



Spring 2024

TURNING DEAS NTO OPPORTUNITIES

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Letter from the Director

Igniting economic growth



Director Technology Transfer

Universities play a critical role in today's innovation economy. By advancing fundamental research, these universities are engines of discovery laying the foundation for ground-breaking innovations that benefit society at large. Recognized as one of the most innovative universities in the world by Reuters since 2017, Vanderbilt's commitment to fostering an entrepreneurial culture and to making strategic investments is paying dividends. Over the past decade, Vanderbilt's strategic investments in faculty research, academic programs and departments, and trans-institutional institutes and centers have produced more than eighteen hundred new innovations, leading to more than nine hundred licenses generating over \$250M in commercialization revenues, and deep corporate collaborations that have increased industry research support by more than \$100M. The time frames are long for translating basic research discoveries

to practical applications; moreover, it generally takes more than a decade for a licensed product to achieve market success. Thus, continual investments in academic research and efforts put forth today will pay dividends for Vanderbilt – and society - long into the future.

In this issue of Driving Innovation Forward, we showcase programs that have successfully translated from early stage ideas in to impactful products and companies. From startups born out of our academic research to strategic collaborations that ignite economic growth, this report highlights our commitment to nurturing an ecosystem where entrepreneurship and innovation flourish.

RESEARCH SUPPORT GENERATED:

\$26,118,619

1,051
MTA's Reviewed
728 Incoming
323 Outgoing

LICENSING REVENUE GENERATED:

\$96,401,756

100

Licenses & Options Executed

231 End-User Licenses Executed

41 Confidentiality Agreements Executed

31 Clinical Trial Agreements Reviewed

FY23 at a glance

Notable Transactions

Evergreen Therapeutics

Vanderbilt University Medical Center (VUMC) teamed up with Evergreen Therapeutics Inc. in July 2022 to investigate the potential of memantine, an Alzheimer's medication, in treating cognitive symptoms related to systemic lupus erythematosus (SLE). This collaboration marks a novel endeavor for the Drug Repurposing Program of the Vanderbilt Institute for Clinical and Translational Research (VICTR), initiated in 2016. The program has been active in finding new applications for existing drugs by identifying drug gene target variants and conducting PheWAS (phenome-wide association studies) and comprehensive literature reviews. A PheWAS analysis targeting the GRIN2a gene, associated with memantine, unveiled its potential link with SLE. This led to speculations, reinforced by literature reviews and insights from VUMC's lupus expert, Dr. April Barnado, that memantine could benefit lupus patients experiencing neurocognitive symptoms. The upcoming clinical trial aims to validate these findings.



Together, the two entities will undertake a clinical trial named "ClearMEMory" for memantine, involving around 60 adult lupus patients. These participants, over a 14-week period, will be split into groups receiving either memantine

or a placebo. Dr. Leslie Crofford (pictured left), director of Rheumatology and Immunology at VUMC, will be at the helm of this study. The overarching ambition is to devise a safe, cost-effective therapeutic strategy for a specific lupus subgroup grappling with cognitive impairments.

HTX Technologies, LLC



In November 2023, HTX Technologies, LLC introduced HTX SubliMATE, a user-friendly sublimation system designed to provide a standardized and controlled approach to sample preparation for matrix-assisted laser desorption/ionization (MALDI) mass spectrometry imaging. Developed in collaboration with Drs. Richard Caprioli (pictured left), David Anderson, and Eric Spivey at Vanderbilt University, HTX SubliMATE enhances the reproducibility and simplicity of the sublimation process, particularly for ultra-high spatial resolution sample preparation with crystal

sizes below 1 micron. The system's controlled heating and cooling contribute to reduced variability in sublimation cycles, ensuring a uniform matrix coating that can be consistently replicated across different users and laboratories.

HTX Technologies develops tissue imaging and molecular imaging technologies, with a primary focus on sample preparation and mass spectrometry imaging.

Phenomapper LLC

Phenomapper LLC dba Flexperc Medical has licensed a self-driving flexible robotic technology to augment its product portfolio. The steerable needle technology was developed in the Vanderbilt University laboratories of Robert J. Webster (pictured right), and the self-driving robotic controller along with the automated 3D route mapping software for the robot were developed in a collaboration between researchers at Vanderbilt and the University of North Carolina at Chapel Hill (UNC). Flexperc's mission is to advance localized cancer interventions to achieve optimal outcomes and efficiency. Cancer remains the #1 cause of death in the world despite



billions of dollars spent to minimize cancer deaths. Nevertheless, advancement in early cancer detection techniques such as liquid biopsy promises highest chance of cancer survival. Localized cancer intervention is the ideal intervention techniques for treating patients diagnosed with early-stage tumors. Its safety, cost-effectiveness and quick post-treatment recovery well-suited for this population. Flexperc's product combines Al-driven clinical decision support tool with a self-driving robot to enable localized treatment with precision and accuracy. Phenomapper has an exclusive license from both of these institutions for the commercialization of this technology for treating lung tumors. Currently, the company is raising money to finalize the development and commercialize this technology globally.

Flexperc Medical was founded in 2019 by Henky Wibowo and Pinyo Taeprasartsit, The company's headquarters is located in San Jose, CA with a development office in Bangkok, Thailand. For further information, please visit https://www.flexperc.com

Revelation Biosciences, Inc.



Revelation Biosciences Inc. recently secured an exclusive worldwide license agreement with Vanderbilt University for the advancement and commercialization of phosphorylated hexaacyl disaccharides (PHADS®). Collaboratively developed with Dr. Edward Sherwood, the PHAD treatment enhances the innate immune response in the human body, demonstrating efficacy in reducing infection duration and severity during preclinical studies. The license encompasses potential applications, including the prevention or mitigation of acquired infections, such as those arising from surgery, severe burns, and antibiotic resistance.

Revelation Biosciences, Inc. is a life sciences company focused on the development of immunologic based therapies for the prevention and treatment of disease.

Master Innovator Recognition Program

Each year, the Center for Technology Transfer and Commercialization recognizes excellence in innovation through its Master Innovator Recognition Program. The yearly recognition program acknowledges Vanderbilt's top innovators and entrepreneurs for their contributions to the creation, development, and commercialization of intellectual property. Awardees have demonstrated excellence in a select number of key commercialization categories, including new inventions disclosed, patent applications filed and issues, new companies formed, technology licenses executed, commercialization revenue generated, and products on the market - all based on the candidate's innovations created at Vanderbilt. Awardees are memorialized as a member of the CTTC Innovators' Hall of Fame.

This year we are recognizing Richard Caprioli, C. David Weaver, Susan Eagle, and Franz Baudenbacher as Master Innovators at Vanderbilt.



Dr. Richard Caprioli has paved the way for advancements in personalized medicine, drug discovery, and the diagnosis and treatment of diseases such as cancer by developing innovative imaging techniques in the field of mass spectrometry. In Richard's spare time apart from creating, funding, and managing the nationally recognized Vanderbilt Mass Spectrometry Research Center, he is an inventor on forty US patents and applications, leading to ten licenses of his technology to the public sector.

Dr. C. David Weaver has been exceptionally productive in research in the field of pharmacology. Dr. Weaver's groundbreaking work has significantly advanced our understanding of drug discovery and development, particularly in the area of G protein-coupled receptors (GPCRs). Dr. Weaver's research activities have led to forty-one US patents and applications, resulting in twenty licenses, including to several startup companies.





Dr. Franz Baudenbacher, through his research in the field of biomedical engineering and physics, has made significant contributions to healthcare technology. Part of Dr. Baudenbacher's work focuses on developing innovative solutions to advance the field of cardiac electrophysiology, microfluidic, biosensors and instrumentation. This has led to the launch of several companies he co-founded with Dr. Eagle, including InvisionHeart LLC. Dr. Baudenbacher's research activities have led to forty-two US patents and applications, resulting in twelve technology licenses.

Dr. Susan Eagle, Professor of Cardiothoracic Anesthesiology at Vanderbilt University Medical Center, possesses a wealth of clinical knowledge and practical experience, which she applies to the development of innovative medical technologies. Dr. Eagle has co-founded several companies, and has been named on twenty-two US patents and applications, leading to ten technology licenses. Dr. Eagle has shared her innovation and entrepreneurship journey with the Vanderbilt community in our From Concepts to Commercialization lecture series (co-sponsored with the Brock Center and VBS).



Innovation mbassadors

The Innovation Ambassadors Program is an institutional initiative to provide Vanderbilt faculty with improved, peer-delivered access to information and assistance related to innovation and entrepreneurship on campus. The Program achieves this goal by recruiting a faculty Ambassador from each department to act as a liaison researchers between and innovation programs across campus. Ambassadors receive instruction on a variety of commercialization, intellectual property, and entrepreneurship topics, as well as application of Vanderbilt policies and procedures, all designed to enable them to help others in their departments obtain quick guidance and access to all their innovation and entrepreneurship needs.

The Innovation Ambassadors Program is an initiative of the Enabling Innovation Initiative, a joint effort between the School of Medicine (SOM), Vanderbilt University Medical Center (VUMC), and Center for Technology Transfer and Commercialization (CTTC). However, the Program is intended to serve the entire Vanderbilt research community and is not limited to life science researchers. The Program's success relies exclusively on the volunteer Ambassadors and support from their departments.

Learn more about the program here.











Ambassador Responsibilities

Each department and/or division that would like to participate will be represented by a single faculty Ambassador, who will commit to a 2-year term with the Ambassador Program. We strive to keep time obligations of Ambassadors to a minimum, with an initial one-time onboarding and training commitment of about six hours, and 1-2 hours per month for workshops, meetings, and activities. Resources describing relevant policies will be provided to adequately prepare faculty for success in the Program.

Ambassadors will connect quarterly to share experiences, successes and challenges, and to identify new initiatives that can positively affect innovation and entrepreneurship on campus. As part of the program, Ambassadors will periodically organize departmental presentations to update their colleagues on innovation and entrepreneurship efforts within the Vanderbilt and the local community. There will also be opportunities for optional activities, such as serving as guest judges during pitch competitions at the Wond'ry and being a member of the Catalyst Fund Review Committee.

Benefits

While Ambassadors will bring a clear value to their home department and/or division, they will also have access to many benefits. As an innovation leader in the Program, Ambassadors will be closely connected with both VU/VUMC and regional leadership. Networking and education opportunities will come through retreats and workshops, presentations, and access to regional conferences.

Ongoing training will be provided to participants (e.g., emerging trends in startup funding, top 10 court cases affecting IP licensing, local and national funding sources, etc.), making them better equipped for their own pursuits. Finally, active Ambassadors will receive special merchandise and swag, such as the custom fleece pullovers with the Ambassador Program logo chosen for our inaugural Ambassadors.

Inventor Spotlight: KARL ZELIK

Revolutionizing Biomechanics and Wearable Technology

Dr. Karl E. Zelik, an associate professor of mechanical engineering, biomedical engineering, and physical medicine and rehabilitation at Vanderbilt University, stands at the forefront of biomechanics and wearable technology innovation. Growing up as an adventurous child, Zelik's journey from a reckless youth to a pioneering researcher is nothing short of remarkable.

"I was very reckless with my body as a kid. I broke a lot of bones and got a lot of stitches. I was always pushing the limits. And I suppose while going to college I discovered that there was a much safer and academic way of doing that through biomedical engineering," Zelik said in an interview.

His initial foray into research occurred in a cardiac bioelectricity lab, all the while maintaining an active presence in track and field, specializing in the long jump and triple jump. After completing his undergraduate studies, Zelik ventured into the medical device industry on the West Coast, where he identified a significant gap in innovation between computer science-driven algorithms and mechanical development in medical devices. Motivated to combine his love for biomechanics with a desire for freedom in innovation, Zelik pursued a Ph.D. at the University of Michigan.

"I wanted to take what I liked about the medical device area, but see if there was something more mechanically-focused and yet had more freedom to innovate," he says. "That's what ultimately drew me over to the side of biomechanics, prosthetics and exoskeletons."





In 2014, he established his research lab at Vanderbilt University, (the Center for Rehabilitation Engineering and Assistive Technology known as CREATE) focusing initially on lower-limb prosthetics. CREATE at Vanderbilt aims improve health, mobility and independence for individuals with physical disabilities, and to enhance human performance and well-being through advances in movement science and assistive technology.

HeroWear LLC

In 2019, while at Vanderbilt University, Zelik and two Vanderbilt alumni Matthew Yandell and Mark Harris founded HeroWear, a company that develops wearable assist devices, called exosuits, to alleviate back strain and injuries—especially for those who do heavy and repetitive lifting. The HeroWear Apex Exosuit, weighing a mere 3 pounds, has found applications in various professions globally, providing relief to thousands of individuals in physically demanding fields. When turned on, the exosuit can reduce the strain on the back muscles by 75 lbs. or more when lifting or leaning.

"Professionally, I've long had my eye on bringing wearable technology like Black Panther's vibranium supersuit off the screen and into real life," he wrote in an article for The Conversation (also published in Fast Company and by the AP).

Army Pathfinder

In April 2021, Zelik received a one-year, \$1.2 million investment from the Army Futures Command's research lab, known as DEVCOM, and the Civil-Military Innovation Institute Inc. The funding supported the Army's Pathfinder program, a collaboration between Vanderbilt and soldiers of the 101st Airborne Division to develop the Soldier Assistive Bionic Exosuit for Resupply, or SABER, a firstof-its-kind exosuit that supports soldiers participating in sustainment and logistics operations. In 2022, SABER transitioned to HeroWear for large-scale manufacturing and commercialization, and for further field use by the Army. This Pathfinder program has also benefited civilian workers, as innovations developed with soldiers have been incorporated into the newest commercial version of the exosuit, the Apex 2, which HeroWear launched in 2023.

"This bottom-up, soldier-centered approach and the exosuit design itself are huge departures from previous exoskeleton attempts that failed to meet soldier needs or achieve Army adoption," Zelik said. "We spent the first few months focused on interviewing, observing and spending time with soldiers. We didn't try to create Iron Man—a complex, full-body, rigid, unrealistic suit. Instead, we started by deeply understanding soldier needs to develop a lightweight, low-profile, nonpowered wearable tool that helps provide much-needed assistance without slowing soldiers down or interfering with other operational tasks."



The Innovation Catalyst

Ignite your innovative potential through the Vanderbilt Innovation Catalyst Fund.

In 2023, CTTC along with the Office of the Vice Provost for Research and Innovation in consultation with Division of Finance, VUMC Office of Research, and academic leadership in Vanderbilt schools and colleges, officially launched the Innovation Catalyst Fund - an internal-funding program designed to expedite the translation of research into real-world applications. The fund has successfully completed its first highly competitive application cycle with the announcement of the awardees of its inaugural funding round.

With these awards, Vanderbilt University fortifies its commitment to fostering a culture of innovation and research impact. For further information on the Innovation Catalyst Fund and future funding opportunities, please visit the Innovation Catalyst Fund website.

Key features of the Innovation Catalyst Fund

Through this fund, Vanderbilt is supporting the advancement of basic research programs with commercial potential toward productization through support for a variety of translational and commercially-oriented development efforts. This program is intended to provide:

EXPERT EVALUATION

peer-reviewed assessment by a committee of Vanderbilt faculty

ACCELERATED DECISION MAKING

prompt feedback and timely decision

FOCUSED
TRANSLATIONAL RESEARCH

commercial potential and social impact prioritized

TRANCHE-BASED FUNDING

project funds distributed based on milestone completion

Use of funds

The Innovation Catalyst Fund project selection will be 'outcomes oriented' and based on clear project endpoints that achieve a commercial goal with translational research.

Uses for funds in this program include:

- Prototype development and testing
- Proof of concept validation and data generation
- Conceptualization and design
- Software development
- Process improvement
- New organization capability
- Program improvement
- Campaign or event

Unallowable uses generally include:

- Services provided by innovation players on campus (e.g., Brock Center, CTTC, Wond'ry)
- Book subventions
- Faculty salaries
- Tuition or financial aid support for students
- Research supported by other internal funding programs, including Scaling Success, Seeding Success, and RAMP programs

Inaugural Awardees



Amy Booth, professor of psychology and human development: "Advancing the Development of AIDA, an Artificially-Intelligent Dialogic Reading Aid." The team seeks to address the societal imperative of literacy by developing a technology that will facilitate dialogue reading between caregivers and young children. These interventions involve encouraging children to engage in conversations around books, rather than just passively listening.



Blythe Corbett, James G. Blakemore Chair in Psychiatry, professor of psychiatry and behavioral sciences: "Expanding SENSE Theatre to Youth with Autism Spectrum Disorder and Intellectual Disability." SENSE Theatre is a unique intervention research program for youth, 10-16 years of age, with autism spectrum disorder (ASD). It is a performance-based intervention targeting social skills that includes trained peer actors and theatre techniques.



Scott Crossley, professor of special education: "Proof of concept validation and data generation for intelligent Texts for Enhanced Lifelong Learning (iTELL)." The iTELL framework restructures text-based learning materials into individual web apps where students can read text content, participate in interactive exercises, and watch educational videos.



Abhishek Dubey, associate professor of computer science: "Mobius, Inc: Last mile Freight Optimization for Heterogenous Fleets." The project aims to further develop a technology around optimizing the routing and charging of mixed-fleet transportation and last-mile freight resources (e.g., buses and trucks).



Daniel Fabbri, assistant professor of biomedical informatics: "DAGCAP: Democratized, Al-Guided Chart Abstraction Platform." DAGCAP aims to create a streamlined and automated curation system that mitigates challenges associated with medical charting. Increases in the quality of curation would drastically expand research, clinical, and operational capabilities across oncology care and research.



Alex Langerman, associate professor of otolaryngology – head and neck surgery: "GownCard Perioperative Workflow App." GownCard is an internally-developed, app-based surgical team information management system used by nurses, scrub techs, and surgeons to eliminate perioperative inefficiencies.



Ethan Lippmann, associate professor of chemical and biomolecular engineering: "Novel Hydrogel to Improve and Restore Blood Flow to Bone Tissues Through Activation of Arteriogenesis." This injectable gelatin-based hydrogel promotes the growth of large blood vessels in a spatially controlled manner to restore blood flow to inadequately supplied areas. Because this hydrogel is formulated without encapsulated growth factors or cells, it can be easily translated to clinical applications.



Megan Salwei, research assistant professor of anesthesiology: "Personalized training on deep inspiration breath hold (DIBH) to improve radiation therapy outcomes in breast cancer patients." The project aims to develop a system to support patient execution of DIBH. The system will feed, real-time, to software driving a VR display to provide visual feedback to patients on their DIBH.

Startup Snapshots

Atlas Endoscopy

Atlas Endoscopy envisions the democratization of colonoscopy, striving to provide real value to all stakeholders. The company is dedicated to enhancing patient care, offering endoscopists precision tools for seamless diagnostic and therapeutic access to the colon, increasing healthcare system capacity, and delivering a comprehensive solution to a global problem.

Eupalinos

Eupalinos is addressing the global problem of Peripheral Artery Disease (PAD) through the development of Cad biomaterials for growth of arterioles in vivo to improve any medical indication. These biomaterials aim to stimulate the growth of arterioles in vivo, thereby enhancing various medical indications. The company is led by CEO and Co-Founder Karrie Dudek, and her Co-Founder and Principal Investigator is Ethan Lippmann, Associate Professor of Chemical and Biomolecular Engineering at Vanderbilt University.

124 Supply Company

124 Supply Company is an engineering design practice that specializes in applications of additive manufacturing, robotics, and assistive devices. They collaborate across disciplines to explore challenges from a different perspective and uncover the art of the possible to deliver value to our clients.

Influent Medical

Influent Medical, the creator of The Atlas and Ohm Stent System, is dedicated to offering a minimally invasive, temporary solution tailored for newborns with HLHS. Their innovative approach aims to enhance and stabilize blood flow to the body until the infant reaches a sufficient level of maturity for open heart reconstruction, providing a crucial lifeline for these young patients.

Sensorium

Sensorium Technological Laboratories emerges from a decade of academic research in mid-infrared nanophotonics. Their patented machine learning technology enables the creation of materials with custom optical responses. The company specializes in engineering advanced optical gas sensors, customized to meet client needs, capable of detecting trace amounts of various gases in challenging chemical environments where conventional sensors fail.

Vasowatch

Vasowatch is dedicated to advancing novel technology aimed at enhancing risk prediction for postpartum hemorrhage (PPH), a significant contributor to mortality during labor and delivery. Leveraging the diverse maternal dataset obtained through their observational study at Pennsylvania Hospital, Vasowatch's proprietary algorithm provides a threefold increase in predictive capability two hours before delivery for the general population and a tenfold increase in predictive capability six hours before delivery for documented uterine atony cases.

Xtremis

Xtremis is a high-tech startup business that leverages advanced artificial intelligence (AI), data science, and automation technologies to improve spectrum utilization. Xtremis is led by a Vanderbilt research and engineering team that won two prestigious Defense Advanced Research Projects Agency (DARPA) Challenges – the Spectrum Challenge (2015) and the Spectrum Collaboration Challenge (2019). They are partnering with Indigo IT and Motorola to deliver rapid, high-surety capabilities to the most daunting spectrum management challenges.

Healthcare Artificial Intelligence Sessions vanderbilt V HEALTH

Brock Family Center for Applied Innovation

The Brock Family Center for Applied Innovation hosted its first annual Healthcare Artificial Intelligence Sessions (HAIS 23) on September 20, 2023. The all-day, in-person event featured presentations from Nashville startup companies:

- Blattner Technologies
- Ampersand Partners
- Switchpoint Ventures
- Ardent Health
- Annalise-Al
- XSOLIS
- The Innovation Studio
- UnityAl

Nference, based in Cambridge presented at the conference and esteemed VUMC and VU faculty researching in the AI space shared their work. Presentations covered the latest development and innovation efforts in AI and healthcare including use cases in imaging, diagnostics, and treatment among others.

The Brock Family Center will be hosting the second annual HAIS 24 conference on October 10, 2024. See the Brock website for further information.

Among the day's presenters was Peter Embí, MD, MS, professor and chair of Biomedical Informatics and senior vice president for research and innovation at VUMC. Embí, who serves on the steering committee for the National Institute of Medicine's health care AI code of conduct initiative, also provided brief remarks to conclude the daylong program.

"We had presentations that covered real-world development and innovation efforts across use cases from imaging, diagnostics, to treatment, to the complex socio-technical factors that have to be considered and reconciled in order to address what it is we we need to accomplish," Embí said from the podium.

"The diversity and depth of the expertise, the thought leadership and collaborative spirit that has been exemplified here today I think is going to end up being a driving force for change and improvement — not only in our region, but there's absolutely no reason why we can't become a hub of innovation and advance beyond anyone else in the nation. I feel very strongly that we're well positioned to do that."

Besides Embí, speakers from Vanderbilt included Jeff Carr, MD, MSc, Jules White, PhD, Jesse Spencer-Smith, PhD, and Laurie Novak, PhD, MHSA. Todd Gary, PhD, from Meharry Medical College, and Charlie Apigian, PhD, from Belmont University, also spoke.

Serving as MC was Ken Holroyd, MD, MBA, lead of the Brock Family Center for Applied Innovation, Vice President for Technology Transfer at Vanderbilt University Medical Center and medical director of CTTC.





Industry Collaborations nderbilt

Targeted research areas for growth include:



Defense & Security



Health & Medical Devices



Education



Mobility & **Electric Vehicles**

The Industry Collaborations team identifies, supports, and stewards corporate research and development partnerships across Vanderbilt University and Vanderbilt University Medical Center.

Focusing on Life Sciences and Physical Sciences, the Industry Collaborations team cultivates collaborative research partnerships across a variety of industries. With the goal of maximizing the effectiveness of Vanderbilt's industry partnerships, the Industry Collaborations team assesses a company's research needs and identifies faculty matches.

"Relationship building with industry partners across" Vanderbilt's research competencies has been our focus this year, resulting in new master agreements with several global companies," Rowe said. "Our partners who seek to further develop and commercialize Vanderbilt technologies, ranging from automotive to pharmaceuticals to defense tech, contributed to the growing industry-sponsored research portfolio."

Under the leadership of the Office of the Vice Provost for Research and Innovation, the Industry Collaborations team works closely with the Center for Technology Transfer and Commercialization, Sponsored Programs Administration, Research Development and Support, and Corporate Advancement and Engagement to build robust research relationships with industry partners.

"We are setting new performance standards for high-impact translational research between academia and industry and rapidly propelling Vanderbilt on an upward trajectory," said C. Cybele Raver, Provost and Vice Chancellor for academic affairs. "With a focus on industry collaborations and a thriving startup ecosystem in a region whose influence is growing nationally and globally, we are fostering stronger partnerships, accelerating discovery and fueling regional economic growth."



