UNIVERSITY of VIRGINIA
LICENSING & VENTURES GROUP

Engaging Ideas

2017 ANNUAL REPORT

Mission Statement

To maximize the impact of UVA's innovation assets via commercialization, while providing high levels of customer service, value-added business development, new venture creation, and a focus on driving quality transactions.

"Strengthen the University's capacity to advance knowledge and serve the Commonwealth of Virginia, the nation, and the world through research, scholarship, creative arts and innovation."

THE UNIVERSITY OF VIRGINIA CORNERSTONE PLAN

A Strategy for the Academic Division, 2014-2019

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LICENSING & VENTURES PROCESS

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12 mos.

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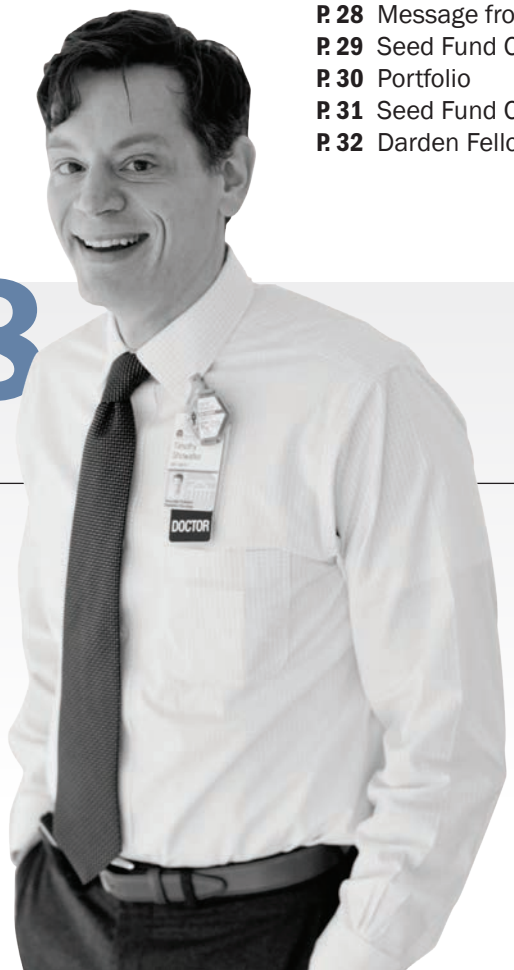

18

30-31 mos. — National Stage

3-4 yrs. — Patent Prosecution

Patent Issued

10-15 yrs. — Patent Maintenance

In Memoriam

Phillip Parrish, Leader of Cross-University Research Initiatives

July 13, 2017 | *UVA Today* | By Fariss Samarrai

PHILLIP A. PARRISH, interim vice president for research at the University of Virginia, played a key role in the development of three new University-wide research institutes — the UVA Brain Institute, the Environmental Resilience Institute and the Global Infectious Diseases Institute — all part of a major initiative to distinguish the University through trans-disciplinary research and scholarship addressing areas of critical global societal need.

Prior to serving for more than two years as interim vice president for research, Parrish served as the University's associate vice president for research and as a board member of the UVA Licensing & Ventures Group.

"Phil's death is a great loss for the UVA community," said UVA President Teresa A. Sullivan. "Over the years he had a significant impact at UVA, providing steadfast leadership while contributing to the establishment of our pan-University research institutes and fostering cross-Grounds collaboration. Before this sad news, all of us were looking forward to Phil's continued and expanded influence in our academic and research community. He will be dearly missed by colleagues, friends and students."

During his tenure at the University, Parrish played an integral role in advancing research activity and collaborations across schools, including the development of UVA's Center for Automata Processing and a joint energy systems collaboration with the Max Planck Society's Institute for Chemical Energy Conversion. He also helped establish an initiative focused on science, technology, policy and innovation partnerships with Latin American universities and companies, and recruitment to UVA of top Brazilian graduate students and postdoctoral fellows.

Parrish also played a key role in the establishment of ResearchNet, a cross-University initiative with the objective of assisting faculty in the discovery of opportunities for external funding support and cross-University collaborations. Parrish additionally served as a principal scientist in materials science at the UVA School of Engineering and Applied Science.

"Phil was an outstanding contributor to UVA, especially as a scholar and researcher with a strong background in materials science," said David Hudson, senior associate vice president for research. "Phil was also an exceptional leader to the creative group of people in the Office of the Vice President for Research. His expertise catalyzed and stimulated our research efforts at the University and throughout the Commonwealth of Virginia. Phil was a kind, thoughtful and considerate colleague and friend and a consummate professional who looked after the best interests of his staff and those of the University."

As the interim vice president for research, Parrish was responsible for the integration and enhancement of research activities across the University's 11 schools and multiple research centers. The office leads University-wide strategic growth activities, including multidisciplinary groups in environmental sustainability, innovation, energy systems and biosciences. The office also coordinates the various University units that make up the research infrastructure, including the acquisition of research funding, research commercialization, proof-of-concept funding for translating new knowledge to new companies, federal compliance, health and safety, and public outreach.

Prior to joining the University in 1996, Parrish worked in private industry, and served as program manager for materials science at the Defense Advanced Research Projects Agency, and as the associate director for materials science at the U.S. Office of Naval Research Global in London, responsible for that agency's international program in nanotechnology and advanced materials.

He held a Ph.D. in materials science and engineering from the University of Florida.

Parrish also co-held four patents, was the author of numerous journal articles, and received several awards from the U.S. military, having served on government scientific and engineering panels.

Board of Directors

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Message from the Executive Director

FACULTY, STAFF and students at the University of Virginia (UVA) make remarkable discoveries every day. The research and innovation culture is present in every lab, clinic, and classroom across Grounds. Our role at the UVA Licensing & Ventures Group (LVG) is to engage early and often with all of our university partners to share our expertise and leverage University resources to support these discoveries in reaching their full potential.

In the profiles that follow, you will meet several UVA faculty who have made extraordinary discoveries and have engaged with LVG to identify a commercialization pathway to bring their ideas to market. You will also learn how the process works from idea generation to company formation and where LVG plays a pivotal role along the way. We highlight several of our portfolio companies that LVG has helped shape, taking an initial discovery from the lab to a product in the market.

During the 2017 fiscal year, LVG solicited and/or received 207 invention disclosures from faculty, staff, and students at the University. In that same period, 105 U.S. provisional patent applications were filed and 43 U.S. patents were issued. We completed 82 transactions with commercial partners and helped launch seven new ventures.

In its second fiscal year, the UVA LVG Seed Fund made an investment in TearSolutions, Inc. Bob Creeden, managing director of the UVA LVG Seed Fund & New Ventures, launched the pilot Due Diligence in Seed Funds course in conjunction with UVA's Darden School of Business and had 17 students participate in its inaugural year. The UVA LVG Seed Fund also employed three Darden students as summer fellows via the Batten Venture Internship Program.

We are proud to welcome Pamela Norris, Ph.D. (senior associate dean, SEAS) and Peter M. Grant II to our Board of Directors. Peter M. Grant II has replaced Erik L. Hewlett as chair of the Board. Erik has served on our board for 24 years and we are indebted to him for his service.

While the year was successful in so many ways, we continue to seek partnerships throughout the University and engage with innovators to support their ideas and concepts from early formation to commercialization. We will look forward to engaging with you in the year to come!

Michael P. Straightiff
Executive Director of UVA LVG

Year at a Glance

fiscal year 2017

207
Invention Disclosures

276
Patents Filed

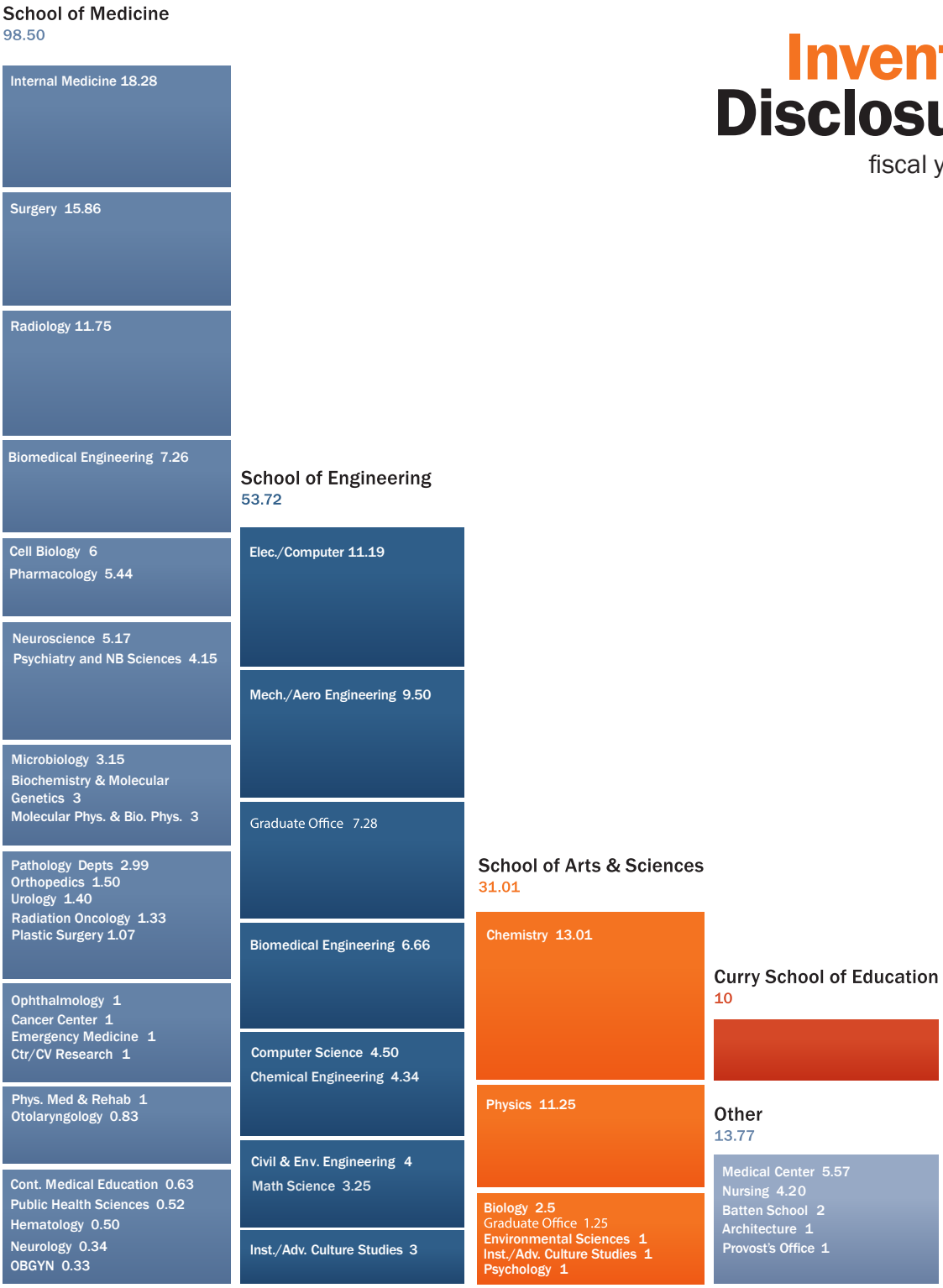
82
Patents Issued

82
Licensing Deals

7
New Ventures

Invention Disclosures

fiscal year 2017



Licensing Deals

fiscal year 2017

UVA LVG works to connect and promote University innovations to our industry partners, including, but not limited to, the following companies:

PorA Pharmaceuticals LLC
psikick Ultra-Low-Power Wireless
BrightSpec Molecular Rotational Resonance Spectroscopy
contraline
The Jackson Laboratory
MSI
typezero
EarJellies
TearSolutions, LLC
io education
ADVAXIS IMMUNOTHERAPIES™
SRC Semiconductor Research Corporation
Honeywell
CUE BIOPHARMA
LUPIN PHARMACEUTICALS, INC.
SOYOTEC
PRESIDIUM
cerillo

LVG licensing team

Patents Issued

US Patent Number	Title	Inventors
9,550,864	Viscoelastic Silicone Rubber Compositions	Louis A. Bloomfield
9,682,078	Compositions and Methods for Tissue Engineering and Cell Based Therapies	Edward A. Botchwey III, Anthony Awojoodu, Anusuya Das, Mary J. Laughlin, Kevin R. Lynch
9,571,312	Expurgated Pulse Position Modulation for Communication	Maite Brandt-Pearce, Mohammad Noshad
9,490,698	Low Input Voltage Boost Converter with Peak Inductor Current Control and Offset Compensated Zero Detection	Benton H. Calhoun, Aatmesh Shrivastava
9,590,638	Low Power Clock Source	Benton H. Calhoun, Aatmesh Shrivastava
9,611,153	Compositions and Methods for Preparing Copper-Containing Paper and Uses Thereof	Theresa A. Dankovich
9,570,559	Graphene Device Including Angular Split Gate	Avik Ghosh, Redwan Noor Sajjad
9,669,198	System and Method for Intracranial Implantation of Therapeutic or Diagnostic Agents	George T. Gillies
9,486,621	Implanting an Electrode Array Against the Spinal Cord Inside the Dura for Stimulating the Spinal Cord and Treating Pain	George T. Gillies
9,387,199	Compositions and Methods for Treating Clostridium Infection and Preventing Recurrence of Infection	Richard L. Guerrant, John H. Moore III, Edward Van Opstal, Cirle Alcantara Warren
9,604,890	Compositions and Methods for Hydrocarbon Functionalization	George Fortman, Thomas B. Gunnoe
9,492,448	Compositions and Methods for Regulating Glucose Homeostasis and Insulin Action	Kyle Hoehn, Brandon Kenwood
9,445,780	Tracked Ultrasound Vessel Imaging	John A. Hossack, Travis N. Blalock
9,526,922	System for Treatment and Imaging Using Ultrasonic Energy and Microbubbles and Related Method Thereof	John A. Hossack, Alexander L. Klibanov, Brian R. Wamhoff
9,561,266	Target Peptides for Immunotherapy and Diagnostics	Donald F. Hunt, Kara L. Cummings, Victor H. Engelhard, Stacy A. Malaker, Rebecca C. Obeng, Jeffrey Shabanowitz, Angela Zarling
9,539,242	Molecular Genetic Approach to Treatment and Diagnosis of Alcohol and Drug Dependence	Bankole A. Johnson
9,623,128	Compositions and Methods for Detecting Plectin-1 as a Biomarker for Cancer	Kimberly A. Kelly
9,430,022	Methods and Apparatus for Modular Power Management and Protection of Critical Services in Ambulatory Medical Devices	Boris P. Kovatchev, Patrick T. Keith-Hynes, Marc D. Brenton, Stephen D. Patek
9,398,869	Method, System, and Computer Program for Improving the Accuracy of Glucose Sensors Using Insulin Deliver Observation in Diabetes	Boris P. Kovatchev, Colleen Hughes Karvetski, Marc D. Brenton, Stephen D. Patek

US Patent Number	Title	Inventors
9,421,177	Imidamide Sphingosine Kinase Inhibitors	Kevin R. Lynch, Andrew Kennedy, Yugesh Kharel, Timothy L. Macdonald, Thomas P. Matthews
9,688,668	Long Chain Base Sphingosine Kinase Inhibitors	Kevin R. Lynch, Joseph D. Houck, Andrew Kennedy, Yugesh Kharel, Timothy L. Macdonald
9,642,534	Systems and Methods for Determining Location of an Access Needle in a Subject	Srijoy Mahapatra, Jason M. Tucker-Schwartz, George T. Gillies
9,468,396	Systems and Methods for Determining Location of an Access Needle in a Subject	Srijoy Mahapatra, Jason M. Tucker-Schwartz, George T. Gillies
9,579,120	Ultrasound for Locating Anatomy or Probe Guidance	William F. Walker, Francesco Viola, F. William Mauldin, Jr.
9,651,645	Systems and Methods for Reduced Off-Resonance Blurring in Spiral Imaging	Craig H. Meyer, Samuel W. Fielden, Xue Feng
9,589,345	Systems and Methods for Accelerated Arterial Spin Labeling Using Compressed Sensing	Craig H. Meyer, Xiao Chen, Frederick H. Epstein, Samuel W. Fielden, John P. Mugler III, Manal Nicolas-Jilwan, Max Wintermark, Li Zhao
9,635,033	Methods, Systems and Computer Readable Media for Detecting Command Injection Attacks	Anh Nguyen-Tuong, John C. Knight, Jason D. Hiser, Jack W. Davidson, Michele Co
9,433,398	Separable Beamforming for Ultrasound Array	Kevin Owen
9,610,370	Compositions and Methods for Tumor Imaging and Targeting by a Class of Organic Heptamethine Cyanine Dyes that Possess Dual Nuclear and Near-Infrared Properties	Dongfeng Pan
9,442,079	Chirped Pulse Frequency-Domain Comb for Spectroscopy	Brooks Hart Pate, Kevin K. Lehmann
9,482,577	Segmented Chirped-Pulse Fourier Transform Spectroscopy	Brooks Hart Pate, Justin L. Neill
9,555,467	Amorphous Steel Composites with Enhanced Strengths, Elastic Properties and Ductilities	Joseph S. Poon, Gary J. Shiflet, Xiao-Jun Gu
9,617,197	Compositions and Methods for Treating Inflammatory Diseases	Yun Michael Shim
9,606,123	Compositions and Methods for Diagnosing and Monitoring Ovarian Cancer Progression and Treatment	Jill K. Slack-Davis, Kimberly A. Kelly
9,677,083	Compositions and Related Methods for Modulating Transcriptional Activation by Incorporating Gag Motifs Upstream of Core Promoter Elements	Michael P. Timko, Paul J. Rushton, Marta T. Bokowiec
9,636,487	Meters for In-Vivo Monitoring	George T. Gillies, Matthew R. Begley, John A. Jane, Jr.
9,640,369	Coaxial Hollow Cathode Plasma Assisted Directed Vapor Deposition and Related Method Therof	Haydn N. G. Wadley
9,468,660	Antinematodal Methods and Compositions	Judith White
9,606,126	Compositions and Methods for Membrane Protein Detergent Stability Screen	Michael C. Wiener, James M. Vergis
9,517,038	Apparatus and Method for Breast Immobilization	Mark B. Williams, Kelly Llanian L. Williams, Olivia P. Sullivan, Tushita Patel, Emily M. Mastandrea, Zongyi Gong

> “The investment in TearSolutions is important from a funding perspective, but perhaps just as important as a symbol of an exciting new era in the commercialization of biotech discoveries at the University of Virginia. The discovery of Lacritin in Dr. Laurie’s UVA lab, the technology licensing from the UVA Licensing & Ventures Group, the formation of a local company, and now funding from the UVA LVG Seed Fund is an example of the potential for Charlottesville as a biotech center.”

–Mark Logan, Executive Chairman and Co-Founder of TearSolutions, Inc.

Faculty & Company Profiles

Manoj Patel, Ph.D.
School of Medicine

ACCORDING TO the American Epilepsy Society, one in 26 Americans will develop epilepsy in their lifetime. The fourth most common neurological disease, epilepsy predisposes a person to recurrent, unprovoked seizures and is a major public health concern around the world.

Manoj Patel, Ph.D., associate professor of anesthesiology, is an electrophysiologist who has been studying seizures at UVA for almost two decades. Seizures occur when there is an overactivity of electrical discharges in brain neurons. Sodium channels play a major role for controlling the electrical discharges, known as action potentials. Humans express nine different sodium channels, each with a unique function. The human brain expresses four different types of sodium channels, and these channels have become important targets in treating a number of neurological disorders.

Anticonvulsants (AEDs) are used to control excessive brain discharges in epilepsy.

Drug therapies on the market today broadly target all sodium channels, including ones that function normally. As a result, a disproportionate number of epilepsy patients continue to experience seizures or severe adverse side effects while taking anticonvulsants. Limitations in the available therapies elucidate the need for more effective and safer antiepileptic medications.

Patel is in the process of designing and testing small molecule compounds that have the potential to become a marketable drug therapy for epilepsy and that are designed to target and suppress overactivity in a specific neuronal sodium channel isoform known as Nav1.6, encoded by the gene *SCN8A*. For nearly a decade, Patel has been collaborating with Mirko Rivara, a medicinal chemist in the department of pharmacy at the University of Parma in Italy, to develop and test the compound.

Since the first pediatric epilepsy patient with a mutation in the *SCN8A* channel was identified in 2012, the mutation was added to the general screening test for epilepsy, and cases are continuously reported. The discovery of this mutation shaped the development of successive generations of compounds, and identified a clear path forward for Patel and Rivara.

Pediatric patients with mutations in *SCN8A* can be diagnosed as early as 4 months old and make up a specific subset of epilepsy patients. A child who took their first steps, or said his or her first words, and has a seizure can experience significant developmental setbacks after the episode-reversing any developmental progress. The disease is devastating in pediatric patients. Almost all have different degrees of motor dysfunction or intellectual disability, and life expectancy rarely exceeds the teenage years. For parents of a child with epilepsy, the work that Patel is conducting at UVA to develop a selective blocker is their only hope.

> **“As a scientist, I have limited business knowledge, so to have access to the resources and expertise at LVG will be crucial for the commercialization of the compound.”**
>
> —Manoj Patel, Ph.D.

“Even if we aren’t successful in making a selective blocker, making one that is safer than what is currently on the market would also be a significant achievement,” Patel said. “The side effects of clinically available anticonvulsants can be severe in adult and especially pediatric patients.”

Pharmaceutical companies have shied away from pursuing research in this area, as it’s seen as add-on therapy to existing anticonvulsants on the market. The opportunity to pursue drug development and its eventual commercialization would come from a licensing agreement with a biotechnology company or by launching a new venture.

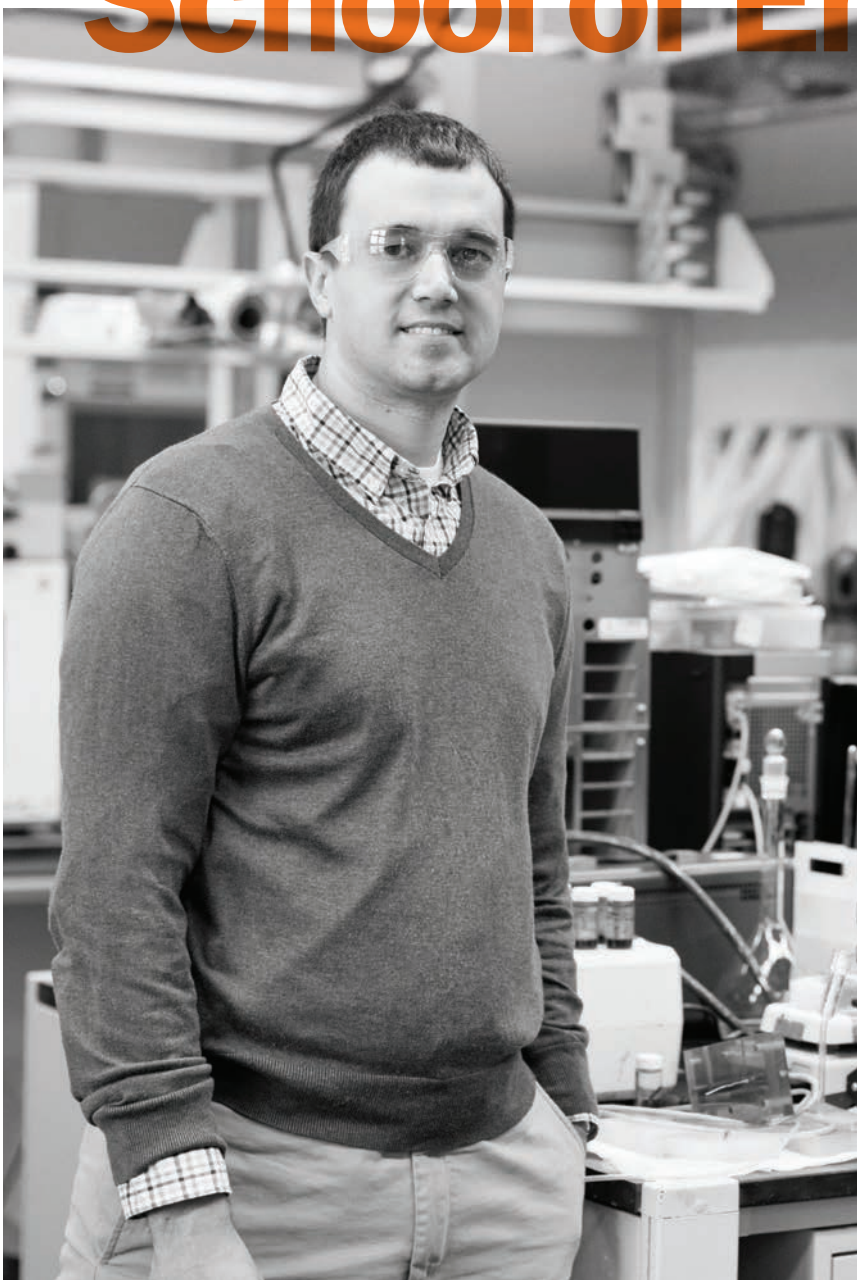
After Patel presented his research on the original compounds to a faculty peer group, Dean Wilkes of the UVA School of Medicine encouraged him to engage with LVG to ensure his research was properly protected. A missed opportunity to patent the original compounds prompted Patel to establish a relationship with LVG to pursue a provisional patent on the secondary iteration of the compounds.

Since 2014, LVG has guided Patel through the patent process and has filed a provisional patent application that converted in 2018. While the patent process is still ongoing, LVG has built rapport with Patel, advising him to pursue funding from the Ivy Foundation. The Ivy Foundation supports biomedical innovation and translational research projects at UVA. LVG is also making industry introductions for Patel to present his research to biotech companies and potential licensees for his compound.

“Our goal is to start a company to further develop these compounds into a drug to treat the small children who suffer from this disease,” says Patel. “As a scientist, I have limited business knowledge, so to have access to the resources and expertise at LVG will be crucial for the commercialization of the compound.”

The licensing team at LVG will continue to pursue avenues to make the commercialization of Patel’s compound a reality.

Gary Koenig, Ph.D.
School of Engineering



IN SEPTEMBER 2016, Samsung issued a massive recall of the Galaxy Note 7 phone after a manufacturing defect caused the phones' batteries to generate excessive heat and catch fire. The exploding phone PR nightmare gave everyone who carries a cellphone reason to consider quality assurance in battery manufacturing.

Gary Koenig, Ph. D., assistant professor of chemical engineering at UVA, developed a new analytical tool for battery materials while researching an entirely different type of batteries known as flow batteries. Flow battery systems are massive in scale and hold and pump liquid acidic electrolytes between cell stacks to generate energy. The energy density in flow batteries is typically very low, so flow systems are best used for large-scale stationary applications such as storing energy from renewable sources, including wind or solar.

In studying an unusual type of flow battery that relies on solid particles, Koenig focused on how the size, shape, and aggregation of the particles affected the performance of the battery. To understand

the properties of the particles, his team developed a new technique to measure the resistance of the active material particles within an agitated fluid. It was discovered that the resistance measured using the technique also correlated to the electrochemical properties of the particles when they were used in conventional lithium-ion batteries—thus the technique used to develop an unusual type of flow battery could also be used to understand and predict the performance of conventional lithium-ion batteries used in laptops and cellphones.

This discovery prompted Koenig to pivot his flow battery project toward the development of a new tool for quality control analysis of lithium-ion batteries, in particular as a rapid method to assess the materials during manufacturing.

Quality control testing in lithium-ion batteries assesses each of the components that go into the final cell individually. Depending on how a battery manufacturing company is integrated, it can source different components of the battery from around the world. Upon arrival, each material requires quality control assurance before its assembly into a battery. Existing analytical tools can test for contaminant concentrations, water and carbon content, and particle size distribution in a matter of hours. What comes next in the testing process is where Koenig's discovery takes shape.

> **"Since I submitted my first invention disclosure in 2014, LVG has been a tremendous help in guiding me through the protection of intellectual property."**
>
> —Gary Koenig, Ph.D.

Battery cell stacks in Koenig's UVA lab

After the individual material components are validated, manufacturers must also verify the charge and discharge performance of the materials assembled into full battery test cells in a pilot run. Currently, this pilot testing before final production can take days if not weeks and is very expensive to complete, as it requires the fabrication of cells to test against the batteries in production. Furthermore, because this test evaluates all components, clear determination of where a defect occurs is challenging.

Koenig is working to further the development and understanding of his technique, called "dispersed particle resistance," or DPR, which evaluates only the active materials within lithium-ion batteries. This analysis exposes how materials within the battery react to each other and can illuminate what causes faulty cells. He is building a prototype device that would collect the same information garnered from the final product testing without the time-consuming steps of having to build and test full battery cells.

Adding the DPR assessment to the battery manufacturing quality control standards could eliminate or reduce the need to fabricate test cells, bringing the final product testing down from weeks or days to under 20 minutes. It also has the potential to significantly cut the cumulative loss and energy waste incurred during late-stage quality testing, not to mention brand-damaging product recalls on exploding phones.

After earning his Ph.D. at the University of Wisconsin, Koenig completed his post-doctoral training at one of the largest Department of Energy battery research groups in the country. He earned his first issued patent on a project during his postdoctoral training, and that experience encouraged him to engage with UVA LVG early on in his tenure as a UVA faculty member.

"Since I submitted my first invention disclosure in 2014, LVG has been a tremendous help in guiding me through the protection of intellectual property," says Koenig. "Throughout the evolution of my various research projects, LVG has pointed me toward other resources that I wouldn't have found elsewhere. Now, I'm working with Bob Creeden and his Darden fellows program to explore the possibility of launching a startup company."

As Koenig continues to refine his working prototype, LVG is protecting both the method and architecture of his DPR assessment technique while also exploring commercialization opportunities in battery and other material manufacturing.

Tim Showalter, M.D.
School of Medicine

MEDICINE OFTEN witnesses a frustrating paradox: The most innovative forms of treatment are available for patients, but scientific advancements are not simultaneously advancing the tools used to deliver them.

Tim Showalter, M.D., a radiation oncologist at the UVA Cancer Center, uses an image-guided radiation therapy treatment for cervical cancer patients that has a rudimentary applicator and accessories that have not evolved from their basic design for more than 60 years. A graduate of the UVA School of Medicine, Showalter returned to UVA in 2012. Soon after arriving, he had an idea that would make the procedure significantly more comfortable for his patients—and advance the field of radiation oncology.

Specializing in prostate and cervical cancer treatment, Showalter uses a radiation implant procedure known as brachytherapy, in which the radiation source is placed in or near the tumor, giving a high radiation dose to the tumor while reducing exposure in the surrounding healthy tissue. A specific type of brachytherapy, known as tandem and ovoid brachytherapy, is required in cervical

cancer treatment. Showalter executes this procedure over 200 times annually, more than any other radiation oncologist in the region.

Part of the procedure, conducted while the patient is awake, requires inserting packing material around the perimeter of the cervix in order stabilize the brachytherapy applicator and protect healthy tissue from the high-dose radiation. There are currently two commercially available options on the market. One involves manually loading gauze into the area using forceps, while the other involves a highly engineered balloon device that costs around $400 per use. A patient with locally advanced cervical cancer would receive a minimum of five tandem and ovoid brachytherapy treatments. Because the cost of the balloon device is the responsibility of the medical center, most clinicians end up using gauze as a less expensive option.

Showalter's solution, which would be more comfortable than gauze for patients, and more cost effective than the balloon device, is a self-expanding hydrogel that reacts and expands once inside the vagina. This material is similar to a spray foam, and it can create the necessary isolation while interacting and absorbing the radiation much more effectively than gauze.

Soon after conceiving this idea, even before finding a polymer chemistry collaborator, Showalter engaged with LVG to discuss the idea and to identify a commercialization pathway that would bring the hydrogel solution to market. His early engagement with LVG led him toward the 4-VA proof-of-concept grant program, which funded a collaboration for the creation of a hydrogel material with Tim Long, Ph.D., a chemist at Virginia Tech. Showalter's team includes his colleague Bruce Libby, Ph.D., a medical physicist in the UVA radiation oncology department who now co-leads clinical development efforts.

A second grant through the Ivy Foundation at UVA funded the design of a delivery system for the hydrogel and the evaluation of this approach in imaging phantoms and cadavers. Leveraging the LVG network, Showalter and his team connected with David Chen, program director for the Coulter Foundation, who shaped a team of UVA biomedical engineering students to build a prototype of a hydrogel delivery system.

"When I first met with Michael Straightiff, he was very supportive in helping make connections for me," Showalter said. "His introductions created our current network of people, all of whom have been instrumental in the development of this idea. As a clinician with limited experience in translational research, the resources and counsel from LVG have been incredibly valuable in helping me to understand how the process works."

Patent protection for both the hydrogel and the delivery device have been in progress at LVG since Showalter and his team submitted their first invention disclosure in 2013. LVG coordinates with Virginia Tech on the intellectual property protection and converted one of the provisional patents in July 2017.

Showalter's initiative in pursuit of this translational research project is rare among clinicians whose priority is patient care. While LVG has been a resource for him to facilitate the technology transfer process, his persistence and resourcefulness drive the creation of this medical device that could change the way radiation oncologists perform tandem and ovoid brachytherapy treatment.

"The available and archaic packing options are a huge personal frustration of mine and represent an area of clinical need in radiation oncology," says Showalter. "There is nobody in the region more familiar with this issue, and having this specialized knowledge comes with the responsibility of making this solution accessible through commercialization."

"As a clinician with limited experience in translational research, the resources and counsel from LVG have been incredibly valuable in helping me to understand how the process works."

—Tim Showalter, M.D.

Amy Mathers, M.D.
School of Medicine

AMY MATHERS, M.D., associate professor of medicine and pathology, Division of Infectious Disease and International Health at UVA, has been studying molecular epidemiology for more than 10 years. Her expertise in tracking bacterial DNA sequences has advanced the understanding of where antibiotic-resistant pathogens originate and how they spread in even the most sterile places, like hospitals.

Mathers arrived at UVA in 2006 for a fellowship in infectious disease and began studying the DNA signatures of antibiotic resistance genes to understand how they are shared between bacteria. During her fellowship, the team identified a gene of drug resistance that, when acquired by bacteria, becomes an antibiotic-destroying superbug. Superbugs pose a major threat because of how quickly they can move and cross over to different strains and species of bacteria. Another challenge to tracking superbugs is how they can be undetected in hospital and health care environments where patients are most susceptible to infections.

Determined to explain the resistance gene movement between bacteria and to understand and combat superbugs, Mathers trained at Oxford University in whole genome sequencing. When she returned to UVA, she used her broadened skillset to study how

other transmissions of infectious bacteria were happening within health care settings and learned that a minority of transmissions came from patient-to-patient contact.

This discovery led her to consider that the unaccounted for transmissions might be coming from the hospital environment, including sink drains and toilets present in the health care environment. Working with colleagues at several institutions, she has documented over 100 cases around the world since 2010.

To understand the dynamics of bacterial spread from hospital room sinks to patients, Mathers and her team built the only sink lab in the U.S., which is composed of 14 replica hospital sinks, to study the spread of drug-resistant bacteria from wastewater systems. A collaboration with the Biomedical Engineering Department facilitated a project for undergraduate students to build and test devices that could be used in the sink lab. The class, taught by Associate Professor of Biomedical Engineering Will Guilford, Ph.D., developed several devices that are now used in the lab to automate the sinks for various tests.

As active faculty researchers, Mathers and Guilford both engage with LVG regularly to keep the organization apprised of their progress. When their collaboration resulted in a student-designed device for the sink lab, LVG helped facilitate an invention disclosure to ensure the protection of the novel technology.

> **"I'm grateful to have LVG as a partner in helping navigate those [industry] requests, and I look to their expertise to help us identify commercialization opportunities for the lab."**
>
> —Amy Mathers, M.D.

Mathers swabs the U-pipe underneath a sink in the UVA sink lab.

With the assistance of another researcher on the team, Shireen Kotay, Ph.D., they used traceable strains of bacteria (E. coli) in the sink lab by colonizing samples in the U-pipe underneath the sink. Running water through the sinks indicated minimal bacteria growth, but they saw movement when the sinks were flushed with typical hospital waste like intravenous fluid and leftover beverages. Their findings, published in early 2017, indicated that nutrient-fed bacteria colonies grew up from the elbow of the drainpipe at an average rate of 1 inch per day, reaching the sink strainer where they can be further transmitted in just one week.

To better understand the role of the sink in transmission of antibiotic resistant bacteria, Mathers has received funding from the Centers for Disease Control and Prevention. She is working with collaborators at the University of British Columbia, Oxford University, and Public Health England to develop interventions that would mitigate the sink drain dispersion.

"You could say I have a bit of an entrepreneurial spirit," Mathers said. "Since we have created the sink lab, we've been getting attention from industry who have shown interest in understanding the design of the sinks or using it for various testing. I'm grateful to have LVG as a partner in helping navigate those requests, and I look to their expertise to help us identify commercialization opportunities for the lab."

Throughout her research, Mathers has collected an immense amount of data that she put to work in a collaborative Coulter Foundation funded project with the UVA Data Science Institute. The movement of bacteria within a hospital setting is extremely complicated to track because of how frequently patients are shuffled to different rooms to receive care. Mathers worked with colleagues to oversee the application of data science techniques to model patient geospatial movement to develop software that could be integrated into health system information technology. The initial software allows visualization of levels of surface cleanliness for each hospital room and informs health care workers, custodial staff, and infection preventionist specialists about areas where cleaning is inadequate as well as assist in hospital cleaning process improvement.

LVG is currently working to assess industry opportunities for the software and identify a third party that would be suited to utilize it in health care environments.

Michael Timko, Ph.D.
College of Arts & Sci

FOR MORE THAN 30 years, professor of biology Michael Timko, Ph.D., has been studying the functional genomics of plants at UVA.

He has conducted sponsored research ranging from the examination of photosynthetic efficiency of pine trees in the southern United States to enhancing the agronomic productivity and nutritional value of cowpeas in West Africa. His expertise in selectively manipulating cellular metabolism is highly valuable to his industrial partners in the plant and human therapeutics arenas. Timko's background led him to working on industrial hemp with 22nd Century Group, a New York-based plant biotechnology company specializing in the production of very low nicotine cigarettes and other smoking cessation devices.

When Timko entered into conversations with 22nd Century to conduct hemp research, he engaged with LVG to facilitate the funded research agreement. LVG collaborated with the UVA Office of Sponsored Programs during the contract negotiations and executed the exclusive license agreement that formed an integral part of the research agreement.

Timko's enthusiasm for industry-funded hemp research extends beyond his

ences

scientific expertise in plant biology to the potential for a hemp industry resurgence in the commonwealth of Virginia. The agreement with 22nd Century allowed him to acquire proprietary hemp seeds and germplasm from the company that will form the basis for generating hemp varieties uniquely adapted for growth in Virginia.

"In the 1800s, Virginia was a leading hemp producer, and we have lost generations of knowledge about growing and cultivating hemp for industrial and medical use," Timko said. "History shows us that the mid-Atlantic region is optimal for growing hemp, and we should be growing it here instead of importing it from overseas. Our goal is to generate elite varieties of hemp plants with commercially useful characteristics that would bring economic value to the commonwealth."

Industrial hemp is a distinct strain of the cannabis or marijuana species with low levels of the psychoactive agent tetrahydrocannabinol (THC). The average THC level in recreational marijuana available today is 18.7 percent whereas industrial hemp is only 0.3 percent. Industrial hemp has antimicrobial properties, making it extremely resistant to disease, and it suitable for producing items such as rope, clothing for mountaineering, and hempcrete for industrial purposes.

Industrial hemp plants in the UVA biology greenhouse

Companies, including Patagonia, are increasingly interested in the value of industrial hemp for clothing material production. As the United States is the only country that continues to classify hemp as a schedule 1 drug, the only current option is to import it from Canada and Europe. After the 2014 Farm Bill that allowed those with research permits to grow the plant, Timko received permits both from the Virginia Department of Agriculture & Consumer Services and the Drug Enforcement Administration, which allow him to work not only on the industrial and manufacturing aspects of the plant, but also on medically related uses. Thus, his work with 22nd Century Group also focuses on helping the company become a supplier of medicinally valuable hemp extracts for human therapeutics and nutritional purposes.

For example, Timko's hemp research also includes studying the cannabinoids that can be extracted from the plants for use in the treatment of patients with epilepsy and inflammatory diseases such as arthritis. UVA has the biggest epilepsy research center in the commonwealth, and Timko is collaborating with faculty in the Department of Pharmacology at the UVA School of Medicine to create different compositions of cannabinoids for various uses. The results could lead to drug development, allowing patients to receive the medicinal benefits of cannabinoids without the psychoactive side effects of recreational marijuana—a favorable alternative for pediatric patients.

> "Our goal is to generate elite varieties of hemp plants with commercially useful characteristics that would bring economic value to the commonwealth."
>
> —Michael Timko, Ph.D.

> **Engaging often with LVG helps maximize the opportunities available through my industry research agreement, and as they explore potential commercialization pathways, I can focus on advancing the research."**
>
> —Michael Timko, Ph.D.

Because much of the stigma associated with marijuana is the presence of psychoactive THC, one of Timko's research goals is to specifically manipulate the biochemistry of industrial hemp to create a zero percent THC strain, removing all psychoactive components while leaving the plant rich in cannabinoids with medicinal value. A THC-free strain would also be beneficial in creating a safe seed product with fat content suitable for animal and fish food. Although industrial hemp and recreational marijuana can be grown in the same or similar environments, this is never done, because growers want to avoid the risk of cross-pollination that would effectively ruin both crops.

"We are reaching a tipping point in the national conversation around marijuana, and I am excited about the prospect of what changing legislation could mean for industrial hemp," Timko said. "Engaging often with LVG helps maximize the opportunities available through my industry research agreement, and as they explore potential commercialization pathways, I can focus on advancing the research."

The LVG team, including those who hold Ph.D.s, J.D.s, and M.B.A.s, offers UVA faculty researchers like Timko resources at the intersection of science and industry. As the national landscape around marijuana evolves, LVG will work with Timko to ensure his research is positioned to generate economically valuable outcomes through commercialization.

Company Profile
Cerillo

IN THE HEART of every UVA research lab, students are working alongside faculty to advance ideas. Jason Papin, Ph.D., professor of biomedical engineering at UVA, runs the Computational Systems Biology Lab, where undergraduate, graduate, and postdoctoral fellows alike gain valuable lab experience working on projects that correlate to their classroom studies.

One of the projects in the Papin lab involved measuring the growth of specific bacteria under varying conditions and required the use of a plate reader. An expensive and large lab instrument, plate readers are used to detect and monitor changes in material samples. The extensive list of controls used in the project resulted in labor-intensive data collection for the postdoctoral student managing the study.

During 24/7 monitoring of the samples in the plate reader, a graduate student, Paul Jensen, now an assistant professor at the University of Illinois, had an idea for a more efficient way to execute massive data collection. Instead of altering the study, Jensen explored the possibility of redesigning the plate reader to accommodate a significant number of samples by shrinking the size of the instrument. That way, you could use multiple miniature plate readers as opposed to rotating the samples through a single, large plate reader.

The world's smallest multiwell plate reader, Cerillo's MiniReader

LVG licensed the intellectual property for the device to Cerillo to launch the company and has supported the team's efforts toward patenting the technology.

After preparing a prototype that was tested in the Papin lab, Jensen and Papin described the device to their close collaborator Erik L. Hewlett, M.D., at the time a professor of medicine and microbiology, who was the chair of the LVG Board of Directors. Hewlett tried the prototype in his lab and, at the same time, encouraged Jensen and Papin to disclose the idea to LVG in order to use the organization's resources to determine a commercialization path forward.

This idea developed in Papin's lab and was passed down to the students that followed Jensen after he graduated. These students furthered the technology through the NSS I-Corps program and were awarded translational research funding from the Coulter Foundation, which helped the team outsource part of the prototype design.

An undergraduate biomedical engineering student who was working in Papin's lab on the project stayed on after graduation as a lab technician to further develop the prototype of the device. That student was Kevin Seitter, who is now the chief engineer of Cerillo, a new venture that formed around the world's smallest multiwell plate reader.

LVG licensed the intellectual property for the device to Cerillo to launch the company and has supported the team's efforts toward patenting the technology.

The Cerillo team, including Papin, Hewlett, and Seitter, also employs two UVA biomedical engineering student interns, and their offices are located on Charlottesville's downtown mall. They have been awarded Small Business Innovation Research (SBIR) funding from the National Science Foundation, which was matched by the commonwealth of Virginia to encourage economic development. The team is using these resources to test the prototype and refine the software. They will pursue a Phase II SBIR grant to begin exploring manufacturing options for the device—the next step toward commercialization.

Company Profile
PorA Pharmaceuticals

IN 2008, Paul Hoffman, Ph.D., and Tim Macdonald, Ph.D., submitted an invention disclosure to LVG. Hoffman, professor of infectious disease at UVA and two-time winner of the Innovator of the Year Award, and Macdonald, professor of chemistry and pharmacology at UVA, had discovered a molecular compound that could target the *Clostridium difficile* infection (C. diff) and its recurrence.

After nearly 10 years of further research and development, their compound, known as Amixicile, has become the basis for launching PorA Pharmaceuticals. The company aims to advance Amixicile toward becoming a marketable drug for the treatment of C. diff.

C. diff is a bacteria predominantly contracted in hospitals and health care facilities that causes gastrointestinal infections in humans. In 2015, the Centers for Disease Control and Prevention reported 14,000 deaths in the U.S. associated with C. diff, resulting in more than $1 billion in excess medical costs. Current drug therapies available to treat C. diff are powerful broad-spectrum antibiotics that kill not only the infection but also the natural gut flora and probiotic bacteria, which can leave patients susceptible to recurring infections. Amixicile functions more selectively by inhibiting an essential enzyme found exclusively in anaerobic organisms, such as C. diff.

Throughout the development of Amixicile, LVG has pursued industry partners in the C. diff market to explore a licensing opportunity for the compound. Each discussion generated useful feedback for the scientists that helped guide their preclinical data collection studies. To execute those studies, Hoffman and Macdonald sought translational research funding and earned a grant from the National Center for Advancing Translational Sciences, a branch of the National Institutes of Health. Working closely with Hoffman and Macdonald, LVG also helped facilitate the patenting of the compounds. The scientists were awarded three U.S.-issued patents and two patents in Europe for the compounds.

While LVG continued to seek industry opportunities for the compound, Hoffman and Macdonald maximized all possible translational funding programs within the University ecosystem.

While LVG continued to seek industry opportunities for the compound, Hoffman and Macdonald maximized all possible translational funding programs within the University ecosystem. The possibility of launching a new venture around Amixicile entered the conversation, and LVG engaged its network to identify leadership for the potential company that would become PorA Pharmaceuticals.

John McCray, an experienced entrepreneur in the biopharmaceutical industry and chief business officer for another UVA startup, Cavion, expressed interest in the technology. He lent his expertise to the team and helped recruit Gary Cupit, the current CEO of PorA Pharmaceuticals. Cupit brings more than 40 years of leadership and operational experience in the pharmaceutical and health care industries to the company.

The alignment of exceptional leadership, the composition of matter on the compound, and an attractive preclinical package were optimal elements to launch the new venture. Today, PorA Pharmaceuticals continues to pursue preclinical trials and is currently raising funds to execute a Phase 1 trial.

UVA LVG Seed Fund

Message from the Managing Director

IT HAS BEEN an energizing and productive launch for the UVA LVG Seed Fund. I am pleased to share with you some of our achievements, along with a look ahead to the next 12 months.

Our first year focused on three goals:

- Make strategic investments
- Implement our internal evaluation process and work closely with the Seed Fund Committee
- Conduct outreach to university innovators, the Charlottesville community and potential co-investors in the venture industry

I am happy to report that we made significant progress in all areas. We closed on two investments and made a commitment to a third at the start of the new fiscal year. TypeZero Technologies, Inc. received the Fund's first investment. The company's inControl software platform includes advisory applications for smart insulin pens and smartphone-based artificial pancreas systems that automatically regulate insulin delivery, reduce hypoglycemia and improve blood glucose levels, thereby reducing the device burden faced by diabetics.

Our second investment addresses a chronic condition affecting many of us—dry eye. TearSolutions, Inc. was founded based on innovation from the lab of Dr. Gordon Laurie at UVA to treat dry-eye and specifically Sjogren's Syndrome. With funding from the National Eye Institute, Dr. Laurie has been working on dry-eye research for more than 15 years and a few years ago discovered a protein in the eye called Lacritin. From this, he developed a synthetic protein to be used as a treatment and co-founded the company with Mark Logan, former CEO of VISX. Together they raised a Series A round and completed pre-clinical studies. Tear Solutions is currently in a Phase I/II trial in 26 sites across the U.S.

One of the most enjoyable components of my role is my interaction with our Seed Fund Committee. Comprised of active, experienced venture capital investors, this group has added significant value by supporting our efforts both pre- and post-investment as well as challenging us to conduct quality diligence on our investment opportunities.

We have been active on Grounds, interfacing with faculty and other commercialization teams at the iLab, Coulter Foundation, and Ivy Foundation, as well as the entrepreneurial innovation groups at each of the schools here at UVA.

Early last year, we began a collaboration with the Darden Business School of Business. What started as extracurricular work has evolved into a full-year course known as Due Diligence in Seed Funds, where we are fortunate to have 10 second-year students filling the role of associates assisting in diligence and supporting our portfolio companies. The course has become popular with more than 30 applications for the most recent 10 spots in the class. The students have made valuable contributions to the Fund, and we look forward to a continuing, mutually beneficial relationship with Darden.

Looking ahead to the next year, we will continue to invest and have already closed one deal and committed to another. With the portfolio and pipeline growing, we have brought on a full time associate, Carleen Bowers, Ph.D. and look to formalize our Advisory Board of successful entrepreneurs to fill roles as coaches, mentors, and potentially managers of our new companies.

We are off to a great start and are well positioned to meet the challenges of sustaining and expanding our progress. I am honored and excited to be part of the LVG team and look forward to working with them, our Seed Fund Committee, Darden students, and Carleen to continue achieving success.

Robert J. Creeden
Managing Director of the UVA LVG Seed Fund & New Ventures

Seed Fund Overview

About the UVA LVG Seed Fund

THE UVA LVG SEED FUND, created in 2016 with funding from the UVA Health System and unrestricted private funds aligns with the second pillar of the UVA Cornerstone Plan to advance knowledge and serve the public through research, scholarship, arts, and innovation.

Objectives

THE UVA LVG SEED FUND is intended to complement the high caliber of research conducted at the University, be capable of generating significant financial returns, and be diversified in supporting a broad range of innovation assets developed at UVA. Structured within the UVA Licensing & Ventures Group (LVG), the organization responsible for the commercialization of University research discoveries, the $10 million UVA LVG Seed Fund is uniquely positioned to provide capital and other resources to accelerate technologies based on UVA research to market. An independent committee comprised of leaders in early-stage investing and new venture creation who are all UVA alum oversee each investment decision. The Fund practices an industry-proven due diligence process to assess the commercialization viability of each opportunity.

Investment Eligibility

THE UVA LVG SEED FUND will invest in companies founded to commercialize UVA intellectual property; companies founded by current faculty, staff, and students at UVA; and iLab companies. In special cases, the UVA LVG Seed Fund may invest in development of innovation assets to improve or enhance the commercial viability, value, or marketability.

> “We are off to a great start and are well positioned to meet the challenge of sustaining and expanding our progress.”
>
> —Robert J. Creeden

Portfolio Companies

Mission Secure, Inc. (MSi)

THE UVA LVG SEED FUND invested in Mission Secure (MSi) as part of the company's largest financing round to date. Headquartered in Charlottesville, MSi was founded on technology developed at UVA and licensed from LVG. The company creates cybersecurity solutions that not only make systems more complex and costly to attack but also takes corrective action against cyber-attacks.

The Department of Defense funded the initial research conducted by MSi's founders, which sought to develop onboard protection mechanisms for unmanned aerial vehicles. The prototype created at UVA evolved into the now patented "MSi Platform," which is used to mitigate cyber-attacks from within operational software. The platform provides monitoring, detection, and corrective capabilities spanning the oil and gas, power, transportation, and defense industries.

TearSolutions, Inc.

THE UVA LVG SEED FUND invested in TearSolutions, Inc. as part of a $3 million funding that helped the company launch its next phase of clinical testing. Discovered by UVA Professor of Cell Biology and Ophthalmology Gordon Laurie, M.D., TearSolutions' first-in-class therapy is a synthetic form of the protein lacritin, which targets the causes of dry eye.

The company is currently conducting Phase II clinical trials, focusing efforts on patients affected by Primary Sjogren's Syndrome, an autoimmune disorder that causes dry eye and dry mouth. These trials will be the first in humans with 200 patients over 26 sites nationwide—all the preceding work in pre-clinical animal studies showed that the drug is effective and appears safe and well tolerated.

TearSolutions, Inc. was founded in 2013 by Dr. Laurie and Mark Logan, a former company executive from Bausch & Lomb, Becton Dickinson, and VISX, after licensing the technology from LVG.

TypeZero Technologies, Inc.

THE UVA LVG SEED FUND made its first investment in TypeZero Technologies, Inc. as part of a $1.5 million funding round. Headquartered in Charlottesville with 15 employees, TypeZero is a digital health company revolutionizing the management of Type 1 and Type 2 diabetes.

In 2014, TypeZero licensed artificial pancreas intellectual property from LVG that was developed by a research team at the UVA Center for Diabetes Technology. Using these foundational technologies, TypeZero built the inControl Diabetes Management Platform, which includes applications for smart insulin pens and smartphone-based artificial pancreas systems that automatically regulate insulin delivery, reduce hypoglycemia, and improve blood glucose levels. The company's clinical trials are ongoing, and TypeZero has licensed its technologies to two medical technology companies in pursuit of the commercialization of the artificial pancreas system.

Seed Fund Committee

Gerry Brunk
Managing Director, Lumira Capital

Jonathan Ebinger
General Partner, Blue Run Ventures

Peter M. Grant II
Partner, Anchormarck Holdings

Dayna Grayson
Partner, New Enterprise Associates

Rob Paull
Co-Founder, Partner, Lux Capital

Melur K. (Ram) Ramasubramanian
Vice President for Research, UVA
(ex-officio)

Dr. Richard Shannon
EVP UVA Health Affairs
(ex-officio)

Darden Fellows Program

Second-year Darden M.B.A. students in the LVG conference room

> The greatest benefit [of taking the course] is listening to Bob pitch the committee, comprised of top-tier venture capitalists in the industry. Hearing what they look for in companies and the approach they take to investing is something I could not learn in a classroom."
>
> —UVA Darden School of Business Graduate, Class of 2017

University of Virginia Darden School of Business Directed Study: Due Diligence in Seed Funds

DUE DILIGENCE in Seed Funds is now in its second year as an elective course in the entrepreneurship, innovation, and strategy discipline of Darden's M.B.A. curriculum. The overwhelming success and positive feedback from the pilot Spring 2017 course ignited plans to expand it to a two-part offering spanning the entire school year.

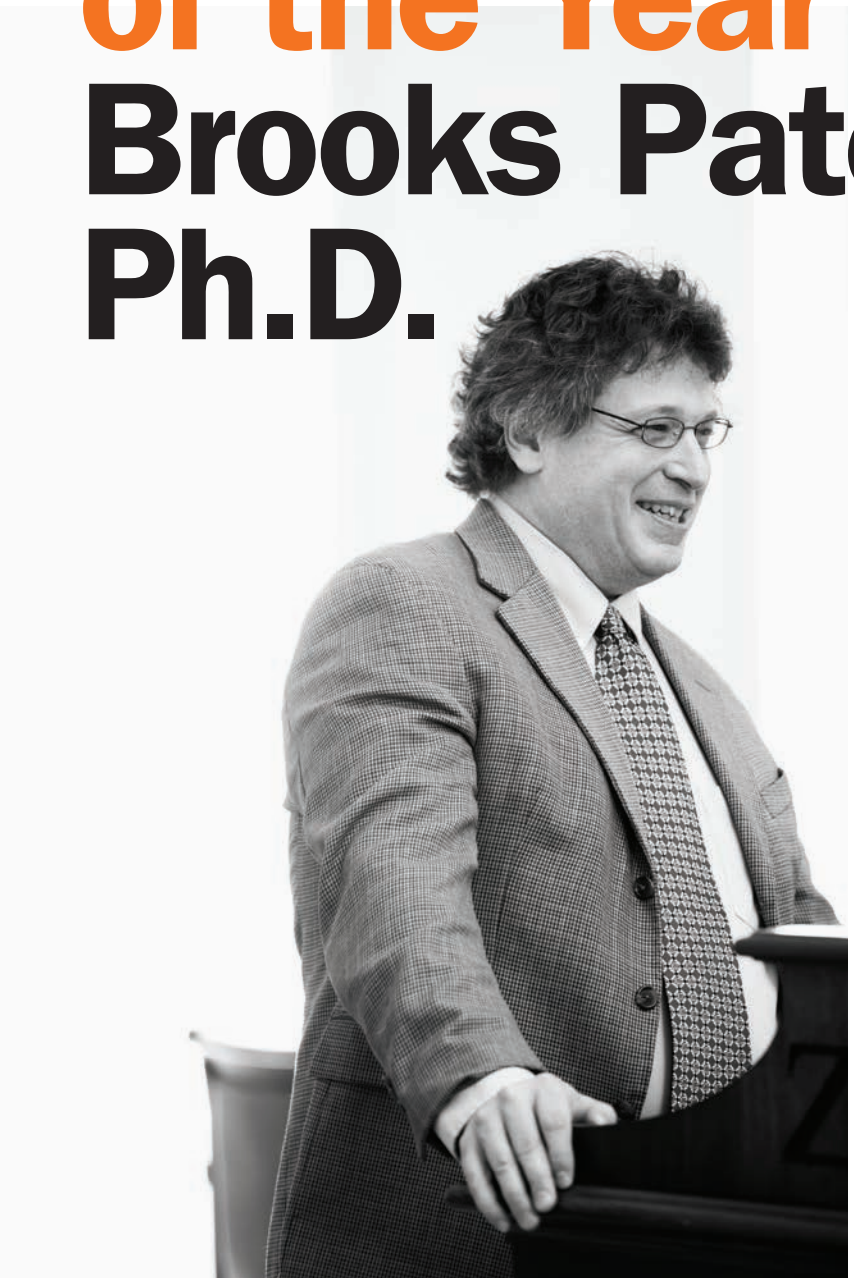
Led by LVG's Managing Director of the UVA LVG Seed Fund & New Ventures Bob Creeden, the course offers second-year business students the opportunity to actively learn about venture capital from experts in the field. The class provides a hands-on experience similar to that of an associate at a traditional venture fund.

Using real examples, Creeden teaches an industry proven due diligence process to assess the viability of investments under consideration of the UVA LVG Seed Fund. On Wednesday evenings, the students fill the LVG conference room to discuss company evaluations and sit in on company pitches to the Fund and to the Fund's investment committee.

Ten second-year students per semester earn spots in the class based on their course applications, resumes, and an in-person interview.

Innovator of the Year

Innovator of the Year Brooks Pate, Ph.D.



Celebrating impact through innovation: The Edlich-Henderson Innovator of the Year Award
May 15, 2017 | *UVA Today* |
By Katie McNally

THE HIGHEST HONOR bestowed on University of Virginia innovators, the Edlich-Henderson Innovator of the Year award recognizes an individual or team each year whose research discovery is making a major impact.

Named for UVA Professor Emeritus Dr. Richard F. Edlich and Christopher J. ("Goose") Henderson, a 25-year veteran of privately owned financial services businesses, the award is a tribute to their enduring support of and commitment to the University and its innovators.

In 2012, the award title and criteria were modified to be more inclusive of University innovators pursuing a variety of different paths to achieve impact for their discoveries. Eligible nominees are current University of Virginia faculty, staff, or students whose research discoveries are making a major impact. Prior to 2012, the award was known as the Edlich-Henderson Inventor of the Year award. Award winners receive a $10,000 cash prize and formal recognition at a special awards reception.

ALTHOUGH HE'S earned many titles and honors for his advancements in molecular research, Brooks Pate sees himself first as a citizen-scientist. The University of Virginia's William R. Kenan Jr. Professor of Chemistry is committed to conducting basic research for the public good.

Pate and his research team are most known for developing a new method for rapid molecular analysis called "chirped pulse Fourier transform molecular rotational resonance." It shortened the standard time for molecular analysis from days or weeks to mere minutes. This analytical ability is opening new doors in everything from pharmaceutical research to the study of interstellar matter.

After its creation, Pate worked with the UVA Licensing & Ventures Group to license the technique to the Charlottesville startup BrightSpec, which began developing it for wider commercial use.

In recognition of this work and his commitment to research for public benefit, the Licensing & Ventures Group named Pate the 2017 Edlich-Henderson Innovator of the Year.

"Brooks is a prolific innovator, a leader in his field and a standout entrepreneur," said Michael P. Straightiff, the group's executive director. "We are thrilled to be recognizing such an accomplished scholar and we cannot wait to hear what he will discover next."

> "Brooks is a prolific inventor, a leader in his field and a standout entrepreneur."
>
> —Michael Straightiff

Before the award was presented Thursday, UVA Today spoke with Pate to find out more about his research and how he views scientific research as a civic duty.

Q. What is the focus of your research?

The field I'm in is physical chemistry. It's about trying to make sure we quantitatively know what structures of molecules are and how those molecules react to form new molecules.

A lot of what we do is look at areas where theory is on the forefront, where they're really developing new tools to predict the behavior of molecules and matter and then look at what needs to happen in the lab to provide test data to make sure that theory is on an accurate path.

Our side of it — although I have worked a little bit on the theory side — has really been creating new scientific instruments to advance molecular measurement in larger, more complicated systems. That's always been the challenge for us — the basic science pursuit of how to advance the firm understanding of the way molecules behave.

Q. What are some examples of how that molecular measurement is used?

We really are focused on extending the applications of our technique towards chirality issues.

The chirality of a molecule refers to a subtle difference in geometry. For example, two chiral glucose molecules are made up of the same number of carbon, hydrogen and oxygen atoms and have the same distances and angles between these atoms, but they are structured as mirror images of each other, not exact copies. One is "left-handed" and one is "right-handed." Chemical reactions within the human body can be different depending on whether the molecule is left-handed or right-handed and that difference is important for the efficacy and safety of new drugs.

My field of physical chemistry has produced the first new approach in well over a decade to measure the handedness of molecules. We are developing technology for chiral analysis and know already that this has important applications for the development and production of pharmaceuticals.

Q. What do you believe are the largest challenges facing modern scientific research?

I've become concerned that not enough people understand the social contract scientists have in this country. The idea of that contract goes back to a very famous document called "Science: The Endless Frontier," commissioned by President Roosevelt and written by Vannevar Bush. It came out just after World

War II and Bush's argument is that basic research builds knowledge that enables large advances in technology and spurs the creation of jobs, improves health and makes it possible to create products in less time. For that reason, he argues, it is important that the public invest in basic research. This report led to the creation of the National Science Foundation — the agency that has supported the instrument development work in my laboratory.

Pate was named 2017 Edlich-Henderson Innovator of the Year in recognition of the advances he's made in molecular analysis.

Prior to World War II, there was very little public funding of basic research. That document set out the pact to support it. Essentially that pact is, "We — the public — will pay the scientists to do the work the scientists want to do because we think it's going to have an impact on society. In exchange, when the scientists discover something, it's their responsibility as a scientist to bring that out and commercialize it." That model is really important to how we think about science, so I'm happy that my work follows this vision of basic research advancing the public good.

It's not always easy to explain to people what I do in my lab and why they should care, but this pact is why. My research has broad applications and what can come out of it are advancements like the techniques we helped uncover to create more effective pharmaceuticals.

Q. How do you bring this scientific pact into the classroom?

I try to make students understand that it's fine to pursue basic research — it's the most fun thing you can do if you're of that mindset of just solving problems every day — but you have to understand the contract you have with the public to get that information out in some form. That may be through education or by making sure that new innovations are brought to the public market — that involves working with places like the UVA Licensing & Ventures Group to protect intellectual property and help spur further development.

I also come from a family of public servants. My father worked for the National Security Agency, he was a career public servant, and my mother was a public school teacher. I was raised in the environment that having a job that helps your fellow citizens is a privilege and you need to do it as well as possible. So I try to pass on that mindset to my students, both at the undergraduate and graduate level.

I tell them, "Your country is investing in you now so that eventually you can help your fellow citizens and humanity more broadly."

"Scientists have a responsibility to the public to make their research discoveries known. That may be through education, or by making sure that new innovations are brought to the public market — that involves working with places like the UVA Licensing & Ventures Group to protect intellectual property and help spur further development."

–Brooks Pate, Ph.D.

Previous Winners

2016 John A. Hossack, Ph.D.
N. Scott Barker, Ph.D.
Arthur W. Lichtenberger, Ph.D.
Robert M. Weikle II, Ph.D.

2015 Benton H. Calhoun, Ph.D.
James A. Smith, Ph.D.

2014 J. Randall Moorman, M.D.
Douglas E. Lake, Ph.D.

2013 Marcia A. Invernizzi, Ph.D.

2012 Robin A. Felder, Ph.D.

2011 Boris P. Kovatchev, Ph.D.

2010 Kevin R. Lynch, Ph.D.
Timothy L. Macdonald, Ph.D.

2009 John P. Mugler, Ph.D.
James R. Brookeman, Ph.D.

2008 George T. Rodeheaver, Ph.D.

2007 Wladek Minor, Ph.D.

2006 George T. Gillies, Ph.D.

2005 Benjamin M. Gaston, M.D.
John F. Hunt, Ph.D.

2004 Haydn N.G. Wadley, Ph.D.

2003 William A. Petri Jr., M.D., Ph.D.
Barbara J. Mann, Ph.D.

2002 Joel M. Linden, Ph.D.

2001 Doris Kuhlmann-Wilsdorf, Ph.D.

2000 Ronald P. Taylor, Ph.D.

1999 John C. Herr, Ph.D.

1997 Richard L. Guerrant, M.D.
Timothy L. Macdonald, Ph.D.

1996 Jessica J. Brand
Patrice G. Guyenet, Ph.D.
Richard D. Pearson, M.D.
Janine C. Jagger, Ph.D.

1995 Donald F. Hunt, Ph.D.
Jeffrey Shabanowitz, Ph.D.
George C. Stafford Jr., Ph.D

1994 Gerald L. Mandell, M.D.
Gail W. Sullivan

1993 Joseph Larner, M.D., Ph.D.

1992 Robert M. Berne, M.D.
Luiz Belardinelli, M.D.
Rafael Rubio, Ph.D.

LVG Staff

Leadership

Michael P. Straightiff
Executive Director

Patrick J. Klepcyk
Director, Licensing

Claudine R. Wispelwey
Director, Operations

UVA LVG Seed Fund & New Ventures

Robert J. Creeden
Managing Director, UVA LVG Seed Fund & New Ventures

Carleen M. Bowers, Ph.D.
Venture Associate

Licensing

Joshua P. Mauldin, Ph.D.
Licensing Manager

Marc Oettinger
Licensing Manager

Hui Wang, Ph.D.
Licensing Analyst

Heather M. Bansbach, Ph.D.
Licensing Analyst

Cortney L. Armstrong, Ph.D.
Licensing Analyst

Legal

Robert J. Decker, J.D.
Senior Patent & General Counsel

Rodney L. Sparks Ph.D., J.D.
Senior Biotechnology Patent Counsel

G. Eden Para
Senior Patent Paralegal

Kathleen A. Moore
Legal Assistant

LVG licensing team working alongside UVA faculty member

Operations

Melissa T. Newman
Executive Assistant to Michael P. Straightiff and Office Manager

Lindsay M. Clark
Manager, Financial Operations

A. Michael Koch
Information Manager

Megan K. Reidy
Manager, Strategic Communications

Noteworthy

Annual Report Photography Credit: Stephanie Gross, Susan Parmar

Pamela Norris, Ph.D., executive associate dean for research, School of Engineering and Applied Science, was appointed to the **LVG Board of Directors** in October 2016.

Mission Secure, Inc. (MSi) awarded patent for MSi Platform in July 2017. The patent covers core control system cybersecurity features and functionality in the patented MSi Platform such as monitoring and detecting anomalous behavior and corrective action capabilities. The patent also includes novel, low-level digital and analog signal analytic capabilities. These non IP-based communication analytic capabilities are paramount for trusted analysis of underlying control system processes to understand the true operational state, recognize cyber events, mechanical failures, and more.

MSi completed fourth and largest successful financing round in August 2017.

TECHLAB® receives FDA 510(k) clearance to market TRI-COMBO PARASITE SCREEN TM to aid clinician in the diagnosis of giardiasis, cryptosporidiosis, and amebiasis in July 2017.

TECHLAB® receives USDA establishment license and product license for GIARDIA VET CHECK TM in November 2017.

BrightSpec, Inc., the molecular rotational resonance (MRR) spectroscopy company, announced the appointment of Cornes Technologies of Japan as exclusive distributor for Japan in August 2017. BrightSpec is the first company to bring to market a line of spectrometers for trace level chemical analysis using Fourier transform molecular rotational resonance (FT-MRR) spectroscopy. The result is fast, direct quantitation of components in chemical mixtures, without the need for chromatography or difficult chemometrics. FT-MRR enables continuous monitoring of chemical processes, including chiral and structural analyses, as well as small volatile compounds that can be difficult to measure in a mixture.

UVA chemist **Ken Hsu** won a $600,000 career development award in October 2017 from the U.S. Department of Defense to pursue an innovative approach to using the body's immune system to kill melanoma cells.

Takeda and **HemoShear Therapeutics** entered into an exclusive drug discovery partnership in liver diseases in October 2017. The agreement combines HemoShear's REVEAL-TxTM platform with Takeda's drug discovery development capabilities.

22nd Century Group, Inc., a plant biotechnology company focused on tobacco harm reduction and cannabis research, announced in October 2017 that the Company and the University of Virginia completed their first successful harvest of hemp plants and identified several promising hemp varieties that could form the foundation for commercial hemp production throughout the legacy tobacco belt region of the United States.

TearSolutions, Inc. completed $8.5 million successful Series B Financing in December 2017. Proceeds will be used to advance LacripepTM, a novel replacement therapy for dry eye disease, through its ongoing Phase I/II clinical trial.

TypeZero Technologies, Inc. Tandem Diabetes Care Reports Successful Completion of First Pilot Study Using t:slim X2 Insulin Pump with TypeZero Hybrid Closed Loop Technology and Dexcom G6 Integration; Confirms IDCL Multi-site Study Timeline.

Cellnovo acquires commercial license for artificial pancreas technology from **TypeZero Technologies, Inc.** in April 2017. The

LVG team engaging in discussion

license purchased for the integration and the commercialization of TypeZero's Artificial Pancreas (AP) technology into Cellnovo's mobile diabetes management system. The non-exclusive worldwide agreement allows Cellnovo to commercialize a Cellnovo-TypeZero product in the future.

Senseonics Holdings, Inc. (SENS), a medical technology company focused on the development and commercialization of Eversense®, a long-term, implantable continuous glucose monitoring (CGM) system for people with diabetes, and **TypeZero Technologies, Inc.**, a personalized diabetes management company, announced the signing of a research and development license agreement to develop artificial pancreas and decision support systems that use the Eversense CGM System.

Cavion, Inc., a clinical stage biopharmaceutical company, appointed Dr. Spyridon "Spyros" Papapetropoulos as executive vice president, research and development and chief medical officer in, August 2017. He will lead Cavion's research and development organization to advance therapies based on the company's T-type calcium channel (Cav3) platform.

PsiKick raised $7.3 million in financing from an undisclosed investor in October 2017. Psikick develops next-generation, self-powered, wireless sensing systems built upon its ultra-low power circuit design.

The **UVA LVG Seed Fund** hired an associate, Carleen Bowers, Ph.D., in January 2018 to assist with identifying new ventures and investment opportunities.

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