

Spark Therapeutics, Inc.
Form 10-K/A
April 30, 2019
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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, DC 20549

FORM 10-K/A
(Amendment No.1)

(Mark One)

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

For the fiscal year ended December 31, 2018

OR

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

For the transition period from _____ to _____

Commission File Number: 001-36819

Spark Therapeutics, Inc.
(Exact Name of Registrant as Specified in Its Charter)

Delaware (State or Other Jurisdiction of Incorporation or Organization)	46-2654405 (IRS Employer Identification No.)
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3737 Market Street Suite 1300 Philadelphia, PA (Address of Principal Executive Offices)	19104 (Zip Code)
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(888) 772-7560
(Registrant's Telephone Number, Including Area Code)
Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Name of each exchange on which registered
Common Stock, \$0.001 par value per share	Nasdaq Global Select Market

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

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

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

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

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Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes No

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§ 229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K.

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

Non-accelerated filer Smaller reporting company
Emerging growth company

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

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

As of June 30, 2018, the last day of the registrant's most recently completed second fiscal quarter, the aggregate market value of the common stock held by non-affiliates of the registrant was approximately \$2,583,300,000, based upon the closing price of the registrant's common stock on June 30, 2018.

As of April 1, 2019, there were 38,733,406 shares of the registrant's common stock, par value \$0.001 per share, outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

None.

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Explanatory Note

This Amendment No. 1 on Form 10-K/A (this “Amendment”) amends the Annual Report on Form 10-K of Spark Therapeutics, Inc., a Delaware corporation (“Company,” “Registrant,” “we,” “us” or “our”), for the year ended December 31, 2018, that was originally filed with the Securities and Exchange Commission (“SEC”) on February 28, 2019, (the “Original Filing”) and is being filed primarily to provide the information required by Part III of Form 10-K. This information previously was omitted from the Original Filing in reliance on General Instruction G(3) to Form 10-K, which permits the information required by Part III to be incorporated in the Form 10-K by reference from a definitive proxy statement if such statement is filed no later than 120 days after our fiscal year end. We are filing this Amendment to include Part III information in our Form 10-K because we do not expect to file our definitive proxy statement containing this information before that date. The reference on the cover of the Original Filing to the incorporation by reference to portions of our definitive proxy statement into Part III of the Original Filing has been deleted. Except for the addition of the Part III information, the update to the cover page and the filing of new certifications by our principal executive officer and principal financial officer, this Amendment does not amend or otherwise update any other information in the Original Filing, and the Original Filing, as amended by this Amendment, continues to speak as of the date of the Original Filing. Accordingly, this Amendment should be read in conjunction with the Original Filing and with our filings with the SEC subsequent to the Original Filing.

References in this Amendment to the Company's website are not intended to, and do not, incorporate by reference into this Amendment any materials contained on such website.

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PART III

Item 10. Directors, Executive Officers and Corporate Governance

Board of Directors

The following table sets forth information concerning each member of our Board of Directors (the "Board") as of April 1, 2019. The biographical description of each director includes the specific experience, qualifications, attributes and skills that the Board would expect to consider if it were making a conclusion currently as to whether such person should serve as a director.

Name	Age	Position
Jeffrey D. Marrazzo	40	Chief Executive Officer and Director
Katherine A. High, M.D.	67	President, Head of Research and Development and Director
Steven M. Altschuler, M.D. (1) (2) (3)	65	Chairman of the Board
Lars G. Ekman, M.D., Ph.D. (1) (3) (4)	69	Director
Anand Mehra, M.D. (4)	43	Director
Vincent J. Milano (2)	55	Director
Robert J. Perez (2) (3)	54	Director
Elliott Sigal, M.D., Ph.D. (3) (4)	67	Director
Lota Zoth, CPA (1) (2)	59	Director

(1) Member of the Audit Committee.

(2) Member of the Compensation Committee.

(3) Member of the Nominating and Corporate Governance Committee.

(4) Member of the Science and Technology Committee.

Jeffrey D. Marrazzo

Jeffrey D. Marrazzo has served as Chief Executive Officer of the Company and as a member of our Board since May 2013. Prior to founding Spark, Mr. Marrazzo launched and was Chief Business Officer of the U.S. division of Molecular Health, Inc. from December 2011 to May 2013. Mr. Marrazzo was part of the founding management of Generation Health, Inc. from May 2009 to January 2011, up to and through the acquisition of a majority of the company's shares by CVS Caremark. From 2008 to 2009, Mr. Marrazzo served as an employee and independent consultant to the business development and finance teams at Tengion, Inc. and, from January 2011 to April 2013, Mr. Marrazzo served as an independent consultant to the Children's Hospital of Philadelphia, or CHOP. Previously, Mr. Marrazzo served as healthcare advisor to former Pennsylvania Governor Edward G. Rendell and as an IBM management consultant to global pharmaceutical companies. Mr. Marrazzo holds a B.S.E. and B.A. in systems science and engineering and economics from the University of Pennsylvania and a dual M.B.A./M.P.A. from The Wharton School and Harvard University. We believe that Mr. Marrazzo is qualified to serve on our Board because of his extensive leadership experience in the life sciences industry and his extensive knowledge of our Company based on his role as Chief Executive Officer.

Katherine A. High, M.D.

Dr. Katherine A. High has served as our President and a member of our Board since September 2014 and has served as our Head of Research and Development since September 2017. From September 2014 through September 2017, Dr. High served as our Chief Scientific Officer. Prior to serving as our President, Dr. High provided advice to Spark and subsequently served as an independent consultant to Spark from December 2013 to September 2014. From July 1999 through September 2014, Dr. High was a Professor at the Perelman School of Medicine at the University of Pennsylvania. From March 2003 through September 2014, Dr. High was an Investigator of the Howard Hughes Medical Institute. She served as the Director of the Center for Cellular and Molecular Therapeutics at CHOP from September 2004 to April 2014. Dr. High began her independent research career at Yale University and the University of North Carolina studying the molecular basis of blood coagulation and the development of novel therapeutics for the treatment of bleeding disorders. Dr. High's studies at CHOP established the first proof of principle of gene therapy for hemophilia in preclinical models and led to a series of studies that characterized the human immune response to

adeno-associated virus, or AAV, vectors in a variety of target tissues. Dr. High served a five-year term, from 2000 to 2005, on the the U.S. Food and Drug Administration Advisory Committee on Cell, Tissue and Gene Therapies and is a past-president of the American Society of Gene & Cell Therapy. Dr. High holds an A.B. in chemistry from Harvard University, an M.D. from the University of North Carolina School of Medicine, a business certification from the University of North Carolina Business School Management Institute for Hospital Administrators and an honorary M.A. from the University of Pennsylvania. We believe that Dr. High is qualified to serve on our Board because of her extensive executive

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and scientific leadership in the life sciences industry and her extensive knowledge of our Company based on her role as President and Head of Research and Development and her previous role as Chief Scientific Officer.

Non-Employee Directors

Steven M. Altschuler, M.D.

Dr. Steven M. Altschuler has served on our Board and has been the Chairman of our Board since October 2013.

Dr. Altschuler has been serving as an Academic Healthcare Consultant working with multiple health systems since October 2017. He has been serving as a Managing Director at Ziff Capital Partners since May 2018. He served as the Executive Vice President of Health Affairs at the University of Miami and Chief Executive Officer of UHealth-University of Miami Health System from January 2016 to October 2017. Previously, he was Chief Executive Officer of CHOP and The Children's Hospital of Philadelphia Foundation, or the CHOP Foundation, from April 2000 to November 2015. Prior to serving as the Chief Executive Officer of CHOP, Dr. Altschuler served in many leadership roles at CHOP including: Division Chief of Gastroenterology, Physician-in-Chief, inaugural holder of the Leonard and Madlyn Abramson Endowed Chair in Pediatrics and Professor and Chair of the Department of Pediatrics at the Perelman School of Medicine at the University of Pennsylvania, where he was a faculty member from 1985 to 2000. Dr. Altschuler served on the board of directors for Mead Johnson Nutrition Company from 2009 through 2017. Dr. Altschuler currently is chair of the Compensation and Audit Committees and has served on the board of directors of Weight Watchers International since 2012. Dr. Altschuler has served on the Board of Adtalem Global Education Inc. since May 2018 and is a member of its Audit and Finance Committee and Academic Quality Committee.

Dr. Altschuler holds a B.A. in mathematics and an M.D., both from Case Western Reserve University. He completed his pediatric internship and residency at Children's Hospital Medical Center-Boston and fellowship training in gastroenterology and nutrition at CHOP and the University of Pennsylvania School of Medicine. We believe that Dr. Altschuler is qualified to serve on our Board because of his extensive experience in the medical industry, his service on the boards of directors of other life sciences companies and his extensive leadership experience.

Lars G. Ekman, M.D., Ph.D.

Dr. Lars G. Ekman has served on our Board since May 2014. He currently is Executive Partner at Sofinnova Ventures, a clinical stage biopharmaceutical venture capital firm, which he joined in March 2008. Prior to joining Sofinnova Ventures, Dr. Ekman was President of Research and Development at Elan Corporation (now Perrigo) from January 2001 to December 2007. Prior to Elan, he was Executive Vice President, Research and Development, at Schwarz Pharma AG (now UCB) and, prior to then, held a variety of senior scientific and clinical roles at Pharmacia (now Pfizer). Dr. Ekman has served as a director of Amarin Corporation since 2008, Prothena Biosciences Inc. since 2012, Sophiris Bio Inc. since 2010, Ultragenyx Pharmaceutical Inc. since 2016 and he co-founded and served as Chief Executive Officer of Cebix, Inc. from 2008 to 2011, and served on its board from 2009 to 2015. Dr. Ekman is a board-certified surgeon and holds an M.D. and a Ph.D. in experimental biology from the University of Gothenburg, Sweden. We believe that Dr. Ekman is qualified to serve on our Board because of his extensive experience in the life sciences industry, both as an executive and as a venture capital investor, in addition to his extensive leadership experience.

Anand Mehra, M.D.

Dr. Anand Mehra has served on our Board since May 2014. Dr. Mehra currently is a General Partner of Sofinnova Investments, which he joined in May 2007. Prior to joining Sofinnova Investments, Dr. Mehra worked in J.P. Morgan's private equity and venture capital group and, before that, Dr. Mehra was a consultant in McKinsey & Company's pharmaceutical practice. Dr. Mehra previously has served on the board of directors of Aerie Pharmaceuticals and Marinus Pharmaceuticals. He currently serves on the board of Aclaris Therapeutics, Inc. and Merus N.V., positions he has held since 2013 and 2015, respectively, as well as several private companies. Dr. Mehra holds a B.A. from the University of Virginia and an M.D. from Columbia University's College of Physicians and Surgeons. We believe that Dr. Mehra is qualified to serve on our Board because of his extensive experience in the life sciences industry, his service on the boards of directors of other life sciences companies and his extensive leadership experience.

Vincent J. Milano

Vincent J. Milano has served on our Board since June 2014. Mr. Milano has served as the Chief Executive Officer of Idera Pharmaceuticals Inc., a clinical stage biopharmaceutical company, since December 2014. Prior to joining Idera, Mr. Milano served as President, Chief Executive Officer and Chairman of the board of directors of ViroPharma Incorporated, or ViroPharma, an international biopharmaceutical company, from March 2008 to January 2014 when it was acquired by Shire Pharmaceuticals, Inc. Mr. Milano joined ViroPharma in 1996 and served as Vice President, Chief Financial Officer and Treasurer from 1997 to 2008. Prior to joining ViroPharma, Mr. Milano served as a Senior Manager at KPMG LLP, independent certified public accountants. Mr. Milano has served on the board of directors of Vanda Pharmaceuticals Inc. since 2010 and the

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board of directors of VenatoRx Pharmaceuticals, Inc., a privately held biotechnology company, since 2013. He also serves on the board of directors of Life Sciences Pennsylvania. Mr. Milano holds a B.S. in accounting from Rider College. We believe that Mr. Milano is qualified to serve on our Board because of his extensive experience in the life sciences industry, his financial expertise and his extensive leadership experience.

Robert J. Perez

Robert J. Perez has served on our Board since January 2018. Mr. Perez has served as the founder and Managing Partner of Vineyard Sound Advisors, a biopharmaceutical advisory firm, since August 2015. Mr. Perez has been serving as an Operating Partner at General Atlantic, a global growth equity firm since January 2019. He served as Chief Executive Officer of Cubist Pharmaceuticals, Inc., a public pharmaceutical development company, from December 2014 until it was acquired by Merck in January 2015. He joined Cubist in August 2003 as Senior Vice President, Sales and Marketing, and led the launch of Cubicin® (daptomycin for injection). At Cubist, he served as Executive Vice President and Chief Operating Officer from August 2007 to July 2012 and President and Chief Operating Officer from July 2012 to December 2014. Prior to joining Cubist, he served as Vice President of Biogen, Inc.'s CNS business unit from 2001 to 2003, where he was responsible for commercial leadership of an \$800 million neurology business unit, and from 1995 to 2001 he held positions of increasing responsibility within Biogen's CNS commercial organization. Mr. Perez currently serves as a member of the board of directors of AMAG Pharmaceuticals, Inc., Zafgen, Inc. and Unum Therapeutics Inc., positions he has held since 2009, 2015 and 2018, respectively. Mr. Perez has been the Founder and Chairman of Life Sciences Cares since January 2016, and also has been a member of the Board of Trustees at The Dana Farber Cancer Institute, Inc. since January 2013. Mr. Perez received a B.S. in business from California State University, Los Angeles and an M.B.A. from the Anderson Graduate School of Management at the University of California, Los Angeles. We believe Mr. Perez is qualified to serve on our Board because of his extensive biotechnical and leadership experience, including his service at Cubist Pharmaceuticals, Inc. and Biogen, Inc.

Elliott Sigal, M.D., Ph.D.

Dr. Elliott Sigal has served on our Board since January 2014. Dr. Sigal served as Chief Scientific Officer of Bristol-Myers Squibb, or BMS, from October 2004 until his retirement in June 2013 and was a member of the board of directors from March 2011 to June 2013. Dr. Sigal joined BMS in 1997 and held positions of increasing responsibility in drug discovery and development and was a member of the executive committee from September 2001 through June 2013. Prior to BMS, he was Vice President of R&D and Chief Executive Officer for the genomics firm Mercator Genetics Inc. Dr. Sigal currently serves as a member of the board of directors for Adaptimmune Therapeutics plc, a role he has held since 2014. Dr. Sigal has served on the Board of Surface Oncology since 2018 and is a member of its Nominating & Corporate Governance Committee. In addition, Dr. Sigal is an advisor to the life sciences venture firm New Enterprise Associates and consults for select biopharmaceutical companies. Dr. Sigal holds B.S., M.S. and Ph.D. degrees in industrial engineering from Purdue University and an M.D. from the University of Chicago. He completed his training in internal medicine and pulmonary medicine at the University of California, San Francisco, or UCSF. He received his research training at the Cardiovascular Research Institute at UCSF, where he served on the faculty of the UCSF Department of Medicine. We believe that Dr. Sigal is qualified to serve on our Board because of his extensive experience in the life sciences industry and his extensive leadership experience.

Lota Zoth, CPA

Lota Zoth has served on our Board since January 2016. Ms. Zoth has served in senior financial roles in a variety of commercial-stage companies over a 30-year career, including serving as Chief Financial Officer of MedImmune Inc., or Medimmune, from 2002 until its acquisition by AstraZeneca in 2007. Prior to joining MedImmune in 2002, Ms. Zoth served as Senior Vice President, Corporate Controller and Principal Accounting Officer at PSINet Inc., Vice President, Corporate Controller and Chief Accounting Officer at Sodexo Marriott Services, Inc., Marriott International and PepsiCo, Inc. Ms. Zoth also served as an auditor at Ernst & Young, LLP and is a Certified Public Accountant. Ms. Zoth received a B.B.A. in accounting from Texas Tech University. She currently serves on the board of Orexigen Therapeutics, Inc., NewLink Genetics Corporation where she serves as the Chair of the Audit Committee and a member of the Compensation Committee, Zymworks where she serves as the chair of the Audit Committee and as a member of the Compensation Committee and Inovio Pharmaceuticals where she is a member of the Audit

Committee and Compensation Committee, roles she has held since 2012, 2015, 2017, and 2019, respectively. Orexigen Therapeutics, Inc. filed a petition for relief under Chapter 11 of the U.S. Bankruptcy Code on March 12, 2018. We believe that Ms. Zoth is qualified to serve on our Board because of her extensive experience in the life sciences industry, her financial expertise and her extensive leadership experience.

Director independence

Rule 5605 of the NASDAQ Listing Rules requires a majority of a listed company's board of directors to be comprised of independent directors within one year of listing. In addition, the NASDAQ Listing Rules require that, subject to specified

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exceptions, each member of a listed company's audit, compensation and nominating and corporate governance committees be independent and that audit committee members also satisfy independence criteria set forth in Rule 10A-3 under the Securities Exchange Act of 1934, as amended, or the Exchange Act. Under Rule 5605(a)(2) of the NASDAQ Listing Rules, a director will only qualify as an "independent director" if, in the opinion of our Board, that person does not have a relationship that would interfere with the exercise of independent judgment in carrying out the responsibilities of a director. In order to be considered independent for purposes of Rule 10A-3, a member of an audit committee of a listed company may not, other than in his or her capacity as a member of the audit committee, the board of directors or any other board committee: (1) accept, directly or indirectly, any consulting, advisory or other compensatory fee from the listed company or any of its subsidiaries; or (2) be an affiliated person of the listed company or any of its subsidiaries. In addition, in affirmatively determining the independence of any director who will serve on a company's compensation committee, Rule 10C-1 under the Exchange Act requires that a company's board of directors consider all factors specifically relevant to determining whether a director has a relationship to such company which is material to that director's ability to be independent from management in connection with the duties of a compensation committee member, including, but not limited to: (1) the source of compensation of the director, including any consulting, advisory or other compensatory fee paid by such company to the director; and (2) whether the director is affiliated with the company or any of its subsidiaries or affiliates. In April 2019, our Board undertook a review of the composition of our Board and its committees and the independence of each director. Based upon information requested from, and provided by, each director concerning his or her background, employment and affiliations, including family relationships, our Board has determined that each of our directors, with the exception of Mr. Marrazzo and Dr. High, is an "independent director" as defined under Rule 5605(a)(2) of the NASDAQ Listing Rules. Our Board also determined that Ms. Zoth and Drs. Altschuler and Ekman, who comprise our Audit Committee, Messrs. Milano and Perez and Dr. Altschuler and Ms. Zoth, who comprise our Compensation Committee, and Drs. Ekman, Altschuler and Sigal and Mr. Perez, who comprise our Nominating and Corporate Governance Committee, satisfy the independence standards for such committees established by the SEC and the NASDAQ Listing Rules, as applicable. In making such determinations, our Board considered the relationships that each such non-employee director has with our Company and all other facts and circumstances our Board deemed relevant in determining independence, including the beneficial ownership of our capital stock by each non-employee director. There are no family relationships among any of our directors or executive officers.

Executive officers

The following table sets forth information regarding our executive officers, as of April 1, 2019:

NAME	Age	Position
Jeffrey D. Marrazzo	40	Chief Executive Officer
Katherine A. High, M.D.	67	President and Head of Research and Development
Stephen W. Webster	58	Chief Financial Officer
Lisa Dalton	46	Chief People Officer
Daniel R. Faga	39	Chief Business Officer
Joseph W. La Barge	47	Chief Legal Officer
Federico Mingozzi, Ph.D.	45	Chief Scientific Officer

Jeffrey D. Marrazzo. Mr. Marrazzo became our Chief Executive Officer and a director in May 2013. Please see Mr. Marrazzo's biographical information set forth in the Board of Directors section in this Amendment.

Katherine A. High, M.D. Dr. High became our President, Chief Scientific Officer and a director in September 2014 and became our President and Head of Research and Development in September 2017. Please see Dr. High's biographical information set forth in the Board of Directors section in this Amendment.

Stephen W. Webster. Mr. Webster has served as our Chief Financial Officer since July 2014. From June 2012 to November 2013, he served as Senior Vice President, Finance and Chief Financial Officer at Optimer Pharmaceuticals. From June 2008 to December 2011, Mr. Webster served as Senior Vice President, Finance and Chief Financial

Officer at Adolor Corporation. Mr. Webster has served on the board of directors of Viking Therapeutics Inc. since June 2014 and on the board of directors of Nabriva Therapeutics AG since August 2016. Mr. Webster holds an A.B. in economics from Dartmouth College and an M.B.A. in finance from The Wharton School at the University of Pennsylvania.

Lisa Dalton. Ms. Dalton has served as our Chief People Officer since January 2019 prior to which she served as Chief Human Resources Officer since February 2018 and Head of Human Resources since July 2014. Prior to joining the Company, Ms. Dalton served as a Vice President, Human Resources at Shire PLC from July 2004 through June 2014 where she led HR merger

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and acquisition activity and implementation, built and led the compensation function, implemented an HR systems platform and established the HR operations function. Ms. Dalton holds a B.A. in psychology from Pennsylvania State University and an M.B.A. from Rutgers University School of Business.

Daniel R. Faga. Mr. Faga has served as our Chief Business Officer since May 2016. From July 2009 until April 2016, Mr. Faga was a Managing Director at Centerview Partners, an investment banking and advisory firm, where he served as a founding member of Centerview's healthcare advisory practice. Prior to Centerview, Mr. Faga worked at Merrill Lynch in its healthcare investment banking group and as a management consultant in the Life Sciences Practice at PRTM. Mr. Faga earned a B.S. in Engineering from Cornell University and an M.B.A. in Health Care Management from The Wharton School at the University of Pennsylvania.

Joseph W. La Barge. Mr. La Barge has served as our Chief Legal Officer since July 2017 and formerly served as our General Counsel from November 2013 to July 2017. Prior to joining the Company, Mr. La Barge was of counsel at Ballard Spahr LLP from April 2012 to April 2013, where he advised biotechnology companies in private and public financings, mergers and acquisitions and collaboration and licensing transactions. He also served as the Deputy General Counsel to the Kennedy Health System from April 2013 to November 2013. Mr. La Barge was the Vice President, General Counsel and Chief Compliance Officer at Tengion, Inc., in increasing roles of responsibility from November 2006 to December 2011, where he oversaw legal affairs, corporate compliance and quality assurance. Mr. La Barge serves on the board of directors of Life Sciences Pennsylvania and the National Pharmaceutical Council and also serves on the Government Affairs Committee of the American Society of Gene & Cell Therapy. Mr. La Barge holds a B.A. from Bucknell University and a J.D. from Temple University.

Federico Mingozzi, Ph.D. Dr. Mingozzi has served as our Chief Scientific Officer since September 2017. Prior to joining the Company, Dr. Mingozzi served as a Research Director at the French National Institute of Health and Medical Research from January 2016 until September 2017. From January 2013 to September 2017, Dr. Mingozzi served as the Head of the Immunology and Liver Gene Transfer Unit at Genethon, a leading French nonprofit research and development organization focused on gene therapy for rare diseases. From January 2013 to September 2017, Dr. Mingozzi served as faculty at the Pierre and Marie Curie University in Paris, France, and from September 2011 to September 2017 at the Universitat Autònoma de Barcelona, Spain. Dr. Mingozzi received his bachelor's degree in biology and his Ph.D. in biochemistry and molecular biology from the University of Ferrara in Italy, and his M.B.A. from Drexel University.

Section 16(a) Beneficial Ownership Reporting Compliance

Section 16(a) of the Securities Exchange Act of 1934, as amended, requires our directors, executive officers and persons who own more than 10% of the Company's common stock to file with the SEC reports of ownership and changes in ownership of our common stock. Such persons are required by regulations of the SEC to furnish the Company with copies of all such filings. Based on our review of the reports we have received, the Company believes that all Section 16(a) filing requirements were complied with during the fiscal year ended December 31, 2018, except for one late Form 4 for Dr. Mingozzi reporting the vesting of his RSUs on June 26, 2018.

Code of Conduct

We have adopted a written code of business conduct and ethics that applies to our directors, officers and employees, including our principal executive officer, principal financial officer, principal accounts officer or controller or persons performing similar functions. We have posted on our website, www.sparktx.com, a current copy of the code and all disclosure that are required by law or Nasdaq Stock Market listing standards concerning any amendment to, or waivers from, any provision of the code.

Board Committees

Our Board has established four standing committees: Audit, Compensation, Nominating and Corporate Governance and Science and Technology, each of which operates under a charter that has been approved by our Board. Each such charter is available on the Investor Relations section of our website at www.sparktx.com.

Audit Committee

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The members of our Audit Committee are Ms. Zoth and Drs. Altschuler and Ekman. Ms. Zoth is the chair of the Audit Committee. During the fiscal year ended December 31, 2018, the Audit Committee met five times. Our Audit Committee's responsibilities include:

- appointing and approving the compensation of and assessing the independence of our independent registered public accounting firm;
- overseeing the work of our independent registered public accounting firm, including through the receipt and consideration of reports from such firm;

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- reviewing and discussing with management and the independent registered public accounting firm our annual and quarterly financial statements and related disclosures;
- monitoring our internal control over financial reporting, disclosure controls and procedures and code of business conduct and ethics, including the Company compliance hotline;
- assessing our risk management policies;
- establishing policies regarding hiring employees from the independent registered public accounting firm;
- procedures for the receipt and retention of accounting related complaints and concerns;
- meeting independently with our independent registered public accounting firm, management and internal auditing staff, if any;
- reviewing and approving or ratifying any related-person transactions; and
- preparing the Audit Committee report required by SEC rules.

All audit and non-audit services to be provided to us by our independent registered public accounting firm must be approved in advance by our Audit Committee.

Our Board has determined that Ms. Zoth is an “audit committee financial expert” as defined by applicable SEC rules. We believe that the composition of our Audit Committee meets the requirements for independence under the current Nasdaq Listing Rules and SEC rules and regulations.

Compensation Committee

The members of our Compensation Committee are Messrs. Milano and Perez, Dr. Altschuler and Ms. Zoth. Mr. Milano is the chair of the Compensation Committee. During the fiscal year ended December 31, 2018, the Compensation Committee met five times. Our Compensation Committee’s responsibilities include:

- annually reviewing and approving corporate goals and objectives relevant to compensation for the Chief Executive Officer and our other executive officers;
- determining our Chief Executive Officer's compensation as well as the compensation of our other executive officers;
- overseeing an evaluation of our senior executives;
- overseeing and administering our cash and equity incentive plans;
- reviewing and making recommendations to our Board with respect to director compensation;
- reviewing and discussing annually with management our “Compensation Discussion and Analysis”; and
- preparing the annual Compensation Committee report required by SEC rules.

Our executive compensation program is administered by the Compensation Committee of our Board, subject to the oversight and approval of our full Board. Our Compensation Committee reviews our executive compensation practices on an annual basis and based on this review approves or, as appropriate, makes recommendations to our Board for approval of our executive compensation program. Our Chief Executive Officer recommends annual executive salary increases, annual equity awards and bonuses, if any, for the other executive officers, which are then reviewed and approved or adjusted by the Compensation Committee.

In designing our executive compensation program, our Compensation Committee considers publicly available compensation data for national and regional companies in the biotechnology/pharmaceutical industry to help guide its executive compensation decisions at the time of hiring and for subsequent adjustments in compensation. In 2017, our Compensation Committee engaged Willis Towers Watson as its independent compensation consultant to provide comparative data on executive compensation practices in our industry and to advise on our executive compensation program generally. The Compensation Committee also engaged Willis Towers Watson for recommendations and review of non-employee director compensation in 2018. Although our Compensation Committee considers the advice and recommendations of Willis Towers Watson as to our executive compensation program, our Compensation Committee ultimately makes their own decisions about these matters. We expect that our Compensation Committee will continue to engage independent compensation consultants to provide additional guidance on our executive compensation programs and to conduct further competitive benchmarking against a peer group of publicly traded companies.

In April 2018, the Compensation Committee reviewed information regarding the independence and potential conflicts of interest of Willis Towers Watson, taking into account, among other things, the factors set forth in the Nasdaq listing

standards. Based on such review, the committee concluded that the engagement of Willis Towers Watson did not raise any conflict of interest.

Our director compensation program is administered by our Board with the assistance of the Compensation Committee. The Compensation Committee conducts an annual review of director compensation and makes recommendations to the Board with respect thereto.

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Nominating and Corporate Governance Committee

The members of our Nominating and Corporate Governance Committee are Drs. Ekman, Altschuler and Sigal and Mr. Perez. Dr. Ekman is the chair of the Nominating and Corporate Governance Committee. During the fiscal year ended December 31, 2018, the Nominating and Corporate Governance Committee met five times. Our Nominating and Corporate Governance Committee's responsibilities include:

- identifying individuals qualified to become board members;
- recommending to our Board the persons to be nominated for election as directors and to each of the Board's committees;
- reviewing and making recommendations to our Board with respect to management succession planning;
- developing and recommending to our Board corporate governance principles; and
- overseeing periodic evaluations of our Board.

Science and Technology Committee

The members of our Science and Technology Committee are Drs. Sigal, Ekman and Mehra. Dr. Sigal is the chair of the Science and Technology Committee. During the fiscal year ended December 31, 2018, the Science and Technology Committee met five times. Our Science and Technology Committee's responsibilities include:

- reviewing, evaluating and advising our Board and management regarding the long-term strategic goals and objectives and the quality and direction of our research and development programs;
- monitoring and evaluating trends in research and development, and recommending to our Board and management emerging technologies for building our technological strength;
- recommending approaches to acquiring and maintaining technology positions;
- advising our Board and management on the scientific aspects of business development transactions; and
- regularly reviewing our research and development pipeline.

Item 11. Executive Compensation

Compensation Discussion and Analysis

Executive summary

We are a leader in the field of gene therapy, seeking to transform the lives of patients suffering from debilitating genetic diseases by developing potentially one-time, life-altering treatments. The goal of gene therapy is to overcome the effects of a malfunctioning, disease-causing gene. Gene therapies have the potential to provide long-lasting effects, dramatically and positively changing the lives of patients with conditions where no, or only palliative, therapies exist.

As described below, during 2018, we made significant progress toward our commercial, clinical development and business goals, including the following, which impacted executive compensation:

- Executed U.S. launch of LUXTURNA® (voretigene neparvovec-ryzl) and shipped 75 vials during 2018 demonstrating strategic capabilities in gene therapy market development and access;
- Secured and executed novel reimbursement and contracting pathways to ensure timely access for patients;
- Established patient services organization to support patient access to LUXTURNA;
- Received European Medicines Agency, or EMA, approval for the marketing authorization of LUXTURNA;
- Progressed clinical programs for hemophilia A by collecting preliminary Phase 1/2 data, receiving breakthrough designation from FDA for SPK-8011 for hemophilia A and advancing U.S. and European Union strategy for clinical development and lifecycle management plans;
-

Received FDA clearance of the Investigational New Drug, or IND, application intended ultimately for non-inhibitor patients for SPK-8016, a novel, internally developed AAV gene therapy candidate;

- Executed partnership with Novartis Pharma AG to commercialize LUXTURNA outside the U.S.;

• Progressed early product pipeline and technology, including an expected initiation of a Phase 1/2 clinical trial for SPK-3006 for Pompe disease in 2019, continuing to advance our technology and intellectual property plan;

• Advanced technical capabilities, including ensuring commercial supply of LUXTURNA in the United States and to Novartis Pharma AG, operationalizing a suspension cell culture system and developing a manufacturing capacity plan to support supply chain and pipeline demands;

• Achieved operational effectiveness as a cash flow positive company in 2018; and

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Sold the Rare Pediatric Disease Priority Review Voucher, or PRV, we received from FDA for LUXTURNA and continued expansion of key talent and capabilities.

The goal of our Compensation Committee is to ensure that our compensation programs are aligned with the interests of our stockholders and our business goals, while ensuring that the total compensation paid to each of our executive officers is fair, reasonable and competitive. We target our executives’ overall total compensation to be within a competitive range of the market median of similar companies in terms of industry, number of employees, lifecycle, prevalence of programs and value provided, where quantifiable. The overall objectives of our executive compensation program are as follows:

- attract, retain and motivate superior executive talent;
- provide incentives that reward the achievement of performance goals that directly correlate to the enhancement of stockholder value, as well as facilitate employee retention; and
- align the interests of executives with those of stockholders through long-term incentives linked to individual and Company performance.

Key elements of our compensation programs include the following:

Element	Purpose	Features
Base salary	To attract and retain highly skilled executives.	Fixed component of pay to provide financial stability, based on responsibilities, experience, individual contributions and peer company data.
Annual cash incentive program	To promote and reward the achievement of key short-term strategic and business goals of the Company as well as individual performance; to motivate and attract executives.	Variable component of pay based on quantitative and qualitative annual Company and individual goals.
Long-term equity incentive compensation	To encourage executives and other employees to focus on long-term Company performance; to facilitate retention; to reward outstanding Company and individual performance.	Typically, subject to multi-year vesting based on continued service primarily in the form of stock options and restricted stock units, the value of which depends on the performance of our common stock, in order to align executive interests with those of our stockholders over the long-term.

In addition to our direct compensation elements, the following compensation program features are designed to align our executive officers with stockholder interests and market best practices:

What We Do

- Maintain commitment to pay-for-performance philosophy
- Maintain an industry-specific peer group for benchmarking compensation
- Target compensation based on market norms
- Deliver compensation primarily through performance-based pay
- Offer market-competitive benefits that are consistent with our Company-wide compensation strategy
- Consult with an independent advisor on compensation levels and practices
- Maintain significant stock ownership guidelines for our non-employee directors and executive officers

Introduction of stock ownership guidelines

What We Don’t Do

- Allow hedging or pledging of equity
- Re-price stock options
- Provide excessive perquisites
- Provide tax gross-up payments for any change-of-control payments

Effective in February 2018, our Compensation Committee approved and our Board ratified stock ownership guidelines for our non-employee directors and our executive officers. These stock ownership guidelines were established in consultation with our compensation consultant and based in part on practice by our Compensation Peer Group, as defined below, and survey data for comparable organizations. We believe these guidelines, together with our long-term incentive compensation, further demonstrate our commitment to aligning the interests of our non-employee directors and executive officers with those of our stockholders, and enable our non-employee directors and named executive officers to share in our long-term growth and success.

Our stock ownership guidelines encourage our non-employee directors and executive officers to acquire and maintain an equity interest in the Company with a value based on a multiple of their cash retainer and base salary, respectively. The following equity holdings count toward satisfying the stock ownership guidelines:

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- Stock directly owned and/or deferred (including vested restricted shares and shares held in retirement accounts);
- Vested and unexercised stock options; and
- Unvested restricted stock and restricted stock units.

We have established the following guidelines for 2018:

Role	Stock Ownership Guideline
Non-employee Director	3x annual cash retainer
Chief Executive Officer	3x base salary
All other executive officers	1x base salary

All of our executive officers and non-employee directors must be in compliance with the applicable stock ownership guidelines by the later of five years after the date of the introduction of the guidelines and the date such individual was determined to be an executive officer or was appointed as a director, as applicable. Based on a preliminary analysis of current levels of base salary and annual retainers, annual restricted stock unit grant levels and our current stock price, we expect all covered individuals to be in compliance with the guidelines within five years, if not sooner.

Compensation benchmarking

In designing our executive compensation program, our Compensation Committee works directly with management and considers publicly available compensation data (public proxy and compensation survey data) for comparable life sciences companies to help guide its executive compensation decisions. Further, in 2018, our Compensation Committee continued its engagement with Willis Towers Watson as its independent compensation consultant to provide strategic advice on matters related to executive and non-employee director compensation. Although our Compensation Committee considers the advice and recommendations of Willis Towers Watson, our Compensation Committee makes its own decisions about these matters. We expect that our Compensation Committee will continue to engage an independent compensation consultant to provide strategic guidance on our executive compensation programs and to conduct further competitive benchmarking based on relevant market data.

The Compensation Committee reviewed information regarding the independence and potential conflicts of interest of Willis Towers Watson, taking into account, among other things, the factors set forth in the Nasdaq Listing Rules. Based on such review, the Compensation Committee concluded that the engagement of Willis Towers Watson did not raise any conflict of interest, and Willis Towers Watson served as an independent advisor.

In evaluating the total compensation of our named executive officers, our Compensation Committee, as advised by Willis Towers Watson, establishes a peer group of publicly traded life sciences companies that is selected considering the following criteria:

- companies with a number of employees, market capitalization and stage of development comparable to us;
- companies against which we compete for executive talent; and
- public companies headquartered in the U.S. for which compensation data are available.

For the purpose of informing 2019 compensation benchmarking decisions, the Compensation Committee, with the advice of Willis Towers Watson, examined our existing peer group in light of the following factors:

- our growth in 2018, which is anticipated to continue in 2019;
- the stage of development of our product, product candidates and clinical programs; and
- changes in our market capitalization.

Following this review, we modified the existing peer group by removing one company: Juno Therapeutics since it was acquired by Celgene Corporation in March 2018. The resulting “Compensation Peer Group” was approved by our Compensation Committee and is comprised of the following 19 companies:

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ACADIA Pharmaceuticals	Exelixis	Neurocrine Biosciences
Agiros Pharmaceuticals	Halozyme Therapeutics	Portola Pharmaceuticals
Alnylam Pharmaceuticals	Insmed	Sage Therapeutics
Amicus Therapeutics	Intercept Pharmaceuticals	Sarepta Therapeutics
Array BioPharma	Intrexon	Tesaro
bluebird bio	Ionis Pharmaceuticals	Ultragenyx Pharmaceutical
Clovis Oncology		

We believe that reviewing the compensation level and practices of the Compensation Peer Group, in addition to the compensation survey data, provide the Compensation Committee with appropriate market references for evaluating named executive officer compensation.

We utilize multiple compensation surveys in setting named executive compensation levels and evaluating leading practices, including:

- Mercer’s Strategic Industry Rewards Solutions;
- Radford’s Global Life Sciences Compensation Survey; and
- Willis Towers Watson’s Pharmaceutical and Health Sciences Executive Compensation DataBank.

Other key factors in determining executive compensation

In addition to market competitive practices based on the Compensation Peer Group and compensation survey data, other performance factors we consider when determining the compensation of our named executive officers include:

- achievement of U.S. commercialization goals with respect to LUXTURNA;
- key research and development achievements, including advances in our clinical product candidates;
- initiation and progress of clinical trials;
- expansion of manufacturing and operational capabilities;
- achievement of regulatory milestones;
- establishment/maintenance of key strategic relationships and new business initiatives, including financings;
- development of organizational capabilities and managing our growth; and
- continued operations expansion.

Executive compensation evaluation process

Our Compensation Committee intends that if we achieve our corporate goals and an executive performs at the level expected, the executive should have the opportunity to receive compensation that is competitive with industry norms. Accordingly, our Compensation Committee generally targets overall compensation for executives toward the 50th percentile of the market data. However, the Compensation Committee does not apply that targeted positioning formulaically and allows for individuals to be positioned at different percentiles based on factors such as experience, historical performance, scope of duties and responsibilities and criticality to our business. At the 2018 Annual Meeting, 99.8% of the votes cast by stockholders on this proposal were cast in support of the compensation paid to our named executive officers. While this vote is considered to be a non-binding advisory vote, our Compensation Committee and Board value the opinions of our stockholders and seriously consider the voting results when making future executive compensation decisions.

In order to accomplish its objectives consistent with its philosophy for executive compensation, the Compensation Committee typically takes the following actions annually:

- reviews Chief Executive Officer performance;
- seeks input from our Chief Executive Officer on the performance of all other executive officers;
- reviews all components of executive officer compensation, including base salary, cash bonus targets and awards, equity compensation and the estimated payout obligations under severance and change in control scenarios;
- consults with Willis Towers Watson, our independent compensation consultant;

holds executive sessions, without management present; and

reviews information regarding the performance and executive compensation of other companies.

Goals for executive leadership are determined during our annual goal-setting process. We first determine goals for the Company as a whole, which helps decide goals for each executive individually. Annual corporate goals are proposed by

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management and approved by the Board. These corporate goals target the achievement of specific commercial, research, clinical, operational and financial objectives. The Compensation Committee determines how the various components of our annual Company goals will contribute to the overall performance evaluation.

Annual individual goals focus on contributions that facilitate the achievement of the corporate goals and are closely aligned with the corporate goals. Individual goals are proposed at the start of each year for each executive and approved by the Chief Executive Officer and, as appropriate, the Compensation Committee. The individual performance goals of each executive officer consist primarily of the key objectives and goals from our annual business plan that relate to the functional area for which the executive officer is responsible.

At the end of each year, the Compensation Committee evaluates corporate and individual performance. The Compensation Committee considers the achievement of the corporate goals and individual performance as factors in determining annual salary increases, annual bonuses and equity awards granted, if any, to our executive officers.

In assessing corporate performance, the Compensation Committee evaluates corporate performance against the approved corporate goals for the year and also evaluates other aspects of corporate performance, including achievements and progress made outside of the corporate goals. In assessing individual performance, the Compensation Committee evaluates corporate performance in the areas of each officer's responsibility and relies on the Chief Executive Officer's evaluation of each executive officer. The Chief Executive Officer prepares evaluations of the other executives and, in doing so, compares individual performance to the individual performance goals. The Chief Executive Officer recommends annual executive salary increases, annual equity awards and bonuses, if any, for the other executive officers, which are then reviewed and approved or adjusted by the Compensation Committee. In the case of the Chief Executive Officer, the Compensation Committee conducts his individual performance evaluation.

For all executives, annual base salary increases, if any, are implemented during the first quarter of the calendar year. Annual equity awards and bonuses, if any, are granted as determined by the Compensation Committee. For 2018, equity awards and annual bonuses were awarded in the first half of 2019.

Base salary

We provide base salaries to our executive officers to compensate them with a fair and competitive base level of compensation. Our Compensation Committee typically determines base salary levels based on the executive's responsibilities, experience, contributions, performance and, if applicable, the base salary level of the executive prior to joining the Company. In addition, our Compensation Committee reviews and considers base salaries paid by our peer group and from compensation survey data for similar positions. Our Compensation Committee believes executive salaries should be targeted within a competitive range of the market median, although it retains discretion to position executives higher or lower than market median based upon an executive's experience, performance or other considerations.

At the beginning of 2019, our Compensation Committee approved base salary increases for each of our other named executive officers, based upon the recommendation of the Chief Executive Officer and each named executive officer's achievement of individual goals and the comparison to the base salary of similar executives in our Compensation Peer Group and relevant compensation survey data. The table below sets forth the adjustments to base salary for each of our named executive officers:

2019 Base Salary Increases

Executive Officer	2018 Base Salary	2019 Base Salary
Jeffrey	\$595,000	\$625,000
Marrazzo	\$470,000	\$485,000
A.		

High, M.D. Stephen Webster	\$ 440,000	\$460,000
Daniel Faga	\$ 430,000	\$450,000
John Furey ⁽¹⁾	\$ 470,000	—

(1) John Furey terminated his employment with the Company on January 1, 2019

Annual cash incentive program

Our Compensation Committee aims to determine an appropriate mix of cash payments and equity incentive awards to meet short- and long-term goals and objectives. In January 2019, our Compensation Committee approved the 2018 annual incentive program payment pool and corporate modifier, including the opportunity for eligible participants to achieve incentive awards above established bonus targets based on performance relative to our 2018 primary corporate objectives.

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Consistent with the Company-wide annual incentive program approved by the Compensation Committee and applicable to all employees, including our named executive officers, both a corporate performance modifier and individual performance modifier factored into the determination of each executive officer's cash bonus award with respect to 2018.

Under the terms of our incentive plan, the corporate performance modifier is based on the degree to which corporate performance objectives have been achieved. This score is determined by the Compensation Committee and may range from 0 to 125%. The individual performance modifier is based on the degree to which individual performance objectives have been achieved, the competencies and behaviors demonstrated in achieving results and the completion of the ongoing responsibilities required by the position. The individual performance score may range from 0 to 125% and is approved by the Compensation Committee. The individual's actual award is then calculated as follows:

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The table below outlines our corporate objectives for 2018, and the corresponding highlights and accomplishments related to each.

Primary corporate objectives	Key highlights and accomplishments
Execute the U.S. launch and establish commercial operations capable of delivering and securing patient access to LUXTURNA	<ul style="list-style-type: none"> • Executed and secured novel reimbursement and contracting pathways to ensure timely access for patients • Established effective patient services organization to support patient access to LUXTURNA • Sold a priority review voucher received from FDA for LUXTURNA • Executed U.S. launch and shipped 75 vials in 2018 • Obtained EMA approval with a label that maximizes patient access and supports appropriate care • Hemophilia A preliminary Phase 1/2 data obtained preliminary outcomes with near elimination of bleeds and infusions
Progress hemophilia A program toward initiation of a confirmatory trial while advancing lifecycle management plans	<ul style="list-style-type: none"> • Advanced strategy (United States and European Union) for clinical development and lifecycle management of hemophilia A program • SPK-8016 IND submitted and IND cleared with approval to proceed in non-inhibitor patients • Received breakthrough designation for SPK-8011 for hemophilia A
Advance early product pipeline and technology toward first-in-human clinical trials in multiple high-value disease targets	<ul style="list-style-type: none"> • Progressed Pompe program toward initiation of Phase 1/2 • Ensured commercial supply of LUXTURNA in U.S. and to Novartis
Ensure LUXTURNA supply while successfully operationalizing suspension cell culture process to support hemophilia A	<ul style="list-style-type: none"> • Operationalized suspension cell culture system for hemophilia A • Developed manufacturing capacity plan to support supply chain and pipeline demands
Operate the business with enhanced efficiency and communication to support our strategic priorities	<ul style="list-style-type: none"> • Cash flow positive in 2018 • Effectively managed capital & assets to fund strategic priorities; • Expanded internal laboratory capacity • Secured \$50 MM credit facility to support laboratory infrastructure buildout • Secured rights to additional leased space to support long term growth strategy

Based upon the above achievements, the Compensation Committee determined to use a corporate performance modifier of 105% for the 2018 bonus calculation.

In assessing each named executive officer's individual performance modifier, the Compensation Committee further agreed:

Mr. Marrazzo:

- met or exceeded overall Company objectives;
- demonstrated exemplary leadership in support of expanding organizational capabilities;
- advanced the scale-up of an efficient global, fully-integrated organization; and

fostered an engaging culture that embodies our mission, vision and shared values.

Dr. High:

- continued to build organizational capabilities;
- progressed clinical programs for hemophilia A: preliminary Phase 1/2 data and obtained preliminary outcomes with near elimination of bleeds and infusions;
- received breakthrough designation for clinical programs for hemophilia A;
- received FDA clearance of IND application for non-inhibitor patients for SPK-8106;
- progressed Pompe program toward initiation of Phase 1/2 clinical trial;
- advanced our product and technology portfolio; and
- continued to progress pre-clinical and emerging programs.

Mr. Webster:

- continued to build organizational capabilities;
- successfully oversaw internal and external financial management and SOX compliance;
- lead finance team and internal resources to support commercial organization;
- cash flow positive in 2018; effectively managed capital & assets to fund strategic priorities; and
- Secured \$50MM credit facility to support laboratory infrastructure buildout.

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Mr. Faga:

- continued to build organizational capabilities;
- sold the Rare Pediatric Disease Voucher, or PRV, we received from FDA for LUXTURNA;
- executed various in-licensing transactions to support portfolio development;
- ensured successful transition of hemophilia B program to Pfizer, including the manufacture of drug substance to support timely Pfizer Phase 3 trial launch;
- supported decision making regarding advancement of our product and technology portfolio; and
- managed partnership with Novartis Pharma AG to commercialize LUXTURNA outside the U.S.

Mr. Furey:

- continued to build organizational capabilities;
- executed U.S. launch of LUXTURNA;
- ensured commercial supply of LUXTURNA in the U.S. and to Novartis;
- operationalized suspension cell culture system for hemophilia A; and
- received EMA approval for the marketing authorization of LUXTURNA.

The table below shows the target award under the incentive program as a percentage of each named executive officer's 2018 base salary and the actual cash bonus payments to our named executive officers for 2018 performance, which were paid in the first half of 2019.

2018 Annual Incentive Payouts

Name	2018		Corporate Performance Modifier	Individual Performance Modifier	2018 Actual Bonus (\$)	2018 Bonus (% of Target)
	Target (% of Salary)	2018 Target (\$ Value)				
Jeffrey D. Marrazzo	60 %	357,000	105%	105%	393,593	110.25%
Katherine A. High, M.D.	45 %	211,500	105%	105%	233,179	110.25%
Stephen W. Webster	40 %	176,000	105%	110%	203,280	115.5%
Daniel R. Faga	40 %	172,000	105%	110%	198,660	115.5%
John Furey ⁽¹⁾	40 %	188,000	105%	100%	197,400	105%

(1) John Furey terminated his employment with the Company on January 1, 2019

Target cash incentive compensation for our named executive officers in 2019

The terms of the 2019 incentive program are substantially the same as the 2018 incentive program. The 2019 annual incentive program includes an opportunity for each named executive officer to achieve his or her target award percentage based on the achievement of our 2019 corporate goals and individual performance objectives.

The table below shows the target award under the incentive program as a percentage of each named executive officer's 2019 base salary, as well as the target annual incentive award opportunity in dollars for 2019. These targets were reviewed and revised by the Compensation Committee to reflect current market practices.

2019 Target Annual Incentive

Name	2019 Target (% of Salary)	2019 Target (\$ Value)
Jeffrey D. Marrazzo	65%	406,250
Katherine A. High, M.D.	45%	218,250
Stephen W. Webster	45%	207,000
Daniel R. Faga	45%	202,500
John Furey ⁽¹⁾	—%	—

(1) John Furey terminated his employment with the Company on January 1, 2019

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Long-term incentive compensation

Our equity awards are designed to:

- reflect long-term stockholder value creation over a sustained period;
- align financial interests of employees with stockholders;
- recognize current performance as well as the expectation of future contributions;
- provide meaningful awards to support and encourage stock ownership; and
- retain key employees.

The market for qualified, talented executives in our industry is highly competitive. Accordingly, we believe equity compensation is a crucial component of our competitive executive compensation package and, as such, makes up the majority of our total executive compensation package.

We typically grant equity awards to each executive officer upon commencement of employment and annually in conjunction with our review of individual performance. Beginning in 2017, equity awards for our named executive officers have consisted of a combination of time-based stock options and restricted stock units. The mix is more heavily weighted toward options than restricted stock units (70% options; 30% restricted stock units), which proportion we consider an appropriate balance of incentivizing continued stockholder value creation and promoting retention.

All equity awards to our named executive officers are approved by our Compensation Committee and, other than awards to new hires, typically are granted at our Compensation Committee's first regularly scheduled meeting each year. No employment agreement contractually requires that a certain level of equity awards is awarded each year. Equity awards vary among our named executive officers based on their position and annual performance assessments. Each job level has a target annual grant level, which our Compensation Committee developed based on market data and input from our independent compensation consultant, Willis Towers Watson. The target annual grant level is used as a starting point in developing grant recommendations for each of the named executive officers. In addition, we review all components of compensation holistically to ensure total compensation is aligned with our overall philosophy and objectives.

All stock options that we grant have an exercise price equal to the fair market value of our stock on the grant date, so that the recipient will not earn any compensation from options unless our share price increases above the exercise price. Accordingly, this portion of compensation is at risk and is directly aligned with stockholder value creation. In addition, equity awards granted to our executives vest over four years, which we believe provides an incentive to our executives to add value to the Company over the long term and to remain employed with the Company. All stock options have a ten-year term. Beginning in 2017, stock options and restricted stock units vest annually over a four-year period. Vesting of equity awards to employees ceases upon termination of employment and exercise rights for vested stock options at time of termination typically cease three months following termination, except in the case of death or disability. Prior to the exercise of an option or settlement of RSUs in stock, the option holder does not have any rights as a stockholder with respect to the shares subject to such option or RSU, as applicable.

In connection with the annual review of each named executive officer's individual performance and consistent with our compensation philosophy, in January 2019, our Compensation Committee approved annual equity incentive awards for our named executive officers. The January 2019 equity awards granted to our named executive officers are set forth in the table below:

2019 Annual Equity Incentive

Name	Stock options (#)	Restricted stock units (#)
Jeffrey D. Marrazzo	98,000	28,000
Katherine A. High, M.D.	35,000	10,000
Stephen W. Webster	35,000	10,000
Daniel R. Faga	35,000	10,000
John Furey ⁽¹⁾	—	—

(1) John Furey terminated his employment with the Company on January 1, 2019

We believe that equity grants provide our executives with a strong link to our long-term performance, create an ownership culture and help to align the interests of our executives and our stockholders. We believe these equity grants, together with our

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stock ownership guidelines, further demonstrate our commitment to aligning the interests of our non-employee directors and executive officers with those of our stockholders and enable our non-employee directors and executive officers to share in our long-term growth and success. In addition, we believe that equity grants with a time-based vesting feature promote executive retention because this feature incentivizes our executives to remain in our employment during the vesting period. Accordingly, our Board periodically reviews the equity incentive compensation of our executive officers and, from time to time, may grant equity incentive awards to them in the form of stock options or other equity awards.

Our insider trading policy expressly prohibits short sales and derivative transactions by our employees; or other hedging or monetization transactions accomplished through the use of prepaid variable forwards, equity swaps, collars and exchange funds. In addition, our insider trading policy expressly prohibits our employees from purchasing our securities on margin, borrowing against Company securities held in a margin account or pledging our securities as collateral for a loan.

Rule 10b5-1 plans

Certain of our executive officers have previously adopted, and our other executive officers may in the future 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 pursuant to parameters established by the officer when entering into the plan, without further direction from the director or officer. It also is possible that the officer could amend or terminate the plan when not in possession of material, nonpublic information. In addition, our executive officers may buy or sell additional shares outside of a Rule 10b5-1 plan when they are not in possession of material, nonpublic information.

Benefits and other compensation

401(k) retirement plan

In 2018, we maintained a 401(k) retirement plan that was intended to be a tax-qualified defined contribution plan under Section 401(k) of the Internal Revenue Code. All of our employees were eligible to participate, beginning on the first day of the month following commencement of their employment. The 401(k) plan included a salary deferral arrangement pursuant to which participants elected to reduce their current compensation by up to the statutorily prescribed limit, equal to \$18,500 in 2018, and have the amount of the reduction contributed to the 401(k) plan. Participants who were at least 50 years old also could make “catch-up” contributions, which in 2018 may be up to an additional \$6,000 above the statutory limit. We also made discretionary matching contributions to our 401(k) plan equal to 100% of the employee contributions up to 6% of the employee’s salary, subject to the statutorily prescribed limit, equal to \$18,500 in 2018. The match immediately vested in full.

Health and welfare benefits

Our named executive officers are eligible to participate in all of our employee benefit plans, including our medical, dental, vision, life and disability insurance plans, in each case on the same basis as other employees. We believe that these health and welfare benefits help ensure that we have a productive and focused workforce through reliable and competitive health and other benefits.

Compliance with IRS Code Section 162(m)

Section 162(m) of the Internal Revenue Code of 1986, as amended, or the Code, generally disallows a tax deduction to public companies for compensation in excess of \$1 million paid to each of the company’s chief executive officer and the three most highly compensated executive officers (other than the chief executive officer and chief financial officer). Pursuant to tax legislation signed into law on December 22, 2017 (the “Tax Act”), for taxable years beginning after December 31, 2017, the Section 162(m) deduction limitation is expanded so that it also applies to compensation in excess of \$1 million paid to a public company’s chief financial officer. Historically, compensation that qualified under Section 162(m) as performance-based compensation was exempt from the deduction limitation. However, subject to certain transition rules, the Tax Act eliminated the qualified performance-based compensation exception. As

a result, for taxable years beginning after December 31, 2017, all compensation in excess of \$1 million paid to each of the executives described above (other than certain grandfathered compensation or compensation paid pursuant to certain equity awards granted during the transition period following our initial public offering) will not be deductible by us.

Compensation risk assessment

We believe that our executive compensation program does not encourage excessive or unnecessary risk taking. This is primarily due to the fact that our compensation programs are designed to encourage our executive officers and other employees to remain focused on both short-term and long-term strategic goals, in particular in connection with our pay-for-performance

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compensation philosophy. As a result, we do not believe that our compensation programs are reasonably likely to have a material adverse effect on us.

Compensation Committee Report

Our Compensation Committee has reviewed and discussed the “Compensation Discussion and Analysis” required by Item 402(b) of Regulation S-K with management. Based upon such review and discussions, our Compensation Committee recommended to our Board that such section be included in this Amendment.

By the Compensation Committee of the Board of Directors of Spark Therapeutics, Inc.,

Vincent Milano, Chairman

Steven M. Altschuler, M.D.

Robert J. Perez

Lota Zoth

Compensation Committee Interlocks and Insider Participation

Messrs. Milano and Perez and Dr. Altschuler and Ms. Zoth served as members of the Compensation Committee during the year ended December 31, 2018. None of our executive officers serves as a director or a member of a Compensation Committee (or other committee serving an equivalent function) of any other entity that has one or more of its executive officers serving as a director or member of our Compensation Committee. None of the members of our current Compensation Committee or our Compensation Committee for the year ended December 31, 2018, is, or has ever been, an officer or employee of our Company.

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Summary compensation table

The following table sets forth information regarding compensation awarded to, earned by or paid to our named executive officers during the fiscal years ended December 31, 2016, 2017 and 2018.

Name and principal position	Year	Salary	Option awards (2)	Stock awards (3)	Non-equity incentive plan compensation (4)	All other compensation (5)	Total
Jeffrey D. Marrazzo Chief Executive Officer	2018	\$596,135 (6)	\$1,811,208	\$758,250	\$393,593	\$39,386	\$3,598,572
	2017	\$563,462 (7)	\$2,736,160	\$1,123,400	\$448,328	\$38,942	\$4,910,292
	2016	\$526,731 (8)	\$3,575,667	\$—	\$435,000	\$38,056	\$4,575,454
Katherine A. High, M.D. President and Head of Research and Development	2018	\$471,039 (9)	\$1,086,725	\$454,950	\$233,179	\$39,058	\$2,284,951
	2017	\$448,654 (10)	\$1,231,272	\$505,530	\$261,984	\$38,942	\$2,486,382
	2016	\$416,558 (11)	\$1,456,637	\$—	\$260,000	\$27,976	\$2,161,171
Stephen W. Webster Chief Financial Officer	2018	\$440,731 (12)	\$965,978	\$404,400	\$203,280	\$39,304	\$2,053,693
	2017	\$414,423 (13)	\$977,200	\$393,190	\$219,535	\$38,942	\$2,043,290
	2016	\$401,346 (14)	\$1,456,637	\$—	\$215,000	\$38,642	\$2,111,625
Daniel R. Faga Chief Business Officer	2018	\$430,867 (15)	\$1,207,472	\$505,500	\$198,660	\$204,410	\$2,546,909
	2017	\$409,616 (16)	\$1,094,464	\$449,360	\$226,320	\$37,532	\$2,217,292
	2016	\$269,231 (17)	\$4,052,876	\$—	\$300,000	\$21,055	\$4,643,162
John P. Furey ⁽¹⁾ Chief Operating Officer	2018	\$469,039 (18)	\$1,207,472	\$884,625	\$197,400	\$39,333	\$2,797,869
	2017	\$450,000 (19)	\$—	\$—	\$248,400	\$38,942	\$737,342
	2016	\$38,077 (20)	\$5,457,325	\$—	\$—	\$2,514	\$5,497,916

(1) Mr. Furey terminated employment with the Company on January 1, 2019.

The amounts reported in the “Options awards” column reflect the aggregate fair value of share-based compensation awarded during the year computed in accordance with the provisions of Financial Accounting Standards Board Accounting Standard Codification, or ASC, Topic 718, Compensation - Stock Compensation. Note that the amounts reported in this column reflect the accounting cost for these stock options, and do not correspond to the actual economic value that may be received by the executives from the options. See notes 3(m) and 13 of “Notes to Consolidated Financial Statements” in our Annual Report on Form 10-K filed with the SEC on February 28, 2019 for a discussion of the assumptions made by the Company in determining the grant date fair value of our option awards for the fiscal year ended December 31, 2018.

The amounts reported in the “Stock awards” column reflect the aggregate fair value of share-based compensation awarded during the year computed in accordance with the provisions of Financial Accounting Standards Board Accounting Standard Codification, or ASC, Topic 718, Compensation - Stock Compensation. Note that the amounts reported in this column reflect the accounting cost for these stock awards, and do not correspond to the actual economic value that may be received by the executives from the awards. See notes 3(m) and 13 of “Notes to Consolidated Financial Statements” in our Annual Report on Form 10-K filed with the SEC on February 28, 2019 for a discussion of the assumptions made by the Company in determining the grant date fair value of our option awards for the fiscal year ended December 31, 2018.

The amounts reported in the “Non-equity incentive plan compensation” column represent bonuses under our annual performance-based cash incentive program. See “Annual cash incentive program” for a description of that program. Annual cash incentive compensation earned during the year is typically paid in the following year. Mr.

Faga's payments also represent a sign-on bonus paid in May 2016 of \$150,000.

The compensation included in the "All other compensation" column consists of premiums we paid with respect to each of our named executive officers for: (a) medical, dental and vision insurance; (b) personal accident insurance; (5)(c) life insurance; (d) long-term disability insurance; (e) short-term disability insurance; (f) matching contributions to our 401(k) plan; and (g) additional "safe harbor" contributions to our 401(k) plan for 2016. Mr. Faga's payments also represent imputed income of \$186,418 for commuting reimbursement costs.

(6) Mr. Marrazzo's annualized base salary increased to \$595,000 from \$565,000 in January 2018.

(7) Mr. Marrazzo's annualized base salary increased to \$565,000 from \$525,000 in January 2017.

(8) Mr. Marrazzo's annualized base salary increased to \$525,000 from \$450,000 in February 2016.

(9) Dr. High's annualized base salary increased to \$470,000 from \$450,000 in January 2018.

(10) Dr. High's annualized base salary increased to \$450,000 from \$415,000 in January 2017.

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- (11) Dr. High's annualized base salary increased to \$415,000 from \$405,000 in February 2016.
(12) Mr. Webster's annualized base salary increased to \$440,000 from \$415,000 in January 2018.
(13) Mr. Webster's annualized base salary increased to \$415,000 from \$400,000 in January 2017.
(14) Mr. Webster's annualized base salary increased to \$400,000 from \$350,000 in February 2016.
(15) Mr. Faga's annualized base salary increased to \$430,000 from \$410,000 in January 2018.
(16) Mr. Faga's annualized base salary increased to \$410,000 from \$400,000 in January 2017.
(17) Mr. Faga joined the Company on May 2, 2016. Mr. Faga's annualized base salary for 2016 was \$400,000.
(18) Mr. Furey's annualized base salary increased to \$470,000 from \$450,000 in January 2018.
(19) Mr. Furey's annualized base salary was \$450,000 in January 2017.
(20) Mr. Furey joined us on December 1, 2016. Mr. Furey's annualized base salary for 2016 was \$450,000.

Pay ratio

The following is a reasonable estimate, prepared under applicable SEC rules, of the ratio of the annual total compensation of our Chief Executive Officer to the median of the annual total compensation of our other employees. As is permitted under the SEC rules, we used 2018 "base salary" to determine our median employee definition and not total compensation as set forth in our Summary Compensation Table. We annualized pay for those who commenced employment during 2018. Of our 349 total employees, five employees were excluded from two countries (less than 2% of total workforce) as follows: United Kingdom - 4, Spain - 1. This resulted in an employee population of 344 that we used for purposes of our Chief Executive Officer pay ratio calculation. Using the fiscal year end date of December 31, 2018, we calculated the median base salary of this employee population. We then produced a sample of employees who were paid within a 5% range of that median base salary and selected an employee from within that group as our median employee. Because the median employee used in 2017 terminated employment, there is a different median employee used for the 2018 computation. We determined that this median employee's total compensation for 2018 was \$182,200. The Chief Executive Officer's total compensation for 2018 was \$3,598,572 as disclosed in the Summary Compensation Table. Therefore, our estimate of the ratio of Chief Executive Officer pay to median employee pay is 20:1. Given the different methodologies that various public companies will use to determine an estimate of their pay ratio, the ratio reported above should not be used as a basis for comparison between companies.

Grants of plan-based awards

The following table shows information regarding grants of plan-based awards during the fiscal year ended December 31, 2018 to our named executive officers.

Name and principal position	Grant date	All other stock awards:		All other option awards: Number of securities underlying options (#)	Exercise or base price of stock and option awards (\$/share) (1)	Grant date fair value of stock and option awards (2)
		Number of shares of stock or units (#)				
Jeffrey D. Marrazzo Chief Executive Officer	1/18/2018	15,000	52,500	(3)	\$50.55	\$2,569,458
Katherine A. High, M.D. President and Head of Research &	1/18/2018	9,000	31,500	(3)	\$50.55	\$1,541,675

Development

Stephen W. Webster Chief Financial Officer	1/18/2018	8,000	28,000	(3)\$50.55	\$1,370,378
Daniel R. Faga Chief Business Officer	1/18/2018	10,000	35,000	(3)\$50.55	\$1,712,972
John P. Furey Chief Operating Officer	1/18/2018	10,000	35,000	(3)\$50.55	\$1,712,972
	1/18/2018	7,500	—	—	\$379,125

The exercise price of these stock options is determined by the Company based on the closing price of its common stock on the Nasdaq Global Select Market on the grant date. See notes 3(m) and 13 of "Notes to Consolidated (1) Financial Statements" in our Annual Report on Form 10-K filed with the SEC on February 28, 2019 for a discussion of the assumptions made by the Company in determining the grant date fair value of our option awards for the fiscal year ended December 31, 2018.

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- (2) Amounts represent the grant date fair value of the executive officer's stock options and awards, calculated in accordance with FASB ASC Topic 718, using a Black-Scholes valuation model for stock options.
- (3) Option awarded with time-based vesting criteria established by the Compensation Committee and described in Compensation Discussion and Analysis above.

Outstanding equity awards at December 31, 2018

The following table sets forth information concerning outstanding equity awards at December 31, 2018 for each of our named executive officers.

Name	Option awards			Stock awards			Market value of shares or units of stock that have not vested (\$)(1)
	Number of securities underlying unexercised options exercisable	Number of securities underlying unexercised options unexercisable	Option exercise price (\$/share)	Option expiration date	Number of shares or units of stock that have not vested		
Jeffery D. Marrazzo	—	52,500	(2) \$50.55	1/17/2028	30,000	(22)\$1,174,200	
	17,500	52,500	(3) \$56.17	1/17/2027	—	—	
	92,813	42,187	(4) \$40.44	1/4/2026	—	—	
	117,188	7,882	(5) \$68.45	3/15/2025	—	—	
	176,071	—	(6) \$3.45	7/2/2024	—	—	
Katherine A. High, M.D.	—	31,500	(7) \$50.55	1/17/2028	15,750	(22)\$616,455	
	7,875	23,625	(8) \$56.17	1/17/2027	—	—	
	37,813	17,187	(9) \$40.44	1/4/2026	—	—	
	65,625	4,375	(10) \$68.45	3/15/2025	—	—	
	73,249	—	(11) \$3.45	7/2/2024	—	—	
Stephen W. Webster	—	28,000	(12) \$50.55	1/17/2028	13,250	(22)\$518,605	
	6,250	18,750	(13) \$56.17	1/17/2027	—	—	
	37,813	17,187	(14) \$40.44	1/4/2026	—	—	
	56,250	3,750	(15) \$68.45	3/15/2025	—	—	
	106,015	—	(16) \$3.45	7/7/2024	—	—	
Daniel R. Faga	—	35,000	(17) \$50.55	1/17/2028	16,000	(22)\$626,240	
	7,000	21,000	(18) \$56.17	1/17/2027	—	—	
	70,000	60,000	(19) \$37.62	5/1/2026	—	—	
John P. Furey	—	35,000	(20) \$50.55	1/17/2028	17,500	(22)\$684,950	
	40,000	80,000	(21) \$49.74	11/30/2026	—	—	

- (1) The fair market value of the unvested stock awards was calculated using our common stock price of \$39.14 per share, the closing price of our common stock on the Nasdaq Global Select Market on December 31, 2018.

Represents options to purchase 52,500 shares of common stock granted on January 18, 2018. The shares underlying these options vest as follows: 25% will vest on January 18, 2019 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 70,000 shares of common stock granted on January 18, 2017. The shares underlying these options vest as follows: 25% vested on January 18, 2018 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 135,000 shares of common stock granted on January 5, 2016. The shares underlying these options vest as follows: 25% vested on January 5, 2017 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 125,000 shares of common stock granted on March 16, 2015. The shares (5) underlying these options vest as follows: 25% vested on March 16, 2016 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 437,071 shares of common stock granted on July 2, 2014. The shares underlying (6) these options vest as follows: 25% vested on May 24, 2015 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 31,500 shares of common stock granted on January 18, 2018. The shares (7) underlying these options vest as follows: 25% will vest on January 18, 2019 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 31,500 shares of common stock granted on January 18, 2017. The shares (8) underlying these options vest as follows: 25% vested on January 18, 2018 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 55,000 shares of common stock granted on January 5, 2016. The shares underlying (9) these options vest as follows: 25% vested on January 5, 2017 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 70,000 shares of common stock granted on March 16, 2015. The shares (10) underlying these options vest as follows: 25% vested on March 16, 2016 and the remainder vests in equal quarterly installments over the following three years.

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Represents options to purchase 158,249 shares of common stock granted on July 2, 2014. The shares underlying (11) these options vest as follows: 25% vested on May 24, 2015 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 28,000 shares of common stock granted on January 18, 2018. The shares (12) underlying these options vest as follows: 25% will vests on January 18, 2019 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 25,000 shares of common stock granted on January 18, 2017. The shares (13) underlying these options vest as follows: 25% vested on January 18, 2018 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 55,000 shares of common stock granted on January 5, 2016. The shares (14) underlying these options vest as follows: 25% vested on January 5, 2017 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 60,000 shares of common stock granted on March 16, 2015. The shares (15) underlying these options vest as follows: 25% vested on March 16, 2016 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 186,015 shares of common stock granted on July 7, 2014. The shares underlying (16) these options vest as follows: 25% vested on July 7, 2015 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 35,000 shares of common stock granted on January 18, 2018. The shares (17) underlying these options vest as follows: 25% will vest on January 18, 2019 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 28,000 shares of common stock granted on January 18, 2017. The shares (18) underlying these options vest as follows: 25% vested on January 18, 2018 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 160,000 shares of common stock granted on May 2, 2016. The shares underlying (19) these options vest as follows: 25% vested on May 2, 2017 and the remainder vests in equal quarterly installments over the following three years.

Represents options to purchase 35,000 shares of common stock granted on January 18, 2018. The shares (20) underlying these options vest as follows: 25% will vest on January 18, 2019 and the remainder vests in equal annual installments over the following three years.

Represents options to purchase 160,000 shares of common stock granted on December 1, 2016. The shares (21) underlying these options vest as follows: 25% vested on December 1, 2017 and the remainder vests in equal quarterly installments over the following three years.

(22) Restricted stock award granted on January 18, 2017. The award vests in four equal annual installments through January 18, 2021.

Option exercises and stock vested

The following table shows the number of shares acquired upon exercise of stock options and the number of shares that vested under restricted stock awards held by each of our named executive officers during the fiscal year ended December 31, 2018.

Name	Option awards number of shares acquired on exercise	Option awards value realized on exercise	Stock awards number of shares acquired on vesting	Stock awards value realized on vesting
Jeffery D. Marrazzo	6,000	\$207,529	5,000	\$252,750

Katherine A. High, M.D.	—	\$—	2,250	\$113,738
Stephen W. Webster	—	\$—	1,750	\$88,463
Daniel R. Faga	—	\$—	2,000	\$101,100
John P. Furey	40,000	\$1,210,896	—	\$—

Employment, severance and change-in-control arrangements

We have written employment agreements with each of our named executive officers - Mr. Marrazzo, Dr. High, Mr. Webster, Mr. Faga and Mr. Furey, who terminated his employment with us on January 1, 2019. The agreements with each of our executive officers provide for at-will employment. In addition, each of our executive officers is subject to invention assignment, non-disclosure, non-competition and non-solicitation agreements through separate agreements that were executed and delivered by the executives in connection with their employment agreements.

Potential payments upon termination or change in control

Pursuant to the terms of each executive officer's employment agreement, upon execution and effectiveness of a separation agreement and release of claims, each executive officer is entitled to severance payments if his or her employment is terminated under specified circumstances.

Mr. Marrazzo

If we terminate Mr. Marrazzo's employment without cause, or if Mr. Marrazzo terminates his employment with us for good reason, each as defined in his employment agreement, Mr. Marrazzo is entitled to continue receiving his base salary and insurance benefits for a period of 18 months following the date of termination of employment, the amount of any bonus determined by our Board to be payable to Mr. Marrazzo for the immediately preceding year that has not yet been paid and a payment in an amount equal to the pro rata portion of his target bonus for the fiscal year in which the termination occurs.

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If, within 24 months following a change in control, as defined in Mr. Marrazzo's employment agreement, we terminate Mr. Marrazzo's employment without cause or Mr. Marrazzo terminates his employment with us for good reason, Mr. Marrazzo is entitled to continue receiving his base salary for a period of 24 months and insurance benefits for a period of 18 months following the date of termination of employment, the amount of any bonus determined by our Board to be payable to him for the immediately preceding year that has not yet been paid, a payment in an amount equal to the pro rata portion of Mr. Marrazzo's target bonus for the fiscal year in which the termination occurs and an additional payment equal to two times his target bonus for the fiscal year in which the termination occurs.

Other executive officers

If we terminate any of our other executive officers' employment without cause, or if such executive officer terminates his or her employment with us for good reason, each as defined in his or her employment agreement, such executive officer is entitled to continue receiving his or her base salary and health insurance benefits for a period of 12 months following the date of termination of employment, the amount of any bonus determined by our Board to be payable to the executive officer for the immediately preceding year that has not yet been paid and a payment in an amount equal to the pro rata portion of his or her target bonus for the fiscal year in which the termination occurs.

If, within 24 months following a change in control, as defined in such executive officer's employment agreement, we terminate such executive officer's employment without cause or such executive officer terminates his or her employment with us for good reason, such executive officer is entitled to continue receiving his or her base salary and health insurance benefits for a period of 18 months following the date of termination of employment, the amount of any bonus determined by our Board to be payable to the executive for the immediately preceding year that has not yet been paid, a payment in an amount equal to the pro rata portion of such executive officer's target bonus for the fiscal year in which the termination occurs and an additional payment equal to 1.5 times his or her target bonus for the fiscal year in which the termination occurs.

Equity awards

If we terminate any of our executive officers' employment without cause, or if any such executive officer terminates his or her employment with us for good reason, the vesting periods for such named executive officer's unvested equity awards will accelerate based on the ratio of months worked by the executive during the vesting period to the number of months in the vesting period.

In addition, if there is a change in control, any unvested equity granted prior to the corporate conversion will vest as follows: (a) 50% of the unvested portion of each of our executive officers' unvested equity awards that were outstanding at the time of the change in control will vest immediately, and (b) the remaining 50% will vest in equal quarterly installments over the following two years or, if shorter, over the remaining period of the award's original vesting schedule; provided, however, that the new vesting schedule will not replace any more favorable vesting acceleration provision provided for in any equity award agreement governing an equity award held by such executive officer. Following a termination without cause or for good reason within 24 months of the change in control, such executive officer's unvested equity awards that were outstanding at the time of the change in control will vest in full. To the extent that any severance or other compensation payment to any of our executive officers pursuant to an employment agreement or any other agreement constitutes an "excess parachute payment" within the meaning of Sections 280G and 4999 of the Internal Revenue Code of 1986, as amended, then such executive officer will receive the full amount of such severance and other payments, or a reduced amount intended to avoid the application of Sections 280G and 4999, whichever provides the executive with the highest amount on an after-tax basis.

Consulting agreement with Mr. Furey

In connection with his resignation of employment from the Company on January 1, 2019, we entered into a consulting agreement with John Furey, our former Chief Operating Officer, in November 2018, pursuant to which Mr. Furey agreed to provide certain transition services and expertise to the Company, as requested, following the end of his employment. Mr. Furey's consulting agreement became effective on January 2, 2018 and will terminate on June 28, 2019, or, in certain circumstances, an earlier date as set forth in his consulting agreement (the "Consultancy Period"). In exchange for his services as a consultant, Mr. Furey is entitled to receive the following benefits: (i) reimbursement of all reasonable, necessary, and documented out of pocket expenses incurred or paid by Mr. Furey in connection with the consulting services; (ii) continued vesting in certain stock option and restricted stock units awards until the end of

the Consultancy Period ("Equity Awards"); and (iii) a monthly consultancy fee of \$39,166.67. Mr. Furey's agreement also provides that any acceleration provisions set forth in

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the Equity Awards and in Section 9(c) of our 2015 Stock Incentive Plan ("2015 Plan") are not applicable to the Equity Awards. Instead, should Mr. Furey be terminated following a Change in Control Event (as defined in the 2015 Plan), Mr. Furey will be entitled to receive all fees and vesting of the Equity Awards as if Mr. Furey had provided services to the Company for the entirety of the Consultancy Period. Mr. Furey is also bound by certain propriety information and invention assignment obligations as set forth in his consulting agreement.

Potential termination and change-in-control payments

Potential termination and change-in-control payments pursuant to the employment agreements assuming (i) a qualifying termination or CIC (where all outstanding equity awards were assumed, substituted or continued by the successor), occurred on December 31, 2018 and (ii) the Company experienced a CIC (where all outstanding equity awarded were assumed, substituted or continued by the successor) are set forth in the table below using our common stock price of \$39.14, the closing price of our common stock on the Nasdaq Global Select Market on December 31, 2018. In addition to the amounts shown in the table below, each executive would receive payments for amounts of base salary and vacation time accrued through the date of termination and payment for any reimbursable business expenses incurred.

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Name	Benefit	Triggering event					
		Change in control (without termination)	Resignation for good reason or termination without cause (Absent a CIC)	Resignation for good reason or termination without cause within 24 months following CIC			
Jeffrey D. Marrazzo	Severance payments	\$—	\$ 892,500	(2)	\$ 1,904,000	(3)	
	Bonus payment	—	357,000	(4)	357,000	(4)	
	Continuation of benefits	—	31,218	(5)	31,218	(5)	
	Market value of stock vesting	587,100	(6)	326,310	(7)	1,174,200	(8)
	Total		\$587,100		\$ 1,607,028		\$ 3,466,418
Katherine A. High, M.D.	Severance payments	\$—	\$ 470,000	(2)	\$ 1,022,250	(3)	
	Bonus payment	—	211,500	(4)	211,500	(4)	
	Continuation of benefits	—	15,799	(5)	23,699	(5)	
	Market value of stock vesting	308,227	(6)	167,832	(7)	616,455	(8)
	Total		\$308,227		\$ 865,131		\$ 1,873,904
Stephen W. Webster	Severance payments	\$—	\$ 440,000	(2)	\$ 924,000	(3)	
	Bonus payment	—	176,000	(4)	176,000	(4)	
	Continuation of benefits	—	20,812	(5)	31,218	(5)	
	Market value of stock vesting	259,302	(6)	139,847	(7)	518,605	(8)
	Total		\$259,302		\$ 776,659		\$ 1,649,823
Daniel R. Faga	Severance payments	\$—	\$ 430,000	(2)	\$ 903,000	(3)	
	Bonus payment	—	172,000	(4)	172,000	(4)	
	Continuation of benefits	—	—	(5)	—	(5)	
	Market value of stock vesting	358,720	(6)	177,797	(7)	717,440	(8)
	Total		\$358,720		\$ 779,797		\$ 1,792,440
John P. Furey ⁽¹⁾	Severance payments	\$—	\$—	(2)	\$—	(3)	
	Bonus payment	—	—	(4)	—	(4)	
	Continuation of benefits	—	—	(5)	—	(5)	
	Market value of stock vesting	—	(6)	—	(7)	—	(8)
	Total		\$—		\$—		\$—

Mr. Furey terminated employment with the Company on January 1, 2019. In connection with this termination, Mr. (1)Furey entered into a consulting agreement with the Company, as discussed above and in the Form 8-K filed November 15, 2018.

Upon involuntary termination or termination for Good Reason (not associated with a change in control), the Chief Executive Officer is entitled to 18 months base salary, while other named executive officers are eligible for 12 months base salary.

Upon involuntary termination or termination for Good Reason (within 24 months of a change in control), the Chief Executive Officer is eligible for 24 months base salary and two times the target annual incentive, while other named executive officers are eligible for 18 months base salary and 1.5 times the target annual incentive.

Upon involuntary termination or termination for Good Reason, all named executive officers are eligible to receive a prorata bonus for the year of termination based on the executive's individual incentive target and hire date.

Upon termination, named executive officers are eligible for the Company to continue to pay the employer-paid portion of medical and dental benefits. The Chief Executive Officer is entitled to 18 months of the employer-paid portion of benefits for involuntary termination or termination for Good Reason (not associated with a change-in-control or within 24 months of a change-in-control). Other named executive officers are eligible for 12 months of the employer-paid portion of benefits for involuntary termination or termination for Good Reason (not associated with a change-in-control) and 18 months of the employer-paid portion of benefits for involuntary termination or termination for Good Reason (within 24 months of a change-in-control). Mr. Faga does not participate in Spark's medical and dental coverage, therefore there is no value associated with the continuation of benefits upon termination.

Upon a change-in-control, vesting for 50% of unvested equity awards will accelerate upon the change-in-control. The remaining 50% will continue to vest quarterly over a two-year period or, if shorter, over the remaining period of the award's original vesting schedule.

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- (7) Upon an involuntary termination or termination for Good Reason (absent a change-in-control), unvested equity will vest based on the proportion of the vesting schedule worked as of the date of termination.
- (8) Upon an involuntary termination or termination for Good Reason (within 24 months of a change-in-control), all unvested equity awards will vest.

Director compensation

The following table sets forth a summary of the compensation we paid to our non-employee directors during 2018. Neither Mr. Marrazzo nor Dr. High, our directors who also serve as our Chief Executive Officer and our President and Head of Research and Development, respectively, receive any additional compensation for his or her service as a director. The compensation received by each of Mr. Marrazzo and Dr. High as an employee during 2018 is presented in the “Summary Compensation Table”.

Name (1)	Fees earned or paid in cash	Option awards (2)	Stock awards (3)	Total
Steven M. Altschuler, M.D. (4)	\$91,278	\$210,595	\$122,295	\$424,168
Lars G. Ekman, M.D., Ph.D.	\$65,000	\$210,595	\$122,295	\$397,890
Anand Mehra, M.D.	\$46,222	\$210,595	\$122,295	\$379,112
Vincent J. Milano	\$55,000	\$210,595	\$122,295	\$387,890
Robert J. Perez (5)	\$46,083	\$510,077	\$289,575	\$845,735
Elliott Sigal, M.D., Ph.D.	\$55,306	\$210,595	\$122,295	\$388,196
Lota Zoth, CPA	\$66,583	\$210,595	\$122,295	\$399,473

- The aggregate number of stock option awards outstanding as of December 31, 2018 for the non-employee members of the Board was: Dr. Altschuler: 51,203, Dr. Ekman: 51,203, Dr. Mehra: 51,203, Mr. Milano: 51,203, (1)Mr. Perez: 12,000, Dr. Sigal: 56,989, and Ms. Zoth: 26,000. The aggregate number of restricted stock awards outstanding as of December 31, 2018 for the non-employee members of the Board was: Dr. Altschuler: 1,500, Dr. Ekman: 1,500, Dr. Mehra: 1,500, Mr. Milano: 1,500, Mr. Perez: 4,500, Dr. Sigal: 1,500, and Ms. Zoth: 1,500. The amounts reported in the Option awards column represent the grant date fair value of the stock options granted to our non-employee directors during 2018 as computed in accordance with ASC Topic 718, Compensation - Stock Compensation, not including any estimates of forfeitures. See note 13 of “Notes to Consolidated Financial (2)Statements” in our Annual Report on Form 10-K filed with the SEC on February 28, 2019 for a discussion of assumptions made by the Company in determining the grant date fair value of our option awards for the fiscal year ended December 31, 2018. Note that the amounts reported in this column reflect the accounting cost for these stock options, and do not correspond to the actual economic value that may be received by the directors from the options. The amounts reported in the Stock awards column represent the grant date fair value of the stock awards granted to (3)our non-employee directors during 2018 as computed in accordance with ASC Topic 718, Compensation - Stock Compensation, not including any estimates of forfeitures.
- Prior to July 1, 2015, Dr. Altschuler served as the CEO of CHOP and the CHOP Foundation. Pursuant to his (4)agreement with such entities, Dr. Altschuler continues to hold options to purchase 37,203 shares of common stock as nominee of the CHOP Foundation, which will receive the economic benefit associated with such option awards. (5)Mr. Perez joined the Board in January 2018.

Director compensation arrangements

For 2018, our non-employee directors are compensated for their services on our Board as follows:

- upon appointment to the Board, directors receive a one-time stock option award of 8,000 shares and 3,000 restricted stock units;
- annually, each member of the Board receives a grant of an option to purchase 4,000 shares and 1,500 restricted stock units, on the date of the annual meeting;
- each non-employee director receives an annual retainer of \$40,000;

the chairman of the Board receives an additional annual retainer of \$30,000; each non-employee director who serves as member of a committee of our Board receives additional compensation as follows:

Audit Committee - an annual retainer of \$10,000; chair - an annual retainer of \$20,000;

Compensation Committee - an annual retainer of \$7,500; chair - an annual retainer of \$15,000; and

Nominating and Corporate Governance Committee - an annual retainer of \$5,000; chair - an annual retainer of \$10,000; and

Science and Technology Committee - an annual retainer of \$5,000; if a non-employee director chair - an annual retainer of \$10,000.

Each annual retainer is payable in arrears in four equal quarterly installments on the last day of each quarter, provided that the amount of each payment will be prorated for any portion of a quarter that a director is not serving on our Board.

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Each member of our Board also will be entitled to be reimbursed for reasonable travel and other expenses incurred in connection with attending meetings of the Board and any committee of the Board on which he or she serves.

Limitation of liability and indemnification

Our Restated Certificate of Incorporation limits the personal liability of directors for breach of fiduciary duty to the maximum extent permitted by the Delaware General Corporation Law, or DGCL, and provides that no director will have personal liability to us or to our stockholders for monetary damages for breach of fiduciary duty or other duty as a director. However, these provisions do not eliminate or limit the liability of any of our directors:

- for any breach of the director's duty of loyalty to us or our stockholders;
- for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law;
- for voting or assenting to unlawful payments of dividends, stock repurchases or other distributions; or
- for any transaction from which the director derived an improper personal benefit.

Any amendment to, or repeal of, these provisions will not eliminate or reduce the effect of these provisions in respect of any act, omission or claim that occurred or arose prior to such amendment or repeal. If the DGCL is amended to provide for further limitations on the personal liability of directors of corporations, then the personal liability of our directors will be further limited to the greatest extent permitted by the DGCL.

In addition, our Restated Certificate of Incorporation provides that we must indemnify our directors and officers and we must advance expenses, including attorneys' fees, to our directors and officers in connection with legal proceedings, subject to very limited exceptions.

We maintain a general liability insurance policy that covers certain liabilities of our directors and executive officers arising out of claims based on acts or omissions in their capacities as directors or executive officers. In addition, we intend to enter into indemnification agreements with each of our directors and executive officers. These indemnification agreements may require us, among other things, to indemnify each such director or executive officer for some expenses, including attorneys' fees, judgments, fines and settlement amounts incurred by him or her in any action or proceeding arising out of his or her service as one of our directors or executive officers.

Certain of our non-employee directors may, through their relationships with their employers, be insured and/or indemnified against certain liabilities incurred in their capacity as members of our Board.

Insofar as indemnification for liabilities arising under the Securities Act of 1933, as amended, or the Securities Act, may be permitted to 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.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters Equity Incentive and Other Compensation Plans

Stock option and other compensation plans

In this section we describe our 2014 stock incentive plan, as amended to date, or the 2014 plan, our 2015 stock incentive plan, or the 2015 plan, and our 2015 employee stock purchase plan. Prior to our initial public offering, we granted awards to eligible participants under the 2014 plan. Following the effectiveness of the registration statement for our initial public offering, we ceased granting awards under the 2014 plan and started granting awards to eligible participants under the 2015 plan.

2014 plan

The 2014 plan was adopted by our Board and approved by our stockholders in May 2014. The 2014 plan provides for the grant of incentive stock options, nonstatutory stock options, restricted stock awards, restricted stock unit awards, stock appreciation rights and other stock-based awards. Our employees, officers, directors, consultants and advisors are eligible to receive awards under our 2014 plan; however, incentive stock options may only be granted to our employees.

The type of award granted under our 2014 plan and the terms of such award are set forth in the applicable award agreement.

Pursuant to the terms of the 2014 plan, our Board (or a committee delegated by our Board) administers the plan and, subject to any limitations in the plan, selects the recipients of awards and determines:

• the number of shares of our common stock covered by options and the dates upon which the options become exercisable;

• the type of options to be granted;

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the duration of options, which may not be in excess of ten years;
the exercise price of options, which must be at least equal to the fair market value of our common stock on the date of grant; and

the number of shares of our common stock subject to, and the terms of any stock appreciation rights, restricted stock awards, restricted stock units or other stock-based awards and the terms and conditions of such awards, including conditions for repurchase, measurement price, issue price and repurchase price (though the measurement price of stock appreciation rights must be at least equal to the fair market value of our common stock on the date of grant and the duration of such awards may not be in excess of ten years).

Effect of certain changes in capitalization.

Upon the occurrence of any of a stock split, reverse stock split, stock dividend, recapitalization, combination of shares, reclassification of shares, spin-off or other similar change in capitalization or event, or any dividend or distribution to holders of our common stock other than an ordinary cash dividend, our Board shall equitably adjust:

the number and class of securities available under the 2014 plan;

the number and class of securities and exercise price per share of each outstanding option;

the share and per-share provisions and the measurement price of each outstanding stock appreciation right;

the number of shares subject to, and the repurchase price per share subject to, each outstanding restricted stock award; and

the share and per-share related provisions and the purchase price, if any, of each other stock-based award.

Effect of certain corporate transactions

Upon a merger or other reorganization event (as defined in our 2014 plan), our Board may, in its sole discretion, take any one or more of the following actions pursuant to the 2014 plan as to some or all outstanding awards other than restricted stock:

provide that all outstanding awards shall be assumed, or substantially equivalent awards shall be substituted, by the acquiring or successor corporation (or an affiliate thereof);

upon written notice to a participant, provide that all of the participant's vested but unexercised awards will terminate immediately prior to the consummation of such reorganization event unless exercised by the participant;

provide that outstanding awards shall become exercisable, realizable or deliverable, or restrictions applicable to an award shall lapse, in whole or in part, prior to or upon such reorganization event;

in the event of a reorganization event pursuant to which holders of shares of our common stock will receive a cash payment for each share surrendered in the reorganization event, make or provide for a cash payment to the participants with respect to each award held by a participant equal to (1) the number of shares of our common stock subject to the vested portion of the award (after giving effect to any acceleration of vesting that occurs upon or immediately prior to such reorganization event) multiplied by (2) the excess, if any, of the cash payment for each share surrendered in the reorganization event over the exercise, measurement or purchase price of such award and any applicable tax withholdings, in exchange for the termination of such award; and/or

provide that, in connection with a liquidation or dissolution, awards shall convert into the right to receive liquidation proceeds (if applicable, net of the exercise, measurement or purchase price thereof and any applicable tax withholdings).

Our Board does not need to take the same action with respect to all awards and may take different actions with respect to portions of the same award.

In the case of certain restricted stock units, no assumption or substitution is permitted, and the restricted stock units will instead be settled in accordance with the terms of the applicable restricted stock unit agreement.

Upon the occurrence of a reorganization event other than a liquidation or dissolution, the repurchase and other rights with respect to outstanding awards of restricted stock will continue for the benefit of the successor company and will, unless the Board may otherwise determine, apply to the cash, securities or other property into which shares of our common stock are converted or exchanged pursuant to the reorganization event. Upon the occurrence of a reorganization event involving a liquidation or dissolution, all restrictions and conditions on each outstanding

restricted stock award will automatically be deemed terminated or satisfied, unless otherwise provided in the agreement evidencing the restricted stock award.

At any time, our Board may, in its sole discretion, provide that any award under the 2014 plan will become immediately exercisable in full or in part, free of some or all restrictions or conditions, or otherwise realizable in full or in part.

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As of April 1, 2019, there were options to purchase 471,704 shares of our common stock outstanding under the 2014 plan, at a weighted-average exercise price of \$3.89 per share, and options to purchase 1,623,919 shares of our common stock had been exercised.

Our Board may amend, suspend or terminate the 2014 plan at any time, except that stockholder approval may be required to comply with applicable law or stock market requirements.

2015 plan

Our 2015 plan, which became effective on January 30, 2015, was adopted by our Board and approved by our stockholders in January 2015. The 2015 plan provides for the grant of incentive stock options, nonstatutory stock options, stock appreciation rights, restricted stock awards, restricted stock units and other stock-based awards. Under the 2015 plan, the number of shares of our common stock that is reserved for issuance is the sum of: (1) 1,830,000 plus; (2) 209,519 shares reserved for issuance under the 2014 plan that remained available for grant under the 2014 plan immediately prior to the closing of our initial public offering and the number of shares of our common stock subject to outstanding awards under the 2014 plan that expire, terminate or are otherwise surrendered, cancelled, forfeited or repurchased by us at their original issuance price pursuant to a contractual repurchase right; plus (3) an annual increase, to be added on the first day of each fiscal year, beginning with the fiscal year ending December 31, 2016 and continuing until, and including, the fiscal year ending December 31, 2025, equal to the lowest of 1,724,000 shares of our common stock, 4% of the number of shares of our common stock outstanding on the first day of such fiscal year and an amount determined by our Board. As of December 31, 2018, 1,422,190 shares were available for issuance under the 2015 Plan. As of January 1, 2019, the number of shares authorized for issuance under the 2015 plan automatically increased, pursuant to the terms of the plan, by 1,510,533 shares of common stock.

Our employees, officers, directors, consultants and advisors are eligible to receive awards under the 2015 plan.

Incentive stock options, however, may only be granted to our employees.

Pursuant to the terms of the 2015 plan, our Board (or a committee delegated by our Board) administer the plan and, subject to any limitations in the plan, will select the recipients of awards and determine:

- the number of shares of our common stock covered by options and the dates upon which the options become exercisable;

- the type of options to be granted;

- the duration of options, which may not be in excess of ten years;

- the exercise price of options, which must be at least equal to the fair market value of our common stock on the date of grant; and

- the number of shares of our common stock subject to and the terms of any stock appreciation rights, restricted stock awards, restricted stock units or other stock-based awards and the terms and conditions of such awards, including conditions for repurchase, issue price and repurchase price (though the measurement price of stock appreciation rights must be at least equal to the fair market value of our common stock on the date of grant and the duration of such awards may not be in excess of ten years).

If our Board delegates authority to an executive officer to grant awards under the 2015 plan, the executive officer will have the power to make awards to all of our employees, except executive officers. Our Board will fix the terms of the awards to be granted by such executive officer, including the exercise price of such awards (which may include a formula by which the exercise price will be determined), and the maximum number of shares subject to awards that such executive officer may make.

As of April 1, 2019, there were options to purchase 2,956,571 shares of our common stock outstanding under the 2015 plan, at a weighted-average exercise price of \$50.03 per share, and 1,304,318 options to purchase shares of our common stock had been exercised.

Effect of certain changes in capitalization

Upon the occurrence of any stock split, reverse stock split, stock dividend, recapitalization, combination of shares, reclassification of shares, spin-off or other similar change in capitalization or event, or any dividend or distribution to holders of our common stock other than an ordinary cash dividend, our Board shall equitably adjust:

- the number and class of securities available under the 2015 plan;
- the share counting rules under the 2015 plan;
- the number and class of securities and exercise price per share of each outstanding option;
- the share and per-share provisions and the measurement price of each outstanding stock appreciation right;
- the number of shares subject to, and the repurchase price per share subject to, each outstanding restricted stock award;
- and

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the share and per-share related provisions and the purchase price, if any, of each other stock-based award.

Effect of certain corporate transactions

Upon a merger or other reorganization event (as defined in our 2015 plan), our Board may, on such terms as our Board determines (except to the extent specifically provided otherwise in an applicable award agreement or other agreement between the participant and us), take any one or more of the following actions pursuant to the 2015 plan as to some or all outstanding awards, other than restricted stock awards:

provide that all outstanding awards shall be assumed, or substantially equivalent awards shall be substituted, by the acquiring or successor corporation (or an affiliate thereof);

upon written notice to a participant, provide that all of the participant's unvested and/or vested but unexercised awards will terminate immediately prior to the consummation of such reorganization event unless exercised by the participant (to the extent then exercisable);

provide that outstanding awards shall become exercisable, realizable or deliverable, or restrictions applicable to an award shall lapse, in whole or in part, prior to or upon such reorganization event;

in the event of a reorganization event pursuant to which holders of shares of our common stock will receive a cash payment for each share surrendered in the reorganization event, make or provide for a cash payment to the participants with respect to each award held by a participant equal to (1) the number of shares of our common stock subject to the vested portion of the award (after giving effect to any acceleration of vesting that occurs upon or immediately prior to such reorganization event) multiplied by (2) the excess, if any, of the cash payment for each share surrendered in the reorganization event over the exercise, measurement or purchase price of such award and any applicable tax withholdings, in exchange for the termination of such award; and/or

provide that, in connection with a liquidation or dissolution, awards shall convert into the right to receive liquidation proceeds (if applicable, net of the exercise, measurement or purchase price thereof and any applicable tax withholdings).

Our Board does not need to take the same action with respect to all awards, all awards held by a participant or all awards of the same type.

In the case of restricted stock units, no assumption or substitution is permitted, and the restricted stock units will instead be settled in accordance with the terms of the applicable restricted stock unit agreement.

Upon the occurrence of a reorganization event other than a liquidation or dissolution, the repurchase and other rights with respect to outstanding restricted stock awards will continue for the benefit of the successor company and will, unless the Board may otherwise determine, apply to the cash, securities or other property into which shares of our common stock are converted or exchanged pursuant to the reorganization event. Upon the occurrence of a reorganization event involving a liquidation or dissolution, all restrictions and conditions on each outstanding restricted stock award automatically will be deemed terminated or satisfied, unless otherwise provided in the agreement evidencing the restricted stock award or any other agreement between the participant and us.

The 2015 plan provides that, except to the extent specifically provided to the contrary in an award agreement or any other agreement between the participant and us, immediately prior to a change in control event (as defined in our 2015 plan), the vesting schedule of each outstanding option and restricted stock award shall be accelerated in part so that 50% of the unvested portion of such award shall immediately become exercisable or free from forfeiture or repurchase, as applicable, and the remaining 50% shall vest in substantially equal quarterly installments over the following two years, or, if shorter, in accordance with the original vesting schedule set forth in the award agreement governing such award. Additionally, each such option or restricted stock award shall vest in full and become exercisable or free from forfeiture or repurchase, as applicable, if, on or prior to the second anniversary of the change in control event, the participant's employment with the Company or the acquiring company is terminated for good reason by the participant or is terminated without cause by the Company or the acquiring corporation (as such terms are defined in the 2015 plan). However, if the acquiring corporation does not provide for the assumption or substitution of unvested options or restricted stock awards in connection with the change in control event, each such option and restricted stock award shall vest in full and become exercisable or free from forfeiture or repurchase, as

applicable, immediately prior to the change in control event. Our Board may specify in an award agreement at the time of grant the effect of a change in control event on restricted stock units, stock appreciation rights or other stock-based awards.

At any time, our Board may, in its sole discretion, provide that any award under the 2015 plan will become immediately exercisable in full or in part, free of some or all restrictions or conditions, or otherwise realizable in whole or in part as the case may be.

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No award may be granted under the 2015 plan on or after January 29, 2025. Our Board may amend, suspend or terminate the 2015 plan at any time, except that stockholder approval may be required to comply with applicable law or stock market requirements.

2015 employee stock purchase plan

Our 2015 employee stock purchase plan, or the 2015 ESPP, which became effective upon the closing of our initial public offering, was adopted by our Board and approved by our stockholders in January 2015. The 2015 ESPP is administered by our Board or by a committee appointed by our Board. The 2015 ESPP initially provided participating employees with the opportunity to purchase an aggregate of 220,000 shares of our common stock. The number of shares of our common stock reserved for issuance under the 2015 ESPP automatically will increase on the first day of each fiscal year, beginning with the fiscal year ending December 31, 2016, and continuing until, and including, the fiscal year ending December 31, 2026, in an amount equal to the lowest of: (1) 440,000 shares of our common stock; (2) 1% of the total number of shares of our common stock outstanding on the first day of the applicable fiscal year; and (3) an amount determined by our Board. For the year ended December 31, 2018, we issued 30,814 shares of common stock pursuant to the 2015 ESPP. As of January 1, 2019, the number of shares authorized for issuance under the 2015 ESPP automatically increased, pursuant to the terms of the plan, by 377,633 shares of common stock.

All of our employees and employees of any of our designated subsidiaries, as defined in the 2015 ESPP, are eligible to participate in the 2015 ESPP, provided that:

• such person is customarily employed by us or a designated subsidiary for more than 20 hours a week and for more than five months in a calendar year; and

• such person was our employee or an employee of a designated subsidiary at least fifteen business days prior to the first day of the applicable offering period under the 2015 ESPP.

No employee may purchase shares of our common stock under the 2015 ESPP and any of our other employee stock purchase plans in excess of \$25,000 of the fair market value of our common stock (as of the date of the option grant) in any calendar year. In addition, no employee may purchase shares of our common stock under the 2015 ESPP that would result in the employee owning 5% or more of the total combined voting power or value of our stock.

Each offering will consist of a six-month offering period during which payroll deductions will be made and held for the purchase of our common stock at the end of the offering period. Our Board may, at its discretion, choose a different period of not more than 12 months for offerings.

On the commencement date of each offering period, each eligible employee may authorize up to a maximum of 15% of his or her compensation to be deducted by us during the offering period. Each employee who continues to be a participant in the 2015 ESPP on the last business day of the offering period will be deemed to have exercised an option to purchase from us the number of whole shares of our common stock that his or her accumulated payroll deductions on such date will buy, not in excess of the maximum numbers set forth above. Under the terms of the 2015 ESPP, the purchase price shall be determined by our Board for each offering period and will be at least 85% of the applicable closing price of our common stock. If our Board does not make a determination of the purchase price, the purchase price will be 85% of the lesser of the closing price of our common stock on the first business day of the offering period or on the last business day of the offering period.

An employee may, for any reason, withdraw from participation in an offering prior to the end of an offering period and permanently withdraw the balance accumulated in the employee's account. If an employee elects to discontinue his or her payroll deductions during an offering period but does not elect to withdraw his or her funds, funds previously deducted will be applied to the purchase of common stock at the end of the offering period. If a participating employee's employment ends before the last business day of an offering period, no additional payroll deductions will be made and the balance in the employee's account will be paid to the employee.

We will be required to make equitable adjustments to the number and class of securities available under the 2015 ESPP, the share limitations under the 2015 ESPP and the purchase price for an offering period under the 2015 ESPP to reflect stock splits, reverse stock splits, stock dividends, recapitalizations, combinations of shares, reclassifications of shares, spin-offs and other similar changes in capitalization or events or any dividends or distributions to holders of our common stock other than ordinary cash dividends.

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In connection with a merger or other reorganization event (as defined in the 2015 ESPP), our Board or a committee of our Board may take any one or more of the following actions as to outstanding options to purchase shares of our common stock under the 2015 ESPP on such terms as our Board or committee determines:

• provide that options shall be assumed, or substantially equivalent options shall be substituted, by the acquiring or succeeding corporation (or an affiliate thereof);

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upon written notice to employees, provide that all outstanding options will be terminated immediately prior to the consummation of such reorganization event and that all such outstanding options will become exercisable to the extent of accumulated payroll deductions as of a date specified by our Board or committee in such notice, which date shall not be less than ten days preceding the effective date of the reorganization event;

upon written notice to employees, provide that all outstanding options will be cancelled as of a date prior to the effective date of the reorganization event and that all accumulated payroll deductions will be returned to participating employees on such date;

in the event of a reorganization event under the terms of which holders of our common stock will receive upon consummation thereof a cash payment for each share surrendered in the reorganization event, change the last day of the offering period to be the date of the consummation of the reorganization event and make or provide for a cash payment to each employee equal to (1) the cash payment for each share surrendered in the reorganization event times the number of shares of our common stock that the employee's accumulated payroll deductions as of immediately prior to the reorganization event could purchase at the applicable purchase price, where the acquisition price is treated as the fair market value of our common stock on the last day of the applicable offering period for purposes of determining the purchase price and where the number of shares that could be purchased is subject to the applicable limitations under the 2015 ESPP minus (2) the result of multiplying such number of shares by the purchase price; and/or

provide that, in connection with our liquidation or dissolution, options shall convert into the right to receive liquidation proceeds (net of the purchase price thereof).

The 2015 ESPP may be terminated at any time by our Board. Upon termination, we will refund all amounts in the accounts of participating employees.

In 2018, the Company created a sub-plan in the United Kingdom under the Company's 2015 employee stock purchase plan for the Company's employees in the United Kingdom. This sub-plan incorporates and reflects key benefits and features from the 2015 employee stock purchase plan, but was specifically created for employees of the Company's UK subsidiary. The sub-plan complies with the relevant provisions of the US tax code as required by the 2015 employee stock purchase plan.

Securities authorized for issuance under equity compensation plans

The following table contains information about our equity compensation plans as of December 31, 2018. As of December 31, 2018, we had three equity compensation plans, our 2015 plan, 2015 ESPP and 2014 plan, each of which were approved by our stockholders.

Plan category	Number of securities to be issued upon exercise of outstanding options and vesting of restricted stock units	Weighted-average exercise price of outstanding options, warrants and rights	Number of securities remaining available for future issuance under equity compensation plans (excluding securities reflected in column(a))
	(a)	(b)	(c)
Equity compensation plans approved by security holders	4,645,280	(1)\$ 40.11	(2)2,605,510
Equity compensation plans not approved by security holders	—	—	—
Total	4,645,280	\$ 40.11	2,605,510

(1) Includes 1,264,330 restricted stock units that will entitle the holder to one share of each unit that vests over the holder's period of continued service to the Company.

(2) The calculation does not take into account the 1,264,330 shares of common stock subject to outstanding restricted stock units. Such shares will be issued at the time the restricted stock units vests, without any cash consideration payable for those shares.

(3) Consists of shares available for future issuance under the 2015 plan and 2015 ESPP. As of December 31, 2018, 1,485,322 shares of common stock were available for issuance under the 2015 plan, and 1,120,188 shares of common stock were available for issuance under the 2015 ESPP. While there are outstanding equity grants under the 2014 plan the Company no longer issues equity grants under the 2014 plan.

(4) Our 2015 plan and our 2015 ESPP contains an "evergreen" provision, which allows for an annual increase in the number of shares of common stock available under the plans on the first day of each fiscal year. The annual increase in the number of shares for the 2015 plan, shall be equal to the lowest of 1,724,000 shares of our common stock, 4% of the number of shares of our common stock outstanding on the first day of the fiscal year and an amount determined by our Board. The annual increase in the number of shares for the 2015 ESPP, shall be equal to the lowest of 440,000 shares of our common stock, 1% of the number of shares of our common stock outstanding on the first day of the fiscal year and an amount determined by our Board.

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Security Ownership of Certain Beneficial Owners, Management and Related Stockholder Matters

The following table sets forth information with respect to the beneficial ownership of our common stock, as of April 1, 2019, by:

- each person known by us to beneficially own more than 5% of our common stock;
- each of our directors;
- each of our named executive officers;
- and all of our executive officers and directors as a group.

The number of shares beneficially owned by each stockholder is determined under rules issued by the SEC and includes voting or investment power with respect to securities. Under these rules, beneficial ownership includes any shares as to which the individual or entity has sole or shared voting power or investment power. Each of the stockholders listed has sole voting and investment power with respect to the shares beneficially owned by the stockholder unless noted otherwise, subject to community property laws where applicable. The information is not necessarily indicative of beneficial ownership for any other purpose.

The percentage ownership calculations for beneficial ownership are based on 38,733,406 shares of common stock outstanding as of April 1, 2019. In computing the number of shares beneficially owned by an individual or entity and the percentage ownership of that person, shares of common stock subject to options, warrants or other rights held by such person that are currently exercisable, or will become exercisable within 60 days of April 1, 2019, are considered outstanding, although these shares are not considered outstanding for purposes of computing the percentage ownership of any other person.

Unless otherwise indicated, the address of all listed stockholders is 3737 Market Street, Suite 1300, Philadelphia, PA 19104.

Name of beneficial owner	Number of shares beneficially owned	Percentage of shares beneficially owned	
Named Executive Officers and Directors			
Jeffrey D. Marrazzo (1)	764,159	2.0	%
Katherine A. High, M.D. (2)	282,272	*	
Stephen W. Webster (3)	236,305	*	
Daniel R. Faga (4)	48,828	*	
John P. Furey (5)	10,000	*	
Steven M. Altschuler, M.D. (6)	79,203	*	
Lars Ekman, M.D., Ph.D. (7)	54,203	*	
Anand Mehra, M.D. (8)	533,973	1.4	%
Vincent J. Milano (9)	54,203	*	
Robert J. Perez (10)	9,167	*	
Elliott Sigal, M.D., Ph.D. (11)	102,762	*	
Lota Zoth, CPA (12)	29,000	*	
All executive officers and directors as a group (15 persons)	2,415,581	6.1	%
5% Stockholders			
BlackRock, Inc. (13)	3,106,293	8.0	%
The Vanguard Group (14)	2,917,324	7.5	%
JPMorgan Chase & Co (15)	2,442,909	6.3	%

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Partner Fund Management, L.P. (16)	2,209,870	5.7	%
CHOP Foundation (17)	1,992,160	5.1	%
T. Rowe Price Associates, Inc. (18)	1,970,766	5.1	%

* Less than 1%

Consists of (a) 355,215 shares of common stock and (b) 408,944 shares of common stock underlying options that (1) are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Mr. Marrazzo.

(2) Consists of (a) 278,834 shares of common stock and (b) 3,438 shares of common stock underlying options that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Dr. High.

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- (3) Consists of (a) 6,102 shares of common stock and (b) 230,203 shares of common stock underlying options that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Mr. Webster.
- (4) Consists of (a) 38,828 shares of common stock and (b) 10,000 shares of common stock underlying options that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Mr. Faga. Consists of 10,000 shares of common stock underlying options that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Mr. Furey. Mr. Furey terminated his employment with the Company in January 1, 2019.
- (5) Consists of (a) 26,500 shares of common stock owned by Dr. Altschuler, (b) 15,500 shares of common stock underlying options and restricted stock units that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Dr. Altschuler, and (b) 37,203 shares of common stock underlying options that are exercisable as of April 1, 2019 that were issued to Dr. Altschuler in his previous capacity as chief executive officer of the CHOP Foundation. Dr. Altschuler holds such options as a nominee of the CHOP Foundation, which shall receive any economic benefit associated with such option. Dr. Altschuler disclaims beneficial ownership of such options.
- (6) Consists of (a) 1,500 shares of common stock and (b) 52,703 shares of common stock underlying options and restricted stock units that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Dr. Ekman.
- (7) Consists of 518,473 shares of common stock owned by Sofinnova Venture Partners VIII, L.P. ("SVP VIII") and (b) 15,500 shares of common stock under options and restricted stock units that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Dr. Mehra. Sofinnova Management VIII, L.L.C. ("SM VIII") is the general partner of SVP VIII and Anand Mehra, Michael Powell and James I. Healy, are the managing members of SM VIII (the Managing Members"). SVP VIII, SM VIII, SM VIII and the Managing Member may be deemed to have shared voting and dispositive power over the shares owned by SVP VIII. Such persons and entities disclaim beneficial ownership over the shares owned by SVP VIII except to the extent of any pecuniary interest therein. The address of each such person or entity is Sofinnova Ventures, 3000 Sand Hill Road, Bldg. 4, Suite 250, Menlo Park, CA 94025. We obtained much of the information regarding beneficial ownership of these shares from a Schedule Form 4 that was filed with the SEC on July 26, 2017. Dr. Mehra is a managing member of Sofinnova Management VIII, L.L.C., the sole general partner of Sofinnova Venture Partners VIII, L.P. Dr. Mehra may be deemed to have voting and investment power over the shares held by Sofinnova Venture Partners VIII, L.P. Dr. Mehra disclaims beneficial ownership of such shares except to the extent of any pecuniary interest therein.
- (8) Consists of (a) 1,500 shares of common stock and (b) 52,703 shares of common stock underlying options and restricted stock units that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Mr. Milano.
- (9) Consists of (a) 1,000 shares of common stock and (b) 8,167 shares of common stock underlying options and restricted stock units that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Mr. Perez.
- (10) Consists of (a) 12,714 shares of common stock owned by Dr. Sigal, (b) 31,559 shares of common stock owned by Sigal Family Investments, LLC and (c) 58,489 shares of common stock underlying options and restricted stock units that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date. Dr. Sigal is a manager of Sigal Family Investments, LLC. Dr. Sigal may be deemed to have voting and investment power over the shares held by Sigal Family Investments, LLC. Dr. Sigal disclaims beneficial ownership of such shares except to the extent of any pecuniary interest therein.
- (11) Consists of (a) 1,500 shares of common stock and (b) 27,500 shares of common stock underlying options and restricted stock units that are exercisable as of April 1, 2019 or will become exercisable within 60 days after such date owned by Ms. Zoth.
- (12) The address for BlackRock, Inc. is 55 E 52nd Street, New York, NY 10055. Various persons have the right to receive or the power to direct the receipt of dividends from, or the proceeds from the sale of the common stock of the Company. No one person's interest in the common stock of the Company was more than five percent of the
- (13)

- total outstanding common shares. Based on information provided in a Schedule 13G filed on February 6, 2019. The address for The Vanguard Group is 100 Vanguard Blvd, Malvern, PA 19355. Vanguard Fiduciary Trust Company, a wholly-owned subsidiary of The Vanguard Group, Inc., is the beneficial owner of 62,337 shares of the common stock of the Company as a result of its serving as investment manager of collective trust accounts and Vanguard Investments Australia, Ltd., a wholly-owned subsidiary of The Vanguard Group, Inc., is the beneficial owner of 9,563 shares of the common stock of the Company. Based on information provided in a Schedule 13G filed on February 11, 2019.
- (14)
- (15) The address for JPMorgan Chase & Co is 270 Park Avenue, New York, New York 10017. Based on information provided in a Schedule 13G filed on January 28, 2019. Consists of (a) 1,954,957 shares of common stock owned by the CHOP Foundation and (b) 37,203 shares of common stock underlying options that are exercisable as of April 1, 2019 issued to Dr. Altschuler as a nominee of the CHOP Foundation. The CHOP Foundation's board of trustees, or a committee designated by the board of trustees, has voting and investment power of their shares. The address of the CHOP Foundation is 34th Civic Center Boulevard, Philadelphia, PA 19104. We obtained much of the information regarding beneficial ownership of these shares from a Schedule 13D that was filed with the SEC on March 7, 2019. Based on information provided in the Schedule 13G/A filed on February 14, 2019. T. Rowe Price Associates, Inc. ("Price Associates") does not serve as custodian of the assets of any of its clients; accordingly, in each instance only the client or the client's custodian or trustee bank has the right to receive dividends paid with respect to, and proceeds from the sale of, such securities. The ultimate power to direct the receipt of dividends paid with respect to, and the proceeds from the sale of, such securities, is vested in the individual and institutional clients which Price Associates serves as investment adviser. Any and all discretionary authority which has been delegated to Price Associates may be revoked in whole or in part at any time. The address of Price Associates is 100 E. Pratt Street, Baltimore, MD 21202.
- (17)
- (18) As reported on a Schedule 13G/A filed with the SEC on February 14, 2019 by Partner Fund Management, L.P. ("PFM"), Partner Fund Management GP, LLC ("PFM-GP"), Partner Investment Management, L.P. ("PIM"), Partner Investment Management GP, LLC ("PIM-GP"), Brian D. Grossman ("Grossman") and Christopher M. James ("James") with respect to shares of common stock owned by Healthcare Emerging Growth Master Fund, L.P., a Cayman Islands limited partnership ("HEGM"), PFM Global Long Alpha Master Fund, L.P., a Cayman Islands limited partnership ("GLAM"), PFM Global Long Alpha Institutional Master Fund, L.P., a Cayman Islands limited partnership ("GLAI"), PFM Healthcare Master Fund, L.P., a Cayman Islands limited partnership ("HCM"), PFM Healthcare Long Master Fund, L.P., a Cayman Islands limited partnership ("HCLM"), PFM Thematic Growth Master Fund, L.P., a Cayman Islands limited partnership ("TGM"), PFM Thematic Growth Institutional Master Fund, L.P., a Cayman Islands limited partnership ("TGIM"), PFM Therapeutics Master Fund, L.P., a Cayman Islands limited partnership ("TM"), PFM Healthcare Principals Fund, L.P., a Delaware limited partnership ("HCP"), PFM Thematic Growth Principals Fund, L.P., a Delaware limited partnership ("TGP" and, collectively with HEGM, GLAM, GLAI, HCM, HCLM, TGM, TGIM, TM and HCP, the "PFM Funds"). PFM is the investment advisor for the PFM Funds other than HCP and TGP. PIM is the investment advisor for HCP and TGP. PFM-GP and PIM-GP are, respectively, the general partners of PFM and PIM. Grossman is the portfolio manager for the health care strategy for the PFM Funds. James is the chief investment officer for PIM and PFM and member manager of PFM-GP and PIM-GP. PFM and PFM-GP may be deemed to beneficially own 2,183,393 shares of common stock. PIM and PIM-GP may be deemed to beneficially own 26,477 shares of common stock. Grossman may be deemed to beneficially own 2,209,870 shares of common stock. James may be deemed to beneficially own 2,209,870 shares of common stock. The address of the principal business office of such entities and persons is c/o Partner Fund Management, L.P., 4 Embarcadero Center, Suite 3500, San Francisco, CA 94111.

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

During 2018, we have engaged in the following transactions with our directors, executive officers and holders of more than 5% of our voting securities and affiliates of our directors, executive officers and holders of more than 5% of our voting securities. We believe that all of the transactions described below were made on terms no less favorable to us than could have been obtained from unaffiliated third parties.

Ongoing collaboration with CHOP

In October 2013, we entered into a licensing agreement with CHOP, which we amended in December 2013, May 2014, December 2014 and October 2015. We also entered into a technology assignment agreement, a master research service agreement and an administrative services agreement with CHOP in October 2013, a sponsored research agreement with CHOP in October 2014 and multiple clinical trial agreements with CHOP at various times regarding the conduct of our various clinical trials. We also entered into an additional licensing agreement with CHOP in November 2015, which supplements our existing license agreement with CHOP by granting us a worldwide exclusive license, with the right to sublicense, to use and practice a provisional patent application related to the production of gene therapies. Pursuant to these agreements, we paid CHOP \$5.7 million during the year ended December 31, 2018. Steven M. Altschuler, M.D., chairman of our Board, previously served as the chief executive officer of CHOP and the CHOP Foundation.

Indemnification arrangements

Our Restated Certificate of Incorporation provides that we will indemnify our directors and officers to the fullest extent permitted by Delaware law. In addition, we have entered into indemnification agreements with each of our directors and executive officers that may be broader in scope than the specific indemnification provisions contained in the DGCL. See the “Director Compensation—Limitation of liability and indemnification” section of this Amendment for a further discussion of these arrangements.

Policies and procedures for related-person transactions

On December 29, 2014, our Board adopted written policies and procedures for the review of any transaction, arrangement or relationship in which we are a participant, the amount involved exceeds \$120,000 and one of our executive officers, directors, director nominees or 5% stockholders (or their immediate family members), each of which we refer to as a “related person,” has a direct or indirect material interest.

If a related person proposes to enter into such a transaction, arrangement or relationship, which we refer to as a “related-person transaction,” the related person must report the proposed related-person transaction to our Chief Legal Officer. The policy calls for the proposed related-person transaction to be reviewed and, if deemed appropriate, approved by the Audit Committee of our Board. Whenever practicable, the reporting, review and approval will occur prior to entry into the transaction. If advance review and approval is not practicable, the committee will review and, in its discretion, may ratify the related-person transaction. The policy also permits the chair of the Audit Committee to review and, if deemed appropriate, approve proposed related-person transactions that arise between committee meetings, subject to ratification by the committee at its next meeting. Any related-person transactions that are ongoing in nature will be reviewed annually.

A related-person transaction reviewed under the policy will be considered approved or ratified if it is authorized by the committee after full disclosure of the related person’s interest in the transaction. As appropriate for the circumstances, the committee will review and consider:

- the related person’s interest in the related-person transaction;
- the approximate dollar value of the amount involved in the related-person transaction;
- the approximate dollar value of the amount of the related person’s interest in the transaction without regard to the amount of any profit or loss;
- whether the transaction was undertaken in the ordinary course of our business;
- whether the terms of the transaction are no less favorable to us than terms that could have been reached with an unrelated third party;
- the purpose of, and the potential benefits to us of, the related-person transaction; and
- any other information regarding the related-person transaction or the related person in the context of the proposed transaction that would be material to investors in light of the circumstances of the particular transaction.

The Audit Committee may approve or ratify the transaction only if the Audit Committee determines that, under all of the circumstances, the transaction is not inconsistent with our best interests. The Audit Committee may impose any conditions on the related-person transaction that it deems appropriate.

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In addition to the transactions that are excluded by the instructions to the SEC's related-person transaction disclosure rule, our Board has determined that the following transactions do not create a material direct or indirect interest on behalf of related persons and, therefore, are not related-person transactions for purposes of this policy:

interests arising solely from the related person's position as an executive officer of another entity (whether or not the person is also a director of such entity) that is a participant in the transaction, where (a) the related person and all other related persons own in the aggregate less than a 10% equity interest in such entity; (b) the related person and his or her immediate family members are not involved in the negotiation of the terms of the transaction and do not receive any special benefits as a result of the transaction and; (c) the amount involved in the transaction equals less than the greater of \$200,000 or 5% of the annual gross revenues of the company receiving payment under the transaction; and a transaction that is specifically contemplated by provisions of our certificate of incorporation or bylaws.

The policy provides that transactions involving compensation of executive officers shall be reviewed and approved by the Compensation Committee in the manner specified in its charter.

Item 14. Principal Accountant Fees and Services

Auditor's fees

The following table summarizes the fees of KPMG LLP, our independent registered public accounting firm, billed to us for each of the last two fiscal years.

Fee category	2017	2018
Audit fees (1)	\$805,000	\$862,500
Audit-related fees	—	—
Tax fees (2)	229,422	279,720
All other fees	5,000	5,000

Total fees \$1,039,422 \$1,147,220

(1) Audit fees consist of fees for the audit of our financial statements, the review of our interim financial statements and services associated with the issuance of comfort letters and the preparation of consents on potential registration statements.

(2) Tax fees consists of fees incurred for tax compliance, tax advice and tax planning and includes fees for tax return preparation and tax consulting.

The aggregate fees included in the Audit fees are billed for the fiscal year. The aggregate fees included in the Audit-related fees and Tax fees are fees billed in the fiscal year.

All such audit and non-audit services and fees were pre-approved by our Audit Committee in accordance with the "Pre-approval policies" described below.

Pre-approval policies

The Audit Committee of our Board has adopted policies and procedures for the pre-approval of audit and non-audit services for the purpose of maintaining the independence of our independent auditor. We may not engage our independent auditor to render any audit or non-audit service unless either the service is approved in advance by the Audit Committee, or the engagement to render the service is entered into pursuant to the Audit Committee's Pre-approval policies and procedures.

PART IV

Item 15. Exhibits, Financial Statement Schedules

The following is a list of the Company's Exhibits:

Exhibit Number	Description of Exhibit	Incorporated by Reference			Filed/Furnished Herewith
		Form	File Number	Date of Filing Exhibit Number	
31.3	<u>Certification of principal executive officer pursuant to Rule 13a-14(a)/15d-14(a) of the Securities Exchange Act of 1934, as amended</u>				X
31.4	<u>Certification of principal financial officer pursuant to Rule 13a-14(a)/15d-14(a) of the Securities Exchange Act of 1934, as amended</u>				X

SIGNATURES

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

Date: April 30, 2019

SPARK THERAPEUTICS, INC.

By: /s/ Jeffrey D. Marrazzo
Jeffrey D. Marrazzo
Chief Executive Officer
(Principal Executive Officer)

By: /s/ Stephen W. Webster
Stephen W. Webster
Chief Financial Officer
(Principal Financial and Accounting Officer)