

DISCOVER 2019

UNIVERSITY OF TENNESSEE
RESEARCH FOUNDATION

Where Discovery and Opportunity Connect



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Research
Growth



Intellectual Property
Commercialization



Entrepreneurial
Culture



Economic
Development

From the President

2019 showcased what we can achieve when we connect the dots from discovery to the marketplace. That's what UTRF is here to do, and we continue to see these innovations benefiting society and broadly helping to build Tennessee's economy more than ever before.

From research support and IP disclosures, to commercialization and growth of subsidiary and spinout companies, the University of Tennessee has significant impact on statewide economic development.

UTRF received 168 invention disclosures in FY19, and executed 30 license agreements. These statistics are strong on their own, but the innovations behind the numbers are mind-blowing: We worked on licensing new cancer treatments, forage grass for cattle, novel athletic training equipment, and inventions in material science that help protect the health of more than one billion people worldwide.

We celebrated alongside subsidiaries that UTRF supported from conception as they made progress in the marketplace and reached major milestones: This year Genera secured more than \$118 million in new investment to produce sustainable packaging made from grasses, sourced from our rural Tennessee communities; the novel regional health care network known as CTN2 began clinical trials in Memphis; the Cherokee Farm Development Corporation leased up Innovation North and executed an option for ground lease for a new 81,000 sqft project; and Domtar announced an investment in Prisma Renewable Composites to develop new plastic compounds from lignin.



This year's list of wins is long, but each was preceded by a single idea, in a lab or in a classroom, with a group of researchers conducting experiments and analyzing endless streams of data.

The point is, university faculty, staff, and students are making breakthrough scientific discoveries everyday that create a bolder, brighter future for Tennessee's economy, workforce, and society at large. The road from discovery to market can be long, but it's rewarding. UTRF helps connect the dots to foster Tennessee's growing technology-driven economy.

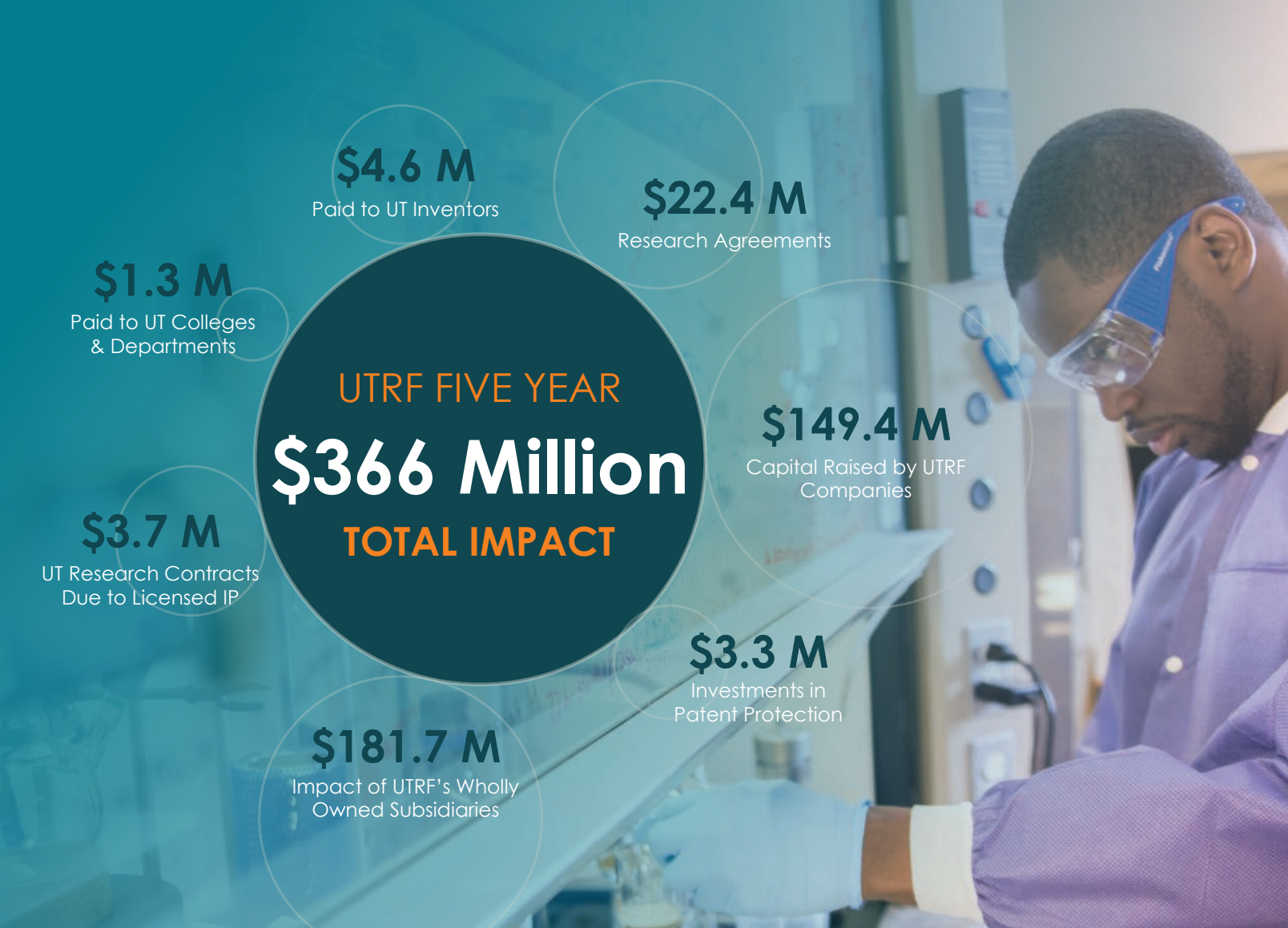
I've never been more proud to call myself a member of UTRF and the University of Tennessee team. We are honored to serve faculty, staff, and students across the University of Tennessee's campuses and institutes through our technology transfer mission, and we look forward to reaching new heights in 2020.

A handwritten signature in black ink that reads "Stacey S. Patterson". The signature is fluid and cursive.

Stacey S. Patterson, PhD,
UTRF President

UTRF'S 4 PRONG MISSION

The mission is to support an entrepreneurial culture, enhance research, and facilitate economic development by commercializing intellectual property created within the University of Tennessee System.



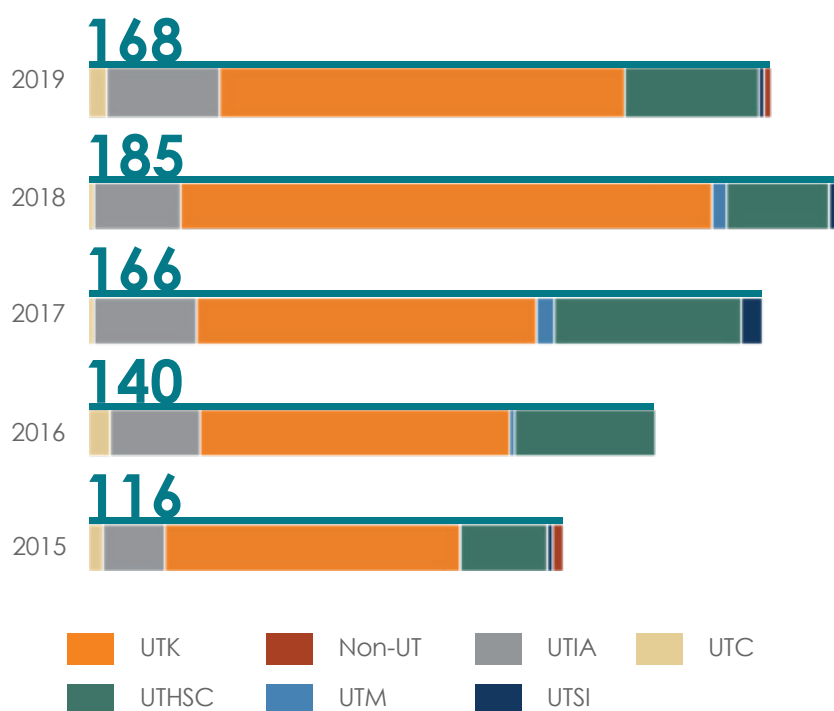
DISCLOSURES

Disclosures by Campus



Total Disclosures in FY19

Disclosures come from all corners of our state-wide university system: from engineering and medicine to business and agriculture, and everything in between.



PATENTS

433

Filed

Over the Last 5 Yrs

138

Issued

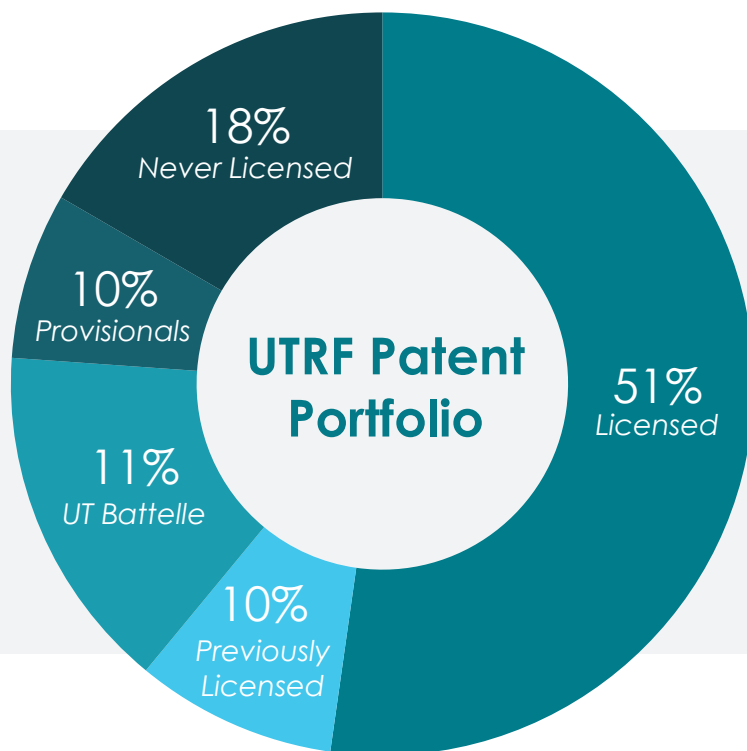
Over the Last 5 Yrs

108

Filed FY19

36

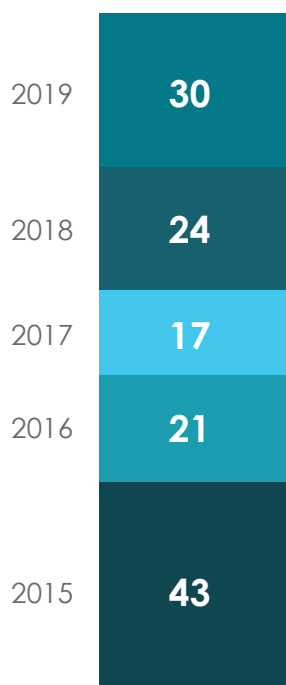
Issued FY19



UTRF by the **NUMBERS**

UTRF provides the tech transfer services to faculty, staff, and students system-wide.

Deal Flow



LICENSES



Licensing Revenue



UTRF *Connecting Discovery & Opportunity*

Protecting Innovations in the New World of AI & Machine Learning

UT professors and researchers across the state are taking the potential of AI and machine learning (ML) and applying these techniques to address challenging problems in medicine, engineering, and computer science. At the Health Science Center in Memphis, Director of the Center for Biomedical Informatics Bob Davis and his team present ways to improve the detection and prediction of sepsis and cardiac arrhythmia. Meanwhile, UT's TENNLab team in Knoxville develops neural network architectures and dynamic training algorithms for high-performance, low-energy computing that emulates the human brain, known as neuromorphic computing. Many more applications of AI and ML appear throughout recent UT publications, theses, and dissertations.

As more technologies incorporate AI and ML, universities and businesses around the

world grapple with a central question: how to protect this intellectual property. In the past year, patent offices in the U.S., EU, and Japan issued guidance clarifying the scope and bounds of patentability for inventions based on AI and ML.

Each office uses examples from several technical fields, such as facial-detection methods and network-monitoring algorithms, to demonstrate how the office will analyze subject-matter eligibility of AI/ML inventions.

With a stronger understanding of the patentability of inventions based on machine learning and/or artificial intelligence, UTRF is now well-positioned to support UT researchers who develop innovative applications of these technologies.

Commercialization Analyst Program Opens Doors to Diverse Careers

UTRF's Commercialization Analyst Program provides qualified graduate students with hands-on experience in the commercialization of intellectual property. Students work together with the UTRF licensing staff to aid in the evaluation, marketing, and licensing of innovative technologies developed across all campuses of the University of Tennessee. From participating in invention disclosure screenings and discovery meetings, to assessing the intellectual property landscape and identifying potential licensees, commercialization analysts play a key role in moving innovations from the lab to the marketplace.

Other benefits of the program extend beyond technology transfer. Students hone communication skills and learn market and industry analyses that benefit them

professionally, regardless of their chosen career path. They also observe practical application of business principles in areas of entrepreneurship, intellectual property protection, and licensing agreements. As a result, students leave the program with a greater understanding of the commercialization process and the impact of intellectual property on research growth and economic development.

Since the program's inception in 2011, UTRF has hosted 26 analysts, who have gone on to secure jobs in areas including law, venture capital, consulting, business development, and entrepreneurship. The unique education in commercializing UT innovations continues to help students develop career skills and explore opportunities away from the bench.



"The Commercialization Analyst Program highlighted the skill set I developed in graduate school and helped me prepare for job interviews by providing concrete examples of how I used particular skill sets in a non-lab setting."

Vanessa Nguyen, PhD, 2018 - 2019 Commercialization Analyst



OUTREACH



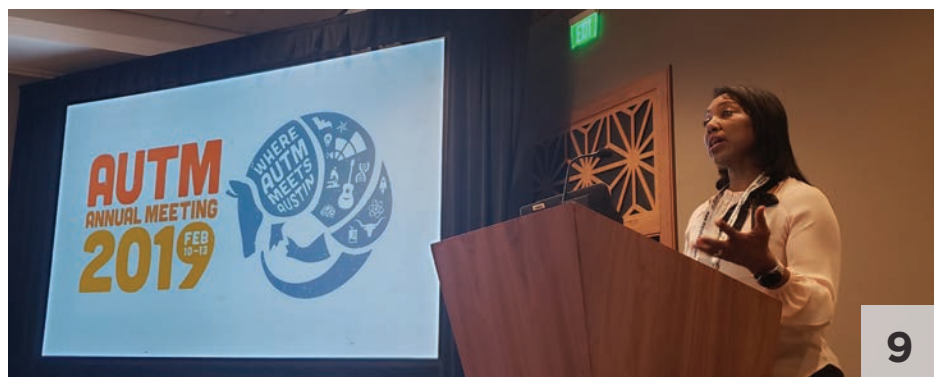


1. UTRF Licensing Associate Delira Robbins works the UTRF table at the 2019 UTHSC Research Resource Fair.
2. Geetika Singh, UTRF Ximbassador, presents about Ximbio and how faculty can provide their research reagents for licensing.
3. UTRF Licensing Associate Nghia Chiem received an AUTM Volunteer Service Award for his hard work as a member of the Better World Project Committee.
4. Rise and Grind informational session on “Preparing to Access Capital: Financials/Bookkeeping” with Three Roots Capital.
5. UTRF Vice President Richard Magid gives a tech talk on Technology Transfer Basics at UTHSC.
6. Winter Innovations receives the Innov865 Startup Day 2019 Crowd Favorite and Judge’s Choice Prizes.
7. UTC’s ReSEARCH Dialogues celebrates the work of faculty, staff, and students.
8. Anderson CEI & Haslam Business faculty member Shawn Carson gives an overview of customer development to participants of this year’s NSF I-Corps South Regional Program.
9. Senior Staff Attorney Dr. Lakita Cavin represents UTRF at AUTM 2019 Annual Meeting via a panel on compliance with recent amendments to the Bayh-Dole Act and ensuring effective assignment of IP.
10. Launch Tennessee hosts an SBIR/STTR workshop to discuss opportunities and resources available to entrepreneurial researchers in Tennessee.

EVENTS



8



9



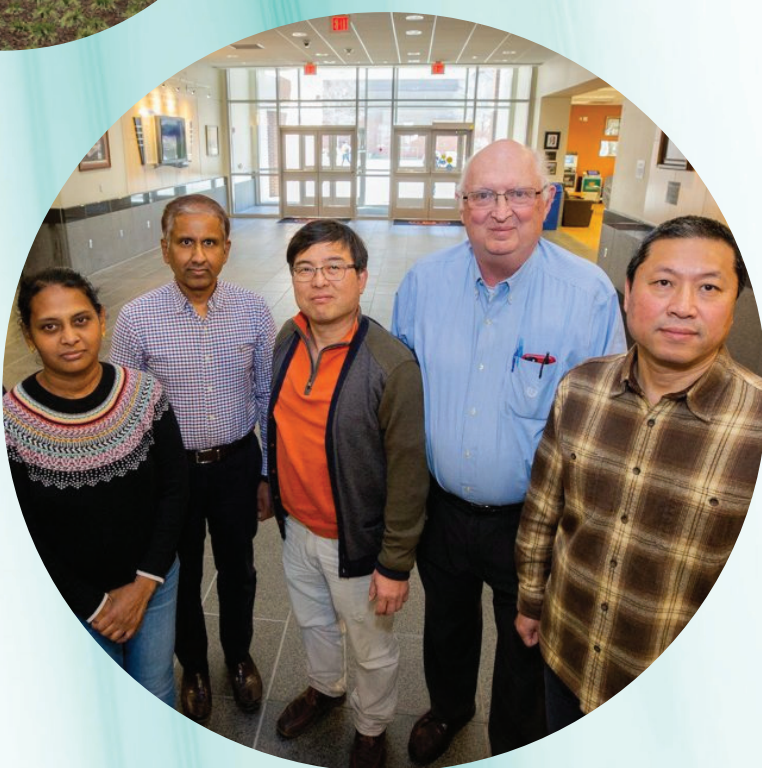
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RESEARCH

Growth & Collaboration

"Innovative medical treatments aren't widely associated as emerging from Tennessee - people tend to think of the Research Triangle area, Boston, or California," says Richard Magid. "But our assets, partnerships, and expertise position the University of Tennessee to achieve these breakthroughs through collaboration."



Tennessee's Triangle of Biotech Innovation

There's a triangle of teamwork in the state of Tennessee that's developing the future of targeted therapeutics. The UTHSC College of Medicine, UTHSC College of Pharmacy, and Oak Ridge National Laboratory are combining efforts and expertise to create breakthrough treatments for renal (kidney) disease – an extraordinary scientific and academic effort that's already attracting commercial biotech interest.

This new treatment stems from the research of Dr. L. Darryl Quarles, the UTMG Endowed Professor and Division Director of Nephrology at the UTHSC College of Medicine. Darryl's work uncovered a novel bone-kidney axis – pinpointing how the two are linked by a hormone known as fibroblast growth factor 23, or FGF23.

This discovery kicked off an effort formally known as computational drug discovery, a technologically-based method of discovering new drugs and developing new treatments. The trio of partners each played a key role in the process to translate this new knowledge into targeted treatments for chronic kidney diseases.

UTRF Takes UT Prototype to Market to Help Hospitals Cut Costs on IV Drug Use

As hospitals across the country see an increase in patients addicted to injectable opioids, they're also facing new treatment challenges: patients with a history of intravenous drug use who bring illegal drugs into the hospital to inject directly into their vascular access lines, which transport the drugs directly to their heart.

With the help of UTRF, a tamper-evident lock box named 'TEL BOXX' went to market in September 2018 to address this challenge. The team effort toward commercialization between UTRF and inventors from the Department of Mechanical, Aerospace, and Biomedical Engineering in UT's Tickle College of Engineering has resulted in the use of the box in eleven hospitals across eight states.

Promising New Treatment for Prostate Cancer Also Demonstrates Encouraging Results Against Triple Negative Breast Cancer

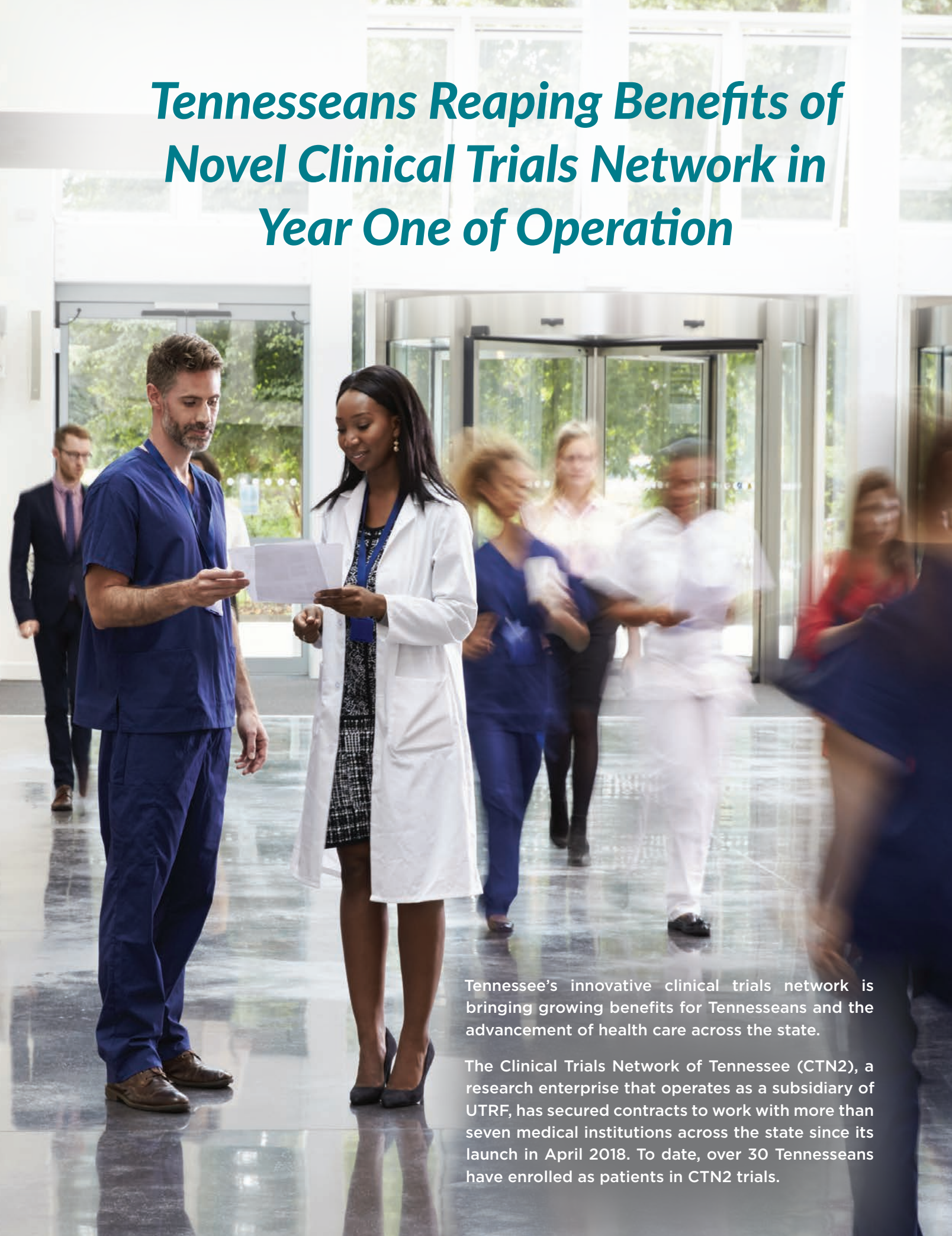
A research collaboration between the University of Tennessee Health Science Center, UTRF, and biopharmaceutical company Veru Inc. has resulted in a promising next generation oral cancer therapy. Known as VERU-111, this cancer therapy has the potential to treat not only advanced prostate cancer, but other cancer types including triple negative breast cancer, or TNBC.

VERU-111 is a first-in-class selective small molecule that targets and disrupts microtubules in cancer cells. Both in vitro and in vivo animal studies conducted by the UTHSC research team demonstrate the molecule's ability to inhibit tumor growth and metastasis, as well as overcome multidrug resistance. Although VERU-111 is currently being evaluated in advanced prostate cancer patients in an ongoing Phase1b/2 clinical trial, the preclinical efficacy results against TNBC reported in the October edition of *Molecular Cancer Therapeutics* provide further support that VERU-111 may also effectively treat other types of cancer.

Entitled "An orally available tubulin inhibitor, VERU-111, suppresses triple-negative breast cancer tumor growth and metastasis and bypasses taxane resistance," the published work combines expertise from the labs of Dr. Wei Li, professor of pharmaceutical sciences and Director of the UTHSC College of Pharmacy Drug Discovery Center, and Dr. Tiffany Seagroves, professor of pathology in the UTHSC College of Medicine. The research article's lead author is Shanshan Deng.

Images courtesy of Allen Gillespie/UTHSC, Shawn Poynter/UTK TCE, and Oak Ridge National Laboratory, U.S. Dept. of Energy.

Tennesseans Reaping Benefits of Novel Clinical Trials Network in Year One of Operation



Tennessee's innovative clinical trials network is bringing growing benefits for Tennesseans and the advancement of health care across the state.

The Clinical Trials Network of Tennessee (CTN2), a research enterprise that operates as a subsidiary of UTRF, has secured contracts to work with more than seven medical institutions across the state since its launch in April 2018. To date, over 30 Tennesseans have enrolled as patients in CTN2 trials.



CTN2 Officers & Advisors: from left to right, Phil Cestaro, Karen Johnson, Chancellor Steve Schwab, Steven Goodman, Robert Davis, Bill Mason, and Ari VanderWalde. Image courtesy of Kandi Hodges.

CTN2 is a state-wide clinical trial facilitator, bringing together hospitals, academic-grade research, and shared health data from across Tennessee to spearhead groundbreaking clinical research studies. These clinical trials, conducted by University of Tennessee Health Science Center (UTHSC) faculty, create a novel, robust research enterprise that operates as an independent arm of the University of Tennessee Research Foundation (UTRF).

“This network meets a huge need for UTHSC clinical research,” said CTN2 President and CEO Steve Goodman. “UTHSC is a leader in health care innovation and health technology, and CTN2 takes patient care to the next level by opening up access to novel therapies and medical devices.”

Just one year into operations, CTN2 has numerous studies underway and in the pipeline. Four clinical trials are open and enrolling patients, including a phase II trial in colon cancer and another building an outcomes registry for heart transplants. More than seven therapeutic studies are preparing to launch: phase I trials in advanced malignancies and oral premalignant lesions; phase II trials in heart failure; and phase III trials in bladder cancer, heart failure, and cardiomyopathy. A separate phase III study is forthcoming in ophthalmology.

In addition, CTN2 is spearheading research and data mining projects into the procurement of human biospecimens and post-market surveillance for medical device implants.

The innovative network is a unique asset to Tennessee residents, and as CTN2 grows, it will be a boon to public health and health care access. With affiliated practices and hospitals across the entire state, citizens in every region now have the opportunity to participate in CTN2 studies and reap the benefits of clinical research. Historically, Tennesseans have been underrepresented in large-scale studies leading to drug approval. CTN2 also affords state residents potential access to effective medications prior to wide approval.

“All Tennesseans stand to benefit from CTN2’s success, particularly the partnerships it’s building between hospitals, academia, and partners from the pharmaceutical and medical device industries,” said Richard Magid, vice president of UTRF. “Just one year in, CTN2 is already bringing novel medical studies home to state residents who need them, right here in their own communities.”



Focus on **ENTREPRENEURSHIP**

Following the Molecules: From Drug Discovery to Entrepreneurship

SEAK Therapeutics, LLC, began in the research lab of Pharmaceutical Sciences Professor Wei Li, who also serves as the Director of the UT College of Pharmacy Drug Discovery Center at the University of Tennessee Health Science Center. In 2017, Wei read a paper published by Muxiang Zhou, a professor at the Emory University School of Medicine, about the identification of a known small molecule that showed promise in mouse models of pediatric cancers. Intrigued, he reached out to suggest a collaboration.

UTHSC researchers began designing and synthesizing new compounds, known as analogs, similar in structure to the original molecule, while their Emory collaborators initiated the testing of their creations on protein targets and pediatric tumors. These efforts led to the discovery of a new analog with demonstrated ability to inhibit leukemia in a mouse xenograft model, without showing observable toxicities at the tested dosages.

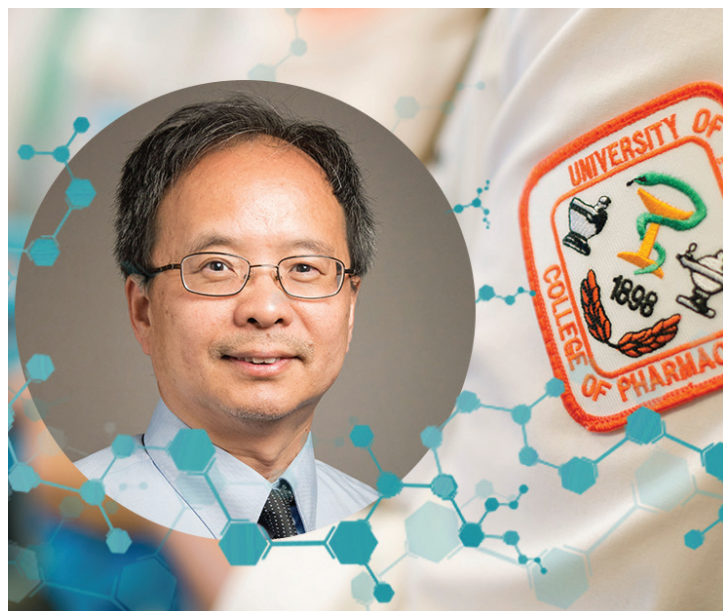
With support from UTRF, the new treatment's promising potential led Wei to form his own startup. The resulting company, SEAK Therapeutics, focuses on advancing drug development for pediatric cancers and potential small molecule drugs for neurodegenerative diseases. The startup was awarded its first SBIR grant in 2019.

Knoxville Scipreneur Challenge to Advance STEM Entrepreneurship

In partnership with Life Science Tennessee, Oak Ridge National Laboratory (ORNL), the University of Tennessee, and the Knoxville Entrepreneur Center, UTRF cosponsored the inaugural Knoxville Scipreneur Challenge, a nine-week training and outreach competition to promote STEM entrepreneurship in the Knoxville region. The program held its kickoff event in early September.

The Knoxville Scipreneur Challenge divides enterprising students, postdoctoral fellows, and mentors into teams and assigns each a STEM-related innovation developed by researchers at the University of Tennessee or ORNL.

During the nine-week challenge, participants learn how to create a business model, raise capital, conduct market research, adhere to government regulations, and pitch to investors. At the culminating pitch



Wei Li, founder of SEAK Therapeutics.



Participants of the Knoxville Scipreneur Challenge listen to overviews of STEM-related innovations.

competition, participants show off their ideas to a live audience — teams pitch their plans to the Knoxville business community in a chance to win cash prizes.



Nima Tamaddoni, Graham Taylor, & Andy Sarles.

Graham Taylor and Nima Tamaddoni are the founders of T&T Scientific, a company that makes tools and devices to help scientists and researchers more effectively and efficiently develop and utilize nanoparticles, known as liposomes. T&T specializes in technology that makes working with and producing liposomes more efficient, cleaner, effective, and cheaper.

To address inefficient lab tools and problems with contamination as well as save valuable research time, they designed a new NanoSizer™ Mini-extruder for liposome preparation, which not only improved the process but enlightened them on the potential of liposome preparation work.

UTRF helped the partners license a patent pending cell membrane measurement system, invented by Graham and his PhD advisor Andy Sarles, so that T&T Scientific could begin to develop and market the system globally. Graham and Nima credit their previous experience and UTRF's support in equipping them with the tools and connections to turn their business dreams into reality.

Genera Secures Investment for Sustainable Packaging and Fiber Products Made From Grass

In July, Genera announced the procurement of more than \$118 million in new investment for its first manufacturing facility to produce its Earthable® line of sustainable agricultural fiber products.

Genera will use locally grown grasses and other agricultural crops to make compostable food service packaging products like plates, bowls, and takeout containers at its new manufacturing facility in Vonore, TN. In addition to making products that are a sustainable alternative to plastics and polystyrene (Styrofoam-type products), Genera's Earthable® fibers are also used to produce a wide array of towel, tissue, cupstock and other paper products. Earthable® will be the largest fully integrated, domestic solution for ag-based fiber and food-grade packaging in the United States, designed to meet the growing, consumer-driven demands for more eco-friendly products in the food and consumer industries.



Example of Genera's Earthable® paper products.

T&T Scientific: From UT's Lab, to the Global Marketplace

Two University of Tennessee graduates are shaking up scientific research and manufacturing at a cellular level.

TennEra LLC, an affiliate of UTRF, has leased its former biorefinery in Vonore, TN, to Genera for development of the new manufacturing facility.

UT Researcher Makes a Business of Turning Organic Waste Into Fuel

Harnessing the power of communities can achieve great things, both in academia and the petri dish. Just ask the University of Tennessee's Alex Lewis, whose interdisciplinary education in biology, energy science, and engineering led to the cofounding of Electro-Active Technologies, a revolutionary startup making low-cost, renewable products from organic waste streams.



Alex Lewis gives an overview of Electro-Active Technologies.

Originally from Northern California, Alex came to East Tennessee for the unique opportunity to pursue a PhD in Energy Science and Engineering at the Bredesen Center for Interdisciplinary Research, which unites the assets of the University of Tennessee and Oak Ridge National Laboratory (ORNL). With undergraduate studies in biology, Alex was particularly interested in applications of microbial communities.

The Bredesen Center connected him with the UT Center for Renewable Carbon, where researchers work on technologies to render crops into usable biofuels. The processes take place in biorefineries, and leave behind a large waste product of carbon.

Advised by Chemical and Biomolecular Engineering Research Professor Abhijeet Borole, Alex set about looking for ways to save this carbon waste to make valuable, usable products like hydrogen. The biggest problem the team encountered was of special interest

to Alex: Biorefinery waste is complex and toxic, even to the microorganisms needed to degrade it.

In search for a solution to this problem, the partners set about evolving a new community of microorganisms that could stomach it, filtering out the weak and unresponsive while enriching and adapting the strong. They developed new technologies inside a novel dual-sided system: On one side, the special community of bacteria work together to break down waste into protons and electrons, which are sent to the other side and reacted to form hydrogen gas.

The initial innovation succeeded in creating a diverse microbial community as well as enabling the conversion of waste into hydrogen gas, usable as a fuel source.

After graduating from the Bredesen Center in 2017, Alex co-founded Electro-Active Technologies to make a business of producing renewable products from organic waste. That's when Alex and co-founder Dr. Abhijeet Borole widened the scope of their research: If microbial communities can adapt to take on biorefinery waste, what other more pressing possible applications might exist?

Enter the staggering global problem of food waste. An estimated 40% of the world's food goes to waste, in the U.S. this equates to more than 60 million tons every year. This waste has an estimated financial burden of \$218 billion, with the vast majority going into trash cans and landfills each year. That's not only wasteful, it's actively harmful: Food waste in landfills is one of the leading sources of methane emissions, 25 times more potent than CO₂. As a result, food waste became the microbial feedstock of choice for the new technologies.

Alex compliments UTRF for their guidance throughout the startup's inception and during the patenting process for his technologies: "UTRF was a critical partner to our creation of a new business and a central driver as we move forward in the commercialization process."



Licensing Ceremony - Seated: Michelle Buchanan of ORNL, Alex Lewis of Electro-Active Technologies, & Stacey Patterson of UTRF. Standing: Mike Paulus & Jennifer Caldwell of ORNL; Abhijeet Borole of Electro-Active Technologies; Maha Krishnamurthy of UTRF; & Edna Gergel and Brian Davison of ORNL.

“Alex’s idea was part of the inaugural NSF I-Corps South Regional program in October of 2017, where he got his feet wet in understanding customer needs,” remarks UTRF Vice President Maha Krishnamurthy. “Since that time, assisting Alex in the launch of Electro-Active Technologies has been a great experience in collaborative technology transfer and continued customer discovery. We look forward to seeing the outcome of Alex’s technologies, leveraging the many resources of UT and ORNL, with the potential to contribute to sustainability in industries and communities alike.”

Electro-Active Technologies is registered as a public-benefit corporation, and is already gaining significant ground. Earlier this year, the startup was accepted into accelerators in New York and California, and is now a member of ORNL’s Innovation Crossroads program. Additionally, the company recently secured more than \$1 million in new investments for further research and expansion and will be closing their seed round around the beginning of the new year.



Inventor Spotlight

In each monthly newsletter, UTRF shines the inventor spotlight on a UT faculty member. This is an opportunity to support and encourage the inventors who partner with UTRF to bring their innovations to market.



DANIEL COSTINETT

Department of Electrical Engineering and Computer Science, UTK



ANDY SARLES

Department of Mechanical, Aerospace, and Biomedical Engineering, UTK



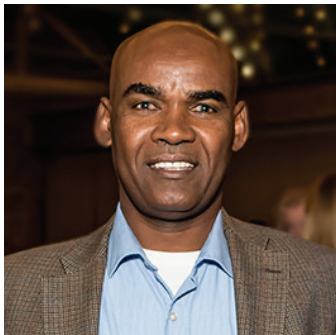
JENNIFER RICHARDS

Department of Agricultural Leadership, Education and Communications, UTIA



DARRYL QUARLES

Department of Medicine-Nephrology, UTHSC



OUDESSA KERRO DEGO

Department of Animal Science, UTIA



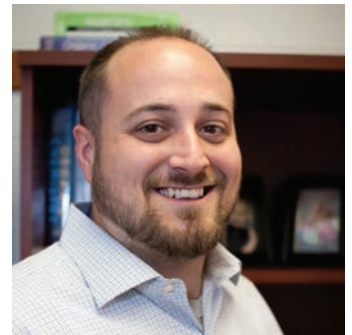
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College of Engineering and Computer Science, UTC



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College of Engineering and Computer Science, UTC

Technology IMPACT

“The measure of tech transfer should be lives impacted.”

- Maha Krishnamurthy

UT Researcher's Nonwoven Fabrics Protect the Health of More Than a Billion People

Peter Tsai may not be a household name, but odds are you know his work. The recently retired research faculty member of Material Sciences is the architect behind the essential technology in N95 respirators. In addition to respirators, Peter's technology has been widely used by industries for over three decades in products such as HVAC filters and medical face masks.

The University of Tennessee's world-renowned expert in nonwoven fabrics has 12 U.S. patents and over 20 commercial license agreements and counting under his belt. In the last six months alone, UTRF has non-exclusively licensed his most recent technology to four companies globally. His research has not only advanced the efficiency and application of nonwoven fabrics but has revolutionized the electrostatic charging and melt blowing processes themselves. Just last year, Peter developed a new approach to apply electrostatic charge to fabrics through friction. The resulting nonwoven fabric boasts a filter efficiency 20 times greater than that of untreated fabrics.

His diligent commitment has paid off in spades for people around the globe: It's estimated that more than one billion people have used Peter's technologies to protect and improve their health.

UT Extension Licenses Impact Young Lives

Curriculum development is a world of endless options, with one common goal: direct impact on the lives of students. UTRF works to multiply that direct impact to students around the country by assisting with the licensing of innovations coming from UT Extension.

As the educational outreach unit of UT's Institute of Agriculture, UT Extension brings the expertise and research capabilities of the state's flagship university directly to local communities. It provides educational programming to county residents on a wide universe of topics, including agriculture and natural resources, family and consumer sciences, community development, and 4-H youth development. In coordination with Assistant Professor of Agricultural Leadership, Education and Communications Jennifer Richards, who holds a split appointment as the curriculum specialist for Tennessee's 4-H program, UTRF has licensed four original curricula and counting.

From middle school food safety and STEM education, to the greenhouse and the engineering lab, UTRF is proud to partner with and support innovators who work to improve the education and future of students around the country, demonstrating that innovation can truly come from anywhere.



Curriculum specialist Jennifer Richards works with a student.



Gary Bates works with a new variety of orchardgrass.

Greener Pastures at UT's Beef and Forage Center

Gary Bates, professor and director of the UT Beef and Forage Center, and David McIntosh, coordinator of the Beef and Forage Center, have developed an improved, hardy foraging crop.

Persist orchardgrass, one of the most popular commercial forage grasses currently in use throughout the nation, grew out of the University of Tennessee nearly 20 years ago. Persist is a particularly vigorous variety, the bread-and-butter of livestock pasture diets. It was developed by Bob Conger, now retired from heading the UT Institute of Agriculture's forage breeding and genetics program. But could this already-successful orchardgrass be improved? Gary asked himself that very question when he realized a lack in the development of a new variety.

After nearly 10 years of research and trials, Gary and David achieved a new variety of orchardgrass with higher yields, increased persistence against grazing, and better disease resistance. Though most varieties of orchardgrass are developed by private companies, not many are developed by academics looking at the specific characteristics of Persist, and even fewer are developed in the mid-south area of Tennessee, Gary explained. The new variety is specifically adapted to this climate, a tremendous asset to Tennessee producers.

The Weight of Water

A team of recent University of Tennessee graduates stand to revolutionize competitive swimming training with the invention of a swim resistance device, newly licensed with the assistance of UTRF. The technology was born out of Associate Professor Emeritus J.A.M. Boulet's senior design course for fourth-year students in the Department of Mechanical, Aerospace, and Biomedical Engineering (MABE).

The students spent a full year designing the new system and testing prototypes in the pool with UT swimmers. They brainstormed options, ranking them by how each might solve any one of the swimmers' problems: affordability; size; and ease to maneuver, set up, and use, etc. The result is a small rectangular box, around 18 in. long and 6 in. high. Inside the box are two compartments containing the mechanical components, and an external component allows swimmers to choose resistance levels. The device connects to the diving platform and enables two swimmers to use it simultaneously. Once the swimmer stops swimming, the cable can automatically start reeling back in, eliminating the previously manual part of the process.

The swim resistance system was such a success that Professor Boulet connected the team with UTRF for potential patent and licensing support. UTRF walked the team through the licensing process, and the swim resistance system was officially licensed in 2018, making UTRF's first undergraduate technology to be licensed.



UT swimmer tests the swim resistance system.



The annual maturation program aims to assist researches in advancing new technologies on the path to market by awarding up to \$15,000 in direct costs to the highest ranking proposals. The program is open to researchers, faculty, staff, and students across all University of Tennessee campuses and institutes.

2019 TECHNOLOGY MATURATION GRANT RECIPIENTS

Inventors	Technology
Tarek Hewezi UTIA - Department of Plant Sciences	Experimental Validation of Novel Soybean Cyst Nematode Resistance Genes
Kaitlin Oliver-Butler & Caleb Rucker UTK - Department of Mechanical, Aerospace & Biomedical Engineering	The EndoTheia System: Endoscopic Surgical Tools with Notched-Tube Continuum Robots
Oudessa Kerro Dego UTIA - Department of Animal Science	Staphylococcal Surface Proteins as Vaccine Antigens to Control Mastitis in Dairy Cows
Michio Kurosu & Bilal Bin Hafeez UTHSC - Department of Pharmaceutical Sciences	In Vivo Studies of a Novel DPAGT1 Inhibitor, APPB for Treatment of Pancreatic Cancers
Monica Jablonski & Mohamed Moustafa UTHSC - Department of Ophthalmology	Pregabalin Microemulsion Glaucoma Therapy: Stability Studies
Tayebah Pourmotabbed & Anton Reiner UTHSC - Department of Microbiology, Immunology and Biochemistry; Department of Anatomy & Neurobiology	Determination of the Dosing Regimen and Duration of Benefit of DNZ6 DNAzyme Treatment in R6/2 Mice
Adebowale Adebisi UTHSC - Department of Physiology	Methods of Detecting and Reducing Acute Kidney Injury in Infants



2019 INNOVATION Awards

The 2019 University of Tennessee Research Foundation (UTRF) Innovation Awards celebrated a banner year in innovation and marketplace success for university-based technologies. The Innovation Awards ceremonies, held on December 4 in Knoxville and December 5 in Memphis, recognized the UT researchers whose innovations better society. Throughout this year, UTRF received 168 invention disclosures and filed 108 patents for UT inventions.

2019 honorees at the Knoxville awards ceremony included researchers who patented 19 new innovations and/or secured 28 licenses, as well as a new startup company showing enormous potential, Electro-Active Technologies. Five teams of UT researchers were awarded Maturation Grants, helping to further the development of technologies with potential for commercial success. The University of Tennessee's Dr. Peter Tsai was honored with the prestigious Innovator Hall of Fame Award for his decades of innovation, developing life-saving technologies that have protected the health of more than one billion people across the globe.

Dr. Tsai's technology has been widely used by industries for over three decades in products such as respirators, HVAC filters, and medical face masks. He holds 12 U.S. patents and has secured 20 commercial license agreements and counting; in 2019 alone, UTRF non-exclusively licensed Dr. Tsai's most recent technology to four companies globally.

"The Innovator Hall of Fame Award is reserved for the University of Tennessee's most extraordinary researchers, who are

proactively advancing their innovations to the marketplace where they can change lives for the better," said Dr. Stacey Patterson, UTRF president and University of Tennessee vice president for Research, Outreach and Economic Development.

Recognizing career-spanning excellence in innovation and commercialization, the award is presented to a UT researcher who has consistently pursued commercialization and market success for significant university-based technologies with dogged enthusiasm and energy. The award is sponsored by a generous gift from the B.Otto and Kathleen Wheeley Foundation.



Peter Tsai receives the Innovator Hall of Fame Award.



Duane Miller is recognized for receiving his 100th patent.

The Memphis Innovation Awards held at the University of Tennessee Health Science Center (UTHSC) honored researchers who patented 13 new technologies; innovators who secured 8 licensing agreements; and two startups born from UTHSC technologies for their outstanding progress, SEAK Therapeutics, LLC and Azimuth Sleep Solutions, Inc. UTRF awarded four Technology Maturation Grants to UTHSC faculty and research teams to support further development of commercially-viable projects. Additionally, two spotlight presenters shared about their innovations in biomedical engineering and biomechanics. The ceremony's guest of honor was UTHSC College of Pharmacy's Dr. Duane Miller, who recently received his 100th U.S. patent.

"Earning 100 U.S. patents is a rare achievement even for the very best inventors, and Dr. Miller's accomplishment marks his preeminence among academic researchers across the globe," said Dr. Richard Magid, vice president of UTRF at UTHSC. "We're proud to have helped Dr. Miller reach this extraordinary achievement through his research at UTHSC."

Dr. Miller was inducted into the National Academy of Inventors in 2015 for his life-changing innovations using synthetic medicinal structures to attack diseases. His research helped discover the first new nonsteroidal selective androgen receptor modulators (SARMs). The world-renowned expert in pharmaceutical sciences holds over 400 patents and patent applications, has authored more than 430 publications and 16 book chapters, and has presented at over 360 U.S. and international conferences.

"The UT innovators honored at this year's awards showcase the enormous potential of the University of Tennessee's research" said Dr. Maha Krishnamurthy, vice president of UTRF. "Through commercialization and prioritizing industry partnerships in the marketplace, inventions built here in Tennessee are impacting lives across the globe."

"The enormous successes of 2019 show how the University of Tennessee significantly impacts our region throughout the lifeline of innovation with UTRF's support."

- Stacey Patterson

Jillian Maeder & Michael Berry receive a 2020 Technology Maturation Grant.



Azimuth Sleep Solutions, Inc., receives a startup award.



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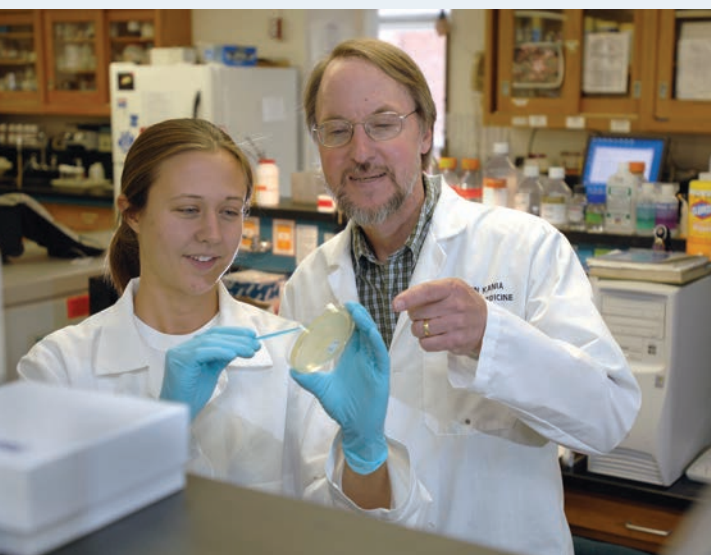
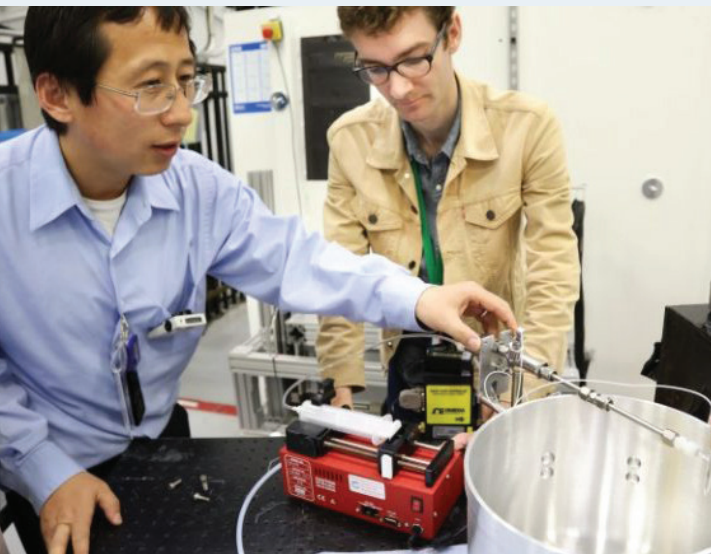
Board Members	Role
Rhonda Rice	Board Chair, External Representative, Knoxville
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Mike Paulus, PhD	UT-Battelle Representative
Jamie Woodson, JD	UT Board of Trustees Representative

FY 2019

PATENTS



10,010,516	Method for Regulating Retinal Endothelial Cell Viability	10,155,728	Compounds for Treatment of Cancer
10,010,521	Sarms and Method of Use Thereof	10,160,645	Microwave AC Conductivity of Domain Walls
10,017,391	Direct Polymer Templating Synthesis of Mesoporous Carbon	10,160,813	Tissue Plasminogen Activator Antibodies and Methods of Use
10,017,471	Selective Androgen Receptor Degradar (SARD) Ligands and Methods of Use Thereof	10,177,647	DC Current Controller for Continuously Variable Series Reactor
10,019,470	Method and Apparatus for Constructing, Using and Reusing Components and Structures of an Artificial Neural Network	10,179,180	Local Thermal Actuation of Material Surfaces via Micro- and Nanowire Heating for the Prevention of Cellular Attachment and Biological Fouling
10,022,356	Compounds for Treatment of Cancer	10,191,094	Synchrophasor Measurement Method for Power Systems
10,024,897	Mobile Electric Field Sensor Based Phasor Measurement Unit for Monitoring an Electric Power Grid	10,202,478	Multigraft Copolymer Superelastomers by Emulsion Polymerization
10,035,763	Selective Androgen Receptor Degradar (SARD) Ligands and Methods of Use Thereof	10,213,506	Targeting Immunotherapy for Amyloidosis
10,046,050	Targeting Immunotherapy for Amyloidosis	10,221,355	Ternary Metal Halide Scintillators
10,053,418	Selective Androgen Receptor Modulators and Methods of Use Thereof	10,248,675	Method and Apparatus for Providing Real-Time Monitoring of an Artificial Neural Network
10,055,434	Method and Apparatus for Providing Random Selection and Long-Term Potentiation and Depression in an Artificial Networks	10,255,684	Motion Correction for Pet Medical Imaging Based on Tracking of Annihilation Photons
10,093,613	Selective Androgen Receptor Degradar (SARD) Ligands and Methods of Use Thereof	10,258,596	Method of Treating Her2-Positive Breast Cancers with Selective Androgen Receptor Modulators (SARMS)
10,095,718	Method and Appartus for Constructing a Dynamic Adaptive Neural Network Array (DANNA)	10,301,285	Compounds for Treatment of Cancer
10,100,232	Wood Adhesives Containing Reinforced Additives for Structural Engineering Products	10,308,685	Inhibitory Peptides of Viral Infection
10,106,807	Transcription Factor which Regulates Flavonoid, Phenylpropanoid, Tyrosine, and Tryptophan Pathways	10,314,771	Methods and Compositions for Preventing and Treating Tooth Erosion
10,123,718	Methods, Systems, and Assemblies for Measuring Bioelectrical Signals of Intra-Abdominal Organs	10,314,797	Selective Androgen Receptor Degradar (SARD) Ligands and Methods of Use Thereof
10,145,063	Comprehensive Process for Selectively Separating Lignocellulosic Biomass into Purified Components with High Yield	10,314,807	A Method of Treating Her2-Positive Breast Cancers with Selective Androgen Receptor Modulators (SARMS)
		D826,874	Tampering Detection Clamping Box for Ingress/Egress Lines
		D826,875	Tampering Detection Clamping Box for Ingress/Egress Lines



Featured Inventors

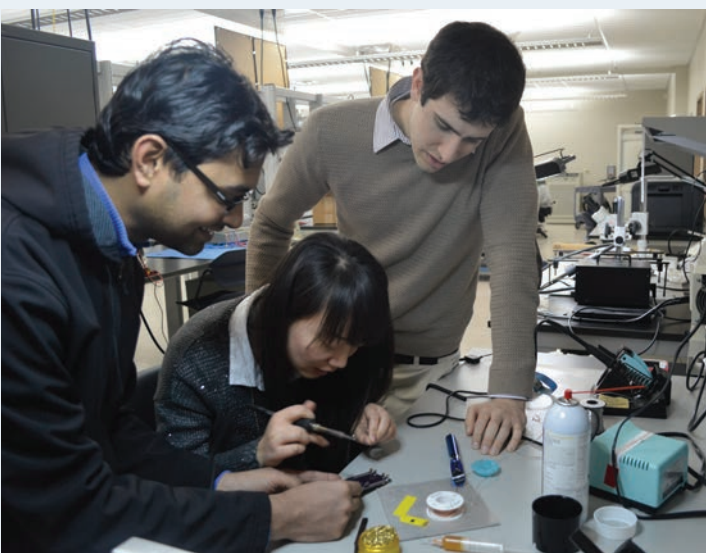
UT researchers who submitted invention disclosures 7/1/2018 - 6/30/2019.

- | | |
|----------------------------------|----------------------------|
| Abbas Babajani-Feremi | Daniel Velasquez Padilla |
| Adrien Hespel | David Anderson |
| Agnieszka Anna Piatek | David Marsh |
| Ahmed Bettaieb | Dayakar Penumadu |
| Alessandro Occhialini | Debolina Ganguly |
| Alex Pawlowski | Deborah Weighill |
| Alex Stiles | Denita Hadziabdic-Guerry |
| Alexander Pfotenhauer | Dingrui Li |
| Alexis Hall | Dong-Jin Hwang |
| Andrew Reis | Duane Miller |
| Andy Pulte | Dustin Crouch |
| Anna Furches | Edward Rosloniec |
| Ansul Lokdarshi | Edwin Rodger Ling |
| Austin Saporito | Eric Muckley |
| Baoshan Huang | Erica Grant |
| Barry Bruce | Fangxing (Fran) Li |
| Bernd Meibohm | Farah Kandah |
| Bin Hafeez | Floyd Ostrowski |
| Bob Martin | Fran Li |
| Bode Adebowale Olukolu | Francesco Giorgianni |
| Brad Fisher | Francisco Barrera Olivares |
| Brett Compton | Fred Wang |
| Brian Leib | Garrett Rose |
| Brian Long | Gavin M. Webb |
| Burt Sharp | Gustav Miranda-Carboni |
| Caleb Marshall Walker | Hairong Qi |
| Cameron Fili | Handong Gui |
| Carrie Stephens | Hantao Cui |
| Catherine Virden | Heather Young |
| Chad Duty | Henry Yin |
| Charles Melcher Charles Rizzo | Hicham Khei Ghossein |
| Charles Ryan Yates Chris Bridges | Hoi Chun Ho |
| Chris Maroon | Ishita Ray |
| Chris Wyman | James Blackford |
| Christopher Robert Duff | James Brosnan |
| Clayton Maner | James Coder |
| Cong Trinh | James Dee |
| Daniel Hartman | James Schumacher |
| Daniel Sarver | James Swart |
| | Jared Burris |
| | Jason Williams |
| | Jay Whelan |

Jennifer Ferris
 Jennifer Richards
 Jerry Duncan
 Jiahao Niu
 Jiecheng "Jeff" Zhao
 Jillian McCarthy Maeder
 Jimmy McClure
 Jingxin Wang
 John Daniel Till
 John Haas
 John Sorochan
 Jon Chapman
 Jon Wall
 Jonathan Jaggar
 Jordan Andrew Failla
 Jose Guillermo Stovall
 Joseph Keith Warner
 Josh Campbell
 Juan Luis Jurat-Fuentes
 Kaizhong Guan
 Karen Tobias
 Kaustubh Mungale
 Kevin Tomsovic
 Krishna Prasad Koirala
 Kristina Wick
 Kyle Houston
 Kiley Dickson
 Larry Millett
 Laura Detti
 Lawrence Pfeffer
 Leon Tolbert
 Leroy Selvidge
 Li Zhang
 Lia L. Winter
 Liam Frederic Page
 Lin Zhu
 Ling Lin
 Lingyue Zhang
 Longfei Zhang
 Lorraine Albritton
 Maria Angeles Osuna
 Marie Dennis Leo
 Mark Dadmun
 Mark Stephen Whorton
 Marko Radic
 Martin Grossbeck
 Matthew Mench
 Max Ferrari Maglia
 Md Adnan
 Meena Jaggi

Meg Staton
 Meggan Graves
 Mehdi Chaib
 Meng Xie
 Merry Koschan
 Michael McDonald
 Michael W. Berry
 Michael Winstead
 Mina Sartipi
 Miriam Larson
 Mohamad Elabiad
 Murali Yallapu
 Natalie Bumgarner
 Nate Brady
 Nathan Oliver
 Nawajes Mandal
 Neal Stewart
 Neiko Levenhagen
 Patrick Biddix
 Patrick Jung
 Paul Rollins
 Paul Terry
 Peter Liaw
 Philip D. Rack
 Phillip Myer
 Phillip Wadl
 Pradeep Lukka
 Preston Provins IV
 Qiang He
 Qijun Zhang
 Raja Gangaraju
 Raji Rajesh Lenin
 Rajiv Dhand
 Ramesh Krishnan
 Ramesh Narayanan
 Ramki Kalyanaraman
 Randi Dunagan
 Rebekah Thompson
 Remigiusz Grzeskowiak
 Richard Lee
 Robert Counce
 Robert Dan Lieberthal
 Robert Grzywacz
 Robert Snowden
 Robert Trigiano
 Rui Feng
 Ryan Blair
 Ryan Flint
 Ryan Ginder
 Samantha Bratcher






Samuel Evans
Sara Parvanezadeh Esfahani
Sarah Boggess
Sarka Beranova
Saurabh Pethe
Saxton Long
Scott Lenaghan
Sean Keith Alcorn
Sean Quisenberry
Seddik Djouadi
Seunghyun Ryu
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William Klingeman III
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Xinyi Wang
Xueping Li

Yali He
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Yang Song
Yilu Liu
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Yuanjun Song
Yuntao Wu
Zachary Sims
Zhifei Zhang
Zhihao Jiang
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