ANNUAL REPORT

Bringing Ideas to Life

TechTransfer and Ventures

23

VCU Research

Bringing Ideas to Life

23 Annual Report

Mission

Our mission is to facilitate commercialization of university inventions for the benefit of the public, to foster a culture of innovation and entrepreneurship at the university, and to promote industry collaborations and new venture creation.

COVER PHOTO: *BROAD SPECTRUM NANO-ANTENNA*

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An UNbelievable year that was all part of the plan

The results are in. They are phenomenal. And as importantly, they are intentional.

At no other time in VCU's history have our researchers and trainees been more widely recognized for their contributions to transformative innovation across the sciences, the arts and the humanities, healthcare, engineering and mathematics.

And this was all part of our plan — specifically, the One VCU Research Strategic Priorities Plan. It is a multi-year effort to ensure VCU stands at the forefront of innovation through collaboration across traditional boundaries, advancing human knowledge and improving and saving lives — while tackling society's grand challenges.

We are delivering that plan to the global stage.

In the past year, VCU achieved a record $464.6 million in sponsored research, up 71% since 2018. We were named the No. 47 public research university by the National Science Foundation, and in the top 100 for utility patents by the National Academy of Inventors. And VCU secured a top 20 ranking as one of the nation's most innovative public universities from U.S. News and World Report.

This fall, Richmond was also named by the White House as one of 31 "Tech Hubs" across the nation, with our region focused on advanced pharmaceutical manufacturing. Much of that activity is centered on the VCU Medicines for All Institute. Such examples are a direct reflection of how far we have come, who we are as an institution and how we achieve impact.

VCU TechTransfer and Ventures is responsible for taking innovations from the labs and translating them into real-world applications that improve the world. In 2023, we executed a record 29 new licenses, filed 165 patents and generated close to $3 million in licensing revenue. Many more licensing deals are in the pipeline that could someday see VCU research incorporated into a range of applications across medicine, pharmaceuticals, engineering, humanities and more.

Our team is also responsible for supporting startups born from VCU intellectual property and executed 12 licenses to startups this year alone. And we have built up an entrepreneur-in-residence program that puts seasoned executives directly in front of entrepreneurial researchers and keeps them on a path to success.

On these pages, we invite you to meet a diverse array of Rams who wear many hats — as researchers, professors, trainees and company founders.

While our success is welcomed and intended as part of our plans, there is no way we could have predicted the innovative technologies that VCU has developed in recent years. Our researchers are the ones who make VCU's achievements possible and are the reasons why our university and region's potential is truly **UNlimited**.

With sincere gratitude,

P. Srirama Rao, Ph.D.
Vice President for Research and Innovation

Ivelina Metcheva, Ph.D., MBA
Assistant Vice President for Innovation

23 FISCAL YEAR AT A GLANCE

DEPARTMENTS WITH 10 OR MORE INVENTION DISCLOSURES

- **19** Biochemistry and Molecular Biology
- **17** Pharmaceutics
- **12** Medicinal Chemistry
- **10** Mechanical and Nuclear Engineering

DEPARTMENTS WITH FIVE TO NINE INVENTION DISCLOSURES

- **8** Biomedical Engineering
- **8** Internal Medicine
- **8** Human and Molecular Genetics
- **6** Microbiology and Immunology
- **6** Chemistry
- **5** Computer Science
- **5** Physics
- **5** Surgery
- **5** Chemical and Life Science Engineering

Distribution of Invention Disclosures (by School/College)

Medicine	54
Pharmacy	21
Engineering	15
Humanities & Sciences	11
Dentistry	2
Social Work	2
The Arts	2
Nursing	1
Other	1
Health Sciences	1

126 Invention Disclosures

165 Patents Filed

118 Industry Engagements

29 Options/ Licenses

26 Patents Issued

$3M Licensing Revenues

12 Licenses to startups

17 Copyrights & Trademarks

Photo: Clement Britt

P. Srirama Rao, Ph.D., vice president for research and innovation; Curtis N. Sessler, M.D., the Orhan Muren Distinguished Professor in the Department of Internal Medicine at the School of Medicine; Ivelina Metcheva, Ph.D., assistant vice president for innovation at VCU TechTransfer and Ventures; and Joseph Benevento, Virginia deputy secretary of commerce and trade and interim CEO of the Virginia Innovation Partnership Corp., at the Innovator of the Year ceremony at the Virginia Museum of the Fine Arts in November 2023.

The 2023 Billy R. Martin Innovator of the Year

Found by chance, created by collaboration

VCU's 2023 Innovator of the Year led a team to create a scale used in ICUs worldwide

Serendipity. A deliberate approach. And more than two decades since its creation, a meme.

It's the story of the Richmond Agitation-Sedation Scale — the RASS. Used primarily by intensive-care unit clinicians and researchers, but with the same idea as the patient-friendly Wong-Baker FACES pain scale, the RASS has been trusted worldwide for 22 years to describe an ICU patient's level of alertness or agitation.

"We wanted to understand the consciousness of our ICU patients for a research project, and we looked at what was available in terms of existing scales and decided that none of them were really what we were looking for," says Curtis N. Sessler, M.D., the Orhan Muren Distinguished Professor in the Department of Internal Medicine at the VCU School of Medicine. "So we created our own."

When developing the scale more than two decades ago, Sessler and his team were deliberate about collaborating with other ICU providers to ensure whatever they made would be of value for a range of users. "It was important that not only doctors participate in creating this scale, but nurses, pharmacists and everybody who works in the care of the patient," he says.

For his and his team's work to create the scale, made available in 2002, Sessler was named the 2023 Billy R. Martin VCU Innovator of the Year.

The RASS is an assessment tool, as well as a communication method that offers a single number that corresponds to the patient condition, giving ICU providers consistency. The scale is used millions of times a year, mostly referenced for mechanically ventilated patients in order to avoid over- or under-sedating. Excessive sedation, for example, can delay a patient's recovery, while under-sedation may leave a person in discomfort.

The RASS was copyrighted and protected by VCU TechTransfer and Ventures. Terms allow for the scale's free use by health systems, clinicians and researchers (it is easily found online). Pharmaceutical companies must license the scale for use in clinical trials.

RASS has been translated into numerous languages, and Sessler is surprised at where it has wound up. ICU nurses have created badge reels, buttons and T-shirts with the phrase, "Calm Your RASS Down!" for sale on sites such as Amazon and Etsy. "ICU nurses have a great sense of humor," he says. "I've enjoyed hearing from people around the world with their interest in RASS, and their clever ideas to incorporate it into their research and patient care. It's rewarding."

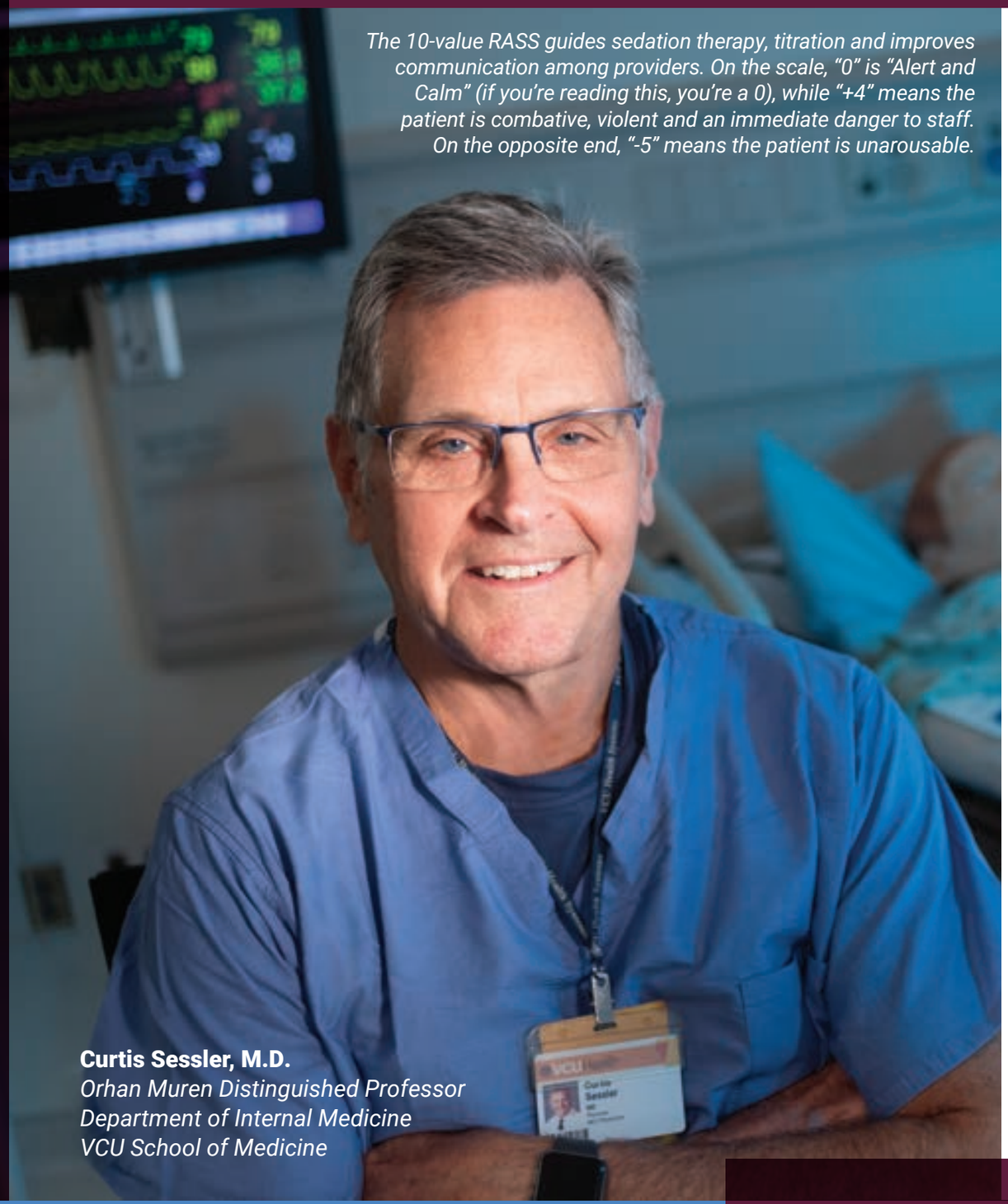
Even more, he said, is the satisfaction of knowing the scale that a VCU team created helps sick ICU patients become a bit more comfortable and recover faster.

Sessler's advice to others who have a potential innovation to explore: "Build a good team to look at the idea from all angles, make it practical and easy to use and rigorously test it in different populations to confirm it does what you intend it to."

He has a patent on another product related to airways, and isn't ruling out someday inventing something else. Up first though? Spoiling grandkids in retirement, which began on New Year's Day 2024.

"Dr. Sessler shows that research and innovation at VCU doesn't have to take place in a laboratory — it just takes intuition and an understanding of your market or your specialty. Practicing physicians are hands-on, know their world well, and can develop new ideas to address unmet needs in clinical care."

Ivelina Metcheva, Ph.D.
Assistant Vice President for Innovation
VCU TechTransfer and Ventures

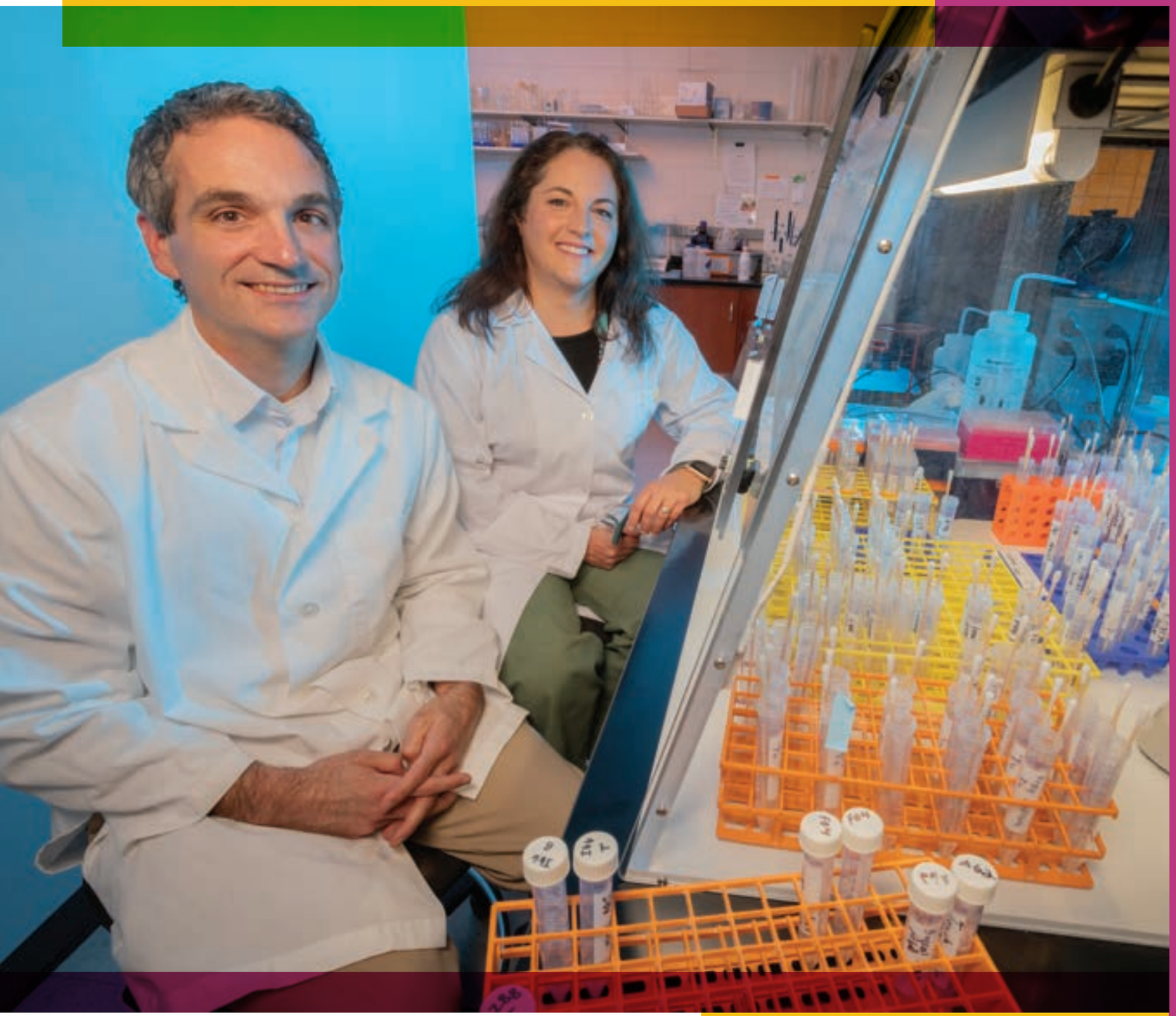


The 10-value RASS guides sedation therapy, titration and improves communication among providers. On the scale, "0" is "Alert and Calm" (if you're reading this, you're a 0), while "+4" means the patient is combative, violent and an immediate danger to staff. On the opposite end, "-5" means the patient is unarousable.

Curtis Sessler, M.D.
Orhan Muren Distinguished Professor
Department of Internal Medicine
VCU School of Medicine

"Forensics as a scientific field is constantly evolving with so many new developments even in the last 20 years. So many things you work on in forensics have the potential to change the field. That is really appealing to me."

Christhopher Ehrhardt, Ph.D.
Associate Professor, Department of Forensic Science
College of Humanities and Sciences



Diving deeper into new frontiers of forensic biology

Figuring out whose DNA is found at the scene of a crime is a routine task for crime labs.

But what kind of tissue is the source of that DNA? And how long has it been there?

That's more difficult to determine. And courts that have historically focused on the "who" increasingly care about the "what" and "how."

"Crime labs have the equipment to test DNA, but their technology unfortunately leaves judges and juries' questions about the circumstances of its deposition unanswered," explains Kate Philpott, a Virginia-based scientific and legal consultant and affiliate faculty in the Department of Forensic Science.

There, she's worked for nearly a decade with forensics professor Christopher Ehrhardt, Ph.D., developing a technology to analyze "non-genetic attributes" of cells within forensic evidence. They hope to bridge the current gap in knowledge about biological evidence found at crime scenes.

Those unknowns — sample age, where it came from — often create a gray area where factfinders are essentially left to guess about the reliability of critical elements of allegations. It's a particular problem, given prosecutors bear the burden of proving their case beyond a reasonable doubt, Philpott says.

To uncover those answers, the pair are researching applications of flow cytometry, a technique that analyzes fluorescent and scattered light signals produced by cells and particles as they flow past a laser beam. The signals are analyzed through machine-learning algorithms that compare the properties to a database of cells where factors like age, tissue source or the presence of environmental compounds are known. The aim is for the software to differentiate cells of unknown origin.

Ehrhardt is the co-founder of a company, Rapid Forensic Cell Typing, that is exploring real-world use of the technology in the legal system. RFCT's technology is used to provide information about biological samples before time-consuming and expensive DNA testing is performed.

"It will allow forensic labs to quickly determine the value of a sample before it gets to DNA profiling, which can make crime labs more efficient and reduce delays in the legal system," says Ehrhardt, whose lab is housed at the VCU College of Humanities and Sciences.

Philpott notes their work could also address two societal issues within the justice system: An individual's constitutional right to a speedy trial, and inherent human biases in law enforcement when gathering and processing evidence. Backlogs in processing DNA evidence can lead to extended jail time for individuals who are presumed to be innocent until proven otherwise, too.

The company's IP could also serve a profit center for crime labs that choose to integrate it into their services, particularly privately funded ones that compete for business from legal stakeholders. "Prosecutors, defense attorneys and police alike have expressed a strong interest in the information that RFCT's technology is able to provide," Philpott says.

As a company, RFCT plans to provide an online subscription to crime labs to access the technology. The company is conducting testing and analysis to attract trial users. This year, RFCT was awarded a $270,578 grant from the National Science Foundation to further test its technology.

Eyeing a new way of nasal drug delivery

Laleh Golshahi, Ph.D. is in the business of controlling chaos.

It's the chaos that comes from using nasal or oral inhalers for treating allergies, respiratory conditions like asthma or someday even heart or other serious conditions. How one person holds a spray is different from how someone else holds it — there's variability, or chaos. And the way the spray enters the nostril also varies from one person's anatomy to the next.

But what if consistency could be brought to the way the devices work, while delivering to the body the amount of medicine that drug makers intend?

"We want to make sprays and inhalers in a way where people don't have to think about how they're holding them, and the device and medicine inside always works as planned," says Golshahi, an associate professor in the Department of Mechanical Engineering. "Our end goal is really to look at where the drug lands in the nose, because that's where it's supposed to have the most local action."

And so Golshahi, founder and director of the College of Engineering's Respiratory Aerosol Research and Educational (RARE) laboratory, is studying how different nasal drug delivery products work in different people's noses. She and her team have developed six nose models — three adult, three pediatric — that can be used by researchers and pharmaceutical companies to determine how aerosolized droplets land inside the nasal passages of millions of people of varying ages, genders and ethnicities.

Golshahi hopes that the casts will speed development of vaccines and medicines and even usher in a new era of medications that can be taken through the nostrils — a doorway to the extrathoracic airways of the head and lungs.

Like a 3-D puzzle, the models are made from smaller parts that allow researchers to open them up and study how the aerosolized medicine spreads throughout the nose. The models were created with an interdisciplinary partnership that included head and neck surgeons from the School of Medicine to secure CT scans of healthy adults and children.

When it comes to approving generic nasal drugs, the U.S. Food and Drug Administration measures "bioequivalence" — or whether the generic works as well as the name-brand version on the market. Lab tests are limited, as it's hard to measure the size of the drug droplets or how they dissolve in the nose. Golshahi's nasal casts are a way to measure the sprays in humans — without actually using real people.

"These are product development tools. They could be used by regulators to create new metrics for drug developers to ensure they are meeting standards," she says. "And drug companies can save money early on, before going to costly clinical trials, to have a predictive understanding of the variations they are making to their devices and formulations."

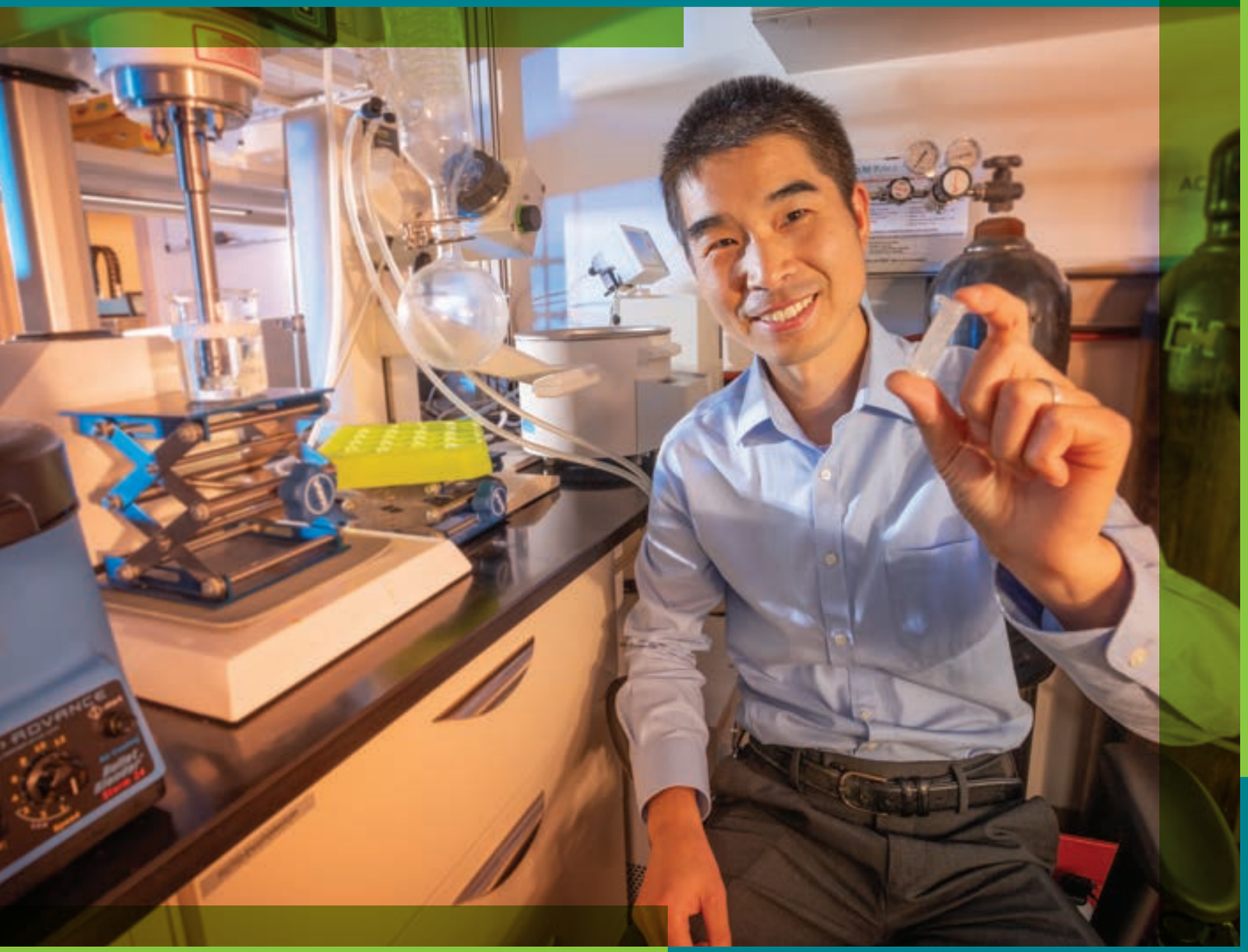
"We want to create simple tools that find patterns, minimize complexity and control chaos," Golshahi says.

Ultimately, if VCU researchers can get consistent results, the casts could lead to a new class of drugs that are delivered through the nose and mouth. "My whole goal is to minimize pain in different forms — for allergies, for asthma and even for mental health issues and heart disease," she says.

"Laleh began actively working with the TechTransfer office in 2022, and we have been in contact with several companies showing strong interest in these nasal casts. She is one of the most passionate inventors I work with."

Brittaney Ritchie
VCU TechTransfer and Ventures
Medical Devices Licensing Manager

Turning a therapeutic for one disease into treatment for another



Could a drug used to treat high cholesterol be repurposed to treat eye disorders?

The connection between the two isn't as far-fetched as it sounds, and Qingguo Xu, Ph.D., an associate professor in the Department of Pharmaceutics at the School of Pharmacy, is on a path to making it work.

His lab has formulated a pharmaceutical using fenofibrate, an FDA-approved oral drug used to treat high cholesterol, to hopefully someday treat certain eye diseases.

Fenofibrate activates a protein in the body known as peroxisome proliferator-activated receptor alpha (PPAR-alpha), which Xu's lab is studying for its ability to improve the body's "good" cholesterol, decrease triglycerides and reduce inflammation. Those factors cause diabetic retinopathy and speed up macular degeneration, which can impair vision and even cause blindness.

The current treatment for those ocular conditions is a class of drugs, known as anti-VEGF, that slow growth of abnormal blood vessels in the eye. The drugs are injected into the numbed eye, typically once a month, by an ophthalmologist. While the medication can stabilize most patients' vision, it improves eyesight in only one-third of them.

Xu's fenofibrate formulation is also injected into the eye but releases the medication slowly over time. Patients would need only one or two injections a year. And, he said, activating PPAR-alpha is likely more effective than targeting VEGF, the substance that stimulates vessel formation in the eye.

"We're repurposing a drug that has known safety, efficacy and is used routinely, and patients will be more compliant because they don't have to get as many treatments over the course of a year," Xu says.

He and his research partner, Jian-Xing Ma, M.D., Ph.D., the chair and a professor of biochemistry at Wake Forest University, were granted a patent on the formulation in June 2022 with the guidance of VCU TechTransfer and Ventures. Xu was one of six recipients of the fall 2022 round of TechTransfer and Ventures' Commercialization Fund Awards.

"We're repurposing a drug that has known safety, efficacy and is used routinely, and patients will be more compliant because they don't have to get as many treatments over the course of a year."

Qingguo Xu, Ph.D.
Associate Professor
Department of Pharmaceutics
VCU School of Pharmacy

A new way to power A.I. and antennas

Supriyo Bandyopadhyay, Ph.D. is breaking new ground in electronics design with tiny hardware and nanomagnet-based antennas. His works hold the promise to revolutionize the circuitry that underpins artificial intelligence, antennas and more.

The College of Engineering professor of electrical and computer engineering's "matrix multipliers" are smaller than a human hair and significantly enhance the efficiency and security of AI algorithms. Unlike traditional hardware, his nonvolatile multipliers use magnets, preserving data when powered off. That's crucial for applications in high security or remote locations where there isn't online access.

Bandyopadhyay has developed nanomagnet-based antennas that efficiently radiate low-frequency signals without requiring large sizes. The antennas have the potential to power medically implanted devices, wearable electronics and ultrasmall listening devices — all while consuming minimal energy.

"A medically implanted antenna cannot radiate at gigahertz frequencies since it would harm human tissue," he says. "We want to overcome this limit and make a tiny antenna radiate just as efficiently as a large antenna. That requires a completely new method of making these devices."

The inventor is working to establish industry partnerships, particularly with device manufacturers. That last part isn't easy — companies don't want to place bets, they want to buy established, revenue-generating technology and incorporate them into their portfolios.

"Big businesses don't necessarily care that you have a better product, they want to see that you have a product that is already in use and making money. It creates inertia when trying to get new products into the market," Bandyopadhyay says. "But we're working hard to shift that mindset."

"Supriyo's research centers on cutting-edge concepts in electronics design. He is not merely redesigning the way things have been done but completely changing the way electronics components are created and used."

Brent Fagg
VCU TechTransfer and Ventures
Senior Licensing Manager

A startup developing first-in-class immune modulators

If all the ideas coming out of her lab were her own, Rebecca Martin, Ph.D. jokes, “we’d have a pretty short run here.”

And so researchers like her rely on graduate students like Anuj Tharakan. “He came up with this really good idea that took my lab in a new direction,” says Martin, an assistant professor in the Department of Microbiology and Immunology at the VCU School of Medicine.

The idea: to modify immune responses that underpin allergic reactions and other immunological disorders, leading to longer term reversal of disease.

And there are a host of diseases caused by the immune system. Some, like allergies and asthma, attack external particles and are treated with steroids or medications that shut down the immune response. But those therapies have side effects, such as greater susceptibility to infection, which can be life-threatening.

Tharakan and Martin want to use their small molecule drugs to reprogram immune responses that cause disease, without the side effects of broad immune suppression.

Their research is focused on dendritic cells, which make the immune system’s decisions on how or whether to respond to particles and proteins, thus triggering reactions. They have shown that their drug candidate, PT-002, can alter dendritic cell function to treat allergic diseases in a more targeted manner than existing therapies. Their initial drug would treat allergic asthma, with other disease states to follow.

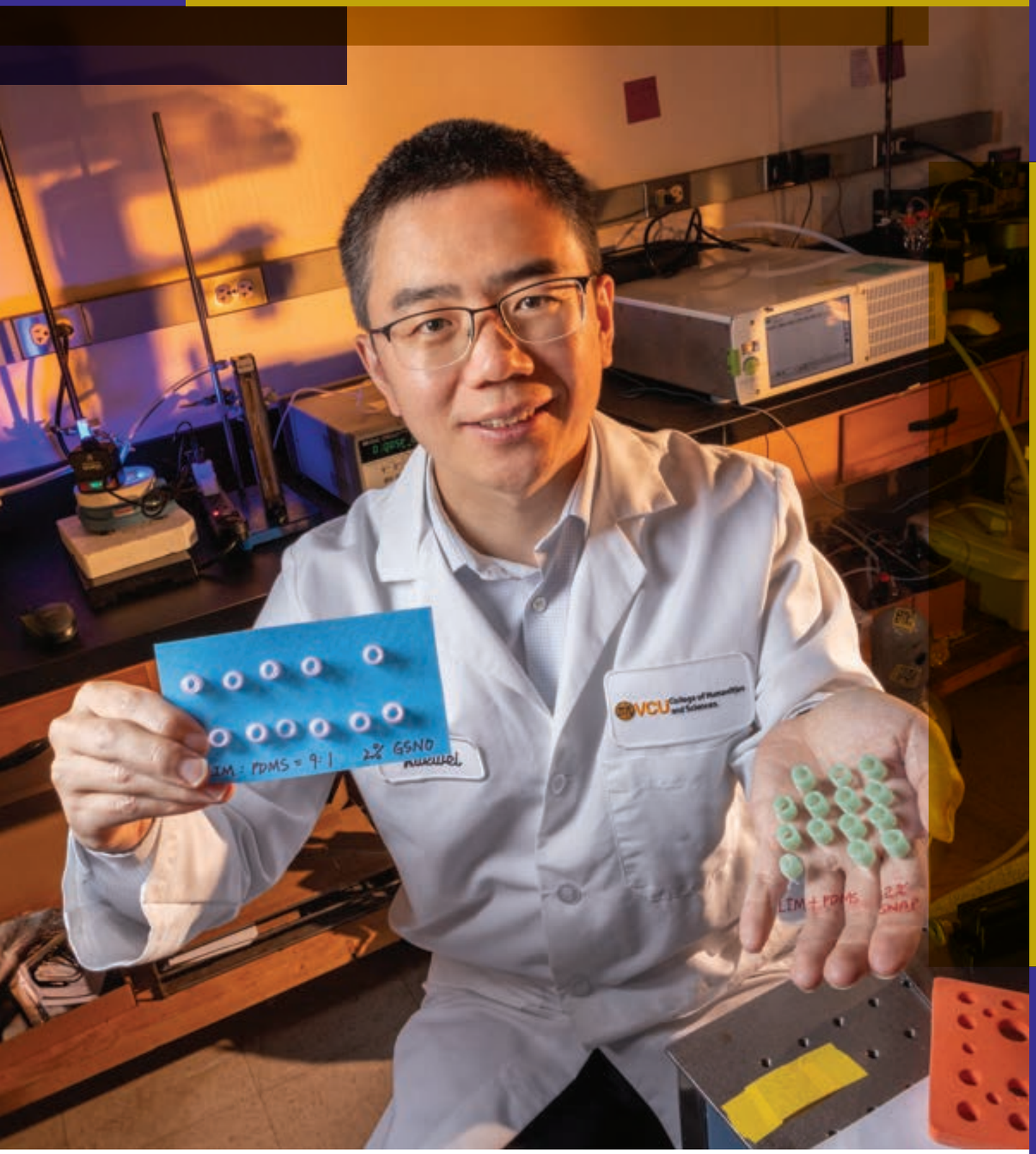
Tharakan and Martin formed a company, Pleros Therapeutics, which is further developing the drugs. Tharakan, who is completing VCU’s M.D./Ph.D. program, has his eyes on treating an even broader range of conditions that aren’t normally thought of as immune-related.

“Any disease state in humans, things that we don't really think of as immune conditions — like strokes or heart disease — they all have an immunological basis,” he says. “There's absolutely a role for modifying immune responses in many of these diseases. It could benefit a lot of different conditions.”

Martin didn’t originally see Tharakan’s idea leading to a startup, but decided to form one after companies they approached for partnerships had competing interests.

TechTransfer and Ventures has given the researcher-founders feedback on their positioning and milestones to hit to keep progressing.

“The contacts that TechTransfer has provided us have been completely invaluable,” Martin says. “Lawyers for establishing resources, their own entrepreneurs-in-residence…we wouldn’t have started a company if it hadn’t been for them.”



When it comes to NO, one inventor says YES

You've seen the tanks and the trucks delivering them: cylinders of nitric oxide (NO), each one 64 pounds, highly pressurized and more than four feet tall.

NO gas is required for anesthesia, sedation and a range of healthcare applications, including treating cardiopulmonary disease (the gas widens blood vessels in the lungs).

"But what if there was a way to generate the same quality and same amount of NO from a very small chemical reaction, without the need for a tank?" asks Xuewei Wang, Ph.D., an assistant professor in the Department of Chemistry of the College of Humanities and Sciences. "It would be a huge value."

His lab wants to generate inhaled NO in a cost-effective, compact and safe fashion. He and the team discovered that certain organic compounds, which offer their chemical properties as "donors" to create NO, are highly soluble and stable when mixed with a solvent. When Wang hits the donor and solvent with an LED light, the donors start releasing NO. They're now fine-tuning the release of the gas.

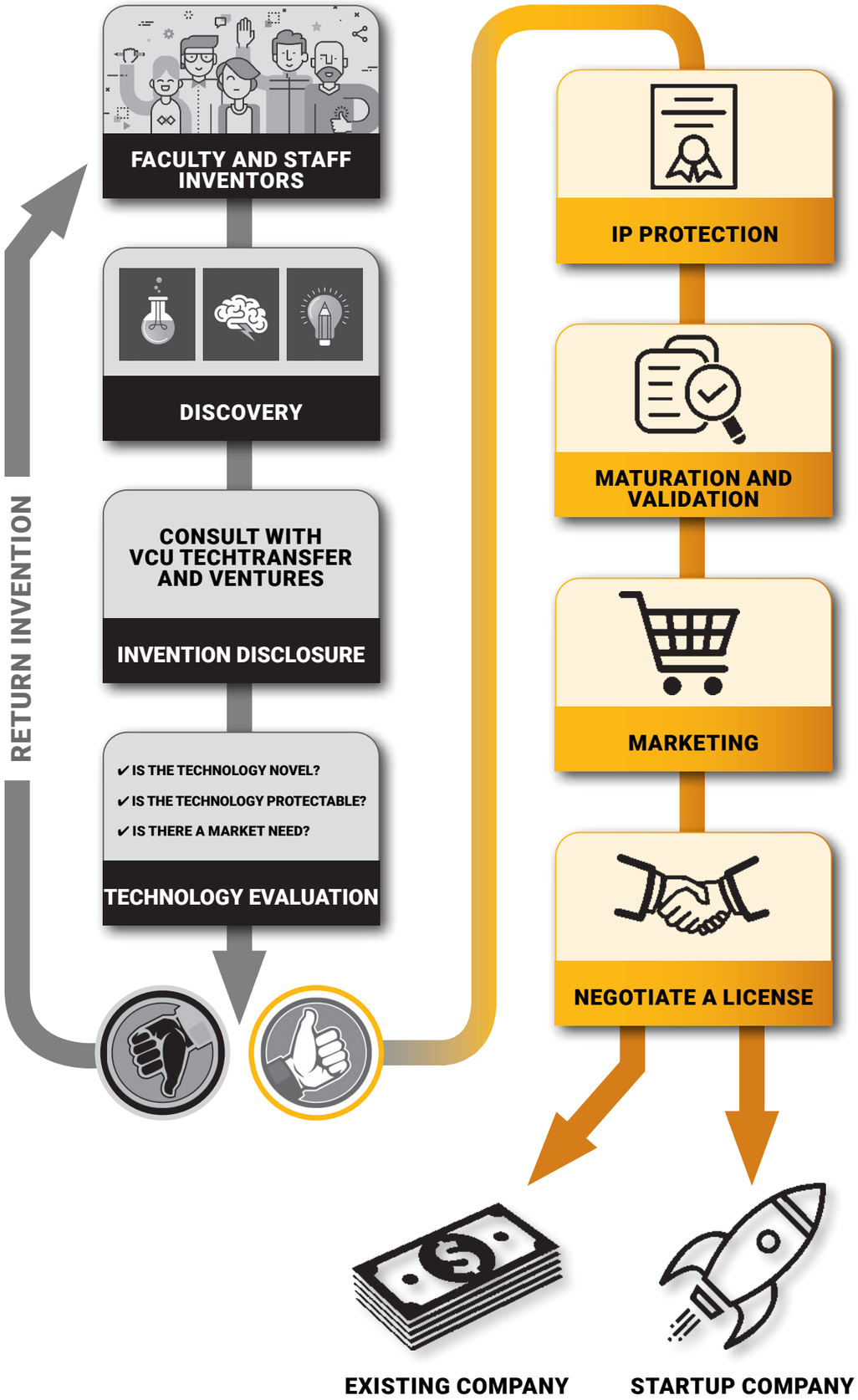
"You cannot just randomly generate NO. If you have too much, it could be toxic. Too little, it's not effective. You must control the levels of NO very precisely and stably," he says. "We have been focusing on formulations of nitric oxide donors, and we have developed some unique formulations to make NO release from the donor very stably. We are the only ones who can make NO sustainably compared to the much larger NO generators on the market."

He's using his NO knowledge in other ways, too.

This year, the National Heart, Lung, and Blood Institute, part of the National Institutes of Health, awarded a $1.52 million grant to Wang and his team for their NO solution to help prevent infectious and thrombotic complications for patients receiving chemotherapy, dialysis and other treatments through their veins via central venous catheters. The team's lock solution is a liquid that fills the catheter when not in use to prevent clotting. It delivers a controlled release of NO, which Wang says "serves as a natural anti-platelet and antimicrobial agent in the human body."

Wang, who studies drug delivery, medical implants' use alongside NO and the development of chemical sensors for health monitoring and diagnosis, has also received grants from the National Institute of Biomedical Imaging and Bioengineering (also part of NIH), the Virginia Innovation Partnership Corporation, the VCU C. Kenneth and Dianne Wright Center for Clinical and Translational Research, the VCU Commercialization Fund and industry for this research. He is working with VCU TechTransfer and Ventures on patent protection for formulations and sensors that his team is developing.

The VCU Technology Transfer Process



VCU Issued Patents

7/12/2022 — US Patent No. 11,384,115

Shunlin Ren, M.D., Ph.D., William M. Pandak Jr., M.D.
Nuclear Sulfated Oxysterol, Potent Regulator of Lipid Homeostasis, for Therapy of Hypercholesterolemia, Hypertriglycerides, Fatty Liver Diseases, and Atherosclerosis

7/12/2022 — US Patent No. 11,383,066

Michael Joseph Vitto, Ph.D., Kashyap Venuthurupalli, M.S., Chandana Muktipaty, M.S., Teri-Yae Yarbrough, M.S., Nicholas Brown, M.S.
Guidewire systems and methods for precventing wire advancement into the body during catheterization

8/2/2022 — US Patent No. 11,401,241

Martin K. Safo, Ph.D., Jurgen Venitz, Ph.D., Yan Zhang, Ph.D., Mohini Ghatge, Ph.D., Guoyan Xu, Ph.D., Piyusha Pagare, Ph.D
Aromatic aldehydes with sustained and enhanced in vitro and in vivo pharmacologic activity to treat sickle cell disease

8/9/2022 — US Patent No. 11,406,646

Shunlin Ren, M.D., Ph.D., Leyuan Xu, Ph.D.
Compositions Comprising 5-Cholesten-3, 25-Diol, 3-Sulfate (25HC3S) or Pharmaceutically Acceptable Salt Thereof and at Least One Cyclic Oligosaccharide

9/6/2022 — US Patent No. 11,432,731

Woonhong Yeo, Ph.D., Connor Howe, Ph.D., Yongkuk Lee, Ph.D.
Novel Ultra-Low Profile Wireless Flow Sensors to Monior Hemodynamic Alterations in the Vascular System

9/13/2022 — US Patent No. 11,441,182

Soma Dhakal, Ph.D., Anisa Kaur, Ph.D.
Multiplexed and recyclable single-molecule sensors for quantitative analysis of nucleic-acid biomarkers

10/4/2022 — US Patent No. 11,458,197

Jason Carlyon, Ph.D.
Anaplasma phagocytophilum surface proteins OmpA, Asp14, and AipA as vaccine/diagnostic targets for Anaplasma phagocytophilum infection

10/25/2022 — Mexico Patent No. 396750

Shunlin Ren, M.D., Ph.D., Leyuan Xu, Ph.D.
Compositions compromising 5-cholesten-3, 25-diol, sulfate (25HC3S) or pharmaceutically aceptable salt thereof and at least one cyclic oligosaccharide

11/11/2022 — Taiwan Patent No. I782421

Shunlin Ren, M.D., Ph.D.
"Uses of Oxygenated Cholesterol Sulfates (OCS)"

11/29/2022 — US Patent No. 11,513,057

Christopher Ehrhardt, Ph.D.
Systems and method for rapid identification and analysis of cells in forensic samples

12/16/2022 — Hong Kong Patent No. 1230918 B

Shunlin Ren, M.D., Ph.D.
Uses of Oxygenated Cholesterol Sulfates (OCS)

12/16/2022 — Hong Kong Patent No. 1230918 B

Shunlin Ren, M.D., Ph.D.
Uses of Oxygenated Cholesterol Sulfates (OCS)

12/20/2022 — US Patent No. 11,531,982

Thang N. Dinh, Ph.D.
Optimal transactions sharding for scalable blockchain

12/27/2022 — US Patent No. 11,534,569

Michael Hindle, Ph.D, P. Worth Longest, Ph.D., Benjamin Spence, Ph.D.
Combination devices, systems, and methods for humidification of the airways and high efficiency delivery of pharmaceutical aerosols

1/18/2023 — European Patent No. 3485061

Yan Zhang, Ph.D., Hamid I. Akbarali, Ph.D., William L. Dewey, Ph.D., Dana E. Selley, Ph.D.
Potent and Selective Mu Opioid Receptor Modulators

1/31/2023 — US Patent No. 11,566,173

Umit Ozgur, Ph.D., Denis O. Demchenko, Ph.D., Indika Arachchige, Ph.D., Venkatesham Tallapally, Ph.D, Tanner Nakagawara, M.S.
Direct-gap group IV alloy nanocrystals with composition-tunable energy gaps and near-infrared photoluminescence

2/28/2023 — US Patent No. 11,590,241

Yan Zhang, Ph.D., Hu Yang, Ph.D., Hamid I. Akbarali, Ph.D., William L. Dewey, Ph.D., Dana E. Selley, Ph.D.
Nanoparticle conjugated NAP and its derivatives for treatment of opioid induced constipation

3/28/2023 — US Patent No. 11,612,609

Shunlin Ren, M.D., Ph.D.
Uses of Oxygenated Cholesterol Sulfates (OCS)

4/4/2023 — China Patent No. ZL201780055805.8

Shunlin Ren, M.D., Ph.D., Leyuan Xu, Ph.D.
Compositions Comprising 5-Cholesten-3, 25-Diol, 3-Sulfate (25HC3S) or Pharmaceutically Acceptable Salt Thereof And at Least One Cyclic Oligosaccharide

5/3/2023 — Korea Patent No. 10-2530119

Shunlin Ren, M.D., Ph.D.
Use of Oxygenated Cholesterol Sulfates (OCS)

5/23/2023 — US Patent No. 11,654,409

Massimo Bertino, Ph.D., Lauren S. White, Ph.D., Dalton R. Echard, M.S.
Methods for fabrication of slica aerogels with custom shapes using freeze drying

5/30/2023 — US Patent No. 11,661,433

Matthew Hartman, Ph.D., Koushambi Mitra, Ph.D.
Near-IR actifatable fluorescent small molecules with dual modes of cytotoxicity

6/1/2023 — Japan Patent No. 7289030

Shunlin Ren, M.D., Ph.D.
Uses of Oxygenated Cholesterol Sulfates (OCS)

6/6/2023 — US Patent No. 11,670,441

Everett E. Carpenter, Ph.D., M.B.A.
Perovskite manganese oxides with strong magnetocaloric effect and uses thereof

6/13/2023 — US Patent No. 11,673,913

Heather R. Lucas, Ph.D., Ricardo D. Fernandez, Ph.D.
Preparation of Recombinant Tetrameric N-Acetylated Alpha-Synuclein

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RTI Innovation Advisors

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VCU TechTransfer and Ventures Team

From left: Brent Fagg, Brittaney Ritchie (on stairs), Christine Benedict, James Redden, Parthay Patel, Ivelina Metcheva, Magdalena Morgan, Gerard Eldering, Ellie Linkous, Richard Pellegrino, Jeff Kelley

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10 Years of Impact

54 *Products on Market*

$37 million *Licensing Revenue*

1,247 *Invention Disclosures*

1,565 *Patents Filed*

206 *Licenses & Options*

221 *Patents Issued*

700 *Industry Engagements*

60+ *Startups*

$97+ million *Startup Funding*

TechTransfer and Ventures