversion of all outstanding Series Preferred; and if at any time the number of authorized but unissued shares of Common Stock shall not be sufficient to effect the conversion of all then outstanding shares of the Series Preferred, the Corporation shall take such corporate action as may be necessary to increase its authorized but unissued shares of Common Stock to such number of shares as shall be sufficient for such purposes, including, without limitation, engaging in reasonable best efforts to obtain the requisite stockholder approval of any necessary amendment to this Certificate of Incorporation. Before taking any action which would cause an adjustment reducing the Conversion Price for any series of Series Preferred below the then par value of the shares of Common Stock issuable upon conversion of such series of Series Preferred, the Corporation will take any corporate action which may, in the opinion of its

counsel, be necessary in order that the Corporation may validly and legally issue fully paid and nonassessable shares of Common Stock at such adjusted Conversion Price, as applicable.

4.3.3 Effect of Conversion. All shares of Series Preferred which shall have been surrendered for conversion as herein provided shall no longer be deemed to be outstanding and all rights with respect to such shares, including the rights, if any, to receive notices and to vote, shall immediately cease and terminate at the Conversion Time, except only the right of the holders thereof to receive shares of Common Stock in exchange therefor. Any shares of Series Preferred so converted shall be retired and cancelled and shall not be reissued as shares of such series, and the Corporation (without the need for stockholder action) may from time to time take such appropriate action as may be necessary to reduce the authorized number of shares of Series Preferred accordingly.

4.3.4 No Further Adjustment. Upon any such conversion, no adjustment to the applicable Conversion Price shall be made for any declared but unpaid dividends on the Series Preferred surrendered for conversion or on the Common Stock delivered upon conversion.

4.3.5 Taxes. The Corporation shall pay any and all issue and other similar taxes (but not any income or similar taxes) that may be payable in respect of any issuance or delivery of shares of Common Stock upon conversion of shares of Series Preferred pursuant to this Section 4. The Corporation shall not, however, be required to pay any tax which may be payable in respect of any transfer involved in the issuance and delivery of shares of Common Stock in a name other than that in which the shares of Series Preferred so converted were registered, and no such issuance or delivery shall be made unless and until the person or entity requesting such issuance has paid to the Corporation the amount of any such tax or has established, to the satisfaction of the Corporation, that such tax has been paid.

4.4 Adjustments to Conversion Price for Diluting Issues.

4.4.1 Special Definitions. For purposes of this Article Fourth, the following definitions shall apply:

(a) **"Convertible Securities"** shall mean any evidences of indebtedness, shares or other securities directly or indirectly convertible into or exchangeable for Common Stock, but excluding Options.

(b) **"Option"** shall mean rights, options or warrants to subscribe for, purchase or otherwise acquire Common Stock or Convertible Securities.

(c) **"Series Preferred Original Issue Date"** shall mean the Series A Original Issue Date with respect to the Series A Preferred Stock, the Series B Original Issue Date with respect to the Series B/B-1 Preferred Stock, the Series C Original Issue Date with respect to the Series C Preferred Stock, the Series D Original Issue Date with respect to the Series D Preferred Stock and the Series D-1 Original Issue Date with respect to the SeriesD-1 Preferred Stock.

(d) **"Series A Original Issue Date"** shall mean the date on which the first share of Series A Preferred Stock was issued.

(e) **"Series B Original Issue Date"** shall mean the date on which the first share of Series B Preferred Stock was issued.

(f) **"Series C Original Issue Date"** shall mean the date on which the first share of Series C Preferred Stock was issued.

(g) **"Series D Original Issue Date"** shall mean the date on which the first share of Series D Preferred Stock was issued.

(h) "**Series D-1 Original Issue Date**" shall mean the date on which the first share of Series D-1 Preferred Stock was issued.

(i) **"Additional Shares of Common Stock"** shall mean all shares of Common Stock issued (or, pursuant to Subsection 4.4.3 below, deemed to be issued) by the Corporation after the applicable Series Preferred Original Issue Date, other than the following shares of Common Stock, and shares of Common Stock deemed issued pursuant to the following Options and Convertible Securities (collectively "**Exempted Securities**"):

(i) shares of Common Stock, Options or Convertible Securities issued as a dividend or distribution on the Series Preferred;

(ii) shares of Common Stock, Options or Convertible Securities issued by reason of a dividend, stock split, split-up or other distribution on shares of Common Stock that is covered by Subsections 4.5, 4.6, 4.7 or 4.8 below;

(iii) shares of Common Stock or Options issued to employees or directors of, or consultants or advisors to, the Corporation or any of its subsidiaries pursuant to a plan, agreement or arrangement approved by the Board;

(iv) shares of Common Stock or Convertible Securities actually issued upon the exercise of Options or shares of Common Stock actually issued upon the conversion or exchange of Convertible Securities, in each case provided such issuance is pursuant to the terms of such Option or Convertible Security;

(v) shares of Common Stock, Options or Convertible Securities issued in connection with sponsored research, collaboration, technology license, development, OEM, marketing, customer, vendor, supplier or other similar agreements or strategic transactions entered into for primarily non-equity financing purposes where both the transaction and

its status as not constituting an anti-dilution trigger are approved by the Board (including the affirmative consent of at least one (1) LC Director);

(vi) shares of Common Stock, Options or Convertible Securities issued in connection with equipment lease financing arrangements, or bank financing transactions, in each case, approved by the Board (including the affirmative consent of at least one (1) LC Director);

(vii) shares of Common Stock, Options or Convertible Securities issued in connection with acquisitions or business combinations, in each case, approved by the Requisite Holders;

(viii) shares of Common Stock, Options or Convertible Securities issued or issuable pursuant to the terms of any Options, Convertible Securities or any arrangements or agreements to issue Options or Convertible Securities outstanding immediately prior to the filing of this Certificate of Incorporation; or

(ix) shares of Common Stock or Convertible Securities issued or issuable pursuant to the terms of the Purchase Agreement.

4.4.2 No Adjustment of Applicable Conversion Price. No adjustment in the Conversion Price for the Series Preferred shall be made as the result of the issuance or deemed issuance of Additional Shares of Common Stock if the Corporation receives written notice from the Requisite Holders agreeing that no such adjustment shall be made as the result of the issuance or deemed issuance of such Additional Shares of Common Stock.

4.4.3 Deemed Issue of Additional Shares of Common Stock.

(a) If the Corporation at any time or from time to time after the applicable Series Preferred Original Issue Date shall issue any Options or Convertible Securities (excluding Options or Convertible Securities which are themselves Exempted Securities) or shall fix a record date for the determination of holders of any class of securities entitled to receive any such Options or Convertible Securities, then the maximum number of shares of Common Stock (as set forth in the instrument relating thereto, assuming the satisfaction of any conditions to exercisability, convertibility or exchangeability but without regard to any provision contained therein for a subsequent adjustment of such number) issuable upon the exercise of such Options or, in the case of Convertible Securities and Options therefor, the conversion or exchange of such Convertible Securities, shall be deemed to be Additional Shares of Common Stock issued as of

the time of such issue or, in case such a record date shall have been fixed, as of the close of business on such record date.

(b) If the terms of any Option or Convertible Security, the issuance of which resulted in an adjustment to the applicable Conversion Price for any series of Series Preferred pursuant to the terms of Subsections 4.4.4 below, are revised as a result of an amendment to such terms or any other adjustment pursuant to the provisions of such Option or Convertible Security (but excluding automatic adjustments to such terms pursuant to anti-dilution or similar provisions of such Option or Convertible Security) to provide for either (1) any increase or decrease in the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any such Option or Convertible Security or (2) any increase or decrease in the consideration payable to the Corporation upon such exercise, conversion and/or exchange, then, effective upon such increase or decrease becoming effective, the applicable Conversion Price for such series of Series Preferred computed upon the original issue of such Option or Convertible Security (or upon the occurrence of a record date with respect thereto) shall be readjusted to such applicable Conversion Price as would have been obtained had such revised terms been in effect upon the original date of issuance of such Option or Convertible Security. Notwithstanding the foregoing, no readjustment pursuant to this clause (b) shall have the effect of increasing the applicable Conversion Price for any series of Series Preferred to an amount which exceeds the lower of (i) the applicable Conversion Price for such series in effect immediately prior to the original adjustment made as a result of the issuance of such Option or Convertible Security, or (ii) the applicable Conversion Price for such series that would have resulted from any issuances of Additional Shares of Common Stock (other than deemed issuances of Additional Shares of Common Stock as a result of the issuance of such Option or Convertible Security) between the original adjustment date and such readjustment date.

(c) If the terms of any Option or Convertible Security (excluding Options or Convertible Securities which are themselves Exempted Securities), the issuance of which did not result in an adjustment to the applicable Conversion Price for any series of Series Preferred pursuant to the terms of Subsections 4.4.4 below (either because the consideration per share (determined pursuant to Subsection 4.4.5 hereof) of the Additional Shares of Common Stock subject thereto was equal to or greater than the applicable Conversion Price for each such series then in effect, or because such Option or Convertible Security was issued before the applicable Series Preferred Original Issue Date), are revised after the Series Preferred Original Issue Date as a result of an amendment to such terms or any other adjustment pursuant to the provisions of such Option or Convertible Security (but excluding automatic adjustments to such terms pursuant to anti-dilution or similar provisions of such Option or Convertible Security) to provide for either (1) any increase or decrease in the number of shares of Common Stock issuable upon the exercise, conversion or exchange of any such Option or Convertible Security or (2) any increase or decrease in the consideration payable to the Corporation upon such exercise, conversion or exchange, then such Option or Convertible Security, as so amended or adjusted, and the Additional Shares of Common Stock subject thereto (determined in the manner provided in Subsection 4.4.3(a) above) shall be deemed to have been issued effective upon such increase or decrease becoming effective.

(d) Upon the expiration or termination of any unexercised Option or unconverted or unexchanged Convertible Security (or portion thereof) which resulted

(either upon its original issuance or upon a revision of its terms) in an adjustment to the applicable Conversion Price for any series of Series Preferred pursuant to the terms of Subsections 4.4.4 below, the applicable Conversion Price for such series shall be readjusted to such applicable Conversion Price as would have been obtained had such Option or Convertible Security (or portion thereof) never been issued.

(e) If the number of shares of Common Stock issuable upon the exercise, conversion and/or exchange of any Option or Convertible Security, or the consideration payable to the Corporation upon such exercise, conversion and/or exchange, cannot be determined at the time such Option or Convertible Security is issued or amended, any adjustment to the applicable Conversion Price for any series of Series Preferred that would result under the terms of this Subsection 4.4.3 at the time of such issuance or amendment shall instead be effected at the time such number of shares and/or amount of consideration is first determinable (assuming for purposes of calculating such adjustment to the applicable Conversion Price for such series that such issuance or amendment took place at the time such determination can be made).

4.4.4 Adjustment of Conversion Price for Series D-1 Preferred Stock, Series D Preferred Stock, Series C Preferred Stock, Series B/B-1 Preferred Stock and Series A Preferred Stock Upon Issuance of Additional Shares of Common Stock. In the event the Corporation shall at any time after the Series D-1 Original Issue Date issue Additional Shares of Common Stock (including Additional Shares of Common Stock deemed to be issued pursuant to Subsection 4.4.3), without consideration or for a consideration per share less than the Conversion Price for the Series D-1 Preferred Stock, Series D Preferred Stock, Series C Preferred Stock, Series B/B-1 Preferred Stock or Series A Preferred Stock, as applicable, in effect immediately prior to such issue, then the Conversion Price for the Series D-1 Preferred Stock, Series D Preferred Stock, Series C Preferred Stock, Series B/B-1 Preferred Stock or Series A Preferred Stock, as applicable, shall be reduced, concurrently with such issue, to the consideration per share received by the Corporation for such issue or deemed issue of the Additional Shares of Common Stock; provided that if such issuance or deemed issuance was without consideration, then the Corporation shall be deemed to have received an aggregate of $0.0001 of consideration for all such Additional Shares of Common Stock issued or deemed to be issued.

4.4.5 Determination of Consideration. For purposes of this Subsection 4.4, the consideration received by the Corporation for the issuance of any Additional Shares of Common Stock shall be computed as follows:

(a) Cash and Property: Such consideration shall:

(i) insofar as it consists of cash, be computed at the aggregate amount of cash received by the Corporation, excluding amounts paid or payable for accrued interest;

(ii) insofar as it consists of property other than cash, be computed at the fair market value thereof at the time of such issue, as determined in good faith by

the Board (including the affirmative consent of at least one (1) LC Director); and

(iii) in the event Additional Shares of Common Stock are issued together with other shares or securities or other assets of the Corporation for consideration which covers both, be the proportion of such consideration so received, computed as provided in clauses (i) and (ii) above, as determined in good faith by the Board (including the affirmative consent of at least one (1) LC Director).

(b) Options and Convertible Securities. The consideration per share received by the Corporation for Additional Shares of Common Stock deemed to have been issued pursuant to Subsection 4.4.3, relating to Options and Convertible Securities, shall be determined by dividing:

(i) the total amount, if any, received or receivable by the Corporation as consideration for the issue of such Options or Convertible Securities, plus the minimum aggregate amount of additional consideration (as set forth in the instruments relating thereto, without regard to any provision contained therein for a subsequent adjustment of such consideration) payable to the Corporation upon the exercise of such Options or the conversion or exchange of such Convertible Securities, or in the case of Options for Convertible Securities, the exercise of such Options for Convertible Securities and the conversion or exchange of such Convertible Securities, by

(ii) the maximum number of shares of Common Stock (as set forth in the instruments relating thereto, without regard to any provision contained therein for a subsequent adjustment of such number) issuable upon the exercise of such Options or the conversion or exchange of such Convertible Securities, or in the case of Options for Convertible Securities, the exercise of such Options for Convertible Securities and the conversion or exchange of such Convertible Securities.

4.4.6 Multiple Closing Dates. In the event the Corporation shall issue on more than one date Additional Shares of Common Stock that are a part of one transaction or a series of related transactions and that would result in an adjustment to the Conversion Price for any series of Series Preferred pursuant to the terms of Subsection 4.4.4 above, and such issuance

dates occur within a period of no more than ninety (90) days from the first such issuance to the final such issuance, then, upon the final such issuance, the applicable Conversion Price for such series shall be readjusted to give effect to all such issuances as if they occurred on the date of the first such issuance (and without giving effect to any additional adjustments as a result of any such subsequent issuances within such period).

4.5 Adjustment for Stock Splits and Combinations. If the Corporation shall at any time or from time to time after the applicable Series Preferred Original Issue Date effect a subdivision of the outstanding Common Stock, the Conversion Price for each series of Series Preferred in effect immediately before that subdivision shall be proportionately decreased so that the number of shares of Common Stock issuable on conversion of each share of such series shall be increased in proportion to such increase in the aggregate number of shares of Common Stock outstanding. If the Corporation shall at any time or from time to time after the applicable Series Preferred Original Issue Date combine the outstanding shares of Common Stock, the Conversion Price for each series of Series Preferred in effect immediately before the combination shall be proportionately increased so that the number of shares of Common Stock issuable on conversion of each share of such series shall be decreased in proportion to such decrease in the aggregate number of shares of Common Stock outstanding. Any adjustment under this subsection shall become effective at the close of business on the date the subdivision or combination becomes effective.

4.6 Adjustment for Certain Dividends and Distributions. In the event the Corporation at any time or from time to time after the applicable Series Preferred Original Issue Date shall make or issue, or fix a record date for the determination of holders of Common Stock entitled to receive, a dividend or other distribution payable on the Common Stock in additional shares of Common Stock, then and in each such event the Conversion Price for each series of Series Preferred in effect immediately before such event shall be decreased as of the time of such issuance or, in the event such a record date shall have been fixed, as of the close of business on such record date, by multiplying the applicable Conversion Price for such series then in effect by a fraction equal to:

(1) the numerator of which shall be the total number of shares of Common Stock issued and outstanding immediately prior to the time of such issuance or the close of business on such record date, and

(2) the denominator of which shall be the total number of shares of Common Stock issued and outstanding immediately prior to the time of such issuance or the close of business on such record date plus the number of shares of Common Stock issuable in payment of such dividend or distribution.

Notwithstanding the foregoing, (a) if such record date shall have been fixed and such dividend is not fully paid or if such distribution is not fully made on the date fixed therefor, the Conversion Price for each series of Series Preferred shall be recomputed accordingly as of the close of business on such record date and thereafter the Conversion Price for each series shall be adjusted

pursuant to this subsection as of the time of actual payment of such dividends or distributions; and (b) that no such adjustment shall be made if the holders of Series Preferred simultaneously receive a dividend or other distribution of shares of Common Stock in a number equal to the number of shares of Common Stock as they would have received if all outstanding shares of Series Preferred had been converted into Common Stock on the date of such event.

4.7 Adjustments for Other Dividends and Distributions. In the event the Corporation at any time or from time to time after the applicable Series Preferred Original Issue Date shall make or issue, or fix a record date for the determination of holders of Common Stock entitled to receive, a dividend or other distribution payable in securities of the Corporation (other than a distribution of shares of Common Stock in respect of outstanding shares of Common Stock) or in other property and the provisions of Section 1 do not apply to such dividend or distribution, then and in each such event the holders of Series Preferred shall receive, simultaneously with the distribution to the holders of Common Stock, a dividend or other distribution of such securities or other property in an amount equal to the amount of such securities or other property as they would have received if all outstanding shares of Series Preferred had been converted into Common Stock on the date of such event.

4.8 Adjustment for Merger or Reorganization, etc. Subject to the provisions of Subsection 2.3, if there shall occur any reorganization, recapitalization, reclassification, consolidation, merger or similar event involving the Corporation in which the Common Stock (but not the Series Preferred) is converted into or exchanged for securities, cash or other property (other than a transaction covered by Subsections 4.4, 4.6 or 4.7), then, following any such reorganization, recapitalization, reclassification, consolidation or merger, each share of Series Preferred shall thereafter be convertible in lieu of the Common Stock into which it was convertible prior to such event into the kind and amount of securities, cash or other property which a holder of the number of shares of Common Stock of the Corporation issuable upon conversion of one share of Series Preferred immediately prior to such reorganization, recapitalization, reclassification, consolidation or merger would have been entitled to receive pursuant to such transaction; and, in such case, appropriate adjustment (as determined in good faith by the Board) shall be made in the application of the provisions in this Section 4 with respect to the rights and interests thereafter of the holders of the Series Preferred, to the end that the provisions set forth in this Section 4 (including provisions with respect to changes in and other adjustments of the applicable Conversion Price for any series of Series Preferred) shall thereafter be applicable, as nearly as reasonably may be, in relation to any securities or other property thereafter deliverable upon the conversion of the Series Preferred.

4.9 Certificate as to Adjustments. Upon the occurrence of each adjustment or readjustment of the Conversion Price for any series of Series Preferred pursuant to this Section 4, the Corporation at its expense shall as promptly as reasonably practicable but in any event not later than ten (10) days thereafter, compute such adjustment or readjustment in accordance with the terms hereof and furnish to each holder of Series Preferred a certificate setting forth such adjustment or readjustment (including the kind and amount of securities, cash or other property into which the Series Preferred is convertible) and showing in detail the facts upon which such adjustment or readjustment is based. The Corporation shall, as promptly as reasonably practicable after the written request at any time of any holder of Series Preferred (but in any event not later than ten (10) days thereafter), furnish or cause to be furnished to such holder a

certificate setting forth (i) the Conversion Price for such series then in effect, and (ii) the number of shares of Common Stock and the amount, if any, of other securities, cash or property which then would be received upon the conversion of Series Preferred.

4.10 Notice of Record Date. In the event:

(a) the Corporation shall take a record of the holders of its Common Stock (or other capital stock or securities at the time issuable upon conversion of the Series Preferred) for the purpose of entitling or enabling them to receive any dividend or other distribution, or to receive any right to subscribe for or purchase any shares of capital stock of any class or any other securities, or to receive any other security;

(b) of any capital reorganization of the Corporation, any reclassification of the Common Stock of the Corporation, or any Deemed Liquidation Event; or

(c) of the voluntary or involuntary dissolution, liquidation or winding-up of the Corporation,

then, and in each such case, the Corporation will send or cause to be sent to the holders of the Series Preferred a notice specifying, as the case may be, (i) the record date for such dividend, distribution or right, and the amount and character of such dividend, distribution or right, or (ii) the effective date on which such reorganization, reclassification, consolidation, merger, transfer, dissolution, liquidation or winding-up is proposed to take place, and the time, if any is to be fixed, as of which the holders of record of Common Stock (or such other capital stock or securities at the time issuable upon the conversion of the Series Preferred) shall be entitled to exchange their shares of Common Stock (or such other capital stock or securities) for securities or other property deliverable upon such reorganization, reclassification, consolidation, merger, transfer, dissolution, liquidation or winding-up, and the amount per share and character of such exchange applicable to the Series Preferred and the Common Stock. Such notice shall be sent at least ten (10) days prior to the record date or effective date for the event specified in such notice.

5. Mandatory Conversion.

5.1 Trigger Events. Upon either (a) the closing of the sale of shares of Common Stock to the public (i) in which the price per share paid by the public (prior to the deduction of underwriting discounts and registration expenses) multiplied by the fully-diluted outstanding shares of the Corporation immediately prior to such closing (inclusive of options, warrants, other convertible securities and shares reserved under any equity plan) is no less than $150,000,000 and (ii) resulting in at least $30,000,000 in gross proceeds to the Corporation (prior to the deduction of underwriting discounts and registration expenses), in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act of 1933, as amended (the "**Qualified IPO**"), or (b) the date and time, or the occurrence of an event, specified by vote or written consent of the Requisite Holders (the time of such closing or the date and time specified or the time of the event specified in such vote or written consent is referred to herein as the "**Mandatory Conversion Time**"), (i) all outstanding shares of Series Preferred shall automatically be converted into shares of Common Stock, at the then effective conversion rate and (ii) such shares may not be reissued by the Corporation.

5.2 Procedural Requirements. All holders of record of shares of Series Preferred shall be sent written notice of the Mandatory Conversion Time and the place designated for mandatory conversion of all such shares of Series Preferred pursuant to this Section 5. Such notice need not be sent in advance of the occurrence of the Mandatory Conversion Time. Upon receipt of such notice, each holder of shares of Series Preferred shall surrender his, her or its certificate or certificates for all such shares (or, if such holder alleges that such certificate has been lost, stolen or destroyed, a lost certificate affidavit and agreement reasonably acceptable to the Corporation to indemnify the Corporation against any claim that may be made against the Corporation on account of the alleged loss, theft or destruction of such certificate) to the Corporation at the place designated in such notice, and shall thereafter receive certificates for the number of shares of Common Stock to which such holder is entitled pursuant to this Section 5. At the Mandatory Conversion Time, all outstanding shares of Series Preferred shall be deemed to have been converted into shares of Common Stock, which shall be deemed to be outstanding of record, and all rights with respect to the Series Preferred so converted, including the rights, if any, to receive notices and vote (other than as a holder of Common Stock), will terminate, except only the rights of the holders thereof, upon surrender of their certificate or certificates (or lost certificate affidavit and agreement) therefor, to receive the items provided for in the last sentence of this Subsection 5.2. If so required by the Corporation, certificates surrendered for conversion shall be endorsed or accompanied by written instrument or instruments of transfer, in form reasonably satisfactory to the Corporation, duly executed by the registered holder or by his, her or its attorney duly authorized in writing. As soon as practicable after the Mandatory Conversion Time and the surrender of the certificate or certificates (or lost certificate affidavit and agreement) for Series Preferred, the Corporation shall issue and deliver to such holder, or to his, her or its nominees, a certificate or certificates for the number of full shares of Common Stock issuable on such conversion in accordance with the provisions hereof, together with cash as provided in Subsection 4.2 in lieu of any fraction of a share of Common Stock otherwise issuable upon such conversion.

5.3 Effect of Mandatory Conversion. All certificates evidencing shares of Series Preferred which are required to be surrendered for conversion in accordance with the provisions hereof shall, from and after the Mandatory Conversion Time, be deemed to have been retired and cancelled and the shares of Series Preferred represented thereby converted into Common Stock for all purposes, notwithstanding the failure of the holder or holders thereof to surrender such certificates on or prior to such date. Such converted Series Preferred may not be reissued as shares of such series, and the Corporation may thereafter take such appropriate action (without the need for stockholder action) as may be necessary to reduce the authorized number of shares of each such series of Series Preferred accordingly.

6. Redemption.

6.1 Request for Redemption. Subject to the terms and conditions of this Section 6 and the provisions of applicable law, the Corporation shall, (i) subject to the Corporation receiving any requisite consents from any applicable lending institutions, upon receiving a written request from LC (as defined in the Purchase Agreement) in the event that the Corporation has not received at least an aggregate of $15,000,000 of gross proceeds under the Purchase Agreement within 120 days after the filing of this Certificate of Incorporation, or (ii) upon receiving a written request at any time after December 31, 2021, signed by the holders of a

majority of the then outstanding shares of the Series D-1 Preferred Stock (the holders making such request in sub-clause (i) or (ii), as applicable, the "**Redeeming Holders**" and each of them, a "**Redeeming Holder**"), redeem, on the date three (3) months following the Corporation's receipt of such written redemption request (the "**Redemption Date**"), all of the Series D-1 Preferred Stock held by such Redeeming Holders that are outstanding on the date the Corporation receives such written redemption request to the extent that such outstanding shares of Series D-1 Preferred Stock have not been previously redeemed or converted into shares of Common Stock at least three (3) days prior to the Redemption Date. The shares of Series D-1 Preferred Stock called for redemption as provided above shall be redeemed in cash at the Redemption Price of such shares of Series D-1 Preferred Stock and such Redemption Price shall be paid from any source of funds legally available therefor, until (a) all outstanding shares of Series D-1 Preferred Stock to be redeemed have been redeemed or have been converted to shares of Common Stock as provided in Section 4 and Section 5 hereof or (b) the request for redemption has been withdrawn or terminated as provided below.

6.2 Withdrawal or Termination of Request. A redemption request may be withdrawn or terminated upon the request of a Redeeming Holder with respect to the shares of Series D-1 Preferred Stock held by such Redeeming Holder, but only with respect to the shares of Series D-1 Preferred Stock that had not been redeemed in full in cash as of the date such request for withdrawal or termination is made. After any such withdrawn or terminated redemption request, the shares of Series D-1 Preferred Stock subject thereto shall again be subject to redemption pursuant to Section 6.1 hereof.

6.3 Redemption Price. The redemption price for each share of Series D-1 Preferred Stock (the "**Redemption Price**") shall equal an amount in cash equal to the higher of (i) the Original Issue Price for the Series D-1 Preferred Stock plus all declared but unpaid dividends on such Series D-1 Preferred Stock up to the Redemption Date and (ii) the fair market value of the share of Series D-1 Preferred Stock, the valuation of which shall be determined by an independent appraisal (exclusive of any liquidity or minority ownership discounts) conducted by an independent third party valuation firm mutually agreed by the Redeeming Holders and the Corporation.

6.4 Insufficient Legally Available Funds. Notwithstanding any other provision set forth in this Section 6, if upon any Redemption Date scheduled for the redemption of shares of Series D-1 Preferred Stock, the funds and assets of the Corporation legally available to redeem such shares of Series D-1 Preferred Stock shall be insufficient to redeem all such shares of Series D-1 Preferred Stock then scheduled to be redeemed, then:

(a) the holders of such shares of Series D-1 Preferred Stock to be redeemed shall share ratably in any redemption in proportion to the respective Redemption Prices that would otherwise be payable in respect of such shares of Series D-1 Preferred Stock held by them upon such redemption if all amounts payable on or with respect to such shares of Series D-1 Preferred Stock were paid in full; and

(b) any unredeemed shares of Series D-1 Preferred Stock shall be carried forward and shall be redeemed (together with any other shares of Series D-1 Preferred Stock then scheduled to be redeemed) at the next such scheduled Redemption Date determined

by the Redeeming Holders to the full extent of legally available funds of the Corporation at such time.

Any such unredeemed shares of Series D-1 Preferred Stock shall continue to be so carried forward until redeemed and shall continue to be outstanding and entitled to all dividend, liquidation, conversion and other rights, powers and preferences of the Series D-1 Preferred Stock respectively until three (3) days prior to the Redemption Date upon which such shares of Series D-1 Preferred Stock are to be redeemed.

6.5 Redemption Notice. At least twenty (20) but no more than sixty (60) days prior to the initial Redemption Date for the shares of Series D-1 Preferred Stock, written notice in accordance with the provisions of Section 9 hereof shall be mailed by the Corporation to each Redeeming Holder, notifying such Redeeming Holder of (a) the redemption to be effected, (b) specifying the Redemption Date(s), the applicable Redemption Price, the number of shares of Series D-1 Preferred Stock held by such Redeeming Holder to be redeemed, the place at which payment may be obtained and the date on which such Redeeming Holder's Conversion Rights as to such shares of Series D-1 Preferred Stock terminate (which date shall be three (3) days prior to each Redemption Date with respect to the shares of Series D-1 Preferred Stock to be redeemed on that date) and (c) calling upon such Redeeming Holder to surrender to the Corporation, in the manner and at the place designated, the certificate or certificates representing the shares of Series D-1 Preferred Stock to be redeemed (the "**Redemption Notice**"). At least thirty (30) days prior to the Redemption Date, written notice in accordance with the provisions of Section 9 hereof shall be mailed by the Corporation to each holder of Series D-1 Preferred Stock that is not at such time a Redeeming Holder, (a) notifying each such holder of the redemption to be effected, (b) specifying the Redemption Date(s), the applicable Redemption Price, the number of shares of Series D-1 Preferred Stock held by such holder that are eligible to be redeemed if such holder elects to participate in such redemption, the place at which payment may be obtained and the date on which such holder's Conversion Rights as to such shares of Series D-1 Preferred Stock terminate if such holder elects to participate in the redemption (which date shall be three (3) days prior to each Redemption Date with respect to the shares of Series D-1 Preferred Stock to be redeemed on that date), (c) providing such holder the opportunity to notify the Corporation within fifteen (15) days after the date of such notice if such holder elects to participate in the redemption, in which case the holder shall thereafter be deemed a Redeeming Holder, and (d) to the extent such holder elects to participation in the redemption, calling upon such holder to surrender to the Corporation, in the manner and at the place designated, the certificate or certificates representing the shares of Series D-1 Preferred Stock to be redeemed.

6.6 Surrender of Certificates. On or before each designated Redemption Date, each Redeeming Holder shall (unless such Redeeming Holder has previously exercised the right to convert such shares of Series D-1 Preferred Stock into shares of Common Stock as provided in Section 4 hereof), surrender the certificate(s) representing such shares of Series D-1 Preferred Stock to be redeemed to the Corporation (or, if such Redeeming Holder alleges that any such certificate has been lost, stolen or destroyed, a lost certificate affidavit), in the manner and at the place designated in the Redemption Notice, and thereupon the Redemption Price for such shares of Series D-1 Preferred Stock shall be payable to the order of the person whose name appears on such certificate(s) as the owner thereof, and each surrendered certificate shall be cancelled and retired. If less than all of the shares of Series D-1 Preferred Stock represented by such certificate

are redeemed, then the Corporation shall promptly issue a new certificate representing the unredeemed shares of Series D-1 Preferred Stock.

6.7 Effect of Redemption. If the Redemption Notice shall have been duly given to each Redeeming Holder, and if on any Redemption Date the Redemption Price for the shares of Series D-1 Preferred Stock to be redeemed thereon is either paid or made available for payment through the deposit arrangements specified in Section 6.8 hereof, then notwithstanding that the certificates evidencing any of the such shares of Series D-1 Preferred Stock so called for redemption on such Redemption Date shall not have been surrendered, such shares of Series D-1 Preferred Stock shall not thereafter be transferred on the Corporation's books and the rights of all of the holders of such shares of Series D-1 Preferred Stock with respect to such shares of Series D-1 Preferred Stock shall terminate on such Redemption Date, except only the right of the holders to receive the Redemption Price from the Corporation or the payment agent, without interest, upon surrender of their certificate(s) therefor (or, if such holder alleges that any such certificate has been lost, stolen or destroyed, a lost certificate affidavit).

6.8 Deposit of Redemption Price. On or prior to the Redemption Date for any shares of Series D-1 Preferred Stock, the Corporation may, at its option, deposit with an independent payment agent, a sum equal to the aggregate Redemption Price for the shares of Series D-1 Preferred Stock called for redemption on that Redemption Date and not yet redeemed, with irrevocable instructions and authority to the payment agent to pay, on or after the Redemption Date, the Redemption Price to the respective holders upon the surrender of their share certificates (or, if such holder alleges that any such certificate has been lost, stolen or destroyed, a lost certificate affidavit). The deposit shall constitute full payment of the shares of Series D-1 Preferred Stock called for redemption on that Redemption Date to their holders, and from and after such Redemption Date, such shares of Series D-1 Preferred Stock shall be deemed to be redeemed and no longer outstanding. Any funds so deposited and unclaimed at the end of one (1) year from such Redemption Date shall be released or repaid to the Corporation, after which time the holders of shares of Series D-1 Preferred Stock called for redemption who have not claimed such funds shall be entitled to receive payment of the Redemption Price only from the Corporation.

7. Redeemed or Otherwise Acquired Shares. Any shares of Series Preferred which are redeemed or otherwise acquired by the Corporation or any of its subsidiaries shall be automatically and immediately cancelled and retired and shall not be reissued, sold or transferred. Neither the Corporation nor any of its subsidiaries may exercise any voting or other rights granted to the holders of Series Preferred following redemption.

8. Waiver. Any of the rights, powers, preferences and other terms of the Series Preferred set forth herein may be waived on behalf of all holders of Series Preferred by the affirmative consent or vote of the Requisite Holders.

9. Notices. Any notice required or permitted by the provisions of this Article Fourth to be given to a holder of shares of Series Preferred shall be mailed, postage prepaid, to the post office address last shown on the records of the Corporation, or given by electronic communication in compliance with the provisions of the General Corporation Law, and shall be deemed sent upon such mailing or electronic transmission.

FIFTH: The Corporation will not, by amendment of this Certificate of Incorporation or through any reorganization, transfer of capital stock or assets, consolidation, merger, dissolution, issue of securities or any other voluntary action, avoid or seek to avoid the observance or performance of any of the terms of the Series Preferred set forth herein, but will at all times in good faith assist in the carrying out of all such terms. Without limiting the generality of the foregoing, the Corporation (a) will not increase the par value of any shares of stock receivable on the conversion of the Series Preferred above the applicable Original Issue Price and (b) will take such action as may be necessary or appropriate in order that the Corporation may validly and legally issue fully-paid and nonassessable shares of stock on the conversion of the Series Preferred from time to time outstanding.

SIXTH: Subject to any additional vote required by this Certificate of Incorporation, in furtherance and not in limitation of the powers conferred by statute, the Board is expressly authorized to make, repeal, alter, amend and rescind any or all of the Bylaws of the Corporation.

SEVENTH: Elections of directors need not be by written ballot unless the Bylaws of the Corporation shall so provide.

EIGHTH: Meetings of stockholders may be held within or without the State of Delaware, as the Bylaws of the Corporation may provide. The books and records of the Corporation may be kept outside the State of Delaware at such place or places as may be designated from time to time by the Board or in the Bylaws of the Corporation.

NINTH: To the fullest extent permitted by law, a director of the Corporation shall not be personally liable to the Corporation or its stockholders for monetary damages for breach of fiduciary duty as a director. If the General Corporation Law or any other law of the State of Delaware is amended after approval by the stockholders of this Article Ninth to authorize corporate action further eliminating or limiting the personal liability of directors, then the liability of a director of the Corporation shall be eliminated or limited to the fullest extent permitted by the General Corporation Law.

Any repeal or modification of the foregoing provisions of this Article Ninth by the stockholders of the Corporation shall not adversely affect any right or protection of a director of the Corporation existing at the time of, or increase the liability of any director of the Corporation with respect to any acts or omissions of such director occurring prior to, such repeal or modification.

TENTH: The Corporation shall, to the maximum extent permitted from time to time under applicable law, indemnify and hold harmless, and upon request shall advance expenses to any person who is or was a party or is threatened to be made a party to any threatened, pending or completed action, suit, proceeding or claim, whether civil, criminal, administrative or investigative, by reason of the fact that such person is or was or has agreed to be a director or officer of the Corporation or while a director or officer is or was serving at the request of the Corporation as a director, officer, employee or agent of any other corporation, partnership, joint venture, trust or other enterprise, including service with respect to employee benefit plans, against any and all expenses (including attorney’s fees and expenses), judgments,

fines, penalties and amounts paid in settlement or incurred in connection with the investigation, preparation to defend or defense of such action, suit, proceeding or claim. Such rights arising under any bylaw, agreement, vote of directors or stockholders or otherwise shall inure to the benefit of the heirs and legal representatives of such person.

The Corporation hereby acknowledges that, to the extent a director is serving on the Board at the direction of a stockholder who owns shares of Series Preferred (an "**Investor**"), such director may have certain rights to indemnification, advancement of expenses and/or insurance provided by the Investor and/or certain of their affiliates (collectively, the "**Investor Indemnitors**"). The Corporation hereby agrees (i) that it is the indemnitor of first resort (i.e., its obligations to such director are primary and any obligation of the Investor Indemnitors to advance expenses or to provide indemnification for the same expenses or liabilities incurred by such director are secondary); (ii) that it shall be required to advance the full amount of expenses incurred by such director and shall be liable for the full amount of all expenses to the extent legally permitted and as required by the terms of this Certificate of Incorporation or the Bylaws of the Corporation, as amended (or any agreement between the Corporation and such director), without regard to any rights such director may have against the Investor Indemnitors; and, (iii) that it irrevocably waives, relinquishes and releases the Investor Indemnitors from any and all claims against the Investor Indemnitors for contribution, subrogation or any other recovery of any kind in respect thereof. The Corporation further agrees that no advancement or payment by the Investor Indemnitors on behalf of such director with respect to any claim for which such director has sought indemnification from the Corporation shall affect the foregoing and the Investor Indemnitors shall have a right of contribution and/or be subrogated to the extent of such advancement or payment to all of the rights of recovery of such director against the Corporation.

Any amendment, repeal or modification of the foregoing provisions of this Article Tenth shall not adversely affect any right or protection of any director, officer or other agent of the Corporation existing at the time of such amendment, repeal or modification.

ELEVENTH: The Corporation renounces any interest or expectancy of the Corporation in, or in being offered an opportunity to participate in, any Excluded Opportunity. An "**Excluded Opportunity**" is any matter, transaction or interest that is presented to, or acquired, created or developed by, or which otherwise comes into the possession of, (i) any director of the Corporation who is not an employee of the Corporation or any of its subsidiaries, or (ii) any holder of Series Preferred or any partner, member, director, manager, stockholder, employee or agent of any such holder, other than someone who is an employee of the Corporation or any of its subsidiaries (collectively, "**Covered Persons**"), unless such matter, transaction or interest was presented to, or acquired, created or developed by, or otherwise came into the possession of, a Covered Person expressly and solely in such Covered Person's capacity as a director of the Corporation. No amendment, repeal or modification of this Article Eleventh shall apply to or have any effect on the liability or alleged liability of any officer, director or stockholder of the Corporation for or with respect to any opportunities which such officer, director or stockholder becomes aware prior to such amendment, modification or repeal.

TWELFTH: For purposes of Section 500 of the California Corporations Code (to the extent applicable), in connection with any repurchase of shares of Common Stock permitted under this Certificate of Incorporation from employees, officers, directors or

consultants of the Corporation in connection with a termination of employment or services pursuant to agreements or arrangements approved by the Board (in addition to any other consent required under this Certificate of Incorporation), such repurchase may be made without regard to any "preferential dividends arrears amount" or "preferential rights amount" (as those terms are defined in Section 500 of the California Corporations Code). Accordingly, for purposes of making any calculation under California Corporations Code Section 500 in connection with such repurchase, the amount of any "preferential dividends arrears amount" or "preferential rights amount" (as those terms are defined therein) shall be deemed to be zero (0).

* * *

3: That the foregoing amendment and restatement was approved by the holders of the requisite number of shares of the Corporation in accordance with Section 228 of the General Corporation Law.

4: That this Certificate of Incorporation, which restates and integrates and further amends the provisions of the Restated Certificate, has been duly adopted in accordance with Sections 242 and 245 of the General Corporation Law.

IN WITNESS WHEREOF, this Eighth Amended and Restated Certificate of Incorporation has been executed by a duly authorized officer of this corporation on August 4, 2016.

By:	/s/ Erik Holmlin
Name:	Erik Holmlin
Title:	Chief Executive Officer

FIRST CERTIFICATE OF AMENDMENT
TO EIGHTH AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
BIONANO GENOMICS, INC.

BioNano Genomics, Inc. (the "***Corporation***"), a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware (the "***DGCL***"), hereby certifies that:

1. The name of the Corporation is BioNano Genomics, Inc. The Corporation's Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on August 16, 2007 under the name of BioNanomatrix, Inc.

2. The Eighth Amended and Restated Certificate of Incorporation of the Corporation (the "***Charter***") was filed with the Secretary of State of the State of Delaware on August 4, 2016.

3. The Board of Directors of the Corporation (the "***Board***"), acting in accordance with the provisions of Sections 141 and 242 of the DGCL, duly adopted resolutions amending the Charter as follows:

The first sentence of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"**FOURTH:** The total number of shares of all classes of stock which the Corporation shall have authority to issue is (i) 190,559,820 shares of Common Stock, $0.0001 par value per share ("**Common Stock**") and (ii) 165,444,677 shares of Preferred Stock, par value $0.0001 per share, 418,767 shares of which are designated "Series A Convertible Participating Preferred Stock" (the "**Series A Preferred Stock**"), 8,101,042 shares of which are designated "Series B Convertible Participating Preferred Stock" (the "**Series B Preferred Stock**"), 7,523,734 shares of which are designated "Series B-1 Convertible Participating Preferred Stock" (the "**Series B-1 Preferred Stock**" and together with the Series B Preferred Stock, the "**Series B/B-1 Preferred Stock**,"), 23,357,047 shares of which are designated "Series C Convertible Participating Preferred Stock" (the "**Series C Preferred Stock**"), 52,835,720 shares of which are designated "Series D Convertible Participating Preferred Stock" (the "**Series D Preferred Stock**"), and 73,208,367 shares of which are designated "Series D-1 Convertible Participating Preferred Stock" (the "**Series D-1 Preferred Stock**" and, together with the Series A Preferred Stock, the Series B/B-1 Preferred Stock, the Series C Preferred Stock, and the Series D Preferred Stock, the "**Series Preferred**")."

4. Thereafter, pursuant to a resolution of the Board, this First Certificate of Amendment was submitted to the stockholders of the Corporation for their approval, and was duly adopted in accordance with Sections 228 and 242 of the DGCL.

5. All other provisions of the Eighth Amended and Restated Certificate of Incorporation of the Corporation, as currently on file with the Secretary of State of the State of Delaware, shall remain in full force and effect.

[SIGNATURE PAGE FOLLOWS]

In Witness Whereof, the Corporation has caused this First Certificate of Amendment to be signed by its Chief Executive Officer this 9th day of December, 2016.

/s/ R. Erik Holmlin

Name: R. Erik Holmlin
Title: Chief Executive Officer

SECOND CERTIFICATE OF AMENDMENT
TO EIGHTH AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
BIONANO GENOMICS, INC.

BioNano Genomics, Inc. (the "***Corporation***"), a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware (the "***DGCL***"), hereby certifies that:

1. The name of the Corporation is BioNano Genomics, Inc. The Corporation's Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on August 16, 2007 under the name of BioNanomatrix, Inc.

2. The Eighth Amended and Restated Certificate of Incorporation of the Corporation (the "***Charter***") was filed with the Secretary of State of the State of Delaware on August 4, 2016.

3. The Board of Directors of the Corporation (the "***Board***"), acting in accordance with the provisions of Sections 141 and 242 of the DGCL, duly adopted resolutions amending the Charter as follows:

(i) The first sentence of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"**FOURTH:** The total number of shares of all classes of stock which the Corporation shall have authority to issue is (i) 211,393,220 shares of Common Stock, $0.0001 par value per share ("**Common Stock**") and (ii) 186,278,077 shares of Preferred Stock, par value $0.0001 per share, 418,767 shares of which are designated "Series A Convertible Participating Preferred Stock" (the "**Series A Preferred Stock**"), 8,101,042 shares of which are designated "Series B Convertible Participating Preferred Stock" (the "**Series B Preferred Stock**"), 7,523,734 shares of which are designated "Series B-1 Convertible Participating Preferred Stock" (the "**Series B-1 Preferred Stock**" and together with the Series B Preferred Stock, the "**Series B/B-1 Preferred Stock**,"), 23,357,047 shares of which are designated "Series C Convertible Participating Preferred Stock" (the "**Series C Preferred Stock**"), 52,835,720 shares of which are designated "Series D Convertible Participating Preferred Stock" (the "**Series D Preferred Stock**"), and 94,041,767 shares of which are designated "Series D-1 Convertible Participating Preferred Stock" (the "**Series D-1 Preferred Stock**" and, together with the Series A Preferred Stock, the Series B/B-1 Preferred Stock, the Series C Preferred Stock, and the Series D Preferred Stock, the "**Series Preferred**")."

(ii) The Last Paragraph of Article FOURTH, Section B.2.3.1 is hereby amended and restated in its entirety as follows:

"Notwithstanding anything to the contrary herein, the sale of shares of Series D-1 Preferred Stock by the Corporation under that certain Series D-1 Convertible Participating Preferred Stock Purchase Agreement, dated on or about the date hereof, by and among the Corporation and the Purchasers set forth on Exhibit A thereto (as the same may be amended from time to time, the "**Purchase Agreement**") shall not in any circumstances be considered a "Deemed Liquidation Event."

4. Thereafter, pursuant to a resolution of the Board, this Second Certificate of Amendment was submitted to the stockholders of the Corporation for their approval, and was duly adopted in accordance with Sections 228 and 242 of the DGCL.

5. All other provisions of the Charter, as amended to date and as currently on file with the Secretary of State of the State of Delaware, shall remain in full force and effect.

[SIGNATURE PAGE FOLLOWS]

IN WITNESS WHEREOF, the Corporation has caused this Second Certificate of Amendment to be signed by its Chief Executive Officer this 25th day of January, 2017.

/s/ R. Erik Holmlin

Name: R. Erik Holmlin
Title: Chief Executive Officer

THIRD CERTIFICATE OF AMENDMENT
TO EIGHTH AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
BIONANO GENOMICS, INC.

BioNano Genomics, Inc. (the "***Corporation***"), a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware (the "***DGCL***"), hereby certifies that:

1. The name of the Corporation is BioNano Genomics, Inc. The Corporation's Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on August 16, 2007 under the name of BioNanomatrix, Inc.

2. The Eighth Amended and Restated Certificate of Incorporation of the Corporation (the "***Charter***") was filed with the Secretary of State of the State of Delaware on August 4, 2016.

3. The Board of Directors of the Corporation (the "***Board***"), acting in accordance with the provisions of Sections 141 and 242 of the DGCL, duly adopted resolutions amending the Charter as follows:

(i) The first sentence of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"**FOURTH:** The total number of shares of all classes of stock which the Corporation shall have authority to issue is (i) 243,160,120 shares of Common Stock, $0.0001 par value per share ("**Common Stock**") and (ii) 218,044,977 shares of Preferred Stock, par value $0.0001 per share, 418,767 shares of which are designated "Series A Convertible Participating Preferred Stock" (the "**Series A Preferred Stock**"), 8,101,042 shares of which are designated "Series B Convertible Participating Preferred Stock" (the "**Series B Preferred Stock**"), 7,523,734 shares of which are designated "Series B-1 Convertible Participating Preferred Stock" (the "**Series B-1 Preferred Stock**" and together with the Series B Preferred Stock, the "**Series B/B-1 Preferred Stock**,"), 23,357,047 shares of which are designated "Series C Convertible Participating Preferred Stock" (the "**Series C Preferred Stock**"), 52,835,720 shares of which are designated "Series D Convertible Participating Preferred Stock" (the "**Series D Preferred Stock**"), and 125,808,667 shares of which are designated "Series D-1 Convertible Participating Preferred Stock" (the "**Series D-1 Preferred Stock**" and, together with the Series A Preferred Stock, the Series B/B-1 Preferred Stock, the Series C Preferred Stock, and the Series D Preferred Stock, the "**Series Preferred**")."

4. Thereafter, pursuant to a resolution of the Board, this Third Certificate of Amendment was submitted to the stockholders of the Corporation for their approval, and was duly adopted in accordance with Sections 228 and 242 of the DGCL.

5. All other provisions of the Charter, as amended to date and as currently on file with the Secretary of State of the State of Delaware, shall remain in full force and effect.

[SIGNATURE PAGE FOLLOWS]

IN WITNESS WHEREOF, the Corporation has caused this Third Certificate of Amendment to be signed by its Chief Executive Officer this 17th day of November, 2017.

/s/ R. Erik Holmlin

Name: R. Erik Holmlin
Title: Chief Executive Officer

FOURTH CERTIFICATE OF AMENDMENT
TO EIGHTH AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
BIONANO GENOMICS, INC.

BioNano Genomics, Inc. (the "***Corporation***"), a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware (the "***DGCL***"), hereby certifies that:

1. The name of the Corporation is BioNano Genomics, Inc. The Corporation's Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on August 16, 2007 under the name of BioNanomatrix, Inc.

2. The Eighth Amended and Restated Certificate of Incorporation of the Corporation (the "***Charter***") was filed with the Secretary of State of the State of Delaware on August 4, 2016.

3. The Board of Directors of the Corporation (the "***Board***"), acting in accordance with the provisions of Sections 141 and 242 of the DGCL, duly adopted resolutions amending the Charter as follows:

(i) The first sentence of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"The total number of shares of all classes of stock which the Corporation shall have authority to issue is (i) 244,097,620 shares of Common Stock, $0.0001 par value per share ("**Common Stock**") and (ii) 218,982,477 shares of Preferred Stock, par value $0.0001 per share, 418,767 shares of which are designated "Series A Convertible Participating Preferred Stock" (the "**Series A Preferred Stock**"), 8,101,042 shares of which are designated "Series B Convertible Participating Preferred Stock" (the "**Series B Preferred Stock**"), 7,523,734 shares of which are designated "Series B-1 Convertible Participating Preferred Stock" (the "**Series B-1 Preferred Stock**" and together with the Series B Preferred Stock, the "**Series B/B-1 Preferred Stock**,"), 23,357,047 shares of which are designated "Series C Convertible Participating Preferred Stock" (the "**Series C Preferred Stock**"), 52,835,720 shares of which are designated "Series D Convertible Participating Preferred Stock" (the "**Series D Preferred Stock**"), and 126,746,167 shares of which are designated "Series D-1 Convertible Participating Preferred Stock" (the "**Series D-1 Preferred Stock**" and, together with the Series A Preferred Stock, the Series B/B-1 Preferred Stock, the Series C Preferred Stock, and the Series D Preferred Stock, the "**Series Preferred**")."

(ii) The first sentence of Section 6.1 of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"Subject to the terms and conditions of this Section 6 and the provisions of applicable law, the Corporation shall, (i) subject to the Corporation receiving any requisite consents from any applicable lending institutions, upon receiving a written request from LC (as defined in the Purchase Agreement) in the event that the Corporation has not received at least an aggregate of $15,000,000 of gross proceeds under the Purchase Agreement within 120 days after the filing of this Certificate of Incorporation, or (ii) subject to the

Corporation receiving any requisite consents from any applicable lending institutions, upon receiving a written request at any time after December 31, 2021, signed by the holders of a majority of the then outstanding shares of the Series D-1 Preferred Stock (the holders making such request in sub-clause (i) or (ii), as applicable, the "**Redeeming Holders**" and each of them, a "**Redeeming Holder**"), redeem, on the date three (3) months following the Corporation's receipt of such written redemption request (the "**Redemption Date**"), all of the Series D-1 Preferred Stock held by such Redeeming Holders that are outstanding on the date the Corporation receives such written redemption request to the extent that such outstanding shares of Series D-1 Preferred Stock have not been previously redeemed or converted into shares of Common Stock at least three (3) days prior to the Redemption Date."

4. Thereafter, pursuant to a resolution of the Board, this Fourth Certificate of Amendment was submitted to the stockholders of the Corporation for their approval, and was duly adopted in accordance with Sections 228 and 242 of the DGCL.

5. All other provisions of the Charter, as amended to date and as currently on file with the Secretary of State of the State of Delaware, shall remain in full force and effect.

[SIGNATURE PAGE FOLLOWS]

IN WITNESS WHEREOF, the Corporation has caused this Fourth Certificate of Amendment to be signed by its Chief Executive Officer this 29th day of June, 2018.

/s/ R. Erik Holmlin

Name: R. Erik Holmlin
Title: Chief Executive Officer

FIFTH CERTIFICATE OF AMENDMENT
TO EIGHTH AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
BIONANO GENOMICS, INC.

BioNano Genomics, Inc. (the "***Corporation***"), a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware (the "***DGCL***"), hereby certifies that:

1. The name of the Corporation is BioNano Genomics, Inc. The Corporation's Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on August 16, 2007 under the name of BioNanomatrix, Inc.

2. The Eighth Amended and Restated Certificate of Incorporation of the Corporation (the "***Charter***") was filed with the Secretary of State of the State of Delaware on August 4, 2016.

3. The Board of Directors of the Corporation (the "***Board***"), acting in accordance with the provisions of Sections 141 and 242 of the DGCL, duly adopted resolutions amending the Charter as follows:

(i) The first sentence of Article ONE of the Charter is hereby amended and restated in its entirety as follows:

"The name of the Corporation is Bionano Genomics, Inc."

(ii) The second paragraph of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"Effective immediately upon the Fifth Certificate of Amendment to this Certificate of Incorporation becoming effective under the General Corporation Law, and without any further action by the holders of such shares, every 21.4 outstanding shares of Common Stock shall automatically combine into and become one validly issued, fully paid and non-assessable share of Common Stock (the "**Reverse Stock Split**"). No fractional shares of Common Stock shall be issued upon the Reverse Stock Split. The Reverse Stock Split shall be effected on a record holder-by-record holder basis, such that any fractional shares of Common Stock resulting from the Reverse Stock Split and held by a single record holder shall be aggregated. If the Reverse Stock Split would result in the issuance of any fractional share, the Corporation shall, in lieu of issuing any fractional share, pay cash equal to the product of such fraction multiplied by the fair market value of one share of Common Stock (as determined by the Board) on the date that the Reverse Stock Split is effective, rounded up to the nearest whole cent. The par value of each share of Common Stock shall not be adjusted in connection with the Reverse Stock Split. All of the outstanding share amounts, amounts per share and per share numbers in this Certificate of Incorporation shall be appropriately adjusted to give effect to the Reverse Stock Split."

(iii) The first sentence of Section 3.2 of Part B of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"The number of directors constituting the Board shall be eight (8)."

(iv) The first sentence of Section 3.2.1 of Part B of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"For so long as any shares of Series D-1 Preferred Stock remain outstanding, the holders of Series D-1 Preferred Stock shall be entitled to elect one (1) member of the Board at each meeting or pursuant to each consent of the Corporation's stockholders for the election of directors."

(v) Section 5.1 of Part B of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"Upon either (a) the closing of the sale of shares of Common Stock to the public (i) in which the price per share paid by the public (prior to the deduction of underwriting discounts and registration expenses) is no less than $6.00 per share (as adjusted for any stock dividends, combinations, splits, recapitalizations and the like with respect to such shares effectuated after July 16, 2018) and (ii) resulting in at least $25,000,000 in gross proceeds to the Corporation (prior to the deduction of underwriting discounts and registration expenses), in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act of 1933, as amended (the "**Qualified IPO**"), or (b) the date and time, or the occurrence of an event, specified by vote or written consent of the Requisite Holders (the time of such closing or the date and time specified or the time of the event specified in such vote or written consent is referred to herein as the "**Mandatory Conversion Time**"), (i) all outstanding shares of Series Preferred shall automatically be converted into shares of Common Stock, at the then effective conversion rate and (ii) such shares may not be reissued by the Corporation."

4. Thereafter, pursuant to a resolution of the Board, this Fifth Certificate of Amendment was submitted to the stockholders of the Corporation for their approval, and was duly adopted in accordance with Sections 228 and 242 of the DGCL.

5. All other provisions of the Charter, as amended to date and as currently on file with the Secretary of State of the State of Delaware, shall remain in full force and effect.

[SIGNATURE PAGE FOLLOWS]

IN WITNESS WHEREOF, the Corporation has caused this Fifth Certificate of Amendment to be signed by its Chief Executive Officer this 16th day of July, 2018.

/s/ R. Erik Holmlin
Name: R. Erik Holmlin
Title: Chief Executive Officer

SIXTH CERTIFICATE OF AMENDMENT
TO EIGHTH AMENDED AND RESTATED
CERTIFICATE OF INCORPORATION
OF
BIONANO GENOMICS, INC.

Bionano Genomics, Inc. (the "***Corporation***"), a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware (the "***DGCL***"), hereby certifies that:

1. The name of the Corporation is Bionano Genomics, Inc. The Corporation's Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on August 16, 2007 under the name of BioNanomatrix, Inc.

2. The Eighth Amended and Restated Certificate of Incorporation of the Corporation (the "***Charter***") was filed with the Secretary of State of the State of Delaware on August 4, 2016.

3. The Board of Directors of the Corporation (the "***Board***"), acting in accordance with the provisions of Sections 141 and 242 of the DGCL, duly adopted resolutions amending the Charter as follows:

(i) Section 5.1 of Part B of Article FOURTH of the Charter is hereby amended and restated in its entirety as follows:

"Upon either (a) the closing of the sale of shares of Common Stock to the public (i) in which the price per share paid by the public (prior to the deduction of underwriting discounts and registration expenses) is no less than $5.00 per share (as adjusted for any stock dividends, combinations, splits, recapitalizations and the like with respect to such shares effectuated after July 16, 2018) and (ii) resulting in at least $25,000,000 in gross proceeds to the Corporation (prior to the deduction of underwriting discounts and registration expenses), in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act of 1933, as amended (the "**Qualified IPO**"), or (b) the date and time, or the occurrence of an event, specified by vote or written consent of the Requisite Holders (the time of such closing or the date and time specified or the time of the event specified in such vote or written consent is referred to herein as the "**Mandatory Conversion Time**"), (i) all outstanding shares of Series Preferred shall automatically be converted into shares of Common Stock, at the then effective conversion rate and (ii) such shares may not be reissued by the Corporation."

4. Thereafter, pursuant to a resolution of the Board, this Sixth Certificate of Amendment was submitted to the stockholders of the Corporation for their approval, and was duly adopted in accordance with Sections 228 and 242 of the DGCL.

5. All other provisions of the Charter, as amended to date and as currently on file with the Secretary of State of the State of Delaware, shall remain in full force and effect.

[SIGNATURE PAGE FOLLOWS]

In Witness Whereof, the Corporation has caused this Sixth Certificate of Amendment to be signed by its Chief Executive Officer this 31st day of July, 2018.

/s/ R. Erik Holmlin

Name: R. Erik Holmlin
Title: Chief Executive Officer

Thomas A. Coll
+1 858 550 6013
collta@cooley.com

July 31, 2018

BioNano Genomics, Inc.
9640 Towne Centre Drive, Suite 100
San Diego, CA 92121

Ladies and Gentlemen:

You have requested our opinion, as counsel to Bionano Genomics, Inc., a Delaware corporation (the "***Company***"), in connection with the filing by the Company of a Registration Statement (No. 333-225970) on Form S-1 (the "***Registration Statement***") with the Securities and Exchange Commission, including a related prospectus filed with the Registration Statement (the "***Prospectus***"), covering an underwritten public offering of up to 6,325,000 shares (the "***Shares***") of the Company's common stock, par value $0.0001, including up to 825,000 Shares that may be sold pursuant to the exercise of an option to purchase additional shares. All of the Shares are to be sold by the Company as described in the Registration Statement and the Prospectus.

In connection with this opinion, we have (i) examined and relied upon (a) the Registration Statement and the Prospectus, (b) the Company's Eighth Amended and Restated Certificate of Incorporation and Bylaws, each as amended, as currently in effect, (c) the Company's Amended and Restated Certificate of Incorporation, filed as Exhibit 3.2 to the Registration Statement, and the Company's Amended and Restated Bylaws, filed as Exhibit 3.4 to the Registration Statement, each of which will be in effect immediately following the closing of the offering contemplated by the Registration Statement, and (d) the originals or copies certified to our satisfaction of such records, documents, certificates, memoranda and other instruments as in our judgment are necessary or appropriate to enable us to render the opinion expressed below and (ii) assumed that the Shares to be sold to the underwriters by the Company will be sold at a price and on terms established by the Board of Directors of the Company or a duly constituted pricing committee thereof in accordance with Section 153 of the Delaware General Corporation Law. We have undertaken no independent verification with respect to such matters. We have assumed the genuineness and authenticity of all documents submitted to us as originals and the conformity to originals of all documents submitted to us as copies and the due execution and delivery of all documents (other than by the Company) where due execution and delivery are a prerequisite to the effectiveness thereof. As to certain factual matters, we have relied upon a certificate of an officer of the Company and have not sought independently to verify such matters.

Our opinion is expressed only with respect to the General Corporation Law of the State of Delaware. We express no opinion as to whether the laws of any particular jurisdiction are applicable to the subject matter hereof. We are not rendering any opinion as to compliance with any federal or state antifraud law, rule or regulation relating to securities, or to the sale or issuance thereof.

On the basis of the foregoing, and in reliance thereon, we are of the opinion that the Shares, when sold and issued against payment therefor as described in the Registration Statement and the Prospectus, will be validly issued, fully paid and non-assessable.

We consent to the reference to our firm under the caption "Legal Matters" in the Prospectus included in the Registration Statement and to the filing of this opinion as an exhibit to the Registration Statement.

Sincerely,

Cooley LLP

/s/ Thomas A. Coll

Cooley LLP 4401 Eastgate Mall San Diego, CA 92121
t: (858) 550-6000 f: (858) 550-6420 cooley.com

Exhibit 10.1

FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT

August 5, 2016

To each of the Purchasers named in Exhibit A of the Series D-1 Convertible Participating Preferred Stock Purchase Agreement of even date herewith (collectively, and whether or not a single person or entity, the "Series D-1 Investors") and each of the other signatories hereto.

This will confirm that in consideration of the Series D-1 Investors' agreement on the date hereof to purchase shares of Series D-1 Convertible Participating Preferred Stock, par value $0.0001 per share (the "Series D-1 Preferred Stock"), of BioNano Genomics, Inc., a Delaware corporation and successor to BioNanomatrix, LLC (the "Company"), pursuant to the Series D-1 Convertible Participating Preferred Stock Purchase Agreement of even date herewith (as the same may be amended from time to time, the "Purchase Agreement") between the Company and the Series D-1 Investors and as an inducement to the Series D-1 Investors to consummate the transactions contemplated by the Purchase Agreement, the Company, the Series D-1 Investors and the other signatories hereto hereby agree as follows:

1. Certain Definitions. Any capitalized term used herein and not otherwise defined herein shall have the meaning ascribed to such term in the Eighth Amended and Restated Certificate of Incorporation of the Company, as the same may be amended from time to time (the "Charter"). In addition, as used in this Agreement (as defined below), the following terms shall have the following respective meanings:

"Affiliate" or "Affiliates" shall mean, with respect to any Person, an individual, firm, corporation, partnership, association, limited liability company, trust or any other entity who, directly or indirectly, controls, is controlled by or is under common control with such Person, including, without limitation, any partner, officer, director, member or employee of such Person and any venture capital fund now or hereafter existing that is controlled by or under common control with one or more general partners or shares the same management company with such Person.

"Agreement" shall mean this Fifth Amended and Restated Investors' Rights Agreement, as the same may be amended from time to time.

"Business Day" shall mean any day that is not a Saturday, Sunday or other day on which commercial banks located in the State of Delaware are authorized or required to be closed.

"Commission" shall mean the U.S. Securities and Exchange Commission or any other federal agency at the time administering the Securities Act.

"Common Stock" shall mean the Common Stock, par value $0.0001 per share, of the Company.

"Exchange Act" shall mean the Securities Exchange Act of 1934, as amended, or any successor federal statute, and the rules and regulations of the Commission thereunder, all as the same shall be in effect at the time.

"Founder" shall mean Han Cao.

"Investor Affiliate" or "Investor Affiliates" shall mean any person (i) who is an "affiliated person" of an Investor, as that term is defined in the Investment Company Act of 1940, as amended, (ii) who is a current or former partner, member or stockholder of an Investor, or (iii) who is managed by, or has the same management company or investment advisor or similar company, as an Investor.

"Investor" or "Investors" shall mean the Series A Investors, the Series B Investors, the Series B-1 Investors, the Series C Investors, the Series D Investors and the Series D-1 Investors, as well as any additional persons or entities becoming parties hereto in accordance with the terms hereof as an "Investor."

"Key Employee" or "Key Employees" shall mean and include the president, chief executive officer, chief financial officer, chief operating officer, chief technology officer, and any senior vice president of operations, finance, research, development, or sales or marketing.

"LC" shall mean LC Fund VI, L.P., LC Parallel Fund VI, L.P., LC HealthCare Fund I, and their Affiliates.

"Person" or "Persons" shall mean an individual, corporation, partnership, limited liability company, joint venture, trust, or unincorporated organization, or a government or any agency or political subdivision thereof.

"Preferred Stock" shall mean the Preferred Stock, par value $0.0001 per share, of the Company, and includes the Series A Preferred Stock, the Series B Preferred Stock, the Series B-1 Preferred Stock, the Series C Preferred Stock, the Series D Preferred Stock, and the Series D-1 Preferred Stock.

"Qualified Public Offering" shall mean the closing of the sale of shares of Common Stock to the public (i) in which the price per share paid by the public (prior to the deduction of underwriting discounts and registration expenses) multiplied by the fully-diluted outstanding shares of the Company immediately prior to such closing (inclusive of options, warrants, other convertible securities and shares reserved under any equity plan) is no less than $150,000,000 and (ii) resulting in at least $30,000,000 in gross proceeds to the Company (prior to the deduction of underwriting discounts and registration expenses), in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act.

"Registrable Securities" shall mean (i) the Common Stock issuable or issued upon conversion of the Preferred Stock; (ii) any Common Stock issued or issuable upon conversion, exchange and/or exercise of any capital stock, options, warrants or convertible securities of the Company acquired by the Investors prior to or after the date hereof; (iii) solely for the purposes of Section 5 (and any analogous provisions) the Common Stock held by the Founder; and (iv) any Common Stock issued as (or issuable upon the conversion or exercise of any warrant, right or other security which is issued as) a dividend or other distribution with respect to, or in exchange for or in replacement of, the shares referenced in clause (i), (ii) and (iii) above; excluding in all cases, however, any Registrable Securities (a) sold to or through a broker or

dealer or underwriter in a public distribution or a public securities transaction, (b) sold in a transaction exempt from the registration and prospectus delivery requirements of the Securities Act under Section 4(1) thereof so that all transfer restrictions and restrictive legends with respect thereto are removed upon the consummation of such sale, (c) registered under the Securities Act pursuant to an effective registration statement filed thereunder, (d) publicly sold pursuant to Rule 144 under the Securities Act, (e) any shares of Common Stock described in this definition, if such shares of Common Stock could be sold under Rule 144 under the Securities Act, during any ninety (90) day period, or (f) sold in a transaction in which the rights granted under Sections 4, 5 or 6 hereof are not assigned in accordance with this Agreement.

"Securities Act" shall mean the Securities Act of 1933, as amended, or any successor federal statute, and the rules and regulations of the Commission thereunder, all as the same shall be in effect at the time.

"Series A Investors" shall mean the holders of Series A Preferred Stock party hereto and any additional persons or entities that become parties hereto.

"Series A Preferred Stock" shall mean the Series A Convertible Participating Preferred Stock of the Company, par value $0.0001 per share.

"Series B Investors" shall mean the holders of Series B Preferred Stock party hereto and any additional persons or entities that become parties hereto.

"Series B Preferred Stock" shall mean the Series B Convertible Participating Preferred Stock of the Company, par value $0.0001 per share.

"Series B-1 Investors" shall mean the holders of Series B-1 Preferred Stock party hereto and any additional persons or entities that become parties hereto.

"Series B-1 Preferred Stock" shall mean the Series B-1 Convertible Participating Preferred Stock of the Company, par value $0.0001 per share.

"Series C Investors" shall mean the holders of Series C Preferred Stock party hereto and any additional persons or entities that become parties hereto.

"Series C Preferred Stock" shall mean the Series C Convertible Participating Preferred Stock of the Company, par value $0.0001 per share.

"Series D Investors" shall mean the holders of Series D Preferred Stock party hereto and any additional persons or entities that become parties hereto.

"Series D Preferred Stock" shall mean the Series D Convertible Participating Preferred Stock of the Company, par value $0.0001 per share.

"Violation" means any loss, claim, damage or liability (joint or several) to which a party hereto may become subject under the Securities Act, the Exchange Act or other federal or state law, insofar as such loss, claim, damage or liability (or any action in respect thereof) arises out of or is based upon: (i) any untrue statement or alleged untrue statement of a material fact

contained in any registration statement of the Company, including any preliminary prospectus or final prospectus contained therein or any amendments or supplements thereto; (ii) an omission or alleged omission to state therein a material fact required to be stated therein, or necessary to make the statements therein not misleading; or (iii) any violation or alleged violation by any other party hereto of the Securities Act, the Exchange Act, any state securities law or any rule or regulation promulgated under the Securities Act, the Exchange Act or any state securities law.

2. Restrictive Legend. Each certificate representing Preferred Stock or Registrable Securities shall, except as otherwise provided in Section 3, be stamped or otherwise imprinted with a legend substantially in the following form:

> "THE SECURITIES REPRESENTED BY THIS CERTIFICATE HAVE NOT BEEN REGISTERED UNDER THE SECURITIES ACT OF 1933 OR APPLICABLE STATE SECURITIES LAWS. THESE SECURITIES HAVE BEEN ACQUIRED FOR INVESTMENT AND NOT WITH A VIEW TO DISTRIBUTION OR RESALE, AND MAY NOT BE SOLD, MORTGAGED, PLEDGED, HYPOTHECATED OR OTHERWISE TRANSFERRED WITHOUT AN EFFECTIVE REGISTRATION STATEMENT FOR SUCH SECURITIES UNDER THE SECURITIES ACT OF 1933 AND APPLICABLE STATE SECURITIES LAWS, OR AN OPINION OF COUNSEL SATISFACTORY TO THE COMPANY THAT SUCH TRANSFER IS EXEMPT FROM THE REGISTRATION PROVISIONS OF THE SECURITIES ACT OF 1933 AND APPLICABLE STATE SECURITIES LAWS."

3. Notice of Proposed Transfer. Subject in all events to the restrictions set forth in the Fifth Amended and Restated Stockholders Agreement dated as of the date hereof (the "Stockholders Agreement") regarding the transfer of capital stock, prior to any proposed sale, assignment, transfer or pledge (other than a pledge in favor of the Company) of any Preferred Stock or Registrable Securities (other than under the circumstances described in Sections 4, 5 or 6), the holder thereof shall give written notice to the Company of its intention to effect such sale, assignment, transfer or pledge. Each such notice shall describe the manner of the proposed sale, assignment, transfer or pledge in sufficient detail and, unless waived in writing by the Company, shall be accompanied by an opinion of counsel reasonably satisfactory to the Company to the effect that the proposed sale, assignment, transfer or pledge may be effected without registration under the Securities Act and any applicable state securities laws, whereupon the holder of such stock shall be entitled to transfer such stock in accordance with the terms of its notice delivered by the holder of such stock to the Company; provided, however, that no such opinion of counsel shall be required for a transfer made in accordance with all applicable securities laws (a) to one or more partners or members or retired partners or retired members (or to the estate of any such parties) of an Investor (in the case of an Investor that is a partnership or a limited liability company, as the case may be), (b) to an Investor Affiliate, (c) to a wholly-owned subsidiary of an Investor, or (d) by an Investor to its stockholders (in the case of an Investor that is a corporation). Each certificate for Preferred Stock or Registrable Securities transferred as above provided shall bear the legend set forth in Section 2, except that such certificate shall not bear such legend if (i)

such transfer is in accordance with the provisions of Rule 144 (or any other rule permitting public sale without registration under the Securities Act) or (ii) the opinion of counsel referred to above is to the further effect that the transferee and any subsequent transferee (other than an affiliate of the Company) would be entitled to transfer such securities in a public sale without registration under the Securities Act.

4. Required Registration.

(a) Any time after the earlier of (i) twelve (12) months following a Qualified Public Offering and (ii) the date that is four (4) years after the date of this Agreement, the holders of at least 66-2/3% of the shares of Preferred Stock then outstanding (or shares of Common Stock issued upon conversion of the shares of Preferred Stock or a combination thereof) may request the Company to register under the Securities Act all or any portion of the shares of Registrable Securities held by such requesting holder or holders for sale in the manner specified in such notice; provided, however, that the shares of Registrable Securities for which registration has been requested shall be at least 20% of the shares of Registrable Securities then held by such requesting holder or holders (or a lesser percentage if the anticipated gross receipts from the offering would exceed $40,000,000).

(b) Following receipt of any notice under this Section 4, the Company shall, within twenty (20) days of receipt thereof, notify all holders of Registrable Securities and Preferred Stock from whom notice has not been received and such holders shall then be entitled within thirty (30) days thereafter to request the Company to include in the requested registration all or any portion of their shares of Registrable Securities. The Company shall use its reasonable best efforts to register under the Securities Act, for public sale in accordance with the method of disposition described in paragraph (a) above, the number of shares of Registrable Securities specified in such notice (and in all notices received by the Company from other holders within thirty (30) days after the giving of such notice by the Company). The Company shall be obligated to register Registrable Securities pursuant to this Section 4 on two (2) occasions only; provided, however, that such obligation shall be deemed satisfied only when (i) a registration statement covering all shares (or such lesser number as permitted by Section 4(d) below) of Registrable Securities specified in notices received as aforesaid (and not subsequently withdrawn) for sale in accordance with the method of disposition specified by the requesting holders shall have become effective and remain effective for the period of distribution contemplated thereby (unless such requesting holders request that such registration statement be withdrawn, in which case such obligation of the Company shall be deemed satisfied unless such requesting holders pay all Registration Expenses (as defined in Section 8) incurred in connection with the withdrawn registration statement), and (ii) where such registration statement has become effective, if such method of disposition is a firm commitment underwritten public offering, and all such shares shall have been sold to the underwriters pursuant thereto (not including shares eligible for sale pursuant to the underwriters' over-allotment option). The Company shall not be obligated to effect, or to take any action to effect, any registration pursuant to this Section 4: (i) during the period within ninety (90) days after the effective date of a registration pursuant to Section 4 or Section 6 hereof, or in which the holders of Registrable Securities shall have been entitled to join pursuant to Section 5; (ii) if the shares of Registrable Securities to be registered may be immediately registered on Form S-3; or (iii) during the period

within twelve (12) months after the closing of an initial public offering of Common Stock by the Company.

(c) The Company shall be entitled to include in any registration statement referred to in this Section 4 shares of Common Stock to be sold by the Company for its own account, except as and to the extent that, in the opinion of the managing underwriter, such inclusion would adversely affect the marketing of the Registrable Securities to be sold. Subject to Section 14(h) and except for registration statements on Form S-4, S-8 or any successor thereto, the Company will not file with the Commission any other registration statement with respect to its Common Stock, whether for its own account or that of other stockholders, from the date of receipt of a notice from requesting holders requesting sale pursuant to an underwritten offering pursuant to this Section 4 until thirty (30) days after the date such registration statement is declared effective. The right of any holder to include such holder's Registrable Securities in an underwritten registration shall be conditioned upon such holder's participation in such underwriting and the inclusion of such holder's Registrable Securities in the underwriting to the extent provided herein. All holders proposing to distribute their securities through such underwriting shall (together with the Company) enter into an underwriting agreement in reasonable and customary form with the underwriter or underwriters selected for such underwriting.

(d) If in the opinion of the managing underwriter the inclusion of all of the Registrable Securities requested to be registered under this Section 4 would adversely affect the marketing of such shares, shares to be sold by the holders of Registrable Securities shall be excluded only after any shares to be sold by the Company and any other parties including shares for sale in such registration have been excluded, in such manner that the shares to be sold shall be allocated among the requesting holders pro rata based on their ownership of Registrable Securities. In the event the number of shares to be sold by requesting holders of Registrable Securities pursuant to an underwritten registration under this Section 4 is reduced pursuant to this Section 4(d), such registration shall still count towards satisfaction of the Company's obligation to register shares under this Section provided that such registration includes at least 40% of the shares of Registrable Securities so requested to be included by the requesting holders.

5. Incidental Registration. If the Company at any time (other than pursuant to Section 4 or Section 6), proposes to register any of its securities under the Securities Act for sale to the public, whether for its own account or for the account of other security holders or both (except with respect to registration statements on Forms S-4, S-8 or another form not available for registering the Registrable Securities for sale to the public), each such time it will give written notice to all holders of outstanding Registrable Securities (including, solely for purpose of this Section 5, the Founder) of its intention so to do. Upon the written request of any such holder, received by the Company within thirty (30) days after the giving of any such notice by the Company, to register any of its Registrable Securities, the Company will use its reasonable best efforts to cause the Registrable Securities as to which registration shall have been so requested to be included in the securities to be covered by the registration statement proposed to be filed by the Company, all to the extent requisite to permit the sale or other disposition by the holder of such Registrable Securities so registered. In the event that any registration pursuant to this Section 5 shall be, in whole or in part, an underwritten public offering of Common Stock, the number of shares of Registrable Securities to be included in such an underwriting may be

reduced (pro rata among the requesting holders based upon the number of shares of Registrable Securities owned by such holders) if and to the extent that the managing underwriter shall be of the opinion that such inclusion would adversely affect the marketing of the securities to be sold by the Company therein, provided, however, that such number of shares of Registrable Securities shall not be reduced if any shares are to be included in such underwriting for the account of any person other than the Company or requesting holders of Registrable Securities. Notwithstanding the foregoing, the Company may withdraw any registration statement referred to in this Section 5 without thereby incurring any liability to the holders of Registrable Securities.

6. Registration on Form S-3. If at any time (i) a holder or holders of Registrable Securities request that the Company file a registration statement on Form S-3 or any successor thereto for a public offering of all or any portion of the shares of Registrable Securities held by such requesting holder or holders, and (ii) the Company is a registrant entitled to use Form S-3 or any successor thereto to register such shares, then the Company shall use its reasonable best efforts to register under the Securities Act on Form S-3 or any successor thereto, for public sale in accordance with the method of disposition specified in such notice, the number of shares of Registrable Securities specified in such notice; provided, however, that the shares of Registrable Securities for which registration has been requested have a reasonably anticipated aggregate offering price to the public of at least $3,000,000. Whenever the Company is required by this Section 6 to use its reasonable best efforts to effect the registration of Registrable Securities, each of the procedures and requirements of Section 4 (including but not limited to the requirement that the Company notify all holders of Registrable Securities from whom notice has not been received and provide them with the opportunity to participate in the offering) shall apply to such registration, provided, however, that there shall be no limitation on the number of registrations on Form S-3 which may be requested and obtained under this Section 6.

7. Registration Procedures. If and whenever the Company is required by the provisions of Sections 4, 5 or 6 to use its reasonable best efforts to effect the registration of any shares of Registrable Securities under the Securities Act, the Company will, as expeditiously as reasonably possible under the circumstances:

(a) prepare and file with the Commission a registration statement (which, in the case of an underwritten public offering pursuant to Section 4, shall be on Form S-1 or other form of general applicability satisfactory to the managing underwriter selected as therein provided) with respect to such securities and use its reasonable best efforts to cause such registration statement to become and remain effective for the period of the distribution contemplated thereby (determined as hereinafter provided);

(b) prepare and file with the Commission such amendments and supplements to such registration statement and the prospectus used in connection therewith as may be necessary to keep such registration statement effective for the period specified in paragraph (a) above and comply with the provisions of the Securities Act with respect to the disposition of all Registrable Securities covered by such registration statement in accordance with the sellers' intended method of disposition set forth in such registration statement for such period;

(c) furnish to each seller of Registrable Securities and to each underwriter such number of copies of the registration statement and the prospectus included therein

(including each preliminary and final prospectus) and such other documents as such persons reasonably may request in order to facilitate the public sale or other disposition of the Registrable Securities covered by such registration statement;

(d) use commercially reasonable efforts to register or qualify the Registrable Securities covered by such registration statement under the securities or "blue sky" laws of such jurisdictions as the sellers of Registrable Securities or, in the case of an underwritten public offering, the managing underwriter reasonably shall request, provided, however, that the Company shall not be required in connection therewith or as a condition thereto to qualify to do business in any states or jurisdictions in which it is not, at the time, so qualified, or otherwise subject itself to general taxation in any such states or jurisdictions;

(e) use its reasonable best efforts to list the Registrable Securities covered by such registration statement to be listed on a national securities exchange or trading system and each securities exchange and trading system on which similar securities issued by the Company are then listed (if any);

(f) provide a transfer agent and registrar for all Registrable Securities registered pursuant hereunder and a CUSIP number for all such Registrable Securities, in each case not later than the effective date of such registration;

(g) promptly notify each seller of Registrable Securities and each underwriter under such registration statement, at any time when a prospectus relating thereto is required to be delivered under the Securities Act, of the happening of any event of which the Company has knowledge as a result of which the prospectus contained in such registration statement, as then in effect, includes an untrue statement of a material fact or omits to state a material fact required to be stated therein or necessary to make the statements therein not misleading in light of the circumstances then existing. The holders of Registrable Securities covered by such registration statement agree upon receipt of such notice forthwith to cease making offers and sales of Registrable Securities pursuant to such registration statement or deliveries of the prospectus contained therein for any purpose until the Company has prepared and furnished such amendment or supplement to the prospectus as may be necessary so that, as thereafter delivered to purchasers of such Registrable Securities, such prospectus shall not include an untrue statement of a material fact or omit to state a material fact required to be stated therein or necessary to make the statements therein not misleading in the light of the circumstances then existing. The Company shall promptly prepare and furnish such amendment or supplement to the prospectus to each such seller of Registrable Securities and each such underwriter;

(h) if the offering is underwritten use its reasonable best efforts to furnish on the date that Registrable Securities are first delivered to the underwriters for sale pursuant to such registration: (i) an opinion dated such date of counsel representing the Company for the purposes of such registration, addressed to the underwriters stating that such registration statement has become effective under the Securities Act and that (A) to the knowledge of such counsel, no stop order suspending the effectiveness thereof has been issued and no proceedings for that purpose have been instituted or are pending or contemplated under the Securities Act, (B) the registration statement, the related prospectus and each amendment or supplement thereof comply as to form in all material respects with the requirements of the Securities Act (except that

such counsel need not express any opinion as to financial statements contained therein) and (C) to such other effects as reasonably may be requested by counsel for the underwriters or by such seller or its counsel and (ii) a letter dated such date from the independent public accountants retained by the Company, addressed to the underwriters, stating that they are independent registered public accounting firm within the meaning of the Securities Act and that, in the opinion of such accountants, the financial statements of the Company included in the registration statement or the prospectus, or any amendment or supplement thereof, comply as to form in all respects with the applicable accounting requirements of the Securities Act, and such letter shall additionally cover such other financial matters (including information as to the period ending no more than five (5) Business Days prior to the date of such letter) with respect to such registration as such underwriters reasonably may request;

(i) make available for inspection by each seller of Registrable Securities, any underwriter participating in any distribution pursuant to such registration statement, and any attorney, accountant or other agent retained by such seller or underwriter, all relevant financial and other records, pertinent corporate documents and properties of the Company, and cause the Company's officers, directors and employees to supply all information reasonably requested by any such seller, underwriter, attorney, accountant or agent in connection with such registration statement, provided such parties agree to keep such information confidential;

(j) advise each selling holder of Registrable Securities, promptly after it shall receive notice or obtain knowledge thereof, of the issuance of any stop order by the Commission suspending the effectiveness of such registration statement or the initiation or threatening of any proceeding for such purpose and promptly use all commercially reasonable efforts to prevent the issuance of any stop order or to obtain its withdrawal if such stop order should be issued;

(k) cooperate with the selling holders of Registrable Securities and the managing underwriters, if any, to facilitate the timely preparation and delivery of certificates representing Registrable Securities to be sold, such certificates to be in such denominations and registered in such names as such holders or the managing underwriters may request at least two (2) Business Days prior to any sale of Registrable Securities;

(l) permit any holder of Registrable Securities, which holder, in the sole and exclusive judgment, exercised in good faith, of such holder, might be deemed to be a controlling person of the Company, to participate in good faith in the preparation of such registration or comparable statement; and

(m) use its commercially reasonable efforts to prevent the issuance, and, if issued, to obtain the withdrawal, of any order suspending the effectiveness of any registration statement at the earliest possible time.

For purposes of Section 7(a) and 7(b) and of Section 4(b), the period of distribution of Registrable Securities in a firm commitment underwritten public offering shall be deemed to extend until the earlier of such time as each underwriter has completed the distribution of all securities purchased by it, and one hundred eighty (180) days after the effective date thereof. The period of distribution of Registrable Securities in any other

registration shall be deemed to extend until the earlier of the sale of all Registrable Securities covered thereby and one hundred eighty (180) days after the effective date thereof.

In connection with each registration hereunder, the sellers of Registrable Securities will furnish to the Company in writing such information with respect to themselves and the proposed distribution by them as reasonably shall be requested by the Company or as shall be necessary in order to assure compliance with federal and applicable state securities laws.

In connection with each registration pursuant to Sections 4, 5 or 6 covering an underwritten public offering, the Company and each seller of Registrable Securities agrees to enter into a written agreement with the managing underwriter selected in the manner herein provided in such form and containing such provisions as are reasonable and customary in the securities business for such an arrangement between such underwriter and companies of the Company's size and investment stature.

Any managing underwriter engaged by the Company in any registration made pursuant to Sections 4 or 6 shall require the approval in writing of the holders of a majority of the Preferred Stock requesting such registration.

It shall be a condition precedent to the obligations of the Company to take any action pursuant to Sections 4, 5, 6 or 7 with respect to the Registrable Securities of any selling holder that such holder shall furnish to the Company such information regarding itself, the Registrable Securities held by it, and the intended method of disposition of such securities as shall be reasonably necessary to effect the registration of such holder's Registrable Securities.

8. Expenses. All expenses incurred by the Company in complying with Sections 4, 5, 6 or 7, including, without limitation, all registration and filing fees, printing expenses, fees and disbursements of counsel and independent public accountants for the Company, fees and expenses (including counsel fees) incurred in connection with complying with state securities or "blue sky" laws, fees of the National Association of Securities Dealers, Inc., fees of transfer agents and registrars, costs of insurance, and reasonable and documented fees and disbursements of one counsel for the sellers of Registrable Securities (which shall not exceed $50,000 per registration) ("Agreed Counsel Fees"), but excluding any Selling Expenses, are called "Registration Expenses." All underwriting discounts and selling commissions applicable to the sale of Registrable Securities and the fees and expenses of any counsel to the sellers other than the Agreed Counsel Fees are called "Selling Expenses."

(a) The Company will pay all Registration Expenses in connection with each registration under Sections 4, 5 or 6. All Selling Expenses in connection with each registration under Sections 4, 5 or 6 shall be borne by the participating sellers (including the Company to the extent the Company shall be a participating seller) in proportion to the number of shares sold by each, or by such participating sellers as they may otherwise agree in writing.

(b) The Company will not be required to pay for Registration Expenses of any registration proceeding begun pursuant to Sections 4, 5 or 6, the request of which has been subsequently withdrawn by the initiating holders of Registrable Securities, unless (i) the withdrawal is based upon material adverse information concerning the Company which was not

provided to the initiating holders at the time of such request, or (ii) the holders of a majority of Registrable Securities agree to forfeit their right to one requested registration pursuant to Sections 4 or 6, as applicable (in which event such right shall be forfeited by all holders). If the holders are required to pay the Registration Expenses, such expenses shall be borne by the holders of the securities (including Registrable Securities) requesting such registration in proportion to the number of securities for which such registration is requested or as otherwise agreed in writing by such holders. If the Company is required to pay the Registration Expenses of a withdrawn offering pursuant to clause (i) above, then the holders of Registrable Securities shall not forfeit their rights to a registration pursuant to Sections 4 or 6, as applicable.

9. Indemnification and Contribution.

(a) In the event of a registration of any of the Registrable Securities under the Securities Act pursuant to Sections 4, 5 or 6, the Company will indemnify, defend and hold harmless each seller of such Registrable Securities thereunder (each, a "Selling Holder"), the partners, members, officers, directors, managers and stockholders of each such Selling Holder, legal counsel and accountants for each Selling Holder, any underwriter (as defined in the Securities Act) for such Selling Holder and each Person, if any, who controls such Selling Holder or underwriter within the meaning of the Securities Act or the Exchange Act, against any Violation, and the Company will pay to each such Selling Holder, underwriter, controlling Person or other aforementioned Person any legal or other expenses incurred thereby in connection with investigating or defending any Violation as such expenses are incurred; provided, however, that the indemnity agreement contained in this subsection 9(a) shall not apply to: (x) amounts paid in settlement of any such Violation if such settlement is effected without the consent of the Company (which consent shall not be unreasonably withheld, conditioned or delayed), (y) any such Violation solely to the extent that it arises out of or is based upon and in conformity with written information furnished expressly for use in connection with such registration by such Selling Holder, underwriter, controlling Person or other aforementioned Person or (z) any such Violation solely to the extent that it arises out of or is based upon such Selling Holder's, underwriter's, controlling Person's or other aforementioned Person's failure to deliver a copy of the registration statement or prospectus or any amendments or supplements thereto or such Selling Holder's, underwriter's, controlling Person's or other aforementioned Person's failure to cease making offers and sales of Registrable Securities pursuant to a registration statement or deliveries of the prospectus contained therein in accordance with Section 7(g) hereof.

(b) Each Selling Holder, severally and not jointly, will indemnify, defend and hold harmless the Company, each of its directors, each of its officers who has signed the registration statement, each Person, if any, who controls the Company within the meaning of the Securities Act, legal counsel and accountants for the Company, any underwriter (as defined in the Securities Act), any other Selling Holder selling securities in such registration statement and any controlling Person of any such underwriter or other Selling Holder, against any Violation, in each case solely to the extent that such Violation arises out of or is based upon actions or omissions made in reliance upon and in conformity with written information furnished by such Selling Holder expressly for use in connection with such registration; and each such Selling Holder will pay to the Company and each other aforementioned Person any legal or other expenses reasonably incurred thereby in connection with investigating or defending any

Violation as such expenses are incurred; provided, however, that the indemnity agreement contained in this subsection 9(b) shall not apply to amounts paid in settlement of any such Violation if such settlement is effected without the consent of such Selling Holder, which consent shall not be unreasonably withheld; and provided further, that, in no event shall any indemnity under this subsection 9(b) exceed the proceeds from the offering (net of any Selling Expenses) received by such Selling Holder, except in the case of fraud or willful misconduct by such Selling Holder.

(c) Promptly after receipt by an indemnified party hereunder of notice of the commencement of any action, such indemnified party shall, if a claim in respect thereof is to be made against the indemnifying party hereunder, notify the indemnifying party in writing thereof, but the omission so to notify the indemnifying party shall not relieve it from any liability which it may have to such indemnified party other than under this Section 9 and shall only relieve it from any liability which it may have to such indemnified party under this Section 9 if and to the extent the indemnifying party is prejudiced by such omission. In case any such action shall be brought against any indemnified party and it shall notify the indemnifying party of the commencement thereof, the indemnifying party shall be entitled to participate in and, to the extent it shall wish, to assume and undertake the defense thereof with counsel reasonably satisfactory to such indemnified party, and, after notice from the indemnifying party to such indemnified party of its election so to assume and undertake the defense thereof, and the indemnifying party shall not be liable to such indemnified party under this Section 9 for any legal expenses subsequently incurred by such indemnified party in connection with the defense thereof other than reasonable costs of investigation and of liaison with counsel so selected, provided, however, that, if the defendants in any such action include both the indemnified party and the indemnifying party and the indemnified party shall have reasonably concluded that there may be reasonable defenses available to it which are different from or additional to those available to the indemnifying party or if the interests of the indemnified party reasonably may reasonably be deemed to conflict with the interests of the indemnifying party, the indemnified party shall have the right to select a separate counsel reasonably satisfactory to the indemnifying party and to assume such legal defenses and otherwise to participate in the defense of such action, with the reasonable expenses and fees of up to one such separate counsel for all indemnified parties with respect to such action and other reasonable expenses related to such participation to be reimbursed by the indemnifying party as incurred.

(d) In order to provide for just and equitable contribution to joint liability under the Securities Act in any case in which either (i) any party otherwise entitled to indemnification pursuant to this Section 9 (the "Indemnified Party") makes a claim for indemnification pursuant to this Section 9 but it is judicially determined (by the entry of a final judgment or decree by a court of competent jurisdiction and the expiration of time to appeal or the denial of the last right of appeal) that such indemnification may not be enforced in such case notwithstanding the fact that this Section 9 provides for indemnification in such case, or (ii) contribution under the Securities Act may be required on the part of any such Indemnified Party in circumstances for which indemnification is provided under this Section 9; then, and in each such case, the Company and such holder will contribute to the aggregate losses, claims, damages or liabilities to which they may be subject (after contribution from others) in such proportion as is appropriate to reflect the relative fault of the party otherwise required to provide indemnification (the "Indemnifying Party") on the one hand, and of the Indemnified Party on the

other, taking into account any other relevant equitable considerations. The relative fault of the parties shall be determined by reference to, among other things, whether the untrue or alleged untrue statement of a material fact or the omission to state a material fact relates to information supplied by the Indemnifying Party or by the Indemnified Party and the parties' relative intent, knowledge, access to information and opportunity to correct such statement or omission; provided, however, that, in any such case, (A) no such holder will be required to contribute any amount in excess of the net proceeds (exclusive of applicable taxes and net of any Selling Expenses) received by such holder from the sale of all Registrable Securities offered by it pursuant to such registration statement; and (B) no person or entity guilty of fraudulent misrepresentation (within the meaning of Section 11(f) of the Securities Act) will be entitled to contribution from any person or entity who was not guilty of such fraudulent misrepresentation.

(e) The Company shall indemnify, defend and hold harmless each Investor and their respective direct and indirect subsidiaries and affiliates and their respective officers, directors, managers, employees, stockholders, members, partners, agents, controlling persons and other representatives (collectively, the "Investor Indemnitees") against any and all Losses of such Investor Indemnitee resulting from or arising out of any third party or governmental action or claim based upon the Investor Indemnitee's status as a security holder of the Company (including, without limitation, any and all Losses arising under the Securities Act, the Exchange Act, or similar securities law, any other federal or state statute, rule, regulation or law, or otherwise, which relate directly or indirectly to the registration, purchase, sale or ownership of any securities of the Company or to any fiduciary obligation owed with respect thereto), including, without limitation, in connection with any third party or governmental action or claim relating to any action taken or omitted to be taken or alleged to have been taken or omitted to have been taken by such Investor Indemnitee as a security holder. Notwithstanding the foregoing, the Company shall not be obligated to indemnify or hold harmless any Investor Indemnitee under this Section 9(e) against any Losses resulting from or arising out of any third party or governmental action or claim if it has been finally determined by a court or other trier of fact of competent jurisdiction that such Losses were the result of (i) any action or omission made by the Investor Indemnitee in bad faith or (ii) any criminal action on the part of such Investor Indemnitee. For purposes of this Section 9(e), "Losses" means all losses, claims (including any claim by a third party), damages, liabilities, reasonable expenses (including reasonable fees, disbursements and other charges of counsel incurred by the Investor Indemnitee in connection with any claim, action, suit or proceeding, including any action between the Investor Indemnitee and the Company or between the Investor Indemnitee and any third party). In connection with the obligation of the Company to indemnify for expenses as set forth in this Section 9(e), the Company shall reimburse each Investor Indemnitee as promptly as practical after the receipt by the Company of a written statement or statements from an Investor Indemnitee requesting such reimbursement for all such reasonable expenses (including reasonable expenses of investigation and reasonable fees, disbursements and other charges of counsel in connection with any claim, action, suit or proceeding) as they are incurred by such Investor.

Unless otherwise superseded by an underwriting agreement entered into in connection with an underwritten public offering, the obligations of the Company and the Selling Holders under this Section 9 shall survive the completion of any offering of Registrable Securities in a registration statement under this Section 9, and otherwise and shall survive the termination of this Agreement.

10. Changes in Common Stock or Preferred Stock. If, and as often as, there is any change in the Common Stock or the Preferred Stock by way of a stock split, stock dividend, combination or reclassification, or through a merger, consolidation, reorganization or recapitalization, or performance-based adjustment or by any other means, appropriate adjustment shall be made in the provisions hereof so that the rights and privileges granted hereby shall continue with respect to the Common Stock and the Preferred Stock as so changed. All shares of capital stock held or acquired by an "affiliated person" of an Investor, as that term is defined in the Investment Company Act of 1940, as amended, shall be aggregated together for the purpose of determining the availability of any rights under this Agreement.

11. Rule 144 Reporting. With a view to making available the benefits of certain rules and regulations of the Commission which may at any time permit the sale of the Registrable Securities to the public without registration, at all times after ninety (90) days after any registration statement covering a public offering of securities of the Company under the Securities Act shall have become effective or following registration under Section 12 of the Exchange Act, the Company agrees to use reasonable best efforts to:

(a) make and keep public information available, as those terms are understood and defined in Rule 144 under the Securities Act;

(b) use its reasonable best efforts to file with the Commission in a timely manner all reports and other documents required of the Company under the Securities Act and the Exchange Act; and

(c) furnish or make available to each holder of Registrable Securities forthwith upon request a written statement by the Company as to its compliance with the reporting requirements of such Rule 144 and of the Securities Act and the Exchange Act, a copy of the most recent annual or quarterly report of the Company, and such other reports and documents so filed by the Company as such holder may reasonably request in availing itself of any rule or regulation of the Commission allowing such holder to sell any Registrable Securities without registration.

12. Preemptive Right.

(a) Preemptive Right. The Company shall not issue, sell or exchange, agree or obligate itself to issue, sell or exchange, or reserve or set aside for issuance, sale or exchange, any (i) shares of Common Stock, (ii) any other equity security of the Company, including without limitation, Preferred Stock, (iii) any debt security of the Company (other than debt with no equity feature) including without limitation, any debt security which by its terms is convertible into or exchangeable for any equity security of the Company, (iv) any security of the Company that is a combination of debt and equity, or (v) any option, warrant or other right to subscribe for, purchase or otherwise acquire any such equity security or any debt security of the Company specified in (i)-(iv) above, unless in each case the Company shall have first offered to sell a portion of such securities (the "Offered Securities") to each Investor who holds at least 5% of the then outstanding shares of Preferred Stock (each an "Offeree" and collectively, the "Offerees") as follows: each Offeree shall have the right (but not an obligation) to purchase (x) up to that portion of the Offered Securities as the number of shares of capital stock then held by

such Offeree (assuming for such purposes exercise, conversion and exchange of all outstanding options, warrants or convertible securities of the Company exercisable, convertible and/or exchangeable into shares of Common Stock) bears to the total number of the outstanding shares of capital stock of the Company (assuming for such purposes exercise, conversion and exchange of all outstanding options, warrants or convertible securities of the Company exercisable, convertible and/or exchangeable into shares of Common Stock) (the "Basic Amount"), and (y) such additional portion of the Offered Securities as such Offeree shall indicate it will purchase should the other Offerees subscribe for less than their respective Basic Amounts (the "Undersubscription Amount"), at a price and on such other terms as shall have been specified by the Company in writing delivered to such Offeree (the "Offer"), which Offer by its terms shall remain open and irrevocable for a period of thirty (30) days from receipt thereof. The Offer shall disclose the identity of the proposed transferee, the Offered Securities proposed to be sold, and the terms and conditions (including price) of the proposed sale.

(b) Notice of Acceptance. Notice of each Offeree's intention to accept, in whole or in part, any Offer made pursuant to Section 12(a) shall be evidenced by a writing signed by such Offeree and delivered to the Company prior to the end of the thirty (30) day period of such Offer, setting forth such of the Offeree's Basic Amount as such Offeree elects to purchase and, if such Offeree shall elect to purchase all of its Basic Amount, such Undersubscription Amount as such Offeree shall elect to purchase (the "Notice of Acceptance"). If the Basic Amounts subscribed for by all Offerees are less than the total Offered Securities available for purchase by all Offerees, then each Offeree who has set forth an Undersubscription Amount in its Notice of Acceptance shall be entitled to purchase, in addition to the Basic Amount subscribed for, the full Undersubscription Amount it has subscribed for; provided, however, that should the Undersubscription Amounts subscribed for exceed the difference between the Offered Securities available for purchase by all Offerees and the Basic Amounts subscribed for (the "Available Undersubscription Amount"), each Offeree who has subscribed for any Undersubscription Amount shall be entitled to purchase only that portion of the Available Undersubscription Amount as the Undersubscription Amount subscribed for by such Offeree bears to the total Undersubscription Amounts subscribed for by all Offerees, subject to rounding by the Board of Directors to the extent it reasonably deems necessary.

(c) Conditions to Acceptances and Purchase.

(i) Permitted Sales of Remaining Securities. The Company shall have ninety (90) days after the expiration of the period set forth in Section 12(a) to close the sale of all or any part of such Offered Securities as to which a Notice of Acceptance has not been given by the Offerees (the "Remaining Securities") to the Person or Persons specified in the Offer, but only in all material respects upon terms and conditions, including, without limitation, price and interest rates, which are no more favorable, in the aggregate, to such other Person or Persons or less favorable to the Company than those set forth in the Offer.

(ii) Reduction in Amount of Offered Securities. In the event the Company shall propose to sell less than all the Remaining Securities (any such sale to be in the manner and on the terms specified in Section 12(c)(i) above), then each Offeree may, at its sole option and in its sole discretion, reduce the number of Offered Securities specified in its respective Notices of Acceptance to an amount which shall be not less than the amount of the

Offered Securities which the Offeree elected to purchase pursuant to Section 12(b) multiplied by a fraction, (i) the numerator of which shall be the amount of Offered Securities which the Company actually proposes to sell, and (ii) the denominator of which shall be the amount of all Offered Securities. In the event that any Offeree so elects to reduce the number or amount of Offered Securities specified in its respective Notices of Acceptance, the Company may not sell or otherwise dispose of more than the reduced amount of the Offered Securities until a portion of such securities have again been offered to the Offerees in accordance with Section 12(a).

(iii) Closing. Upon the closing, which shall include full payment to the Company, of the sale to such other Person or Persons of all or less than all the Remaining Securities, the Offerees shall purchase from the Company, and the Company shall sell to the Offerees, the number of Offered Securities specified in the Notices of Acceptance, as may be reduced pursuant to this Section 12, upon the terms and conditions specified in the Offer.

(d) Further Sale. In each case, any Offered Securities not purchased by the Offerees or other Person or Persons in accordance with Section 12(c) may not be sold or otherwise disposed of until such securities are again offered to the Offerees under the procedures specified in Sections 12(a), 12(b) and 12(c).

(e) Termination of Preemptive Right. The rights of the Offerees under this Section 12 shall terminate immediately prior to, but subject to, the consummation of a firm-commitment underwritten public offering of Common Stock pursuant to an effective registration statement filed under the Securities Act; provided, however, that the rights of the Offerees pursuant to this Section 12 may be waived as to all of such Offerees holding Preferred Stock by the affirmative vote or written consent of the holders of at least 66-2/3% of the shares of Preferred Stock (the "Requisite Holders"), and any such waiver shall be binding on all Offerees holding shares of Preferred Stock with respect to their Preferred Stock, even if any of such Offerees do not execute such waiver and irrespective of whether one or more Offerees participates in the purchase of the Offered Securities; provided further, however, that, with respect to any such waiver of rights pursuant to this Section 12(e), if the Offerees voting in favor or consenting to such waiver subsequently participate in the purchase of the Offered Securities for which such waiver was obtained, then the remaining Offerees not providing such waiver will be granted the right to participate in the purchase of the Offered Securities, on a pro-rata basis amongst all the Offerees participating in such sale.

(f) Exception. The rights under this Section 12 shall not apply to any Exempted Securities, or to any Common Stock issued after the date hereof in connection with a Qualified Public Offering.

The exercise or non-exercise by an Investor of its rights pursuant to this Section 12 shall be without prejudice to its rights under this Section 12 with respect to future sales of Offered Securities.

13. Covenants of the Company and the Investors.

(a) Affirmative Covenants of the Company. Without limiting any other covenants and provisions hereof, and except to the extent the following covenants and provisions

of this Section 13(a) are waived in writing in any instance by the Requisite Holders, the Company covenants and agrees that until the consummation of a Qualified Public Offering, so long as any shares of Preferred Stock are outstanding, it will perform and observe the following covenants and provisions:

(i) Maintenance of Insurance. Maintain from responsible and reputable insurance companies or associations (x) a term life insurance policy on the life of Erik Holmlin (the "CEO") in the amount of at least $2,000,000, and (y) a term life insurance policy on the life of Han Cao (the "CSO") in the amount of at least $1,000,000, in each case, so long as such person remains an employee of the Company and the proceeds of which will be payable to the order of the Company. The Company will not cause or permit any assignment of the proceeds of the life insurance policy specified in the first sentence of this paragraph and will not borrow against such policies. In addition, the Company will maintain Directors and Officers insurance from a responsible and reputable insurance company or association and in an amount and on terms satisfactory to the Requisite Holders.

(ii) Inspection. Permit, upon reasonable request and prior notice, each holder of not less than 5% of the Preferred Stock (each such holder, as applicable, a "Major Investor"), or an agent or representative thereof, to examine and make copies of and extracts from the books of account of, and visit and inspect the properties of the Company and any subsidiary, to discuss the affairs, finances and accounts of the Company and any subsidiary with any of its officers, directors or Key Employees and independent accountants, and consult with and advise the management of the Company and any subsidiary as to their affairs, finances and accounts, all at reasonable times during the Company's normal business hours.

(iii) Indemnification. As promptly as practicable following the election of a director, enter into a director indemnification agreement in a usual and customary form with each such director, and as mutually agreed upon between the Company and such director.

(iv) Meetings of Directors. Call meetings of the Company's Board of Directors at least once every two (2) months, unless the Board of Directors unanimously shall determine otherwise. Ensure that a meeting of the Board of Directors may be called by any two (2) directors or by the holders of at least 20% of the Preferred Stock.

(v) Expenses of Directors. Promptly reimburse in full, each director of the Company who is not an employee of the Company for all of his or her reasonable and documented out-of-pocket expenses incurred in attending each meeting of the Board of Directors of the Company or any committee thereof, and for attendance at or participation in any other activities (including without limitation meetings, trade shows and conferences) which are required and/or requested by the Board of Directors in connection with such director's service on the Board of Directors.

(vi) Stock Options. All stock option grants and sales of stock to employees, officers, consultants, advisors and service providers of the Company shall be pursuant to a stock plan approved by the Board of Directors and shall be approved by the Board of Directors or a Compensation Committee thereof. Unless otherwise approved by the Board of Directors, (a) the exercise price of all such stock options and the sale price of all such sales shall

be no less than the fair market value of the Common Stock underlying such options or shares being sold, as applicable, as of the respective dates of grant or sale, as determined by the Board of Directors or Compensation Committee of the Board of Directors, and (b) all such options, stock or stock rights shall vest over a four (4) year period as follows: after 12 months of employment or service, as applicable, 25% shall vest; the remainder shall vest quarterly over the following 36 months (the terms set forth in (a) and (b) above, the "Vesting Terms").

(vii) Audit and Compensation Committees. The Company will maintain an Audit Committee of the Board of Directors and a Compensation Committee of the Board of Directors. All committees of the Board of Directors, including without limitation, the Audit and Compensation Committees, shall each include at least one (1) director appointed by LC.

(viii) Proprietary Information and Inventions Agreements. The Company shall cause each employee of the Company to enter into a Proprietary Information and Inventions Agreement in a form and substance satisfactory to the Board of Directors and each consultant of the Company shall have entered a consulting agreement containing similar terms regarding proprietary information and invention assignment as are set forth in the Proprietary Information and Inventions Assignment Agreement approved by the Board of Directors.

(ix) Real Property Holding Corporation. The Company shall operate in a manner such that it will not become a "United States real property holding corporation" as such term is defined in Section 897(c)(2) of the Internal Revenue Code of 1986, as amended (the "Code"), and the regulations thereunder.

(x) Small Business Stock. The Company covenants and agrees that so long as any of the Preferred Stock, or the Common Stock into which such Preferred Stock is converted, are held by an Investor (or a transferee of such Investor) in whose hands such Preferred Stock or Common Stock are eligible to qualify as Qualified Small Business Stock as defined in Section 1202(c) of the Code, it will use commercially reasonable efforts to (i) comply with any applicable filing or reporting requirements imposed by the Code on issuers of Qualified Small Business Stock; (ii) execute and deliver to each Investor, from time to time, such forms, documents, schedules and other instruments as may be reasonably requested thereby to cause such Preferred Stock, or the Common Stock into which they are converted, to qualify as Qualified Small Business Stock; and (iii) use reasonable best efforts to ensure (x) the Company continues to meet the requirements of a "qualified small business" as defined in Section 1202(d) of the Code and the Preferred Stock (or Common Stock into which such Preferred Shares are converted) qualify as Qualified Small Business Stock as defined in Section 1202(c) of the Code provided that clause (iii) shall not apply to any failure of the Preferred Stock (or Common Stock into which such Preferred Shares are converted) by reason of (A) Section 1202(c)(3)(A) of the Code or (B) any redemption described in Section 1202(c)(3)(B) of the Code if, in the case of sub-clause (B), the Investor holding any Qualified Small Business Stock participates in such redemption.

(xi) Good Faith. The Company will not, by any voluntary action, avoid or seek to avoid the observance or performance of any of the terms to be performed hereunder by the Company, but will at all times in good faith assist in the carrying out of all of the provisions

of this Agreement and in the taking of all such actions as may be necessary, appropriate in order to protect the rights of the parties hereunder against impairment.

(xii) Fees and Expenses. In connection with a Qualified Public Offering, the Company will reimburse up to $50,000 of expenses for one legal counsel representing the holders of Registrable Securities in connection therewith.

(b) Negative Covenants of the Company. Without limiting any other covenants and provisions hereof, the Company covenants and agrees that until the consummation of a Qualified Public Offering, so long as any shares of Preferred Stock are outstanding, it shall not take any of the following actions without the approval of the Board of Directors (including the affirmative consent of at least one (1) director appointed by LC), either directly or indirectly, by amendment, merger, consolidation, via a subsidiary or otherwise:

(i) Hire, fire or change the compensation of the CEO or the CSO;

(ii) Make any loans or advances to employees, except in the ordinary course of business as part of travel advances consistent with the Company's expenses and reimbursement policies;

(iii) Approve or make any material changes to the Company's business plan or annual budget;

(iv) License or transfer technology, other than in the ordinary course of business;

(v) Enter into any consulting, license, loan or lease agreements obligating the Company to make payments in excess of an aggregate of $250,000 per agreement in any calendar year; or

(vi) Agree to any of the foregoing.

(c) Reporting Requirements.

(i) Financial Statements and Notices of Certain Events. Until the earlier of (a) such time as the Company becomes subject to the reporting requirements of the Exchange Act, or (b) such time as no shares of Preferred Stock remain outstanding, the Company will furnish the following to each Major Investor:

(1) Monthly Reports: as soon as available and in any event within thirty (30) days after the end of each calendar month, unaudited financial statements of the Company and any subsidiaries as of the end of such month, including a consolidated (if applicable) balance sheet and statement of income and cash flows of the Company and any subsidiaries for such month and for the period commencing at the end of the previous fiscal year and ending with the end of such month, setting forth in each case in comparative form the corresponding figures for the corresponding period of the preceding fiscal year, and including comparisons to monthly budgets, cash flow analysis for such month, a schedule showing each expenditure of a capital nature during such month and the Company's current headcount, and a

summary discussion of the Company's principal and leading business indicators, all in reasonable detail and prepared in accordance with generally accepted accounting principles consistently applied (subject to year-end audit adjustments and the absence of footnotes);

(2) Quarterly Reports: as soon as available and in any event within forty-five (45) days after the end of each quarter of each fiscal year of the Company, unaudited financial statements of the Company and any subsidiaries as of the end of such quarter, including a consolidated (if applicable) balance sheet and statement of income and cash flows of the Company and any subsidiaries for such quarter and for the period commencing at the end of the previous fiscal year and ending with the end of such quarter, setting forth in each case in comparative form the corresponding figures for the corresponding period of the preceding fiscal year, and including comparisons to quarterly budgets, cash flow analysis for such quarter, a schedule showing each expenditure of a capital nature during such quarter and the Company's current headcount, a summary discussion of the Company's principal and leading business indicators, and a management report of the Company's principal functional areas summarizing the operations and business outlook of the Company, all in reasonable detail and prepared in accordance with generally accepted accounting principles consistently applied (subject to year-end audit adjustments and the absence of footnotes);

(3) Annual Reports: as soon as available and in any event within one hundred eighty (180) days after the end of each fiscal year of the Company, a copy of the annual audit report for such year for the Company and any subsidiaries, including therein a consolidated (if applicable) balance sheet of the Company and any subsidiaries as of the end of such fiscal year and a consolidated statement of income and cash flows of the Company and any subsidiaries for such fiscal year, setting forth in each case in comparative form the corresponding figures for the preceding fiscal year, all such consolidated statements to be duly certified by independent public accountants of recognized national standing approved by the Audit Committee;

(4) Notice of Adverse Changes: in each case, within ten (10) days of the CEO having actual knowledge of an occurrence, notice (which may be oral) of any material adverse change in the business, operations, affairs or condition (financial or otherwise) of the Company, of any material default under any material loan, lease or other material agreement to which the Company is a party, or of any material violation of applicable law by the Company;

(5) Written Reports: promptly after available and in any event within thirty (30) days after receipt, delivery or publication thereof, (a) any written reports submitted to the Company by independent public accountants in connection with an annual or interim audit of the books of the Company and any subsidiaries made by such accountants, including without limitation, each audit response letter and accountant management letter, (b) any material document (other than tax returns or patent or other intellectual property filings or applications) filed with a government department, commission, board, bureau, agency or instrumentality, domestic or foreign, including without limitation, the Environmental Protection Agency, the Internal Revenue Service or the Commission, and (c) regularly prepared written reports prepared by the Company to comply with any bank loan agreements;

(6) Notice of Proceedings: within five (5) Business Days after receipt of filing, notice (including copies of any publicly available pleadings) of all material actions, suits, litigations and proceedings pending or, to the knowledge of the Company, threatened against the Company, or, to the knowledge of the Company, against any officer, director, Key Employee or holder of more than 5% of the capital stock of the Company relating to such person's performance of duties for the Company or relating to his stock ownership in the Company, as applicable, including, without limiting their generality, actions pending or, to the knowledge of the Company, threatened involving the prior employment of any of the Company's officers or employees in their use in connection with the Company's business of any information or techniques allegedly proprietary to any of their former employers;

(7) Business Plan and Budget: as soon as available and in any event at least thirty (30) days prior to the end of each fiscal year (or such later date as is approved by the Board of Directors), a business plan and annual budget of the Company for the following fiscal year prepared on a monthly basis, including balance sheets, income statements and statements of cash flow for such months and, promptly after prepared, any other budgets or revised budgets prepared by the Company.

(d) Confidentiality. Each Investor agrees that it will, and will cause its employees, representatives and agents (including any observers) to, keep confidential and, except to the extent required by applicable law, not disclose or divulge any confidential, proprietary or secret information which such Investor may obtain from the Company pursuant to any rights granted hereunder and which is not generally available to the public unless such information is or becomes known to the Investor from a source other than the Company that is not known to such Investor to be under a confidentiality obligation with respect to such information, or is or becomes publicly known, or unless the Company gives its written consent to such Investor's release of such information, except that no such written consent shall be required (and the Investor shall be free to release such information to such recipient) if such information is to be provided to the Investor's counsel or accountant, or, with respect to non-technical information, including financial information, to an officer, director, employee, partner or member of such Investor or its Affiliates, provided that, in each case, the Investor shall inform the recipient of the confidential nature of such information, and shall obtain the recipient's agreement to treat the information as confidential. Nothing in this Section 13(d) shall be construed as a representation that an Investor or its Affiliates will not develop or acquire information that is the same as or similar to the Company's confidential information, provided that such party does not do so in breach of this Section 13(d).

(e) Successor Indemnification. If the Company or any of its successors or assignees consolidates with or merges into any other Person and is not the continuing or surviving corporation or entity of such consolidation or merger, then to the extent necessary, proper provision shall be made so that the successors and assignees of the Company assume the obligations of the Company with respect to indemnification of members of the Board of Directors as in effect immediately before such transaction, whether such obligations are contained in the Company's Bylaws, the Charter, or elsewhere, as the case may be.

14. Miscellaneous.

(a) All covenants and agreements contained in this Agreement by or on behalf of any of the parties hereto shall bind and inure to the benefit of the respective successors and permitted assigns of the parties hereto (including without limitation transferees of any Preferred Stock or Registrable Securities), whether so expressed or not, hereto; provided, however, that the rights and obligations of each Investor hereunder may only be assigned by such Investor to an Investor Affiliate or to a Person to which at least 100,000 shares of Registrable Securities (such minimum number of shares to be adjusted for any stock splits, stock dividends, recapitalizations or similar events) are transferred by such Investor; and provided, further, however, that the transferee provides written notice of such assignment to the Company and becomes a party to this Agreement by executing and delivering an instrument of accession in the form of Schedule II agreeing to be bound by and subject to the terms of this Agreement as an Investor hereunder. Each such Person shall thereafter be deemed an Investor for all purposes hereunder.

(b) In case any one or more of the provisions contained in this Agreement shall for any reason be held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability shall not affect any other provision of this Agreement and such invalid, illegal and unenforceable provision shall be reformed and construed so that it will be valid, legal, and enforceable to the maximum extent permitted by law.

(c) All notices and other communications required or permitted to be given pursuant to this Agreement shall be in writing signed by the sender, and shall be deemed duly given (i) on the date delivered if personally delivered, (ii) on the date sent by telecopier with automatic confirmation by the transmitting machine showing the proper number of pages were transmitted without error, (iii) on the Business Day after being sent by Federal Express or another recognized overnight mail service which utilizes a written form of receipt for next day or next Business Day delivery, (iv) two (2) Business Days after mailing, if mailed by United States postage-prepaid certified or registered mail, return receipt requested, or (v) one Business Day following the delivery of a duly transmitted electronic mail, in each case addressed to the applicable party at the address set forth below:

(1) if to the Company or any officer thereof, then at the Company's principal office addressed to the attention of the President and the Secretary, or to the attention of the specific officer, as the case may be, provided that for any notice provided to the Company or any officer of the Company hereunder, a copy (which shall not constitute notice) must also be sent to: Cooley LLP, 4401 Eastgate Mall, San Diego, CA 92121, Attention: Thomas A. Coll, Esq., Telecopier: (858) 550-6420, Telephone No.: (858) 550-6013; or

(2) if to any Investor, to such Investor's address as set forth on Schedule I or any Instrument of Accession hereto, as applicable;

or to such other address as any party hereto may advise the other parties in writing given in like manner.

(d) This Agreement and any and all matters arising directly or indirectly herefrom ("Agreement Matters") shall be governed by and construed and enforced in accordance with the internal laws of the State of Delaware applicable to agreements made and to be performed entirely in that state, without giving effect to the conflict of law principles of any

jurisdiction. Each of the parties hereto hereby (i) irrevocably consents and submits to the sole exclusive jurisdiction of the United States District Court for the District of Delaware and any state court in the State of Delaware (and of the appropriate appellate courts from any of the foregoing) in connection with any suit, arbitration, mediation, action or other proceeding (each a "Proceeding") directly or indirectly arising out of or relating to any Agreement Matter, provided that a party to this Agreement shall be entitled to enforce an order or judgment of such court in any United States or foreign court having jurisdiction over the other party hereto; (ii) irrevocably waives, to the fullest extent permitted by law, any objection that it may now or hereafter have to the laying of the venue of any such Proceeding in any such court or that any such Proceeding which is brought in any such court has been brought in an inconvenient forum; (iii) waives, to the fullest extent permitted by law, any immunity from jurisdiction of any such court or from any legal process therein; and (iv) agrees that service of any summons, complaint, notice or other process relating to such Proceeding may be effected in the manner provided for the giving of notice hereunder. EACH OF THE PARTIES HERETO HEREBY WAIVES ANY RIGHT IT MAY HAVE TO A TRIAL BY JURY IN RESPECT OF ANY CLAIM BASED UPON, ARISING OUT OF OR IN CONNECTION WITH ANY AGREEMENT MATTERS.

(e) This Agreement may not be amended or modified, and no provision hereof may be waived, without the written consent of (i) the Company and (ii) the Requisite Holders; provided, however, that notwithstanding the foregoing, any provision hereof may be waived by the benefiting party on behalf of itself, without the consent of any other party.

(f) This Agreement may be executed in two or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument. This Agreement may be executed by facsimile signature(s) or other electronic means which shall be binding on the party delivering the same, to be followed by delivery of originally executed signature pages. Any amendment, termination or waiver effected in accordance with this Section 14(f) shall be binding on each party and all of such party's successors and permitted assigns, whether or not any such party, successor or assignee entered into or approved such amendment, termination or waiver. No delay or omission to exercise any right, power or remedy accruing to any party under this Agreement, upon any breach or default of any other party under this Agreement, shall impair any such right, power or remedy of such non-breaching or non-defaulting party nor shall it be construed to be a waiver of any such breach or default, or an acquiescence therein, or of any similar breach or default thereafter occurring; nor shall any waiver of any single breach or default be deemed a waiver of any other breach or default theretofore or thereafter occurring. Any waiver, permit, consent or approval of any kind or character on the part of any party of any breach or default under this Agreement, or any waiver on the part of any party of any provisions or conditions of this Agreement, must be in writing and shall be effective only to the extent specifically set forth in such writing. All remedies, either under this Agreement or by law or otherwise afforded to any party, shall be cumulative and not alternative.

(g) The headings contained in this Agreement are for reference purposes only and shall not in any way affect the meaning or interpretation of this Agreement.

(h) The obligations of the Company to register shares of Registrable Securities under Sections 4, 5 or 6 shall terminate as to any holder of Registrable Securities on

the earliest of (i) the fifth (5th) anniversary of the date of a Qualified Public Offering, (ii) the closing of a Deemed Liquidation Event, and (iii) such time following the consummation of a firm-commitment underwritten public offering of Common Stock pursuant to an effective registration statement filed under the Securities Act when all of the Registrable Securities could be sold without restriction under Rule 144 promulgated under the Securities Act in a 3-month period.

(i) Notwithstanding anything else contained herein to the contrary, the Company's obligation to file a registration statement, or cause such registration statement to become and remain effective, may be suspended for a period or periods not to exceed ninety (90) days in any 12-month period if in the Company's good faith judgment upon the advice of counsel it (i) would materially impede, delay, interfere with or otherwise or otherwise adversely affect any pending financing, registration of securities, acquisitions, corporate reorganization or other significant transaction involving the Company or (ii) it would require disclosure of non- public material information that the Company has a bona fide business purpose for preserving as confidential, and it is therefore essential to defer the filing of such registration statement.

(j) The Company will grant the holders of shares of Preferred Stock any pre-emptive rights or registration rights granted to subsequent purchasers of the Company's equity securities to the extent such pre-emptive rights or registration rights are superior, in good faith judgment of the Board of Directors, to those granted to the holders of shares of Preferred Stock hereunder. The Company shall not grant any "piggy-back" registration rights to any holders of shares of the Company that are superior, in good faith judgment of the Board of Directors, to those "piggy-back" registration rights of the holders of shares of Preferred Stock without the written consent of the Requisite Holders.

(k) In the event that after the date of this Agreement, the Company issues additional shares of Preferred Stock to any Person who is not already a party hereto, as a condition to the issuance of such shares the Company shall require that any purchaser of Preferred Stock become a party to this Agreement by executing and delivering an instrument of accession in the form of Schedule II agreeing to be bound by and subject to the terms of this Agreement as an Investor hereunder. Each such Person shall thereafter be deemed an Investor for all purposes hereunder.

(l) Notwithstanding anything set forth herein to the contrary, the joinder of any Person who is not already a party to this Agreement and executes an instrument of accession in substantially the form of Schedule II shall not be deemed an amendment to this Agreement.

(m) Notwithstanding anything to the contrary contained herein, if the Company issues additional shares of Series D-1 Preferred Stock after the date hereof pursuant to the Purchase Agreement, any purchaser of such shares of Series D-1 Preferred Stock may become a party to this Agreement by executing and delivering to the Company an additional counterpart signature page to this Agreement and thereafter shall be deemed a "Series D-1 Investor" for all purposes hereunder and Schedule I hereto shall be amended by the Company to add information regarding additional "Series D-1 Investors" and parties to this Agreement or to modify the information set forth therein.

(n) This Agreement constitutes the entire agreement among the parties with respect to the subject matter hereof and supersedes all prior and/or contemporaneous agreements and understandings, whether oral or written, between them or any of them as to such subject matter. This Agreement amends and restates in its entirety that certain BioNano Genomics, Inc. (formerly BioNanomatrix, Inc.) Fourth Amended and Restated Investors' Rights Agreement dated March 4, 2016, in accordance with Section 14(e) thereof.

[Remainder of Page Intentionally Left Blank]

Please indicate your acceptance of the foregoing by signing and returning the enclosed counterpart of this letter, whereupon this Agreement shall be a binding agreement between the Company and you.

Very truly yours,

THE COMPANY:

BIONANO GENOMICS, INC.

By: /s/ R. Erik Holmlin
Name: Erik Holmlin
Title: Chief Executive Officer

IN WITNESS WHEREOF, the undersigned have executed this Fifth Amended and Restated Investors' Rights Agreement as of the day and year first above written.

INVESTOR:

LC FUND VI, L.P.

By: /s/ Darren Cai, Ph.D.
Name: Darren Cai, Ph.D.
Title: Managing Director

IN WITNESS WHEREOF, the undersigned have executed this Fifth Amended and Restated Investors' Rights Agreement as of the day and year first above written.

INVESTOR:

LC PARALLEL FUND VI, L.P.

By: /s/ Darren Cai, Ph.D.
Name: Darren Cai, Ph.D.
Title: Managing Director

IN WITNESS WHEREOF, the undersigned have executed this Fifth Amended and Restated Investors' Rights Agreement as of the day and year first above written.

INVESTORS:

DOMAIN PARTNERS VIII, L.P.

By: One Palmer Square Associates VIII, L.L.C., its General Partner

By: /s/ Lisa A. Kraeutler
Name: Lisa A. Kraeutler
Title: Attorney-in-fact

DP VIII ASSOCIATES, L.P.

By: One Palmer Square Associates VIII, L.L.C., its General Partner

By: /s/ Lisa A. Kraeutler
Name: Lisa A. Kraeutler
Title: Attorney-in-fact

IN WITNESS WHEREOF, the undersigned have executed this Fifth Amended and Restated Investors' Rights Agreement as of the day and year first above written.

INVESTOR:

NOVARTIS BIOVENTURES LTD.

By: /s/ H.S. Zivi
Name: H.S. Zivi
Title: Chairman

By: /s/ Laurieann Chaikowsky
Name: Laurieann Chaikowsky
Title: Authorized Signatory

SCHEDULE I

BIONANO GENOMICS, INC.
9640 Towne Centre Drive, Suite 100
San Diego, CA 92121

SCHEDULE OF INVESTORS

SERIES A INVESTORS:

Battelle Memorial Institute

BVP GP, LLC

Innovation Valley Partners, LP

Ben Franklin Technology Partners
of Southeastern Pennsylvania

Steve Chazen

SERIES B INVESTORS:

Battelle Memorial Institute

BVP GP, LLC

Innovation Valley Partners, LP

Edward Ericson

Michael Kochersperger

Domain Partners VIII, L.P.

DP VIII Associates, L.P.

Steve Chazen

Gund Investment LLC

Han Cao

SERIES B-1 INVESTORS:

Battelle Memorial Institute

BVP GP, LLC

Innovation Valley Partners, LP

Domain Partners VIII, L.P.

DP VIII Associates, L.P.

Gund Investment LLC

Peter B. Dervan

Robert Austin

SERIES C INVESTORS:

LC Fund VI, L.P.

LC Parallel Fund VI, L.P.

Battelle Memorial Institute

BVP GP, LLC

Innovation Valley Partners, LP

Domain Partners VIII, L.P.

DP VIII Associates, L.P.

Gund Investment LLC

Robert Austin

Han Cao

Steve Chazen

Peter B. Dervan

Michael Kochersperger

Monashee Investment Management, LLC

Federated Kaufmann Fund

Federated Kaufmann Fund II

Shrewsbury Capital Partners LLC

NOVARTIS BIOVENTURES LTD.

with copies to:

Campbell Murray and Christine Brennan
Novartis Venture Fund

and

Albert L. Sokol, Partner
Edwards Wildman Palmer LLP

SERIES D INVESTORS:

LC Fund VI, L.P.

LC Parallel Fund VI, L.P.

Domain Partners VIII, L.P.

DP VIII Associates, L.P.

NOVARTIS BIOVENTURES LTD.

with copies to:

Campbell Murray and Christine Brennan
Novartis Venture Fund

and

Albert L. Sokol, Partner
Edwards Wildman Palmer LLP

Monashee Investment Management, LLC

BVP GP, LLC

Innovation Valley Partners, LP

Shrewsbury Capital Partners LLC

Robert Austin

Ben Franklin Technology Partners
of Southeastern Pennsylvania

Han Cao

Steve Chazen

Peter B. Dervan

Michael Kochersperger

SERIES D-1 INVESTORS:

LC Fund VI, L.P.

LC Parallel Fund VI, L.P.

LC Healthcare Fund I, L.P.

Praise Alliance International Limited

Alexandria Venture Investments, LLC

Full Succeed International Limited

Ascender Prosperity Capital Co., Ltd

AriMed International Ltd.

HybriBio Limited

Domain Partners VIII, L.P.

DP VIII Associates, L.P.

NOVARTIS BIOVENTURES LTD.

with copies to:

Campbell Murray and Christine Brennan
Novartis Venture Fund

and

Albert L. Sokol, Partner
Edwards Wildman Palmer LLP

Monashee Investment Management, LLC

Han Cao

BVP GP, LLC

Steve Chazen

Peter B. Dervan

Michael Kochersperger

Robert Austin

SCHEDULE II

BIONANO GENOMICS, INC.

INSTRUMENT OF ACCESSION

The undersigned, , as a condition precedent to becoming the owner or holder of record of ( ) shares of the Series Convertible Participating Preferred Stock, par value $0.0001 per share, of BioNano Genomics, Inc., a Delaware corporation and successor to BioNanomatrix, LLC (the "Company"), hereby agrees to become an Investor under that certain Fifth Amended and Restated Investors' Rights Agreement dated as of August 5, 2016 by and among the Company and certain stockholders of the Company, as amended to date (the "Investors' Rights Agreement"). This Instrument of Accession shall take effect and shall become an integral part of, and the undersigned shall become a party to and bound by, said Investors' Rights Agreement immediately upon execution and delivery to the Company of this Instrument.

IN WITNESS WHEREOF, this INSTRUMENT OF ACCESSION has been duly executed by or on behalf of the undersigned, as a sealed instrument under the laws of the State of Delaware, as of the date below written.

Signature:

____

(Print Name) ____________________________

Address:

____

____

Date: ________________________________

Accepted:

BIONANO GENOMICS, INC.

By: ________________________________

Name:

Title:

BIONANO GENOMICS, INC.

FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT

This **First Amendment to Fifth Amended and Restated Investors' Rights Agreement** (this "***Amendment***"), amending that certain Fifth Amended and Restated Investors' Rights Agreement by and among **BioNano Genomics, Inc.**, a Delaware corporation (the "***Company***"), and the persons and entities referenced therein (the "***Investors***") dated as of August 5, 2016 (the "***Investor Rights Agreement***"), is entered into as of July 16, 2018 by and among the Company and the Investors. Capitalized terms used herein which are not defined herein shall have the definition ascribed to them in the Investor Rights Agreement.

RECITALS

Whereas, the Company and the Investors have previously entered into the Investor Rights Agreement;

Whereas, Section 14(e) of the Investor Rights Agreement provides that the Investor Rights Agreement may be amended with the written consent of (i) the Company and (ii) the Requisite Holders (as defined therein); and

Whereas, the undersigned constitute the Company and the Requisite Investors.

AGREEMENT

Now, Therefore, in consideration of the foregoing and the promises and covenants contained herein and in the Investor Rights Agreement, and for other good and valuable consideration, the receipt of which is hereby acknowledged, the parties hereto agree as follows:

1. The definition of "Qualified Public Offering" in Section 1 of the Investor Rights Agreement is hereby amended and restated in its entirety to read as follows:

"Qualified Public Offering" shall mean the closing of the sale of shares of Common Stock to the public (i) in which the price per share paid by the public (prior to the deduction of underwriting discounts and registration expenses) is no less than $6.00 per share (as adjusted for any stock dividends, combinations, splits, recapitalizations and the like with respect to such shares after July 16, 2018) and (ii) resulting in at least $25,000,000 in gross proceeds to the Company (prior to the deduction of underwriting discounts and registration expenses), in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act."

2. **Effect of Amendment**. Except as expressly modified by this Amendment, the Investor Rights Agreement shall remain unmodified and in full force and effect.

3. **Governing Law**. This Amendment shall be governed, construed and interpreted in accordance with the laws of the State of Delaware, without giving effect to the principles of conflict of laws.

4. **Counterparts**. This Amendment may be executed in any number of counterparts and signatures delivered by facsimile, each of which shall be deemed an original, but all of which together shall constitute one instrument.

[Remainder of this page intentionally left blank]

In Witness Whereof, the parties hereto have executed this **FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

COMPANY:

BIONANO GENOMICS, INC.

By: /s/ Erik Holmlin

Name: Erik Holmlin

Title: Chief Executive Officer

In Witness Whereof, the parties hereto have executed this **FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDER:

NOVARTIS BIOVENTURES LTD.

By: /s/ Bart Dzikowski

Name: Bart Dzikowski

Title: Secretary of the Board

IN WITNESS WHEREOF, the parties hereto have executed this **FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDERS:

LC FUND VI, L.P.

By: /s/ Jafar Wang
Name: Jafar Wang
Title:

LC PARALLEL FUND VI, L.P.

By: /s/ Jafar Wang
Name: Jafar Wang
Title:

LC HEALTHCARE FUND I, L.P.

By: /s/ Jafar Wang
Name: Jafar Wang
Title:

In Witness Whereof, the parties hereto have executed this **FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDERS:

DOMAIN PARTNERS VIII, L.P.

By: One Palmer Square Associates VIII, L.L.C.,
its General Partner

By: /s/ Lisa A. Kraeutler
Name: Lisa A. Kraeutler
Title: Attorney-in-fact

DP VIII ASSOCIATES, L.P.

By: One Palmer Square Associates VIII, L.L.C.,
its General Partner

By: /s/ Lisa A. Kraeutler
Name: Lisa A. Kraeutler
Title: Attorney-in-fact

IN WITNESS WHEREOF, the parties hereto have executed this **FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDER:

MONASHEE INVESTMENT MANAGEMENT, LLC

By: /s/ Jeff Muller
Name: Jeff Muller
Title: CCO

In Witness Whereof, the parties hereto have executed this **FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDER:

ALEXANDRIA VENTURE INVESTMENTS, LLC

By: Alexandria Real Estate Equities, Inc., its managing member

By: /s/ Aaron Jacobson
Name: Aaron Jacobson
Title: SVP – Venture Counsel

IN WITNESS WHEREOF, the parties hereto have executed this **FIRST AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDER:

FULL SUCCEED INTERNATIONAL LIMITED

By: /s/ Hainian Zeng
Name: Hainian Zeng
Title:

BIONANO GENOMICS, INC.

SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT

This **SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** (this "***Amendment***"), amending that certain Fifth Amended and Restated Investors' Rights Agreement by and among **BIONANO GENOMICS, INC.**, a Delaware corporation (the "***Company***"), and the persons and entities referenced therein (the "***Investors***") dated as of August 5, 2016 (the "***Investor Rights Agreement***"), is entered into as of July 31, 2018 by and among the Company and the Investors. Capitalized terms used herein which are not defined herein shall have the definition ascribed to them in the Investor Rights Agreement.

RECITALS

WHEREAS, the Company and the Investors have previously entered into the Investor Rights Agreement;

WHEREAS, Section 14(e) of the Investor Rights Agreement provides that the Investor Rights Agreement may be amended with the written consent of (i) the Company and (ii) the Requisite Holders (as defined therein); and

WHEREAS, the undersigned constitute the Company and the Requisite Investors.

AGREEMENT

NOW, THEREFORE, in consideration of the foregoing and the promises and covenants contained herein and in the Investor Rights Agreement, and for other good and valuable consideration, the receipt of which is hereby acknowledged, the parties hereto agree as follows:

1. The definition of "Qualified Public Offering" in Section 1 of the Investor Rights Agreement is hereby amended and restated in its entirety to read as follows:

> "Qualified Public Offering" shall mean the closing of the sale of shares of Common Stock to the public (i) in which the price per share paid by the public (prior to the deduction of underwriting discounts and registration expenses) is no less than $5.00 per share (as adjusted for any stock dividends, combinations, splits, recapitalizations and the like with respect to such shares after July 16, 2018) and (ii) resulting in at least $25,000,000 in gross proceeds to the Company (prior to the deduction of underwriting discounts and registration expenses), in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act."

2. **Effect of Amendment**. Except as expressly modified by this Amendment, the Investor Rights Agreement shall remain unmodified and in full force and effect.

3. **Governing Law**. This Amendment shall be governed, construed and interpreted in accordance with the laws of the State of Delaware, without giving effect to the principles of conflict of laws.

4. **Counterparts**. This Amendment may be executed in any number of counterparts and signatures delivered by facsimile, each of which shall be deemed an original, but all of which together shall constitute one instrument.

[Remainder of this page intentionally left blank]

IN WITNESS WHEREOF, the parties hereto have executed this **SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

COMPANY:

BIONANO GENOMICS, INC.

By: /s/ R. Erik Holmlin
Name: Erik Holmlin
Title: Chief Executive Officer

In Witness Whereof, the parties hereto have executed this **SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDER:

NOVARTIS BIOVENTURES LTD.

By: /s/ Bart Dzikowski
Name: Bart Dzikowski
Title: Secretary of the Board

/s/ Anja König
Anja König
Authorized Signatory

In Witness Whereof, the parties hereto have executed this **SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDERS:

LC FUND VI, L.P.

By: /s/ Jafar Wang
Name: Jafar Wang
Title:

LC PARALLEL FUND VI, L.P.

By: /s/ Jafar Wang
Name: Jafar Wang
Title:

LC HEALTHCARE FUND I, L.P.

By: /s/ Jafar Wang
Name: Jafar Wang
Title:

In Witness Whereof, the parties hereto have executed this **SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDERS:

DOMAIN PARTNERS VIII, L.P.

By: One Palmer Square Associates VIII, L.L.C.,
its General Partner

By: /s/ Lisa A. Kraeutler
Name: Lisa A. Kraeutler
Title: Attorney-in-fact

DP VIII ASSOCIATES, L.P.

By: One Palmer Square Associates VIII, L.L.C.,
its General Partner

By: /s/ Lisa A. Kraeutler
Name: Lisa A. Kraeutler
Title: Attorney-in-fact

In Witness Whereof, the parties hereto have executed this **SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDER:

MONASHEE INVESTMENT MANAGEMENT, LLC

By: /s/ Jeff Muller
Name: Jeff Muller
Title: CCO

IN WITNESS WHEREOF, the parties hereto have executed this **SECOND AMENDMENT TO FIFTH AMENDED AND RESTATED INVESTORS' RIGHTS AGREEMENT** as of the date set forth in the first paragraph hereof.

HOLDER:

ALEXANDRIA VENTURE INVESTMENTS, LLC

By: /s/ Aaron Jacobson
Name: Aaron Jacobson
Title: SVP - Venture Counsel

Exhibit 23.1

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the use in this Amendment No. 4 to Registration Statement No. 333-225970 on Form S-1 of our report dated May 11, 2018 (July 16, 2018 as to the effects of the reverse stock split as described in Note 12), relating to the consolidated financial statements of Bionano Genomics, Inc., appearing in the Prospectus, which is a part of such Registration Statement, and to the reference to us under the heading "Experts" in such Prospectus.

/s/ DELOITTE & TOUCHE LLP

San Diego, California
July 31, 2018