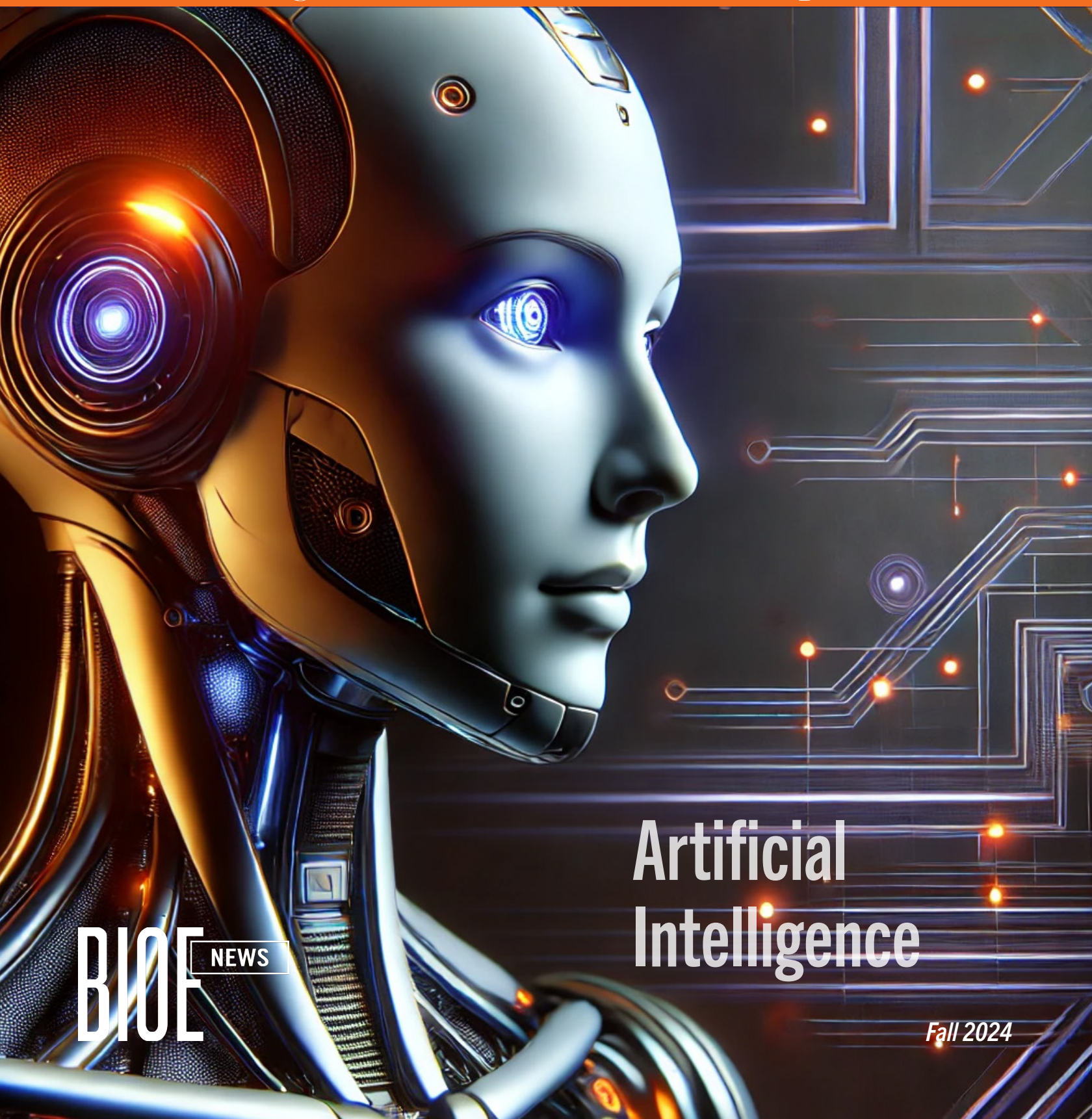
Department of
BIOENGINEERING
Clemson® University

Educating Thinkers, Leaders and Entrepreneurs



Artificial Intelligence

BIOE NEWS

Fall 2024

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Cover and editorial illustrations by Olga Reukova — *AI Concept art, images generated with Dall-e.*

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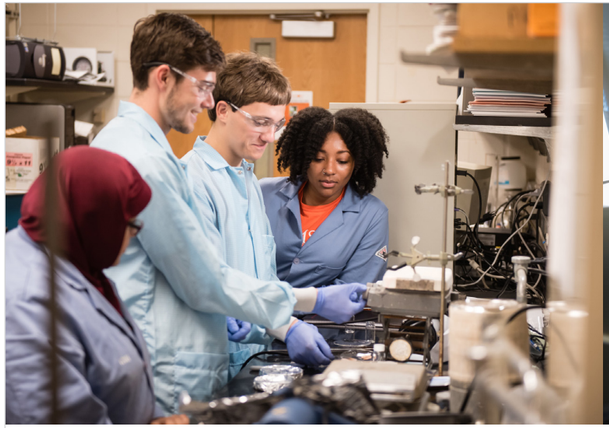
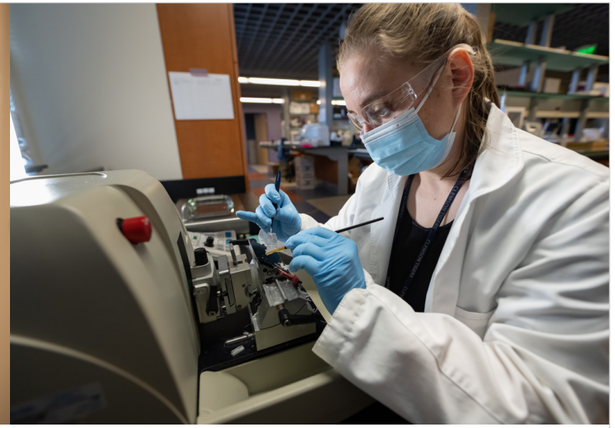




Master of Science in Bioengineering

Non-thesis (1 year)

Offered through:

DEPARTMENT OF BIOENGINEERING AT CLEMSON UNIVERSITY

Overview:

- The Master of Science (M.S.) in Bioengineering - Non-Thesis is a full-time, 1-year, course-based graduate program designed for engineers, scientists, and clinicians.
- Students will be assigned an initial faculty adviser, who will assist the student in designing a plan of study that creates a cohesive degree program with a concentration in a particular bioengineering focus area.
- Focus areas include but are not limited to biomedical devices, biomaterials, bioimaging, biomechanics, biotechnology, and tissue and cell engineering.
- The Clemson bioengineering department offers this degree program across three campuses: Clemson, SC, Greenville, SC, and Charleston, SC.

clemson.edu/cecas/departments/bioe/academics/graduate/ms.html

Program Goals:

Prepare students for exciting careers in industry, academia, or healthcare sectors through a combination of basic science knowledge, engineering strategies, and clinical applications

Program Outcome:

- Earn a graduate MS degree in Bioengineering
- Introduces the students to the major challenges in bioengineers, along with strategies and evolving technologies

Department of BIOENGINEERING Clemson University

CONGRATULATIONS

to 2024 Student Design Team Winners!

National Awards

Bloom Speculum
2024 PDMA Undergraduate Design Competition, 1st Place
2024 Johns Hopkins Healthcare Design Competition, 1st place
2024 SPARK Challenge, 3rd Place
2024 Brook T. Smith Launchpad Liftoff Competition, 1st Place
PDMA"s Global Student Innovation Challenge, Finalist
2024 NIH DEBUT Design Competition, Honorable Mention

NephroGuard
2024 PDMA Undergraduate Design Competition, 3rd Place
2024 SPARK Challenge, 1st Place
2024 Brook T. Smith Launchpad Liftoff Competition, 3rd Place
2024 NIH DEBUT Design Competition, Kidney Technology Development Prize

CallSense
SCInnovates Competition, Semi-Finalists
SCInnovates Competition, Finalists
SCInnovates Competition, 2nd Place

DynaGait
SCInnovates Competition, Semi-Finalists

HemaSTOP
SCInnovates Competition, Semi-Finalists

E-Walk
SCInnovates Competition, Semi-Finalists
SCInnovates Competition, Finalists
SCInnovates Competition, 1st Place
SCInnovates Competition, Audience Favorite
2024 PDMA Undergraduate Design Competition, 2st Place
PDMA"s Global Student Innovation Challenge, Finalist

StepSync, AT-AT Walker
2024 PDMA Undergraduate Design Competition, 3rd Place
2024 SPARK Challenge, 2nd Place

ValiDrug
2024 Engineering World Health Design Competition, 1st Place

Senior Design Expo

Bloom Speculum
1st Place Expo

NeoCom
2nd Place Expo

CathLite
3rd Place Expo

AI concept illustration by Olga Reukova, generated with Dall-e

INNOVATION

INNOVATION AND TECHNOLOGY

TECHNOLOGY

WOUND WARRIORS:

Clemson University bioengineers aim to fight bacterial infections with new sensor

Clemson News | Paul Alongi

A new sensor in development at Clemson University is designed to detect bacterial infections in wounds before they become serious and resistant to antibiotics, a problem affecting millions of Americans each year.

Jordon Gilmore, an associate professor of bioengineering, said his long-term goal is to make the sensor simple and inexpensive enough that it could be used by an at-home caregiver with no special medical training. It would provide answers about infection severity in as little as five minutes.

The sensor could eventually be combined with an imaging device and artificial intelligence to create a fully integrated diagnostic tool, he said.

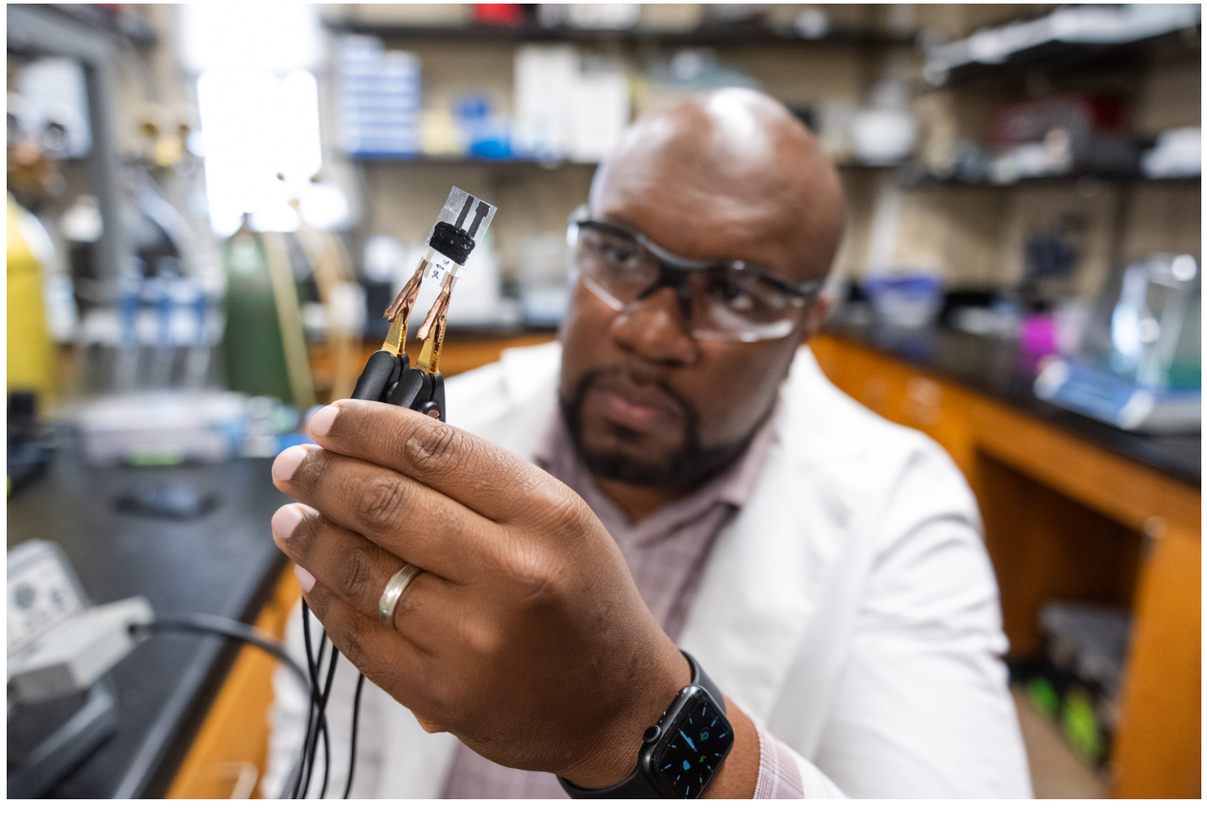
“Someone could put a sensor on a wound and take a picture, and we could put that information together and determine at what stage of infection the wound is,” Gilmore said. “That is the goal, and that is important, because the climate of healthcare and health economics is moving a lot of wound care to home health. Fewer and fewer people are able to afford going to specialized wound care centers, so it’s really important that you have access to clear diagnostics.”

More than 2.8 million drug-resistant infections occur each year in the United States and lead to 35,000 deaths, mostly because antibiotics are ineffective against drug-resistant bacteria, Gilmore said. The healthcare costs hit $4.6 billion annually, he said.

The problem that patients and their doctors face is that bacteria form biofilms that protect themselves from antibiotic treatments. The cell-communication strategy that bacteria use to form biofilms is called quorum sensing.

The sensor that researchers envision would track quorum sensing to provide information on how quickly bacteria are growing and how fast biofilms are developing.

Part of what makes the sensor unique is that it would be flexible and able to measure electrical and chemical activity related to bacteria growth.



Jordon Gilmore shows a prototype of the sensor he and his team are developing as part of a CAREER award from the National Science Foundation

The sensor would help take some of the subjectivity out of how wounds are now diagnosed, Gilmore said.

Doctors now consider factors such as the wound’s size, depth and smell and classify it on a scale of 1-4 with the higher numbers signifying greater contamination. What might seem like a Class 2 wound to one doctor could be a Class 3 to another, Gilmore said.

The sensor would help eliminate some of the ambiguity by giving a quantitative measure of how the wound is doing, Gilmore said.

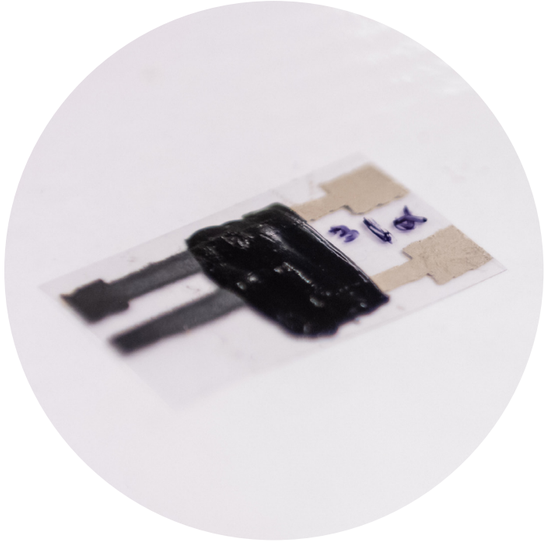
A better and quicker diagnosis would help doctors prescribe the correct antibiotics and dosage at the most opportune time, he said.

Gilmore is conducting the research as part of a CAREER Award from the National Science Foundation. He received his Ph.D. in bioengineering at Clemson and did postdoctoral research at the University before joining the faculty.

As part of the CAREER award, he is planning to start a 10-week virtual education program that would be focused on biomedical applications of artificial intelligence and aimed at veterans and non-traditional students at undergraduate institutions. The goal will be to expose them to undergraduate research through coursework, research and workshop experiences.

Gilmore said the idea was inspired by his undergraduate experience at The Citadel, where he received a Bachelor of Science in electrical engineering. Some of his most impressive classmates were veterans and active-duty personnel who had families and other commitments that prevented them from participating in experiences that would have helped prepare them for research and graduate school, he said.

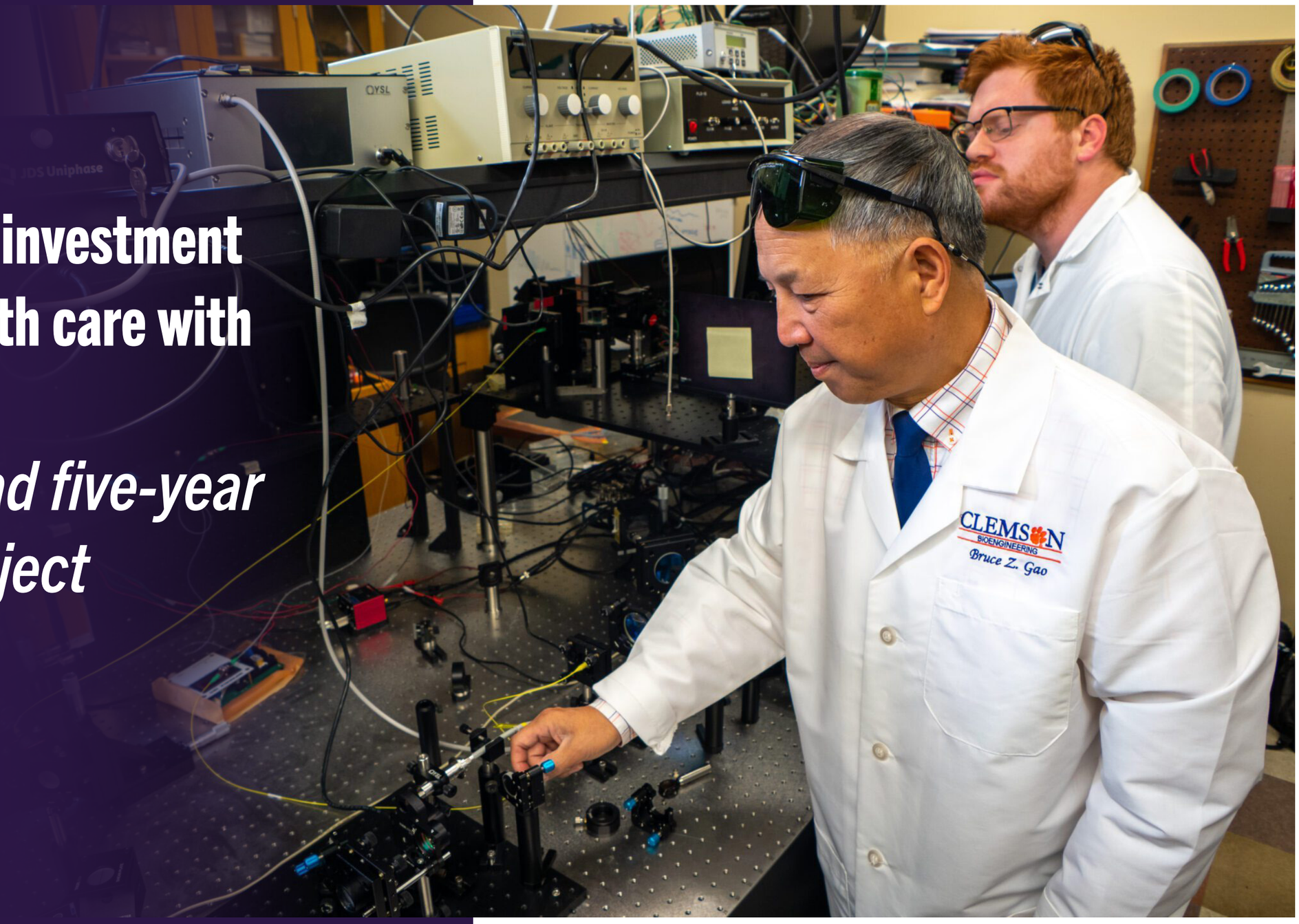
“I want to be able to tap into that really amazing talent pool that they are,” Gilmore said. ■



$20 million NSF investment will change health care with the use of AI.

Clemson to lead five-year ADAPT-SC project

Clemson News | Scott Miller



Health care providers face numerous challenges diagnosing disease, monitoring infections from traumatic injuries and predicting likely outcomes of various treatment plans, but AI can remove some of those challenges. Bruce Gao, ADAPT scientific lead and South Carolina SmartState Endowed Chair of biofabrication engineering at Clemson, is researching solutions to these challenges

A Clemson-led coalition of South Carolina researchers has formed to modernize health care diagnostics and treatment in South Carolina with the use of AI.

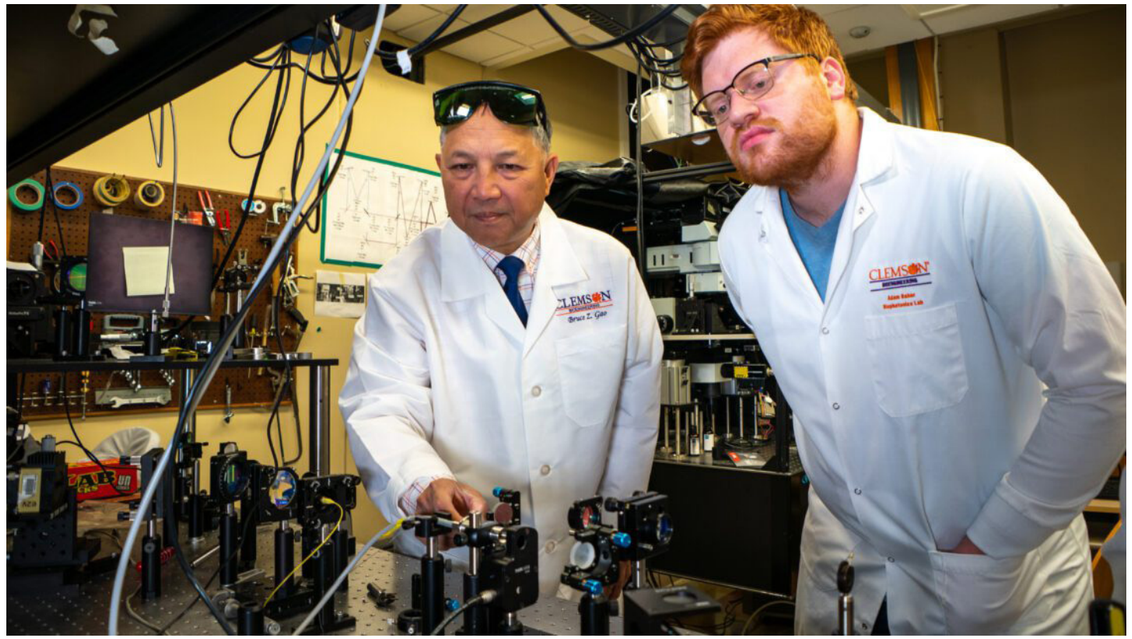
The National Science Foundation announced a $20 million, five-year investment in a multi-institutional project called Artificial Intelligence-Enabled Devices for the Advancement of Personalized and Transformative Health Care in South Carolina or ADAPT-SC. Funding comes from the National Science Foundation's Established Program to Stimulate Competitive Research (NSF EPSCoR) Research Infrastructure Improvement Track-1 Award, which bolsters their overall goal to improve the research and development competitiveness of researchers and institutions within EPSCoR jurisdictions.

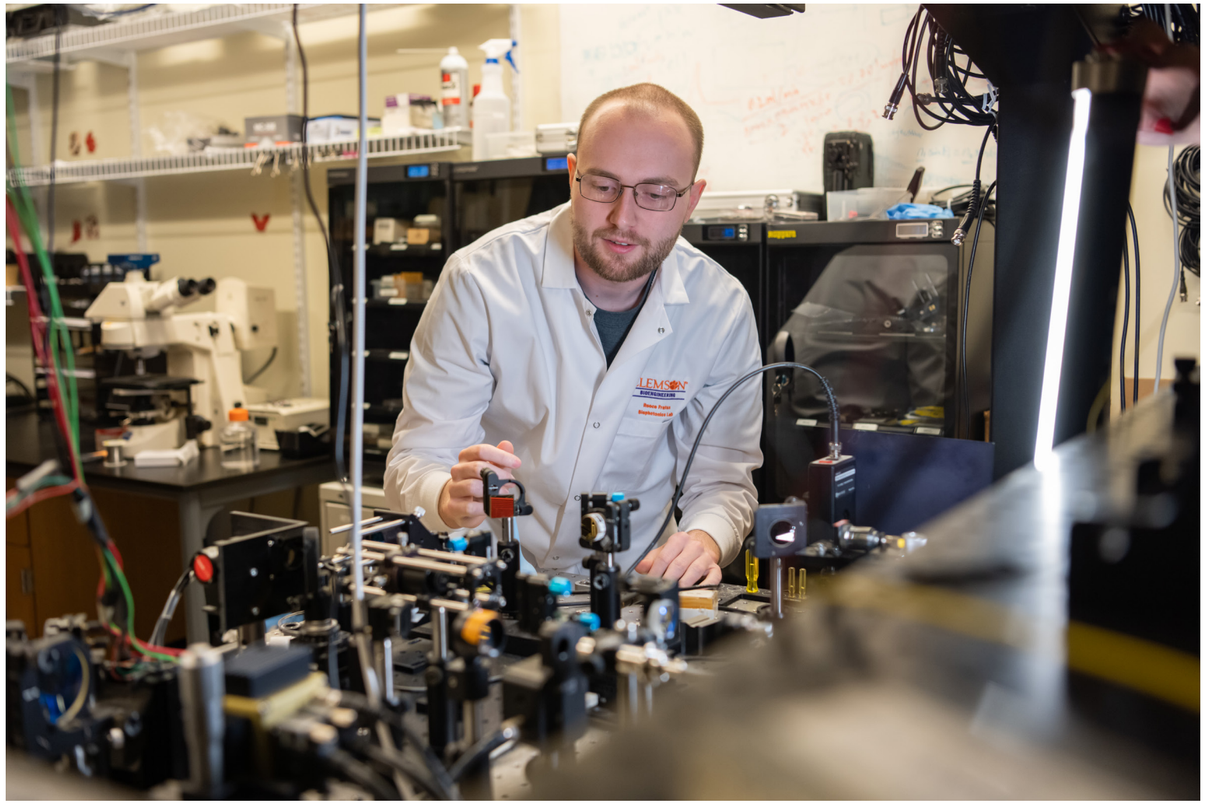
Clemson University will lead a statewide team of researchers from 11 institutions who will work closely with industry to advance AI-enabled medical devices and to train an AI-ready workforce.

Collaborators include the University of South Carolina, the Medical University of South Carolina, Benedict College, Claflin University, South Carolina State University, College of Charleston, Francis Marion University, The Citadel, Winthrop University and Tri-County Technical College. To advance translational research, ADAPT also will work with SC Bio, a statewide economic development organization and life-sciences industry association with nearly 200 members.

"Health innovation has long been a strength at Clemson, and we continue to build a strong platform in AI research. ADAPT will bring these two critical fields together to improve the quality of care and

> "Translational research and economic development will be the cornerstones of ADAPT-SC. With an exceptional network of collaborators, ADAPT-SC is well positioned to reach all areas of South Carolina with life-saving health care technologies and a skilled workforce for the future. I want to thank our partners for joining this effort and NSF for investing in this cause."
>
> *Clemson University President Jim Clements*





life in South Carolina," said Tanju Karanfil, principal investigator on the project and Clemson vice president for research. "Ultimately, patients and their families will be the beneficiaries of what we believe will be life-saving research."

The project has three primary goals:

1. Build research capacity in AI-enabled biomedical devices in strategically identified areas to transform SC's health care system, particularly in underserved areas;

2. Build a diverse talent pool in the field of biomedical AI through innovations in education and workforce development from K-12 through all levels of higher education; and

3. Foster interdisciplinary collaborations and academic–industrial partnerships by establishing research, education, and technology-transfer integrated programs.

Examples of ADAPT research projects include incorporating AI into diagnostic devices to illuminate some of the hidden underlying causes of cardiovascular disease, accurately detect wounds in intensive care units or predict the likely outcome of peripheral artery disease. Digital twins of patients will also be used to test AI-enabled therapy and rehabilitation plans for lung-cancer patients. ADAPT also will evaluate AI trustworthiness and device security.

"Health care providers face numerous challenges diagnosing disease, or monitoring infections from traumatic injuries, or predicting likely outcomes of various treatment plans. It is an incredibly difficult job, but AI can remove some of those challenges," said Bruce Gao, ADAPT scientific lead and South Carolina SmartState Endowed Chair of biofabrication engineering at Clemson. "In particular, AI can provide expedient information that will help physicians create a care of plan specific to each patient's condition and medical history."

To advance the research, EPSCOR funds will support hiring five tenure-track faculty members and eight postdoctoral researchers throughout the state, as well as adding new computing and other infrastructure. The project involves more than 30 faculty members across the institutions and is expected to support training for more than 100 new Ph.D. students and 400 undergraduate students. ADAPT will conduct outreach to encourage K-12 students throughout the state to explore careers in science, technology, engineering and math, and provide training to K-12 STEM educators.

This material is based upon work supported by the National Science Foundation under Grant No. 2242812. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the view of the National Science Foundation. ■

AT THE PINNACLE OF A MEDICAL BREAKTHROUGH FOR FAMILIAL HYPERCHOLESTEROLEMIA

Renee Cottle

Dr. Renee Cottle at her lab

The Clemson Bioengineering Department is strengthening its position as a hub for innovative, high-impact genome engineering research with a new multi-million-dollar R01 project funded by the National Heart, Lung, and Blood Institute at the National Institutes of Health (NIH). The Principal Investigator awarded this 4-year R01 grant is Clemson University's Bioengineering Associate Professor Dr. Renee Cottle. This award comes at the closure of Dr. Cottle's 1-year R56 Bridge grant funded by the same institute at the NIH in September of 2023. Dr. Cottle's new R01 award will begin this September.

The R01 project will involve applying revolutionary, Nobel-prizing winning CRISPR/Cas9 technology as a gene editing therapy for Familial Hypercholesterolemia (FH). FH is an inherited genetic disease that affects 1 in 250 people and is characterized by impaired low-density lipoprotein (LDL) metabolism, resulting in high cholesterol and premature cardiovascular disease. Patients suffering from FH have severely elevated blood LDL-cholesterol levels, which is a serious and life-threatening condition. The available therapies are ineffective in patients carrying two mutant copies of the gene encoding LDL receptors necessary for LDL update and metabolism. Dr. Cottle's R01 project addresses the urgent need for new LDL cholesterol-lowering therapeutics by developing a permeant one-time cell-based therapy.

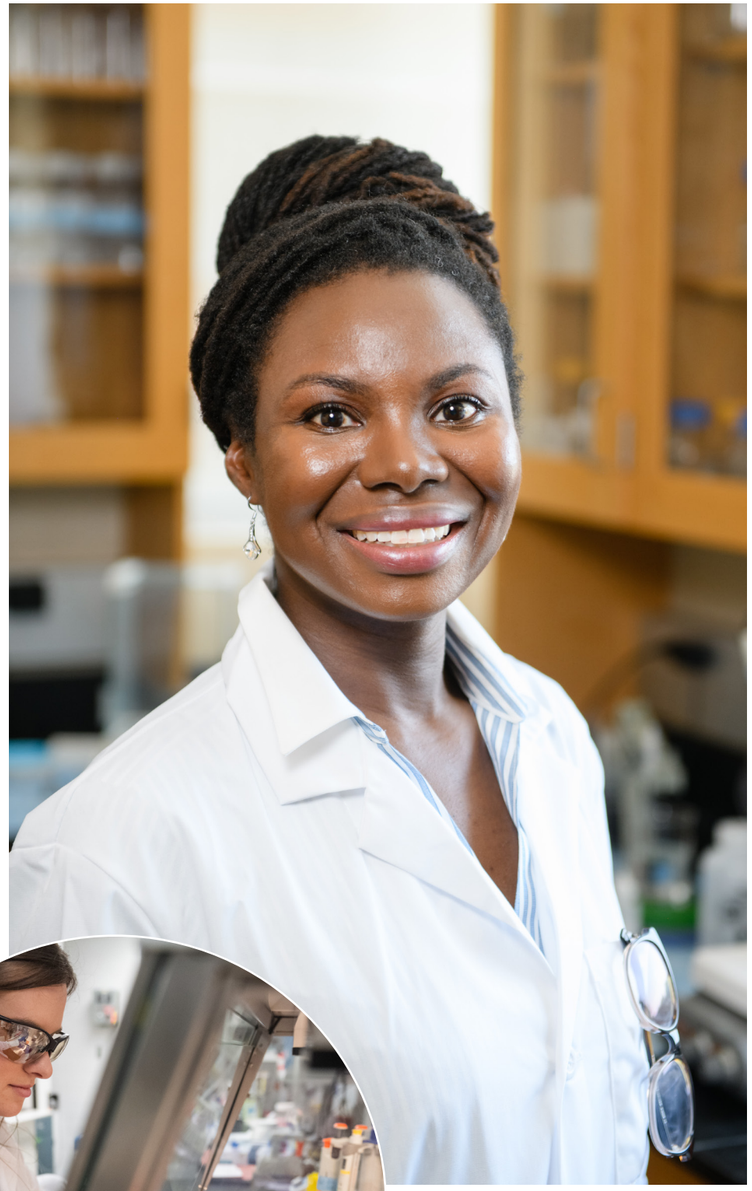
Dr. Cottle and her team will compare different delivery methods to introduce CRISPR/Cas9 gene editors into liver cells in a dish, followed by transplantation into the liver to replace the diseased cells with healthy ones, as a safer gene therapy approach compared to systemic gene editing. The gene editing approach involves using the CRISPR system to precisely disrupt target genes that will modulate blood lipoprotein levels to lower LDL-cholesterol while simultaneously engineering liver cells to have a selective advantage for liver repopulation after engraftment. Dr. Cottle says that her therapy once in the clinic would be a genetic surgery in liver cells isolated from the patient's resected liver, a small portion of a lobe, with subsequent transplantation back into the patient's liver. Dr. Cottle's strategy combines short-term administration of acetaminophen, a pain reliever medication, to select for the gene-edited cells in the liver capable of permanently lowering cholesterol levels. Dr. Cottle's project will demonstrate the proof-of-principle of this therapeutic approach in a mouse of FH.

Dr. Cottle says her project will guide future liver-directed clinical trials on the optimal delivery approach for introducing CRISPR reagents into therapeutic cells. No prior studies like Dr. Cottle's R01 directly compare electroporation, lipid nanoparticle, and viral delivery approaches for therapeutic gene editing applications. Dr. Cottle's project is timely and will inform the safety and efficacy of her treatment in FH mice to lower LDL-cholesterol levels. In addition, Dr. Cottle says that successful completion of the project is critical to the gene therapy field because the gene editing approach she and her team are developing has strong potential to treat many

other genetic diseases that affect the liver and is a step forward towards achieving an autology cell therapy for liver disease.

Dr. Cottle's team consists of a diverse group of internal and external collaborators across the country who all bring unique expertise to the project. The team members are Co-Investigator, Dr. Markus Grompe, Department of Pediatrics Director at the Oregon Health & Science University; Co-Investigator, Dr. Olga Savinova, Associate Professor at the New York Insitute of Technology; Collaborator, Dr. Yamin Li, Assistant Professor at the SUNY Upstate Medical University; Collaborator, Dr. Alexis Stamatikos, Assistant Professor at Clemson University; and Collaborator, Dr. Eric Josephs, Assistant Professor at the Joint School of Nanoscience and Nanoengineering. Dr. Cottle is very excited to be working with this team, along with her graduate and undergraduate students from her lab, on a project that she says has enormous potential to translate into a clinical trial and novel therapy that can save the lives of many people globally who are people suffering from inherited metabolic disease.

Dr. Cottle received news of her R01 award only weeks before receiving Clemson's tenure and promotion decision on her tenure package in the Spring 2024 semester. Dr. Cottle was promoted to Associate Professor in the Bioengineering department in May. Dr. Cottle has received multiple accolades since joining the Bioengineering department in 2016. In 2021, she was honored with two prestigious research awards from professional societies: the Pinnacle Research Award from the American Association for the Study of Liver Disease and the Underrepresented Minority Fellowship Award in Gene and Cell Therapy for Any Indication from the American Society of Gene and Cell Therapy. That year she also received funding from the SCBioCRAFT Pilot Project. In 2016 Dr. Cottle was awarded a SC INBRE Developmental Research Project Program award. Dr. Cottle credits these awards for helping her establish a thriving lab and laying the foundational research needed to secure an NIH-funded R01 as an early-stage junior investigator. She was also awarded the BMES Career Development Award in 2018. ■



The picture is of Callie Clark, a PhD student. It was taken while Callie was conducting experiments in Dr. Cottle's lab, which is located in the Rhodes Research Building

CURF Hosts Annual Innovation Award Ceremony

Clemson University Research Foundation

CURF was excited to host this year's Innovation Awards ceremony and recognize the outstanding achievements of our Clemson University inventors. This year's event, sponsored by Fredrikson & Byron, P.A., featured opening remarks from Provost Bob Jones and special guest speakers Sam Havelock and Sean Solberg. Sam Havelock is an American Venture Developer and former Navy Seal. Sean Solberg is a shareholder and patent attorney at Fredrikson and Bryon P.A. In the opening remarks, Dr. Jones provided insight into the importance of innovation and entrepreneurship in Clemson Elevate and provided words of support to the faculty who seek to innovate and commercialize. Sean Solberg updated us on the Mira medical device commercialization efforts, including its FDA approval and test use in space flight. Sam Havelok addressed the difficulties and chaos that happen in commercialization, the importance of team building, and remaining intrepid when venturing into the unknowns of starting up a company.

This year, we were proud to present 29 Patent Awards and 9 License Awards to over 30 inventors!

Below are those from bioenginneering department who were granted a Patent Award:

- Radiographic Discernable Sensors and Orthopedic Applications for Same - Jeffrey Anker and John DesJardins
- Self-adjusting Tissue Holder with Flow Placement for Universal Integration into Tissue Preparation Processes and Tools for Assembling - Agneta Simionescu and Dan Simionescu
- Target-specific Polymeric Micelle/nucleic Acid Complex Nanotherapeutics - Jeoung Soo Lee
- Channeled Fibers in Separation of Biologically Active Nanoparticles - Terri Bruce

Patent Award Spotlight: Method and apparatus for non-destructive measurement of faceguard structural stiffness - John DesJardins, and Gregory Batt.

Below are those who received a License Award:

Enhance Diagnostics, LLC. - Robert Latour, Tyler Harvey, and Guzeliya Korneva

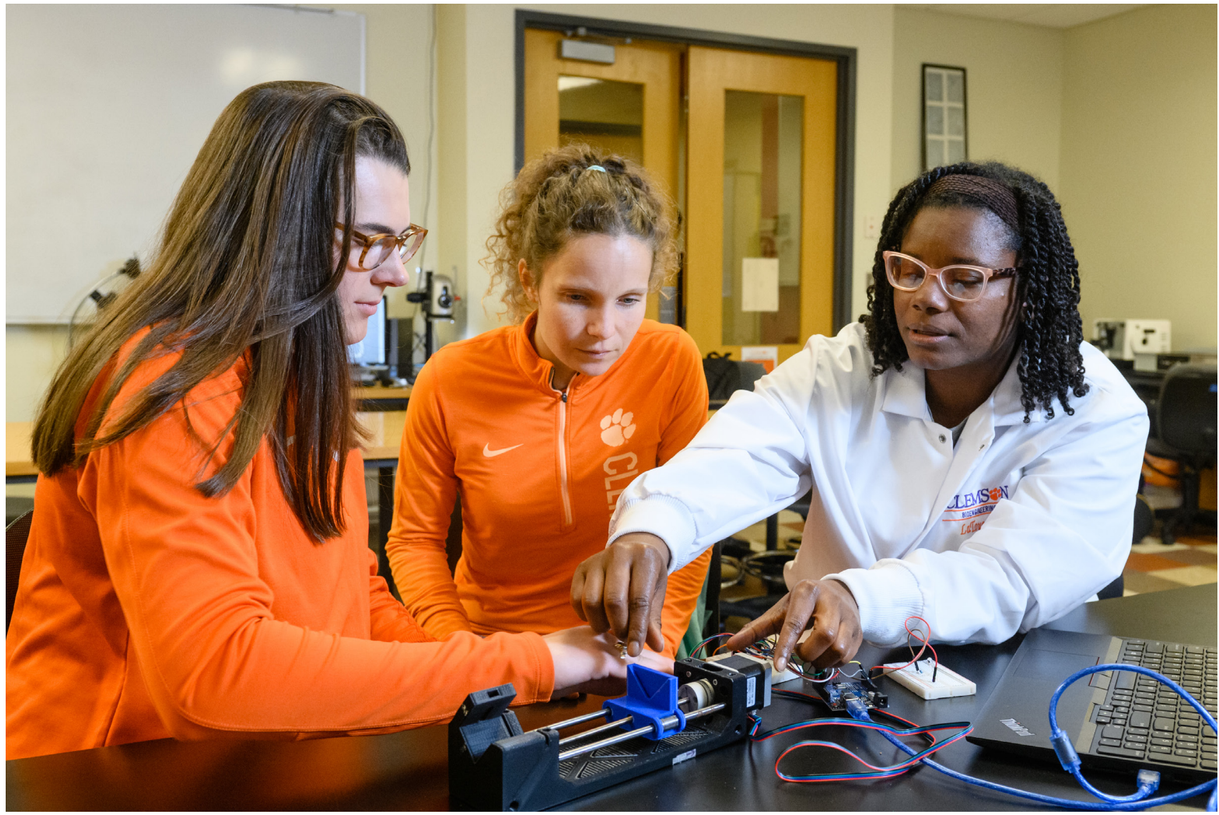
Congratulations to all awardees! We are already looking forward to next year's event. ■

AI in Nursing for Better Ostomy Care

Artificial Intelligence to Better Understand Nursing Care and Ostomy Surgery Outcomes: Clemson Bioengineers' Collaborative Research Recognized at the National Meeting of the Wound, Ostomy, and Continence Nurses Society™

Dr. Melinda Harman and students at the lab at CUBEInC

Dr. Melinda Harman and graduate students from the Bioengineering Department presented their healthcare research at the 2024 national meeting (WOCNext 2024) hosted by the Wound, Ostomy and Continence Nurses Society™. This is the leading professional organization for ostomy nurses and other healthcare professionals that educates and inspires healthcare professionals from around the world on what's new, what's needed, and what's next in wound, ostomy, continence, foot and nail care. While biomedical engineers



were definitely in the minority at this meeting, our research team recognizes the benefit of interacting with end-users and med-tech industry attendees about the latest medical devices and technology used by nurses and patients for ostomy care.

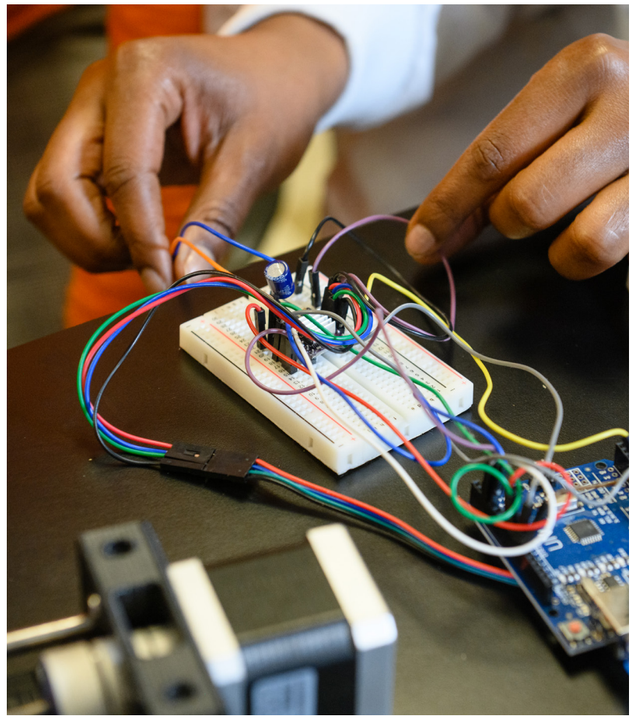
Our healthcare research used a simulated acute-care setting to explore the work practices of nurses providing ostomy care and clinical outcomes for patients undergoing ostomy surgery at the Greenville Memorial Hospital. It was conducted at the Clemson University Biomedical Engineering Innovation Campus (CUBEInC) in Greenville. CUBEInC is an ecosystem for translating technological innovation for the enhancement of healthcare and education in alignment with the key core pillars in the Clemson University strategic plan, Clemson Elevate. Together with our co-PI Dr. Casey Hopkins, Assistant Professor in the Clemson School of Nursing, we assembled a collaborative team that included experts from the Clemson-MUSC Biomedical Data Science and Informatics program, Clemson's Industrial Engineering Department, and colorectal surgeons and certified ostomy care nurses from Prisma Health Upstate. bioengineering graduate students Marketa Haughey and LaToya McDonald pursued their researach while working in Dr. Harman's RE-MED laboratory at CUBEInC and at the Clemson University School of Nursing's Clinical Simulation Laboratory at Greenville Memorial Hospital.

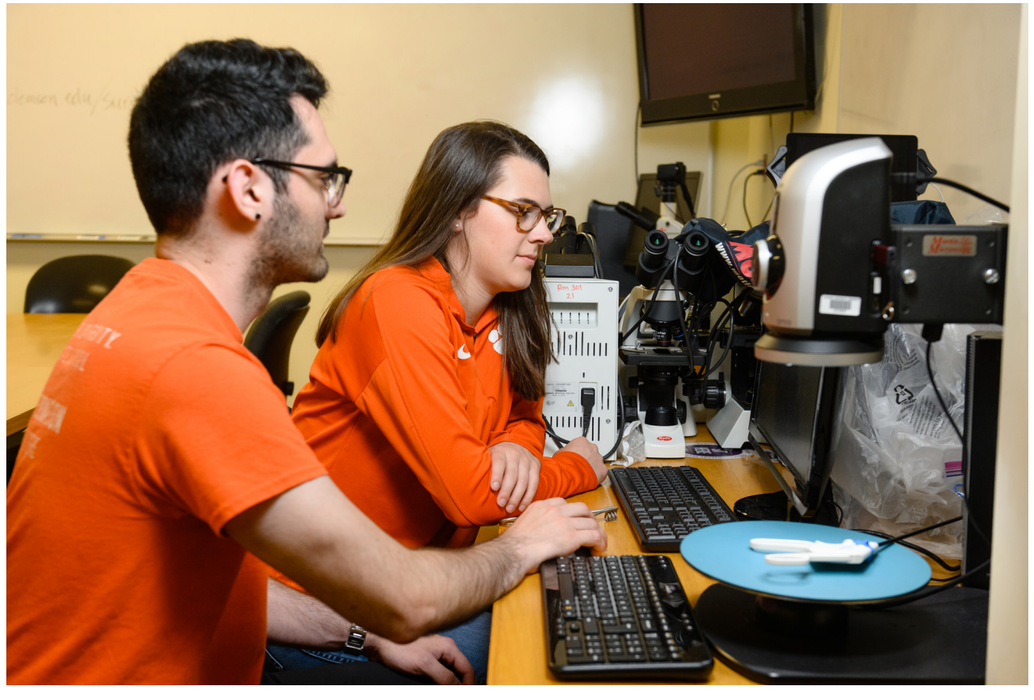
LaToya used artificial intelligence (AI) and machine learning (ML) skills she developed as a graduate student trainee in the National Institutes of Health's AI/ML Consortium to Advance Health Equity and Researcher Diversity (AIM-AHEAD) program and completion of the AIM-AHEAD Data Science Training Core Training Practicum (PRIME). AIM-AHEAD enhances participation of researchers and communities currently underrepresented in the development of AI/ML models to develop skills in AI/ML applications on health disparities and to improve the capabilities of this emerging technology. As one of 26 trainees in the 2022 PRIME cohort, LaToya completed a variety of AI/ML courses over a 6-month period. Applying those skills to her Clemson research, her goal is to develop taxonomy-based risk models inclusive of nursing care following ostomy surgery by applying AI/ML approaches to electronic health records. AI/ML tools will aid data extraction and analysis because nursing care is often documented in free-text data entry fields in electronic health records, making it difficult to extract key details and identifying patterns in terminology is difficult using traditional database tools.

Using a human factors approach aligned with best practices from the International Nursing Association for Clinical Simulation and Learning (INACSL), Marketa led the development of a new metric-based simulation that captured a broad range of clinical decision-making and work practices in ostomy nursing care. The metric-based

simulation combined the use of an enhanced mannequin simulator and reliable video review instrument to capture discrete tasks and clinical decision-making required for managing stoma output and effluent and performing skin care. According to Dr. Harman, “Our simulation-based study addresses the need for simulation-based research in gastrointestinal and urologic care identified by the National Institute of Diabetes and Digestive and Kidney Disorders (NIDDK) and for interdisciplinary approaches to nursing education that includes human factors engineering identified by the Agency for Healthcare Research and Quality (AHRQ)”. Both Dr. Harman and Dr. Hopkins agree that their simulation has potential for use in comprehensive training of practicing nurses and nursing students in ostomy care.

These original research studies involved clinical collaborators from Prisma Health Upstate and Our research was funded by a Research Seed Grant from the Prisma Health Education and Research Institute which . Research Seed Grants supports research that improves health, with a focus on improvement of health system performance, population health, or biomedical science that translates to clinical practice and improved patient outcomes. Dr. Harman and Dr. Hopkins areis a faculty fellows in the Clemson University School of Health Research, which provided administrative support and workspace for their to access electronic health records for this IRB-approved research. Initial results of their studies were published in the scientific journal Clinical Simulation in Nursing and more recent work is currently under review at the Journal of Wound, Ostomy and Continence Nursing. ■





Nectero Medical begins Phase II/III Clinical Trials

Clemson University Research Foundation

The foundation of Nectero Medical’s approach is a patented compound developed by and licensed from Dr. Naren Vyavahare’s lab in the Clemson University’s Department of Bioengineering.

Nectero Medical

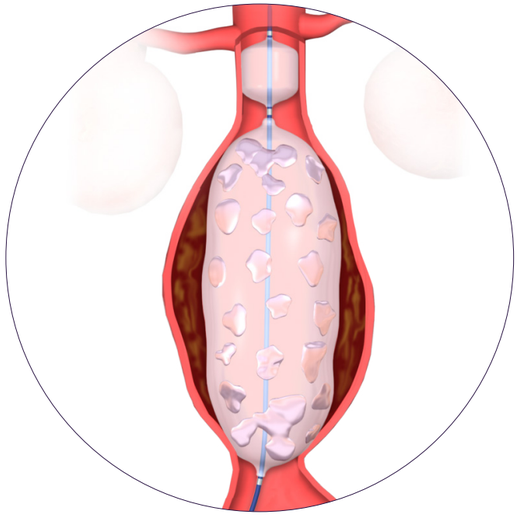
Nectero Medical is a clinical-stage biotech startup that is developing novel therapies to address the challenges of treating aneurysmal disease. The company’s focus is on improving outcomes for patients with abdominal aortic aneurysms (AAA), a condition that affects over 1 million Americans.

The foundation of Nectero Medical’s approach is a patented compound developed by and licensed from Dr. Naren Vyavahare’s lab in the Clemson University’s Department of Bioengineering. This compound is designed to stabilize elastin and improve the strength of the affected tissue, which is a critical factor in the management of aneurysmal disease.

Nectero Medical’s lead product, the Nectero EAST System, is a single-use, endovascular system that delivers this stabilizing compound directly to the aneurysmal wall. The system consists of a dual-balloon delivery catheter and a stabilizer mixture containing pentagalloyl glucose (PGG), which can bind to elastin and collagen to potentially reinforce the aortic vessel wall and reduce the risk of further degradation.

This past year, Nectero Medical has begun Phase II/III clinical trials to evaluate the safety and efficacy of the Nectero EAST System in treating patients with small-to-medium sized abdominal aortic aneurysms, with a diameter between 3.5 - 5.0 cm. Current treatment options are primarily reserved for larger aneurysms or rapidly expanding ones, leaving a significant population of patients with smaller AAAs without an approved therapeutic option beyond surveillance. However, the Nectero EAST System offers a minimally invasive approach that can be completed in under an hour and does not require any specialized tools for vascular surgeons trained in endovascular techniques. Importantly, the procedure does not leave behind any permanent implants, allowing for potential future interventions if necessary.

As the company continues to advance its clinical trials, Nectero Medical remains focused on developing innovative solutions to improve the lives of those affected by aneurysmal disease. Click here for more information and updates on Nectero Medical: https://necteromedical.com/ ■



Nectero Endovascular Aneurysm Stabilization Treatment (Nectero EAST®) System uses an endovascular approach to deliver a proprietary mixture to the site of the aneurysm

THE BEAT GOES ON:

PROMISING HEART DISEASE TREATMENT MOVES TO NEXT STAGE OF RESEARCH

Clemson News | Paul Alongi

Combining stem cells and silicon nanowires has shown promise as a step toward a new treatment for heart damage, and the technology is now ready for its next challenge, said a Clemson University bioengineering professor.

In a new project funded by the National Institutes of Health, researchers plan to genetically modify the stem cells so they will not be rejected by the body as foreign cells. They will test whether the genetic modifications affect the functioning of the stem cells or the nanowires.

The research takes aim at finding a new way to treat heart disease, the leading cause of mortality worldwide. Researchers' ultimate goal is to develop "off-the-shelf" products that could be used to treat patients efficiently and effectively.

Ying Mei, a Clemson bioengineering professor, served as principal investigator on prior research into the proposed treatment and the new project.

"Heart tissue cannot repair itself in the same way as, for example, a cut on the skin, so it is important to find restorative therapies," he said. "Our approach using stem cells and silicon nanowires shows remarkable promise for treating heart damage, and we look forward to answering key questions that could help lead to clinical translation of this technology."

The research sharpens the focus on human pluripotent stem cells, which can be developed into any type of cell in the body, including heart muscle cells. That ability makes them an attractive option for replacing damaged and dead heart muscle, similar to the promise they show for restoring other parts of the body such as the intestine, pancreas, liver, retina, brain, and lungs.

Using human pluripotent stem cells in the heart comes with unique challenges. Researchers led by Mei launched a project in 2017 to begin addressing those challenges and reported their findings in 2023 in the journal Science Advances.

The team combined human pluripotent stem cells and silicon nanowires, which clump into ball-like shapes. The silicon nanowires, visible only by microscope, were key because they improved the electrical connectivity and overall function of the lab-grown tissue, researchers found.

The Science Advances article was titled, "Nanowired human cardiac organoid transplantation enables highly efficient and effective recovery of infarcted hearts."

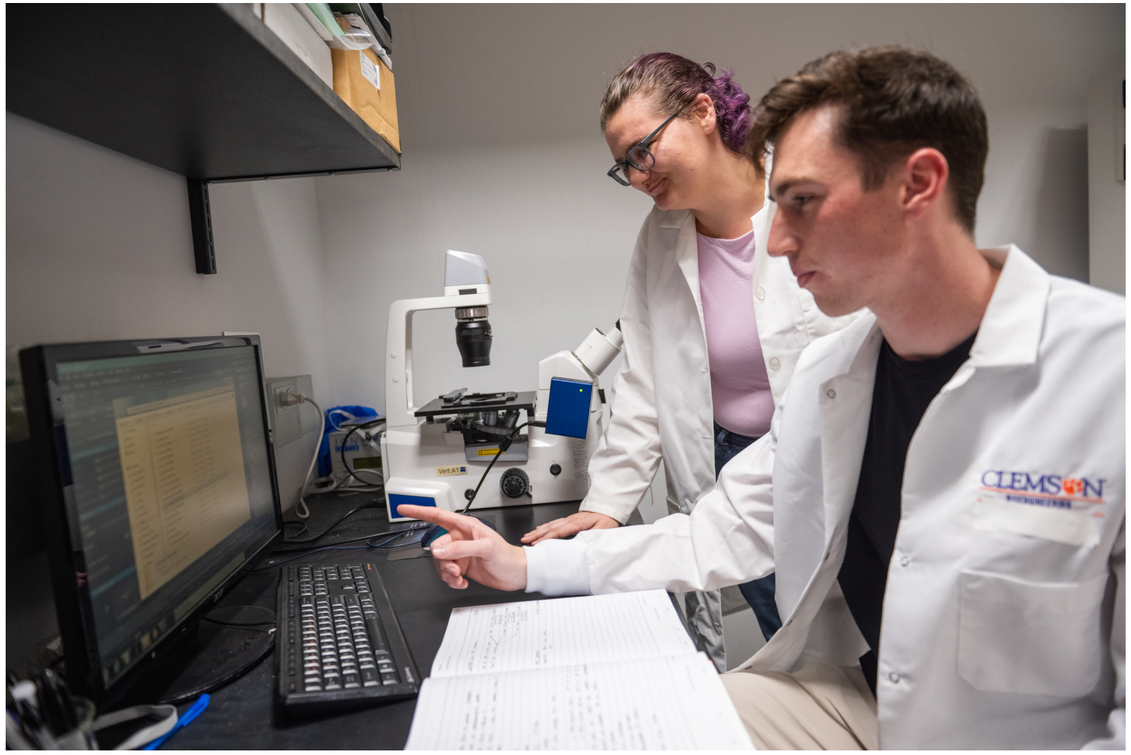
That research set the stage to test the genetic modifications to the stem cells in the new project. The National Institutes of Health has been a key partner, funding the work that started in 2017 with $1.5 million and the new project with $2.6 million.

Senior personnel collaborating on the new project are: William Bridges of Clemson; Xiaojun Lian of Pennsylvania State University; and Kristine DeLeon-Pennell, Leonardo Ferreira and Jean Ruddy, all of the Medical University of South Carolina.

The prior research and new project are based in Charleston as part of the Clemson-MUSC Bioengineering Program, an initiative that embeds Clemson faculty and students on MUSC's campus.

"Our research is a team approach, and all of our members are vital to our success," Mei said. "The idea for the research came out of conversations I have had with collaborators at MUSC and Penn State. I look forward to deepening our partnership with this new project." ■

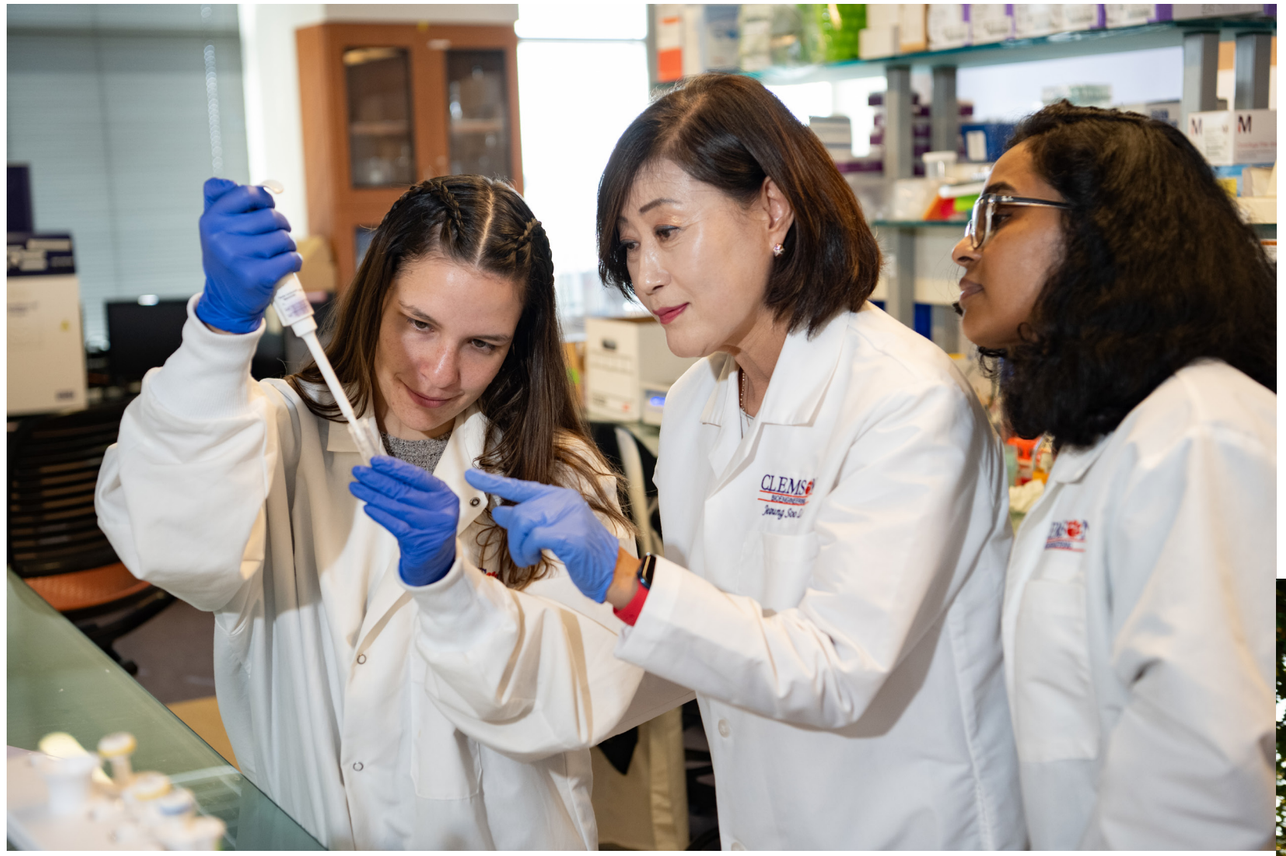
Postdoctoral researcher Ryan Barrs shows some of the work the team will be doing as part of the new project



Clemson University Ph.D. students Nate Hyams and Jacelyn Bain work in a lab on the MUSC campus

JeoungSoo Lee honored with John Witherspoon Gilpin, MD ’82 Distinguished Professorship in Bioengineering

Clemson News | Paul Alongi



JeoungSoo Lee (center) works with Ph.D. student Alex VandenBerg (left) and master's thesis student Namratha Abhisara Appaji at CUBEInC.

JeoungSoo Lee's research into new ways of delivering medicine to parts of the body that need it most and her student mentorship have earned her one of the most prestigious honors on Clemson University's faculty.

Lee has been chosen as the John Witherspoon Gilpin, MD '82 Distinguished Professor in Bioengineering.

"I am honored and very happy to be selected for this professorship and look forward to working with Dr. Gilpin to improve the quality of life for patients who are living with disease or injury," she said.

Named professorships signal to recipients' colleagues that they are considered among the University's leading faculty members. The professorships lend prestige to the University and recipient, helping recruit and retain top talent.

Gilpin made Lee's professorship possible by providing $1 million in 2022 for an endowment. Investment proceeds will be available to Lee to help pay for travel, student assistance and research support and equipment.

In a separate gift announced in 2020, Gilpin provided $250,000 for the John Witherspoon Gilpin, MD '82 Endowed Associate Professorship, first held by Jeremy Mercuri. He recently became a professor of practice, leaving the professorship open with a search ongoing.

"It has been fulfilling to observe these talented bioengineeirng professionals I have invested in pursue and accomplish innovative research," Gilpin said. "With these relationships, I have been blessed more than Clemson University has been. It has been wonderful for me, and I'm glad I have made these financial investments in the department."

Lee specializes in creating advanced nanoparticles that deliver drugs and therapeutic nucleic acids directly to specific parts of the body that need it most. The approach helps maximize the drug benefits while minimizing side effects.

Lee sees potential for using the nanoparticles to help treat a range of injuries and diseases, including those to the spinal cord and brain. She is also working on applying her innovative work to cancer, cardiovascular diseases and hearing impairment.

Lee has begun working to commercialize her research through her company, NeuroHope Therapeutics, which was named by her 17-year old son, Byron Augustine Lee Webb, to "give hope to people who need it." Her lab, office, and company are at the Clemson University Biomedical Engineering Innovation Campus (CUBEInC), which shares a building with Prisma Health at the Patewood location in Greenville.

"I believe that the Gilpin Distinguished Professorship will support and accelerate my efforts to develop my nanotherapeutic technology from bench to bedside," Lee said.

Gilpin received a Bachelor of Science in microbiology from Clemson and the Norris Medal, an honor given annually to the best all-round graduating senior.

He went on to become program director of medical student education in the Department of Radiology at the University of South Carolina School of Medicine Greenville. Gilpin has also served as a board certified diagnostic radiologist at Prisma Health and medical director of the Radiology Department at Prisma Hillcrest Hospital in Simpsonville.

Gilpin said he is honored to be associated with Lee.

"Her work on nanocarriers and polymeric micelles and the potential for drug and therapeutics delivery is potentially unlimited with high utility," he said.

Lee grew up in South Korea, the daughter of the late Juho Lee and Young Hee Park.

Her father died of cancer when she was 16, inspiring her later work in pharmacy and research.

Lee began her career as a pharmacist but enjoyed the research she had done as an undergraduate and wanted to teach, so she decided to return to school for a graduate degree.

John Witherspoon Gilpin's forward-thinking generosity made possible the distinguished professorship now held by Lee.

Lee received a Master of Science and Ph.D., both in Pharmaceutical Sciences from College of Pharmacy, Pusan National University in South Korea. She joined Clemson's bioengineering department in 2003 as a postdoctoral research associate and has steadily risen through the ranks, becoming professor in 2023.

Throughout her career, Lee has advised one research assistant professor, nine postdoctoral researchers, has graduated nine Ph.D. students and eight master's students and served as a research advisor to 34 undergraduates. Her research has been funded by the National Institutes of Health, the U.S. Army, the South Carolina Spinal Cord Injury Research Fund, the Department of Defense, the Department of Veterans Affair, foundations and private industry.

She is married to Ken Webb, a professor and associate chair of undergraduate affairs in the Department of Bioengineering.

The marriage strengthens Lee's ties to the Clemson Family and the broader South Carolina community. Webb's father, the late Byron Kenneth "Bud" Webb, served as chair of Clemson's agricultural engineering department and dean of the Cooperative Extension Service and represented Pickens County's District 3 in the state House of Representatives from 1996-2002.

Lee has carried on that tradition of leadership not only in her work with Clemson but in the community as well. Among her activities is serving as a member of the Saint Joseph's Catholic School Board of Trustees in Greenville.

Delphine Dean, chair of the Department of Bioengineering, congratulated Lee and said she was highly deserving of the professorship.

"Dr. Lee's innovative research, commitment to translating her work to bedside application and her mentorship of students establish her as a key leader within the department and in the field of bioengineering," Dean said. "I thank Dr. Gilpin for his forward-thinking generosity. His gifts of time and treasure to the department are deeply valued and help us solidify our position as a powerhouse of education and research." ■

Lee is working to commercialize her innovations through a start-up, NeuroHope Therapeutics.

GOALI: Leveraging the interconnectedness between mass transfer and cell metabolism for process control of mammalian cell fed-batch and perfusion cultures

NSF / Award Abstract

Medicines derived from cells, known as biopharmaceuticals, play a crucial role in preventing and treating various diseases, such as diabetes and cancers. The biopharmaceutical industry heavily relies on Chinese hamster ovary (CHO) cells as the primary organisms for manufacturing these medicines. However, the cultivation of CHO cells poses challenges due to limited methods available to gauge the oxygen uptake rate (OUR) which is a critical metric for assessing CHO cell health. This project seeks to enhance the accuracy of OUR estimation and develop tools to differentiate cell metabolism from other physical system changes. Furthermore, the project constructs a comprehensive mathematical model of cell behavior to improve CHO cell productivity. Beyond technological advancements, this project has broader impact that includes several modes of interaction between graduate students and industry collaborators and the development of curriculum modules at Clemson, focused on fed-batch and perfusion operation, that are shared broadly through Amgen's curriculum outreach program.

This project develops a controls-oriented metabolic model for Chinese hamster ovary (CHO) cells that correlates cell responses with on-line process signals, such as the dissolved oxygen, pH, base addition rates, gas mass flow rates, and off-gas compositions. Additionally, a robust volumetric oxygen mass transfer coefficient (kLa) estimator that accounts for filtering and latency effects, is developed. Accounting for these filtering and latency effects enables oxygen uptake rate calculations in real-time without distortion. Furthermore, the control algorithm enables distinguishing between chemical and physical process disturbances (i.e., antifoam additions and sampling) from cellular metabolic responses (i.e., glucose depletion). These modeling and feed control innovations will lead to reduced waste ? improved nutrient utilization and more homogeneous critical product quality attributes, a key long-term long-standing vision in the biopharmaceutical industry.

This project is jointly funded by the Systems and Synthetic Biology Cluster in the Division of Molecular and Cellular Biosciences, and the Established Program to Stimulate Competitive Research (EPSCoR).

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria. ■

DEPARTMENT OF BIOENGINEERING *receives $2.1 million SBIR grant*

Alexey Vertegel

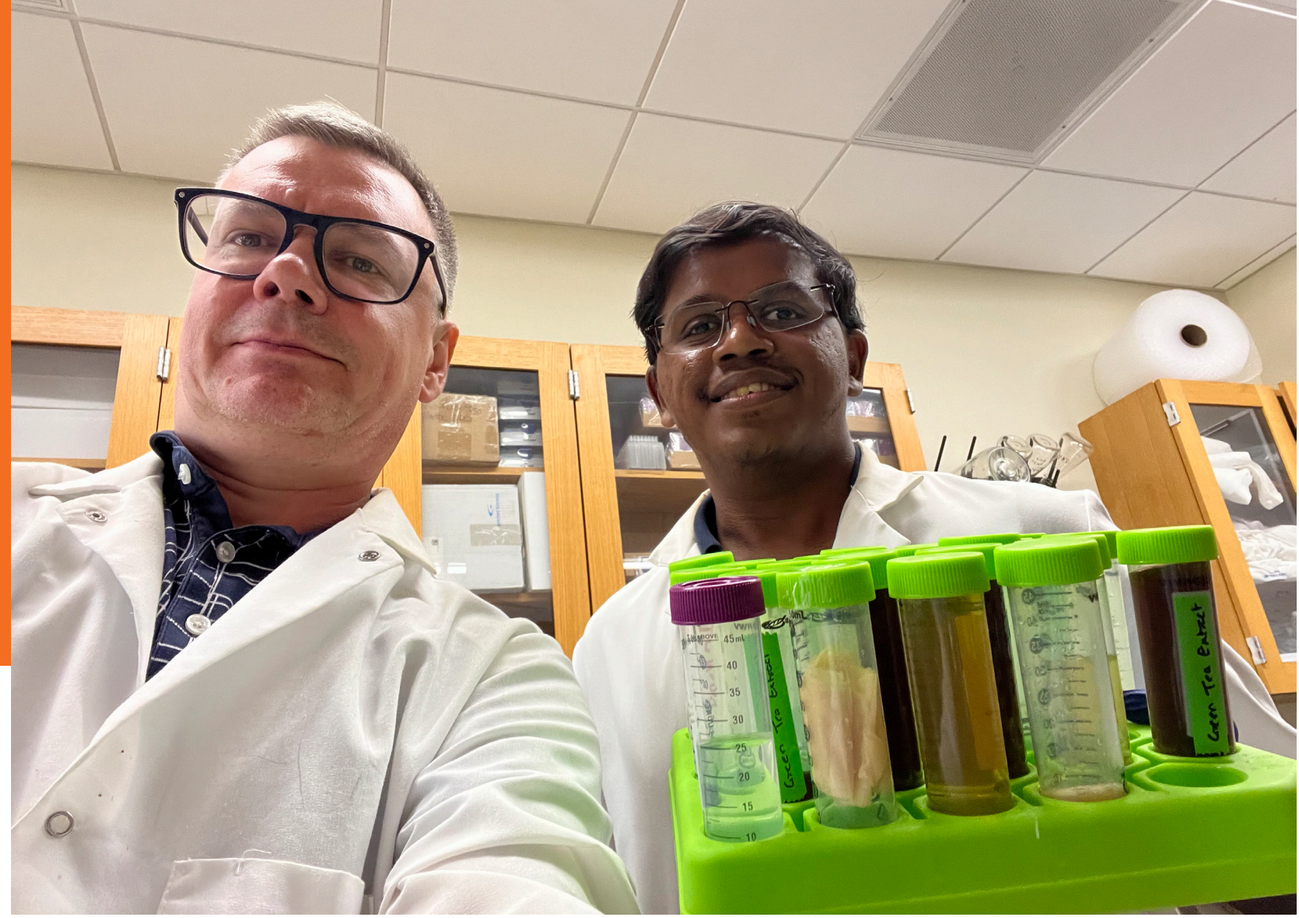
Dr. Alexey Vertegel received a $2.1M SBIR Phase II grant from the National Institute of Allergy and Infectious Diseases (NIAID) to develop long-lasting natural disinfectants. According to the CDC guidelines, disinfection of environmental surfaces in healthcare settings should be performed at 24-hour intervals. In spite of adherence of the hospitals to these guidelines, multiple studies detected contamination of frequently touched surfaces by clinically relevant pathogens such as MRSA and vancomycin-resistant Enterococci. A number of studies found that the use of commercially available disinfectants significantly reduces microbial counts on environmental surfaces for only up to 2-6 hours after treatment. Therefore, the development of a long-lasting disinfectant that would be efficient for at least 24 hours is important for the reduction of healthcare associated infections. Even longer-lasting disinfectants are preferable because they would require less frequent applications and save money on materials and labor.

The necessity for long-lasting disinfectants has become extremely obvious in the age of COVID-19. The use of current commercially available disinfectants significantly reduces microbial counts on surfaces for only 2 to 6 hours after treatment. However, disinfecting frequently touched surfaces every 2 to 6 hours is not feasible, especially in healthcare and public settings. Per most stringent CDC recommendations, the disinfection of environmental surfaces in healthcare settings should be performed at 24-hour intervals. Because of the short-term action of current disinfectants, most of the surfaces will be re-populated by bacteria well before the time of the next treatment. Therefore, there is a clear need for disinfectants capable of forming a durable biocidal film on a treated surface. Such a coating would provide longer lasting and higher quality protection of environmental surfaces while requiring less frequent applications, saving on labor costs, and protecting against hospital acquired infections.

Currently, the only EPA registered long-lasting product available on the market is Microban24 with a proven 24-hour residual efficacy against selected bacteria (S. aureus and E. aerogenes) but not against viruses. Dr. Vertegel's group have recently developed a novel long-lasting disinfectant based on film-forming chitosan/water/ethanol formulations. Chitosan is a naturally derived polysaccharide obtained from chitin in crustacean shells. It is a known broad-range antimicrobial. Our formulation forms stable yet invisible chitosan films on treated surfaces that can provide antimicrobial activity over prolonged periods of time.

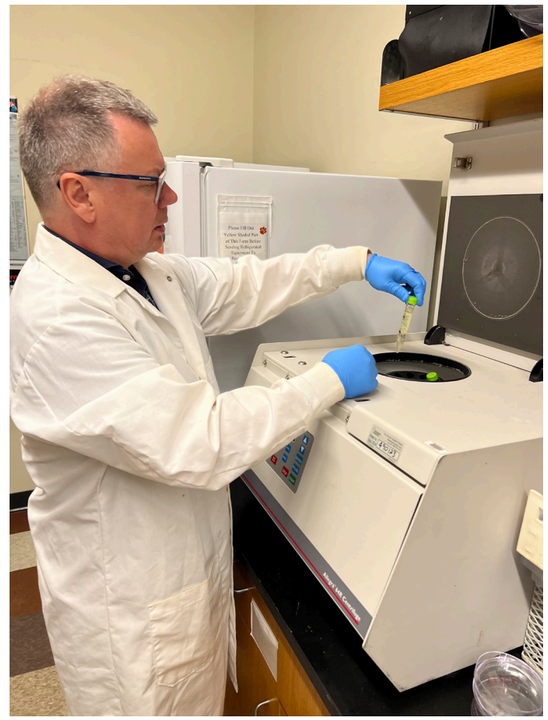
During preliminary studies, we found that chitosan-based formulation containing a natural antimicrobial oil provided up to 72 h complete protection against microbial growth on frequently touched surfaces (door handles and elevator buttons) in a field trial at Clemson. This natural formulation outperformed Microban24 controls (24 h complete protection in the same trial). Based on these findings, we are excited about the prospects of this new disinfectant product.

The proposed disinfectant was found to be effective against a variety of bacterial, fungal, and viral species. The formulation has low viscosity allowing it to be sprayed and has a fast drying time similar to that of other disinfectants. The product is compatible with hard non-porous to semi-porous surfaces. It is very easy to apply and to re-apply. This new product offers the following advantages over currently used topical disinfectants: 1) lower product costs because of the less frequent application rate; 2) lower labor costs for healthcare settings and public facilities that need to disinfect surfaces regularly (could have a massive impact during pandemic times because many employers and public services will be mandated to disinfect); 3) improved cleaning compliance; and 4) reduced risk of infection transmission.



▲ *Dr. Alexey Vertegel and his student Sushant Sawant*

The goal of the proposed Phase II study is to collect comprehensive data required for regulatory approval and customer acceptance of this product and develop scaled up manufacturing to make this product commercialization ready. During the study, we will optimize the composition of the formulation (Aim I) and perform comprehensive toxicity and efficacy studies required for the regulatory approval (Aim II). We will also perform a multi-site filed study of the efficacy of our product on frequently touched environmental surfaces in two hospitals in the Midwest (Cleveland Clinic, OH) and in the Southeast (Prisma Health, SC) (Aim III). Finally, we will undertake a scaling up in collaboration with the largest domestic chitosan manufacturer, Tidal Vision USA. ■



AI concept illustration by Olga Reukova, generated with Dall-e

EDUCATION

EDUCATION AND TRAINING

TRAINING

Bioengineering Department's Education and Workforce Development Strategies to Enhance Global Biomedical Innovation

Tyler Harvey, Martine LaBerge, Delphine Dean, Dayan Ranwala

In aligning with Clemson University strategic plan "Clemson Elevate" and our department's mission to educate and prepare students for professional careers for global competitiveness, we assessed our biomedical engineering (BME) undergraduate program effectiveness in preparing students to achieve their post-graduation career goals.

B.S. in Biomedical Engineering (BME) Program

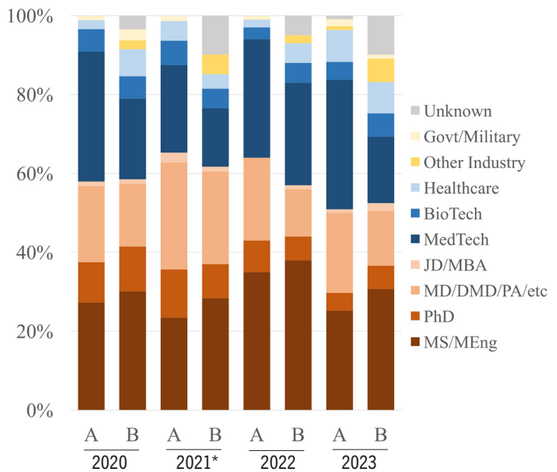
Two Concentrations:

- Biomaterials
- Bioelectrical

Each Includes Four Core Required Courses:

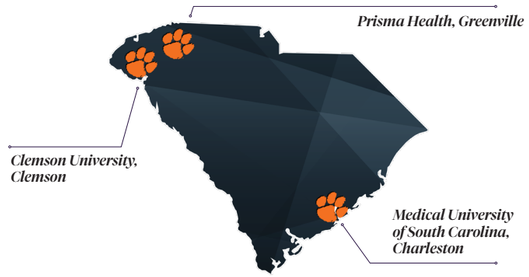
- Biomaterials
- Biomechanics
- Bioinstrumentation and Bioimaging
- Tissue Engineering

We looked into our BME students' reflections on their career plans and motivations during two required courses, Sophomore Seminar and Capstone Design, in the BME curriculum. The Seminar course is usually taken by students in their first or second semester of joining the BME major. This course covers a variety of topics including career paths and professional development opportunities. The Capstone Design course is usually taken by students two semesters prior to graduation. This course covers basic principles of designing a medical device. Students in this course work together as teams of 4-5 students in collaboration with clinicians to identify clinical needs to develop a novel device design solution. In addition to student reflections while they are in the BME program, we looked into their first career position after they graduated from the program as a measure of whether the students achieved their intended career goals. When we compared the post-graduation plans of students' reflections at the start of Capstone Design course to their first post-graduation career position, we found no significant differences (except in the COVID pandemic years of 2021-2022. These results may indicate that the BME curriculum is preparing the students for their choice of careers for global medical innovation.



*Start of Senior Year Career Plan (A) and First Post-Graduation Position (B) of Student Cohorts in 2020-2023. Number of students in 2020 (n=88), 2021 (n=81), 2022(n=100) and 2023 (n=111). *Statistically significant (p<0.05)*

We believe that our innovative curricula including hands-on learning opportunities to teach the skill sets that employers need to thrive in a competitive environment; strategic partnerships with clinicians with two of the state's leading health systems to provide necessary link between bioengineers and medical and surgical practice for conducting state-of-the-art bioengineering education and research; expanded academic portfolio offering specialized curricula that teaches industry-targeted skills such as biomedical manufacturing; close collaboration with clinical and industry partners to prepare graduates for a seamless transition into the professional careers. We plan to continue the assessment of our curricular to understand the needs of students entering the BME program and needs of global demands to make informed decisions about the curriculum and extracurricular programs. ■



Bioengineering department's strategic partnerships with clinicians with two of the South Carolina state's leading health systems

Bioengineering Students Honored by College of Engineering, Computing and Applied Sciences

Clemson News | Paul Alongi

Some of the most outstanding students in the Clemson University College of Engineering, Computing and Applied Sciences were honored in an April 18 ceremony.

The awards recognized top students' accomplishments in a number of areas, including scholarship, character and service.

Anand Gramopadhye, the college's dean, said engineers and scientists' legacy will be defined by the sustainable solutions they provide to the world's grand challenges, such as access to clean water and electricity in parts of the world where they remain dreams.

"To succeed we need a new breed of innovative, diverse, entrepreneurial and service-minded scientists and engineers," Gramopadhye said. "I call upon tonight's honorees to take on these challenges."

The whole article can be found here: click or scan

Winners from the bioengineering department:

ROBERT W. MOORMAN AWARD

Justin Tyler Furgala, Junior

Dr. Robert W. Moorman was the son of Commandant Thomas Moorman, a graduate in civil engineering and head of the Engineering Mechanics Department from 1958 to 1974. The Robert W. Moorman Award is given in his honor to the most outstanding junior in engineering on the basis of scholarship and character.

BLUE KEY ACADEMIC AND LEADERSHIP AWARD

Amanda Lee Beall, Senior

As a result of funds generated from Tigerama, an endowment has been established to give an award to one student in each of the seven colleges at the university who has distinguished himself or herself in academic scholarship and campus leadership. ■

The BEACH Program Celebrates its 6th Year

Tong Ye, Ann Foley

This summer, 14 outstanding rising juniors or seniors in Bioengineering attended the Clemson **B**io**E**ngineering Research and Clinical Summer Immersion at **Ch**arleston, "***BE at Charleston***" for short (**BEACH**). Celebrating its 6th year of establishment, the faculty at the Charleston campus welcomed the largest and most enthusiastic group of students yet. During a period of 6- or 12-week program, students spent at least half a day working in the research labs for bench-top research or shadowing physicians in clinics or operating rooms at the Medical University of South Carolina (MUSC). Other activities included student round tables with trainees in the basic and clinical sciences and an end-of-program evening for "BEACH" volleyball. These events provided informal settings to discuss career options in STEM and build friendships with future lab mates and colleagues. Every Friday, faculty provided lectures on specific research topics to broaden the student's view on biomedical research.

The BEACH program targets rising junior or senior engineering students committed to advancing their engineering expertise in graduate schools or health professions after graduation. Hosted by the Clemson-MUSC Bioengineering Program, through hands-on work in research labs and shadowing experiences in clinics at MUSC in Charleston, students will develop a firsthand perspective about the skills necessary to succeed in graduate or health professional schools. Since its inauguration in 2018, the BEACH program has welcomed 52 outstanding bioengineering students. Four students, Amanda Beall, Karen De Guzman, Mohamed Ismail and Taylor Glostein, have used summer research projects to complete their department honors. Almost all the graduates are currently either working in STEM-related or healthcare industries or pursuing graduate degrees while studying in graduate schools in engineering or medicine. Notably, Marshall Wilson, a BEACH'2018 student, found Dr. Hai Yao's lab to continue his passion for Bioengineering by enrolling in the PhD in Bioengineering Program after graduation. Four BEACH students have been accepted by Medical Schools so far.

BEACH Program

Bioengineering Research And Clinical Summer Immersion At Charleston

The BEACH program is a rewarding research experience for undergraduate students. Many BEACH students have the chance to present their summer research work at national or international conferences and be coauthors in journal publications. For example, Charles Winchester's work (BEACH'22) contributed to the paper "Tbx5 overexpression in embryoid bodies increases TAK1 expression but does not enhance the differentiation of sinoatrial node cardiomyocytes", which was published in the journal Biology Open in 2023. This publication received special attention and was one of our most-read articles published in the June issue of Open Biology. Calvin Chernyatinskiy (BEACH'22) was selected to give an oral presentation about his independent summer research at Photonics West'2023, one of the prestigious international conferences in the field of biophotonics. He also received a CECAS travel award to attend the conference due to his excellent work.

Many of the BEACH students received departmental awards. Amanda Beall, a BEACH'2022 student, won this year's Blue Key Academic and Leadership Award, which honors one student in each of the seven colleges who has distinguished himself or herself in academic scholarship and campus leadership. She highly valued the importance of the mentorship and training provided to her by Dr. Ann Foley, one

Illustration by Olga Reukova for BEACH Program, generated with Dall-e

Illustration by Olga Reukova for BEACH Program, generated with Dall-e

of the instructors of the BEACH program. Calvin Chernyatinskiy and Omar Jr. Aguilar, both BEACH'2022 students, received this year's R. Larry Dooley Entrepreneurship Award and Eugene M. Langan III Service Award, respectively.

One unique feature of the BEACH program is its clinical shadowing component, which has been well-received by previous students. This opportunity is made possible because of the location of this program. Hosted by the Clemson-MUSC Bioengineering Program, directed by Dr. Jeremy Gilbert, the BEACH program takes advantage of cutting-edge research in the research labs and, at the same time, clinical resources at MUSC, whose affiliated medical center is at the forefront of the latest advances in medicine and includes South Carolina's #1 and most preferred hospital (as ranked by U.S. News & World Report on its Best Hospitals 2018-2019 list and the National Research Corporation respectively), a NCI-designated Cancer Center, a Level I Trauma Center, and South Carolina's only nationally recognized children's hospital.

According to Dr. Ye, the director of the BEACH program, students are expected to learn basic lab research skills and methods through the day-to-day lab research. Being exposed to various healthcare professions provides an opportunity for students to explore or scrutinize their future careers related to medicine or biomedical research.

For additional information, students may contact instructors of the BEACH program, Drs. Tong Ye (ye7@clemson.edu), Ann Foley (acfoley@clemson.edu), Yongren Wu (yongren@clemson.edu), and Shangping Wang (shangpw@clemson.edu). ■

INDUSTRY CERTIFICATE PROGRAMS: BRQS and QSE MC

Laura Tam

The Department of Bioengineering is excited to offer the Biomedical Regulatory and Quality Science Certificate Program. This new 14 credit hour program provides program graduates a solid foundation in current industry best practices regarding regulatory compliance and quality standards. The courses in this certificate program provide industry expert insights into what it takes to successfully bring safe and effective, high quality medical device and pharmaceutical products to patients. This certificate is offered in collaboration with the global leaders in cutting edge quality science education, Pathway for Patient Health.

As this is an asynchronous online program, it is open to Clemson students as well as current industry professionals that hold a bachelor's degree in a STEM discipline seeking to continue their education and have a holistic understanding of industry standards outside of their role.

According to the program director, Dr. Laura Tam, "When working in the fast-paced biopharma manufacturing industry, I learned so much while on the job for my specific role, but I wanted to learn more about our industry, specifically the "why" behind standards and practices. I asked "why" constantly. Everyone, especially the quality assurance team, was very patient with me. I was surrounded by many wonderful subject matter experts but could only learn so much from them because time was limited, and I had so many questions. The certificate program fills this gap by providing courses developed and taught by current industry experts that answer questions you didn't even know you had. I wish I would have had this program while working or better yet, before starting in industry."

The Biomedical Regulatory and Quality Science Certificate Program is not only highly valuable for students and industry professionals looking to prepare themselves for future roles and enhance their marketability. For employers, it provides a pipeline of qualified candidates who are struggling to fill regulatory and quality roles within their company and allows them to offer continuing education for their current workforce.

In addition to the Biomedical Regulatory and Quality Science Certificate Program, the Department of Bioengineering continues to offer Pathway for Patient Health's Quality Science Education Micro Credential Program. This strong partnership with Pathway for Patient Health allows Clemson graduate students to receive credit towards their degree programs while participating in Pathway's program consisting of asynchronous online and in person courses. Upon successful completion of this program, students receive the industry-recognized certification as "Certified Quality Science Professional (CQSP)".

These programs are not alone in preparing students for industry professions, as the Department of Bioengineering offers other robust industry specific graduate degree and certificate programs that current and future industry professionals can utilize to accelerate their growth. Departmental certificate programs information can be found here: *https://www.clemson.edu/cecas/departments/bioe/academics/certificates/index.html*

Our first program announcement: click or scan

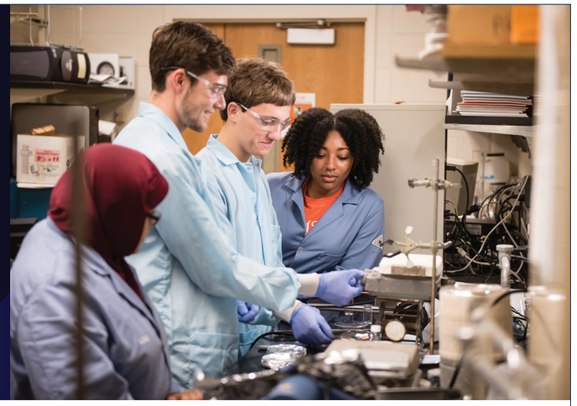
Informational program fliers can be found in this newsletter on pages 34-37.

For more information about the two programs discussed above, please contact Dr. Laura Tam (lemccal@clemson.edu). ■

Master of Engineering

M.ENG BME

Biomedical Engineering



QSE
Quality Science Education Program

Offered through:

DEPARTMENT OF BIOENGINEERING CLEMSON UNIVERSITY

in partnership with

Pathway for Patient Health

Overview:

The Quality Science Education Certificate Program, designed by industry experts, provides a holistic curriculum focused on the multifaceted area of quality assurance. The program delivers a cooperative education including

- Conferences with subject matter experts
- Immersive educational experiences and
- Opportunities for internships and employment

Students will be able to address the scientific and business challenges of today in the medical device and pharmaceutical industries, to pave the pathway for fulfilling careers.

Upon successful completion of QSE, students will receive credit towards their graduate degrees and industry-recognized certification as a "Certified Quality Science Professional (CQSP)."

Program Goals:

Enhance the readiness of students entering industry through immersion in science-based education and real-world experiences in Quality Science for the 21st century.

Program Outcome:

- Credit toward a graduate degree
- Industry-recognized certification as a Certified Quality Science Professional (CQSP)

Department of BIOENGINEERING Clemson University

Master of Engineering

M.ENG BME

Biomedical Engineering

Curriculum Details

- Open to all engineering, science, applied science, and health sciences graduate students.
- The program consists of five graduate-level courses.
- Three online courses offered on-demand through Canvas in the Fall, Spring and Summer semesters.
  - **BIOE 8660**: Global Regulatory and Legal Requirements or Quality for the MedTech Industry *(prerequisite for BIOE 8670 and BIOE 8680)*
  - **BIOE 8670**: Product Development and Validation for the MedTech Industry
  - **BIOE 8680**: Medical Technology Risk and Failure Analysis
- Two in-person courses.
  - **BIOE 8140**: Medical Device Commercialization *(offered Spring Semester)* or other business acumen course
  - **BIOE 6380/6381**: Engineering Controls and Validation for Microbiological Systems *(offered Summer semester)* or other microbiology with laboratory course

Value to Students:

DEVELOP A MARKETABLE SKILL SET

•

ENGAGE WITH INDUSTRY LEADERS

•

TAKE PART IN THE ULTIMATE EXPERIENTIAL LEARNING OPPORTUNITY

•

ENHANCE YOUR MARKETABILITY

•

DIRECT YOUR CAREER PATH

For more information, please contact

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Bioengineering Lecturer
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Department of Bioengineering
Phone: 864-656-7276
Email: lstclai@clemson.edu

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Department of BIOENGINEERING Clemson University

Biomedical Regulatory and Quality Science Certificate Program

Biomedical Regulatory and Quality Science Certificate Program

Offered through:

DEPARTMENT OF BIOENGINEERING AT CLEMSON UNIVERSITY

In collaboration with:

Pathway for Patient Health

Overview:

The Biomedical Regulatory and Quality Science Certificate Program, is filling the need for regulatory and quality experts to support the rapidly growing medical device and pharmaceutical industries. Courses in this program are designed and taught by industry experts, which provides students with the unique opportunity to learn current best industry practices directly from subject matter experts. The rigorous and comprehensive program provides students with:

- An understanding of industry best practices for regulatory compliance and quality through case studies and critical thinking exercises
- Training not just in the how quality and regulation are implemented in industry, but why both systems are crucial for the development and commercialization of safe and effective medical devices and pharmaceuticals
- An ability to recognize that with emerging innovation, regulatory and quality standards need to be evaluated and constantly updated

Regulation and quality form the foundation for industry and ensures the product is safe and effective for the patient. Every industry role involved in the life-cycle of the product has an vital part to play in regulatory compliance and quality assurance.

Program Goals:

Enhance the readiness of students entering the workforce in medical device and pharmaceutical industries by providing training in current regulatory and quality best industry practices.

Program Outcome:

- Credit toward a graduate degree
- Industry readiness with Biomedical Regulatory and Quality Science Certification completion

Department of BIOENGINEERING Clemson University

Enrollment

- Open to graduates who have earned a bachelor's degree in STEM disciplines.
- The Biomedical Regulatory and Quality Certificate Program is a 14 credit hour program.

Curriculum

The curriculum consists of five graduate-level courses allowing students to gain awareness and understanding of:

- Pre-clinical and clinical requirements and regulatory pathways
- Pre-clinical and clinical study design using quality systems and risk management
- Ethical decision making in industry
- Quality systems, Good Supply Practices (GSPs), Good Documentation Practices (GDP) and Current Good Manufacturing Practices (cGMP) throughout the life-cycle of the product
- Quality by Design, design controls, verification and validation
- Decision making in industry with a quality and regulatory mindset
- Risk management assessment and tools
- Failure investigation, reporting and Corrective and Preventative Actions (CAPAs)

Delivery

- All classes are offered asynchronously via web-based technologies to accommodate the demanding schedules of graduate students and working professionals.
- With no residency requirement, students can pursue the certificate online from anywhere in the world.

Industry Readiness:

Upon successful completion of the Biomedical Regulatory and Quality Science Certificate Program, students will be able to:

Describe government regulations, standards and guidance documents that are critical to the product development life-cycle of medical devices and pharmaceuticals.

Interpret regulations, standards and guidance documents through the implementation of industry best practices.

Discuss the basic processes required to successfully design, develop and manufacture safe and effective medical devices and pharmaceuticals.

Explain the basic requirements for pre-clinical studies and clinical trial designs for medical devices and pharmaceuticals.

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For more information, please contact

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Department of BIOENGINEERING Clemson University

CREATIVE INQUIRY PROGRAM RECOGNIZES FACULTY, GRADUATE STUDENT MENTORS

Clemson News | Angela Nixon

Angela Alexander-Bryant, associate professor of bioengineering, has been recognized for her work mentoring undergraduate researchers with the Phil and Mary Bradley Faculty Award for Mentoring in Creative Inquiry.

Alexander-Bryant has been a Creative Inquiry (CI) mentor since 2018 with more than 55 undergraduates participating in her projects. She currently leads three CI projects, ranging from image-guided drug delivery to nanobiomaterials for delivery of cancer therapies to diversity outreach in bioengineering. She is director of the NIH-funded Call Me Doctor ESTEEMED Scholars program, and she received a Early Career Award from the National Science Foundation in 2021 for her research on peptide-based delivery systems for gene therapy.

"Dr. Alexander-Bryant is by far the most helpful and enthusiastic mentor when it comes to research," wrote one student nominator. "She is fully committed not only to furthering her students' expertise in the field of research but also to helping us with our future endeavors. She will always make time to help a student, whether it be by answering questions about the project or providing guidance for us in life outside of the lab. Dr. Alexander-Bryant is the kindest, most caring, and most compassionate mentor out there, and no one deserves this award more than her. She has helped me gain knowledge in the bioengineering field and provided me with numerous opportunities to demonstrate my knowledge to others in the field at conferences and poster seminars."

Alexander Bryant holds bachelor's and master's degrees from Johns Hopkins University and a Ph.D. in Bioengineering from Clemson. ■

◀ *Angela Alexander-Bryant with President Jim Clements and Provost Bob Jones*

About Creative Inquiry + Undergraduate Research

Creative Inquiry + Undergraduate Research combines experiential learning, multi-disciplinary interactions and team-based research. Since it began in 2005, more than 62,000 students from every major have participated in Creative Inquiry projects.

Today, approximately 2,500 students participate in Creative Inquiry each semester, exploring a wide range of topics. Projects typically last for multiple semesters, allowing students and faculty to dive deeper as they tackle tough questions and search for solutions to life's challenges.

Angela Alexander-Bryant in heer labb with students

Research Troubleshooting Club

Lauren Elizabeth Franklin Rentz

Research Troubleshooting Club (RTC) was started while students were returning to Clemson's campus after COVID-19 lockdowns sent students into isolation for months. With graduate student community and connection scarce, this club had the goal of giving students a place to come and find connection with their common goal of Bioengineering research. Imposter Syndrome is common among graduate students when they feel like their research and achievements are not as good as those around them, that they don't belong. Research Troubleshooting Club has the goal of not only solving student research problems but also building a sense of community and belonging. Researchers come together to laugh at common issues, get to know one another, and combat the sense that they are imposters in their program.

Adam Baker was the graduate student who had the idea for this club and was helped by the club's faculty advisor, Dr. Margarita Bruce. They chose a time that would be most convenient for students, in the middle of the day, and provided free lunch. Not only did the lunch encourage students to visit the new club, but also helped breakdown conversation barriers and fill a common student need, food! Within a couple years of starting on Clemson's main campus, the club started another chapter in Charleston at the Clemson Bioengineering MUSC campus. Fewer students are at the MUSC campus, so they are even more isolated than your average graduate student. RTC has been a great way to connect those students and currently has two chapter leads, Daniel Gordon and Nate Hyams, who run meetings there.

The club has had many success stories of solving problems as everyone goes around the room sharing the issues they are currently facing while other students chime in with ideas for solutions. This year, Adam was having trouble with his PDMS films failing, and after using the suggestion from the group of a standardized procedure, his PDMS films started coming out reliably and successfully. While research areas vary widely among the group, there are often common issues such as the cell culture problem our club treasurer, Arianna Csiszer, recently got help with. RTC also provides educational resources to students such as having a demonstration on how to make dry ice in Rhodes rather than having to drive and purchase dry ice for sample transportation. This knowledge has been helpful to me many times, such as this summer when I needed to carry samples across campus safely in the South Carolina heat. Many researchers expressed interest in learning more about the grant writing process, and how to find student grants. Earlier this year, Dr. Dayan Ranwala kindly volunteered to hold a session. Questions were collected from club members, and Dr. Ranwala came prepared and answered the specific questions that were asked, helping graduate students better understand how grants are processed and where to find grants they can apply to.

While Research Troubleshooting Club has solved many graduate research issues, the biggest win to me has been the community and connections that are made every meeting. Students are meeting researchers in other labs and research areas that would not normally get to know each other, and the club helps graduate students on their academic journeys and hopes to continue helping many more. ■

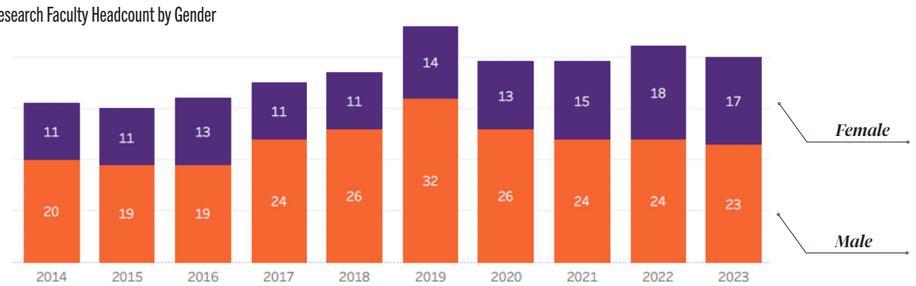
BIOENGINEERING DEPARTMENT MENTORING PROGRAM
"BIOE Faculty Elevate": a Collective Approach Toward Elevating Faculty Professional Development

Dayan Ranwala, Delphine Dean

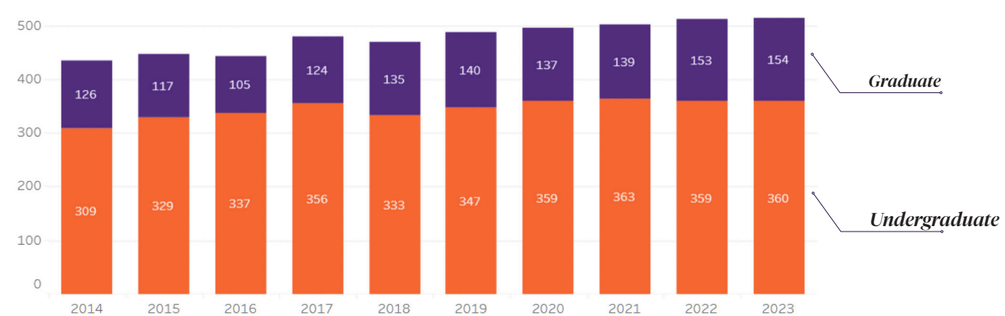
Number of our faculty has been grown over the years. Each faculty member in our department has primary responsibilities of either teaching, research, or both. Their professional development is an essential part of their career lifespan regardless of their primary responsibilities of the faculty appointment. Number of student enrollment has been rising as well. This may be due to anticipated overwhelming needs of global biomedical innovation, its job market, and students' career choice. To address both faculty professional development and to achieve students needs in preparing them for competitive global careers, we have recently introduced the BIOE Faculty Elevate program as a collective approach for mentoring to fulfill faculty needs in relevance to the Clemson Elevate Strategic Plan. We believe that this program will result in tangible impact of reputation on their individual career advancement and regional, national, and global department and institution recognition.

Dr. Martine LaBerge is the Chair for the BIOE Mentoring Committee. We are so grateful for her leadership on this Program, her efforts and time on developing the Program, and her continuous work to make it a successful Program. ■

Faculty Positions (2014-2023)



Student Enrollment (2014- 2023)



Bioengineering Design Teams Claim Multiple National Awards

Exemplary Student Education and Mentoring Aligning with the Clemson University Strategic Plan – Clemson Elevate

Dayan Ranwala, John DesJardins

The bioengineering senior design program has been educating the next generation of designers and innovators since its founding in 2009. The efforts of these young inventors have not gone unnoticed. These teams of students recently accelerated their winning records at regional, national, and international acclaim at some of the most prestigious competitions in the fields of biomedical engineering. These include the US Patent and Trademark Office's Collegiate Inventors Competition; the National Institute of Biomedical Imaging and Bioengineering, and VentureWell's the Design by Biomedical Undergraduate Teams (DEBUT) Challenge competition; the SCInnovates Design Challenge; the Johns Hopkins Healthcare Design Competition; and the Product Development & Management Association (PDMA) Carolinas Competition and its Global Student Innovation Challenge.

The SCInnovates Design Challenge was founded in 2021 and brings all of South Carolina's institutions of higher education together to celebrate innovation and entrepreneurship across the state. It is currently hosted by the South Carolina Department of Commerce and the South Carolina Research Authority. For the Fall 2023 cycle, four Clemson bioengineering teams (DynaGait, CallSense, HemaSTOP, E-Walk) participated and advanced to the Round of 15 and won the 1st place (E-Walk), 2nd place (CallSense), and People's Choice Award (E-Walk) overall.

The PDMA Carolinas and associated Student Innovation Competition is the leading association championing best practices in new product management and development. For 2024, the top universities that participated were Clemson, Rice, and University of North Carolina-Charlotte along with 56 students and 10 faculty advisors. Five undergraduate bioengineering teams (Amputeem, Bloom, E-Walk, NephroGuard, and StepSync) entered and Clemson swept the competition winning the 1st place (Bloom), 2nd place (E-Walk), and 3rd place (by both NephroGuard and StepSync). From this, the top two teams have been selected to complete at the Global Student Innovation Challenge to be held on September 14-17 in St. Louis, MO, USA. In fact, a team of Clemson bioengineering students won last year's Global Challenge for CatheSure which is designed to wirelessly detect shunt malfunctions in hydrocephalus patients in less than five minutes.

In addition, Team Bloom competed in and won the 1st place in the internationally acclaimed 2024 Johns Hopkins Healthcare Design Competition, a first for a Clemson Team.

Continuing their winning successes from last year's 1st place at the 2022-2023 Senior Design Symposium, Team U-Sert entered into the DEBUT competition and was awarded the 2023 DEBUT Design Challenge: National Institute of Nursing Research Technologies to Empower Nurses in Community Settings Prize. They traveled to the annual Biomedical Engineering Society meeting in Seattle, WA to represent Clemson and accept this prize.

Locally, the bioengineering teams have been sweeping other design and entrepreneurship competitions on Clemson campus. The 2024 College of Engineering, Computing and Applied Sciences SPARK Challenge (which is a two-semester program and pitch competition

that seeks to support students and their ideas in the areas of technology, innovation and entrepreneurship) competition awarded 1st place to Team NephroGuard, 2nd place to Team StepSync, and 3rd place to Team Bloom. The inaugural 2024 Brook T. Smith Launchpad (the Entrepreneurship Hub of Clemson University) Liftoff Competition awarded 1st place to Team Bloom and 3rd place to Team NephroGuard.

In total, the 2023-2024 design competition season has awarded over $40,000 across 6 competitions to Clemson Bioengineering design teams. Many of these teams have entered additional competitions at the end of their Spring semester. The results of the Collegiate Inventors Competition and the DEBUT competitions will be announced in early September.

More information on some of our winning teams is listed below, Congratulations Teams!

Team Bloom: The Bloom Speculum

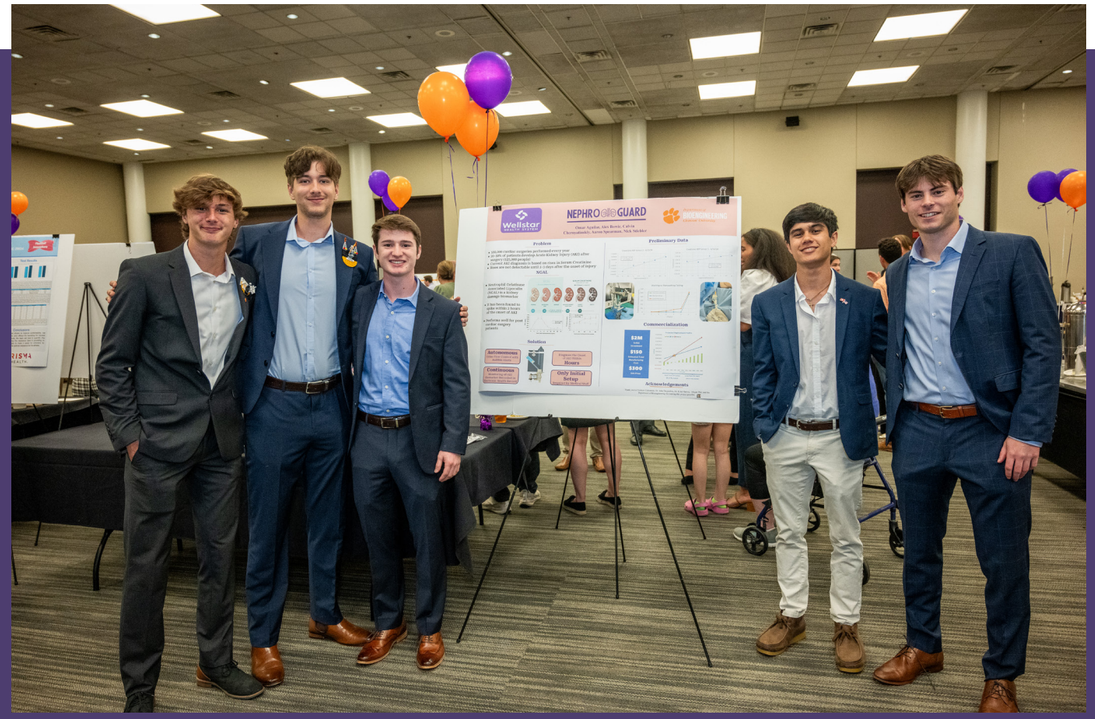
Team: Angeline Chen, Karen De Guzman, Elizabeth Dods, Vaushnavi Kanduri

This team has developed an extendable four-blade vaginal speculum to use during Loop Electrosurgical Excision Procedure (LEEP). It is a procedure used with a small electrical wire loop to remove precancerous cells in the cervix after abnormal cells are found during a pap smear test, colposcopy, or biopsy. About 350,000 women die from cervical cancer each year. Despite the fact that cervical cancer is the fourth most common cancer in women, it is often misdiagnosed or untreated. About half a million LEEPS exams are performed each year. Although this procedure is effective in treating cervical cancer, the type of speculum used during the procedure have a number of impediments and may compromise the safety of the patients and efficacy of LEEP. The current two-blade speculum used can obstruct the gynecologist view of the cervix and in turn precancerous lesions can be missed. They have fixed blade sizes that may not fit individual patient's anatomy requiring the gynecologist to halt the procedure until a proper replacement is found. Electrodes of the LEEP may burn and damage the exposed cervix tissues leading to infections. All these factors contribute to the patient discomfort, duration of the procedure, and cost. To overcome these issues, this team has developed an innovative, extendable, and contour four blade (two lateral and two vertical blades) 'Bloom' speculum. It also has a smoke evacuation tube made of non-conductive sterilizable nylon polymer to enhance patent safety and efficacy of the LEEP.

Team E-Walk

Team: Amanda Beall, Maria Chavez, Sebastian Saenz, Katherine Traver and Christopher Theos

This team has developed a stimulation-based solution to foot drop which causes difficulty lifting the front part of the foot causing it to drag on the ground when walking. It is not a disease but rather a sign of an underlying neurological, muscular, or anatomical problem leading to difficulties in mobility and increasing the risks of falls especially those who are 65 years old and up. It is common among 1.5 million people globally with a higher incidence in men. Current treatments include Ankle-foot orthosis (AFO), braces or splints, physical therapy, nerve stimulations, or surgery. These methods are invasive and costly. There is a lack of other methods to retrain the mobility. The prototype of the E-walk combines electrical stimulation (TENS) and gait analysis (IMU). It initiates stimulus to paretic dorsiflexor muscles in the swing phase and terminates in the stance phase allowing for muscles and nerves to be retained via e-stim. This improves foot clearance by about eight and half centimeters with implications for reducing the effects of foot drop, decreasing the recovery time in physical therapy, and improving overall outcomes. This is superior to AFOs as it induces neuroplasticity changes and improvements in motor functions and mobility and prevents muscular atrophy and permanent gait impairments of AFO use. It is non-invasive, implantable, electrodes are placed on skin over peroneal dorsiflexor nerve muscles. Further development of E-Walk will enhance the quality of life for patients suffering from foot drop by allowing them to reclaim independence and active lifestyles. Given the high indirect costs involved in stroke and spinal cord injuries, further development of E-Walk has the potential to be a low cost and affordable alternative to the currently available treatments for foot drop.



Team NephroGuard: The NephroGuard 'Medical Device for Quicker Diagnosis of Kidney Injury'

Team: Nicholas Stiebler, Calvin Chernyatinskiy, Aaron Spearman, Omar Aguilar, Alex Bowie

One of the most frequent complications of cardiac surgery is kidney injury, a rapid loss of organ function that occurs over the course of hours to days. It complicates 30% of post-cardiac surgery cases. Developing kidney injury is associated with several adverse outcomes such as increasing mortality rates by more than four times, longer hospital and intensive care units stay, and risks of developing chronic kidney diseases. The current method of kidney injury diagnosis is based on a drop in serum creatinine levels. However, this is not an effective method of diagnosis since the drops in creatinine levels do not occur until 2-3 days after the onset of kidney injury. That is why this team has created NEGAR, a medical device, to detect biomarkers early for kidney damage (Figure 3). It is compatible with all catheters, requires 30-second set up., and detects kidney injury within hours. This device is to be placed between a patient's catheter and urine collection bag within 32 seconds by clinicians. Its novel biosensor will detect neutrophil gelatinase-associated lipocalin (NGAL) which is a kidney biomarker that is used to detect kidney damage in cardiac surgery patients. When a NGAL spike is detected indicating kidney injury, it will send an alert to a clinician allowing for earlier diagnosis of kidney injury. Currently there are two immunoassay laboratory tests (Nephro Check and KI) are on the market that use biomarkers. However, they have several disadvantages since both of these tests offer only a spot check as compared to NephroGuard, need longer time to obtain results, and require expensive equipment to run tests. About 500,000 cardiac surgeries are performed every year. Therefore, with further refinement of our device with clinical testing and FDA approval, there is potential for a larger market value for our device. ■

Focus on Creative Inquiry poster symposium highlights undergraduate research

Clemson News | Angela Nixon

Hundreds of Clemson students gathered at the Watt Family Innovation Center to share their research at the 19th annual Focus on Creative Inquiry (FoCI) Poster Forum April 3-5. Projects from every college were presented on a variety of topics such as rocketry engineering, DNA repair, designing medical devices for developing countries, AI and contemporary art.

Creative Inquiry is Clemson's nationally recognized cross-disciplinary undergraduate research and experiential learning program, that gives students the opportunity to work in small groups with a faculty mentor to answer challenging questions and solve real-world problems.

The event allows students to showcase their work, reflect on their experiences and to gain skills that will help them communicate their work to the general public. The three-day event featured more than 265 student projects, making it the largest FoCI event to date.

The whole article can be found here: click or scan

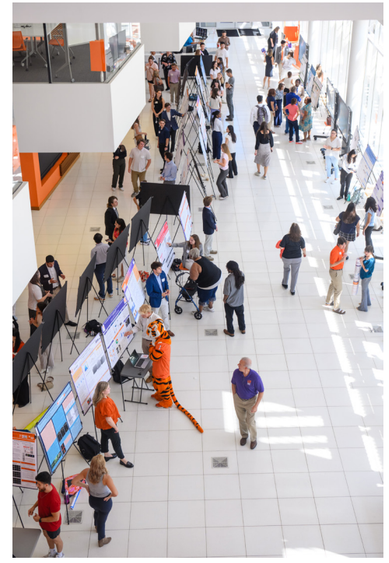
Winners from the bioengineering department:

FoCI Printed Poster Award

2nd place: "Transcript Characterization of lncRNAs in Triple Negative Breast Cancer"

Mentors: Madison Sexton, Mya Beasley and Congyue Peng, Bioengineering

Students: Marissa Beighley and Kennedy Madden, bioengineering; Allison LoRusso and Christina Sims, biological sciences. ■



Biomedical Data Science & Informatics MASTER OF SCIENCE

"I am a data scientist." This is Dr. Alex Alekseyenko's answer to the question, "Can you please describe your research?" The interesting thing about this answer is that Dr. Alekseyenko is not faculty in Clemson University's School of Computing. Instead, he is faculty in the Public Health Sciences Department at the Medical University of South Carolina. Dr. Alekseyenko's research is in the human microbiome and its role in human health and disease. That he would describe his work as "data science" speaks to the significance of biomedical data science to public health research. It also speaks to the growing importance of collaboration across disciplines. Computer science, for example, and public health, but also mathematics and statistics; genetics, and bioengineering.

◀

Student portrait caption: BDSI PhD and MS alumni in front of Clemson's Cooper Library

The growing need for this type of collaboration is what motivates the Biomedical Data Science & Informatics program, an MS and joint-PhD program co-offered by Clemson University and the Medical University of South Carolina. BDSI faculty span nine different departments and two universities, with research that reads like a lesson in cross-pollination. Dr. Jihad Obeid, of MUSC, is a pediatrician formally trained in biomedical informatics. His research interests include artificial intelligence, and more specifically, deep learning with EHR data for e-phenotyping, with a focus on clinical text mining. Dr. Obeid's research focuses on natural language processing, which is also a focus in the research of Dr. Kai Liu, Computer Science faculty in Clemson University's School of Computing. Dr. Liu's work focuses on the creation of machine learning algorithms that are robust, efficient and scalable.

BDSI faculty also work in biostatistics, in the development of predictive, evidence-based public health models, and at the intersection of computer graphics and neuroimaging. The program coordinators, Dr. Aaron Masino of Clemson University, and Dr. Caitlin Allen, of MUSC, are both interested in strengthening clinical decisions, with Dr. Masino focusing on clinical diagnostic planning with large language model interfaces, and Dr. Allen, on the translation of genomics applications to maximize population health impact and improve health equity, which is a key focus of BDSI, particularly in the state of South Carolina. This focus can be seen most clearly in the program's application for and successful receipt of a T15 training grant, funded by the National Institutes of Health. The grant, titled SC BIDS4HEALTH and authored in partnership with South Carolina State University, will support a cohort of BDSI PhD students in the application of data science to address existing health inequities. Clemson University's Emma Coen and Mattia Galanti and MUSC's Bashir Hamidi are three of the students currently working under the grant.

For Clemson undergraduates interested in the way biomedical data science and informatics might intersect with their undergraduate majors, BDSI has partnered with several different degree programs to offer Bachelor of Science-to-Master of Science pathways. These pathways allow undergraduate students interested in BDSI's MS degree to apply graduate BDSI courses to both their undergraduate BS and BDSI MS requirements. Bioengineering undergraduates are included in the list of undergraduate majors who can participate in these partnerships. When asked, Adam Rollins, one of two Graduate Services Coordinators for the School of Computing, spoke of the interdisciplinary qualities of the program, and the way that interdisciplinarity calls for an open-door approach. "Bioengineering majors are welcome to reach out with questions. We're always happy to talk." ■

For more detail on BDSI, visit the program's website at *https://www.cs.clemson.edu/bdsi/*

click or scan

Dr. Aaron Masino, BDSI Program Coordinator for Clemson University

Whatch on Vimeo:
https://vimeo.com/300999949

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Biomedical Data Science & Informatics
MASTER OF SCIENCE

The BDSI-MS is an interdisciplinary program that leverages the broad strengths of a Tier 1 Research University, spanning the fields of computing, engineering, mathematics, biology, and public health. The objective of the program is to produce the next generation of data scientists, prepared to manage and analyze big data sources from mobile sensors to genomic and imaging technologies. Graduates will possess the necessary skills for informatics careers in biology, medicine, and public health, with a focus on the development of prescriptive analytics derived from large fields of data. The program is designed for students with undergraduate computer science, math, engineering, or biomedical sciences experience who wish to make a contribution to biomedical sciences and individual and societal health.

Contacts:

Adam Rollins, Graduate Coordinator: rollin7@clemson.edu

Learn more at **https://www.cs.clemson.edu/bdsi/**

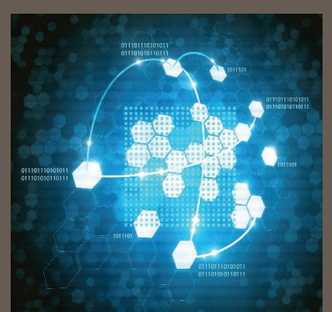
CLEMSON UNIVERSITY

"A key strategic challenge is to ensure that NIH culture changes [are] commensurate with recognition of the key role of informatics and computation for every IC's mission. Informatics and computation should not be championed by just a few ICs, based on the personal vision of particular leaders. Instead, NIH leadership must accept a distributed commitment to the use of advanced computation and informatics toward supporting the research portfolio of every NIH Institute and Center."

- The National Institute of Health, Data and Informatics Working Group, June 2012 Report

"The future of healthcare is data."

- Jordan Ritchie, BDSI PhD Student, Clemson-MUSC



Fulbright Scholarships for the Bioengineering students

Clemson News | Shawna Cass and Blake Mauro

The Fulbright U.S. Student Program is designed to increase mutual understanding between the people of the United States and its 140 participating countries. Student recipients, which include recent college graduates, graduate students and early career professionals from all academic backgrounds, use their awards to pursue graduate study, conduct research, or teach English abroad.

During the application process, students decide which country they would like to apply to and what type of grant they want to pursue.

The whole article can be found here: click or scan

Winners from the bioengineering department:

STUDENT SCHOLAR

Calvin Paulsen

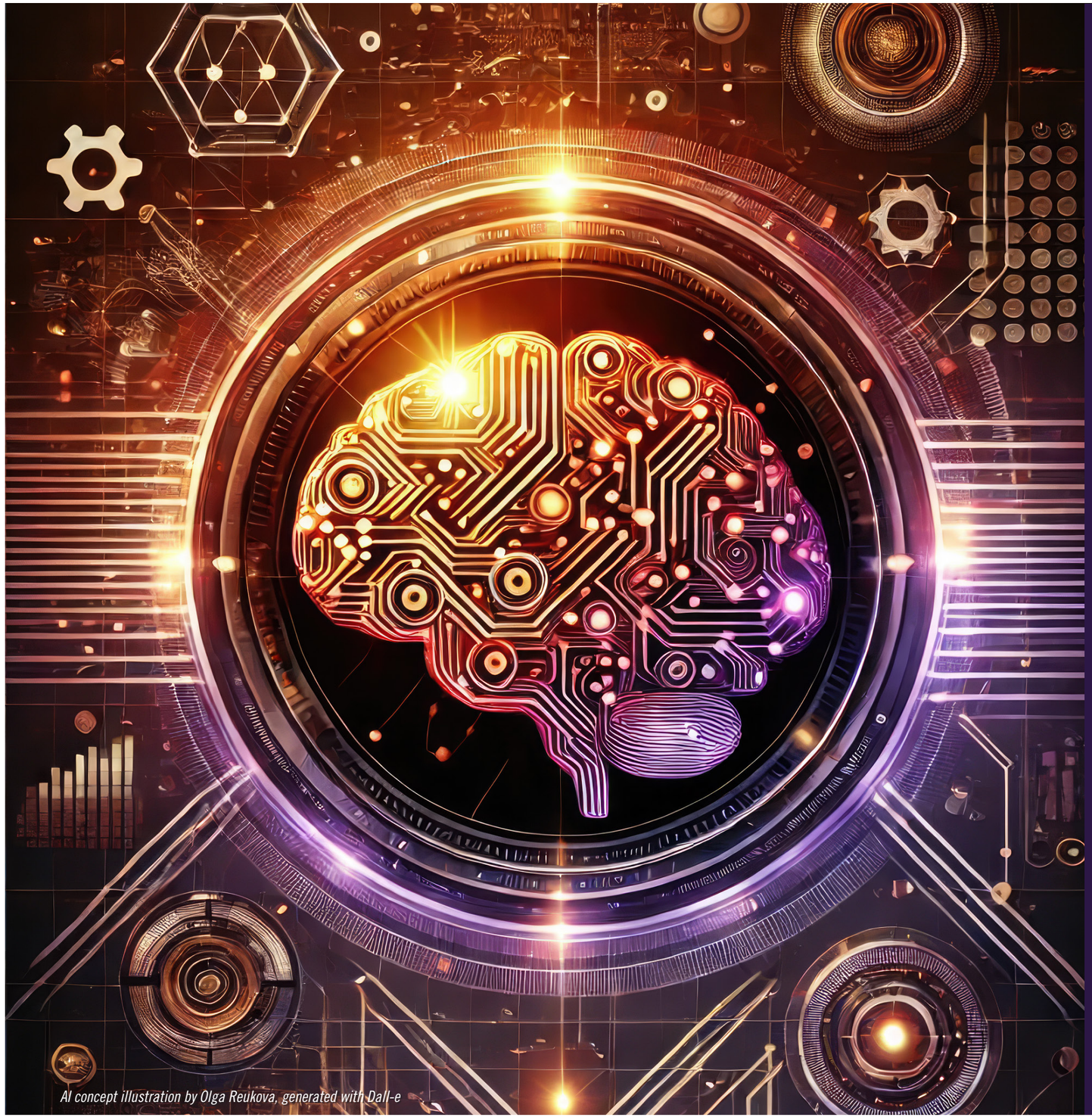
A biomedical engineering major from Summerville, South Carolina, received a research award in Germany that will allow him to work at the Max Planck Institute for Molecular Biomedicine. He has already been working online with a researcher at the institute conducting stem cell research, with their project having the potential to uncover new targeted therapeutics for epithelial-derived cancer and aging. Paulsen established this connection while working as an undergraduate research trainee with a mechanobiology researcher on a National Science Foundation funded Research Experience for Undergraduates (REU) at Washington University in St. Louis last summer. In addition to his research, Paulsen has volunteered with organizations focused on residence life engagement, recycling and sustainability, while also working as an academic tutor.

After his Fulbright experience, Paulsen plans to pursue a Ph.D. in biomedical engineering, with a goal of someday working at a national laboratory, where he can shape health policy and increase international research collaboration.

ALTERNATES

Kaleigh Neely

from Cleveland Heights, Ohio, graduated from Clemson with a bioengineering degree in 2019 and has since earned a master's degree in orthotics and prosthetics in 2022 through Eastern Michigan University. Neely earned alternate status for a Master of Science in Public Health award in Ireland, one of the most competitive awards in the Fulbright competition. She plans to transition from her current work in clinical care to influencing policies related to prosthetic care in the U.S. and abroad.



AI concept illustration by Olga Reukova, generated with Dall-e

DEPARTMENT

DEPARTMENT NEWS AND ACHIEVEMENTS

NEWS AND ACHIEVEMENTS

Pioneering Heart Research Helps Earn Ying Mei the McQueen Quattlebaum Professorship

Paul Alongi

A bioengineer renowned for his research into repairing hearts damaged by attack or disease has been selected for the McQueen Quattlebaum Professorship, a high honor that marks him as a key leader on Clemson University's faculty.

Ying Mei joined Clemson's Department of Bioengineering in 2012 and has steadily advanced research into cardiac organoids that show promise for replacing dead and damaged heart tissue. He is based in Charleston as part of the Clemson-MUSC Bioengineering Program.

The professorship was made possible by a gift from the late Alexander McQueen Quattlebaum, who graduated from Clemson in 1934, was a professor of engineering until World War II and served on the Board of Trustees from 1958-74. He made the gift in honor of his father, McQueen Quattlebaum, who was in Clemson's Class of 1909.

Named professorships such as the one now held by Mei add prestige to the recipient and the University, helping attract and retain top talent. A named professorship signals to colleagues and potential students that the recipient is among Clemson's leading faculty members.

"The department is fortunate to have him on our faculty, and he is truly deserving of the McQueen Quattlebaum Professorship."
Delphine Dean

Mei said that when he learned that he was receiving the professorship, two words came to mind– appreciation and opportunity.

"The professorship shows Clemson's appreciation for the contributions I've made, " he said. "However, I cannot do it alone, and I would like to express my appreciation for the support I've received from the University, the College of Engineering, Computing and Applied Sciences and the Department of Bioengineering.

"This professorship will create opportunities that otherwise wouldn't be available or would be harder to get. It will help open doors to engage with leaders in the field, program officers in agencies that provide research funding and to financial backers, when our technology is ready to be translated to bedside application."

In his most recent research, Mei has tackled some of the unique challenges that come with using human pluripotent stem cells to treat heart muscle damage. It is crucial work because the heart is not able to heal itself in the same way as a cut on the skin would.

Mei and his team have combined the stem cell-derived heart muscle cells with silicon nanowires that are visible only by microscope. The combination results in organ-like structures called organoids.

The silicon nanowires were key because they improved the electrical connectivity and overall function of the lab-grown organoids, researchers found.

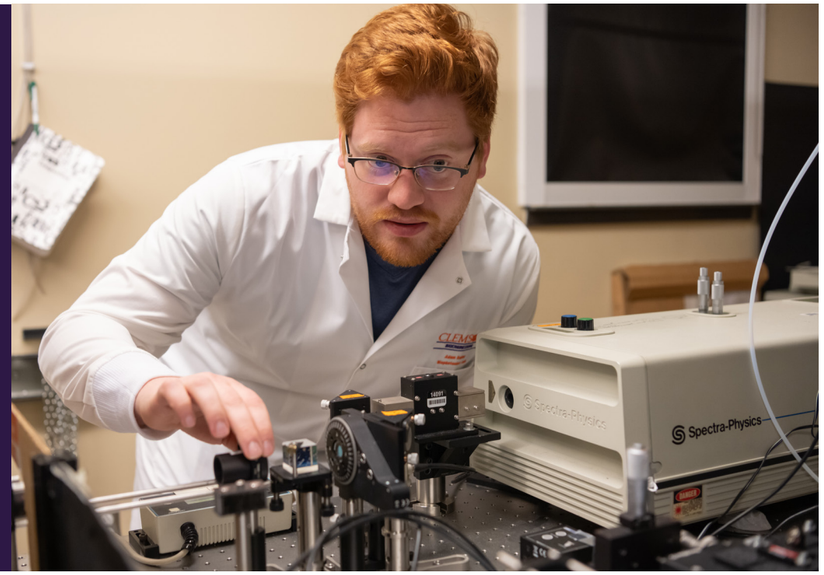
In a new research project, Mei and his team plan to genetically modify the stem cells so they will not be rejected by the human body as foreign cells. They will then test whether the modifications affect the functioning of the stem cells or the nanowires.

"Much of my career has been focused on engineering the human cardiac organoid system, and what I am interested in is how we can accelerate its clinical translation," Mei said. "The McQueen Quattlebaum Professorship will help support my efforts."

Delphine Dean, chair of the Department of Bioengineering, congratulated Mei on the professorship.

"The department is fortunate to have him on our faculty, and he is truly deserving of the McQueen Quattlebaum Professorship," she said. "This prestigious honor not only recognizes his past achievements but also empowers him to continue making groundbreaking advancements in health innovation." ■

Adam Baker Receives Award at Annual BEEC Conference



Adam Baker received an award for an oral presentation given at the Biomedical Engineering Education Community Annual Conference. He was also given the opportunity to publish his work on their associated journal 'Biomedical Engineering Education Journal' and a feature in an upcoming addition of a teaching tips article.

The work came from Baker's capstone project he completed while doing his ESED certificate but was an experiment conducted on BIOE3701, 'Confidence and Creativity in Instrumentation Design'. Included co-authors; Dr. Zhi Gao, Dr. Jordon Gilmore, and Dr. Lucas Schmidt. ■

4th Annual REDDI Lab Research Symposium

Broadening Research and Professional Development in Clinical Diagnostics and Healthcare

Keynote Speakers

Lior Rennert, Ph.D.

Associate Professor, Clemson University Department of Public Health

Director, Clemson University Center for Public Health Modeling and Response

Dr. Rennert's work focuses on the development and application of statistical and mathematical models to guide health-related decision making in the health sciences. Dr. Rennert is PI on multiple NIH awards, including an R01 to develop an infectious disease modeling framework for resource allocation in underserved communities and an R61/R33 to develop data-driven approaches for opioid use disorder treatment, recovery, and overdose prevention in rural communities via mobile health clinics and peer support services. He is also PI on a CDC Center grant to implement Disease modeling and analytics to inform outbreak prevention, response, intervention, mitigation, and elimination (DMA-PRIME).

Carolyn Banister, Ph.D., SCT(ASCP)MB^{CM}

Clinical Assistant Professor, University of South Carolina College of Pharmacy

Director, University of South Carolina Diagnostic Genomics Laboratory

Dr. Banister has focused on health disparities, specifically on the increased rates of colon cancer incidence disproportionately affecting African Americans. From 2020-23 as a faculty member in the College of Pharmacy, she led a major COVID-19 testing facility serving USC and other universities across South Carolina, showcasing her commitment to public health.

Anne Wyllie, Ph.D.

Assistant Professor, Yale University School of Public Health

Director, SalivaDirect

Dr. Wyllie's work has identified saliva as a reliable sample type for the sensitive detection of Streptococcus pneumoniae in health older adults and, more recently, SARS-CoV-2 in persons suspected of COVID-19. In an effort to address many issues regarding infectious disease outbreaks, Dr. Wyllie further validated and optimized saliva for SARS-CoV-2 detection and developed SalivaDirect: a simple, scalable, and (importantly) cost-effective method to help alleviate SARS-CoV-2 testing demands.

Prem Premsrirut, M.D., Ph.D.

Assistant Research Professor, SUNY Downstate Department of Molecular and Cellular Biology

President and CEO, Mirimus, Inc.

Dr. Premsrirut is CEO of Mirimus, Inc. and an expert in the development and use of RNAi transgenic mice. She was an inventor of technological advancements that lead to the development of a high-throughput platform for rapid and efficient generation of conditional RNAi transgenic mice. She also pioneered a novel approach for the generation of "speed" chimeric GEMMs based on rederivation of mouse embryonic stem cells from existing mouse strains with a predisposition to cancer.

Panel Discussion Leaders

Delphine Dean, Ph.D.

Ron and Jane Lindsay Family Innovation Professor, Clemson University Department of Bioengineering

Department Chair, Clemson University Department of Bioengineering

Director, Clemson University Research and Education in Disease Diagnosis and Intervention (REDDI) Lab

Dr. Dean's lab leads a wide range of studies focused on understanding mechanics and interactions of biological systems across length scales and instrumentation and device design. She also currently leads several studies to understand how nanoscale structures and low-dose ionizing radiation affect cells and tissues. Dr. Dean is also the director of the Center for Innovative Medical Devices and Sensors, as well as the REDDI Lab, which ran all of Clemson University surveillance testing during the COVID-19 pandemic and continues to validate saliva-based testing for multiple infection types.

Melissa Nolan, Ph.D., MPH

Associate Professor, University of South Carolina Department of Epidemiology and Biostatistics, Arnold School of Public Health

Dr. Nolan's research interests lie within infectious diseases, health disparities, and maternal-child health. Specifically, her work focuses on patient-oriented public health approaches that disproportionately affect marginalized populations. Her current research focuses on the clinical epidemiology of vector-borne diseases and congenital infections throughout the Americas.

Gustavo Guimaraes Rangel, M.D.

Surgeon, Prisma Health Pediatric Otolaryngology

Clinical Assistant Professor of Surgery, University of South Carolina School of Medicine - Greenville

Dr. Rangel is a head & neck surgeon for pediatric otolaryngology for Prisma Health. He did fellowships for The Ohio State University Wexner Medical Center, Nationwide Children's Hospital – PAA, and St. Jude Children's Research Hospital. Dr. Rangel has unique experience dealing with clinical complications regarding upper respiratory infections and their effect on surgical procedures for infants and toddlers.

Sarah Nickel, MS, MLS(ASCP)CM

Associate Professor, Wichita State University Department of Medical Laboratory Sciences

Director, Wichita State University Molecular Diagnostics Laboratory

Sarah Nickel is the Co-Founder/Director of the Molecular Diagnostics Laboratory at Wichita State University and has extensive knowledge and laboratory experience in clinical microbiology and molecular diagnostic testing methods. Sarah's interests include methods for improving clinical microbiology education, immunological response to commensal and pathogenic bacteria, and advancements in diagnostic microbiology methods.

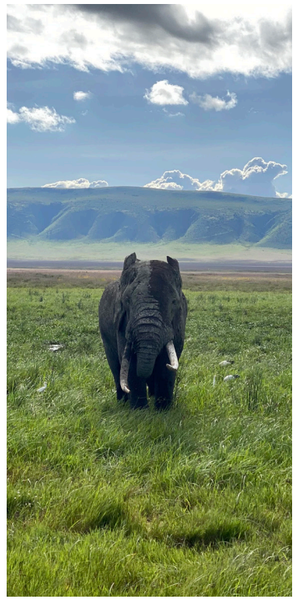
Ted Swann, M.D.

President and Founder, TIGER Diagnostics Laboratory

President, Swann Medicine

Dr. Swann is an independent family medicine physician who received his medical degree from the Medical University of South Carolina and has been serving the Clemson community for over 20 years. During the COVID-19 pandemic, Dr. Swann worked closely with the REDDI Lab to provide the best and most up-to-date medical information to Clemson University and its surrounding communities. In response to the closing of laboratories in upstate South Carolina, and inspired by his transformative experience with the REDDI Lab, Dr. Swann, alongside his partners, has developed TIGER Diagnostics Laboratory to provide precise, punctual, and personable diagnostic testing to patients in upstate South Carolina and beyond. ■

THE DEVICES FOR THE DEVELOPING WORLDS



Students and Faculty Pose together in front of Arusha Technical College, sporting the Clemson Tiger Rag

The Devices for the Developing World Creative Inquiry, lead by Dr. Delphine Dean and Dr. Melinda Harman had their annual trip to Arusha, Tanzania again this past May. The CI works in partnership with Arusha Technical College's electrical engineering program to bring advances in medical technology tailored to developing world countries.

Throughout the year, members of the Creative Inquiry work together in teams to develop new devices and technologies, then they bring these devices to Tanzania to test them out and collaborate with Arusha Technical College students to improve their designs.

Some teams have worked to develop things like improved ankle prosthetics, counterfeit drug detection, point-of-care biosensors, portable EKG, and electrosurgery reprocessing. While in Tanzania, the students had opportunities to test designs, visit medical facilities in the area, and present at a symposium on the work they have been doing.

Students had a great opportunity to work cross-culturally and interdisciplinarily while in Tanzania. The partnership between Clemson University and Arusha Technical College continues to grow. Students collaborate between countries through online communication and planning. ■

Building A Better You Program

Many undergraduates may be gone during the summer, but Clemson Bioengineering is as busy as ever. The Building a Better You (BABY) Program engages 11th and 12th grade high school students in the world of bioengineering during the summer. Students participate in activities as they are mentored by graduate students and professors, and get a jumpstart on hands-on experience in the lab before even coming to college.

Students get lab experience,and tour state-of-the-art facilities both on Clemson's main campus and the Patewood campus, and get to learn about disciplines within bioengineering. In addition to Clemson facilities, students also tour Prisma Memorial Hospital, and are able to witness live surgeries. Hands-on activities range from suturing hearts, culturing cells, and working with biosensors and building their own circuits. In addition to these experiences, students have the opportunity to learn directly from professors and graduate students about their research.

As students tour labs and interact with professors and graduate students, they take note, and many from past summers come back to tour again as they get ready to enter college. This unique summer experience gives students a big head start, and leaves a lasting impression of the world of bioengineering.

High school students work together, pipetting in a bioinstrumentation based activity
(from https://www.clemson.edu/cecas/departments/bioe/academics/pre-college.html)

SPACE BIOLOGY

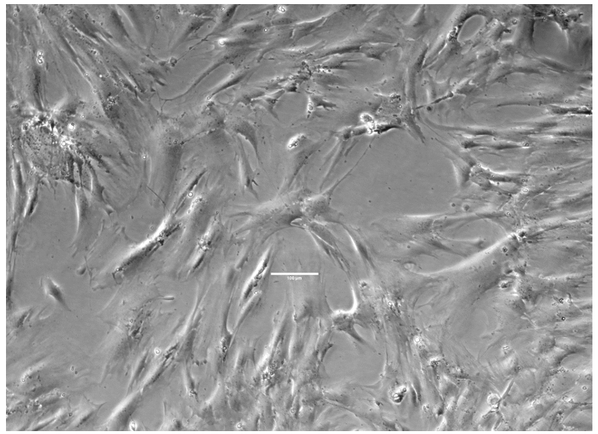
Arianna Csiszer, a graduate student in Dr. Delphine Dean's Multiscale Bioelectromechanics lab, was recently awarded a fellowship with the South Carolina Space Grant Consortium for her research in effects of radiation and microgravity on connective tissues. Csiszer has worked with recent graduate, Calvin Paulsen, to develop a novel method for simulating microgravity to progress space-centric research on Earth, and is working to integrate this with her previous research in radiation. She hopes that her research will allow for safer space travel and allow lead to countermeasures that can protect astronauts from the harmful environment of space.

Csiszer previously has worked with the South Carolina Space Grant Consortium as a recipient of an Outreach Award, and plans to continue to work with them in an outreach capacity as well. On behalf of SCSGC, she was a panelist for "Space Travel and Exploration: Taking a Journey Together" as part of a development series hosted by the Lowcountry Society for Women Engineers and the National Society of Black Engineers Charleston Professionals.

Arianna Csiszer

A Novel Treatment Development for Spinal Muscular Atrophy

Dr. Peng presented at the 2024 World Biomaterials Congress (WBC) meeting on the development of a stem cell-based treatment for spinal muscular atrophy (SMA) patients. Approximately 30,000 Americans present SMA symptoms that range from mild to severe disconnection of motor neurons and muscle junctions. The current treatment regimens are expensive and not effective for adult patients, who occupy one-third of the total SMA patient population. We are developing a stem-cell-based neuronal regeneration approach using an easy-to-obtain stem cell with neural origin, the dental pulp stem cells. We supplemented the cells with the survival motor neuron mRNA and induced the cells into a neuronal-like cell for transplantation. We hope the transplanted cells can restore the impaired motor neuron and muscle connection at least partially and help the patients regain motor neuron function.



Microscopic image of cells Dr. Peng worked on

Faculty Promotion

At the beginning of the Fall semester, the University announced the tenure and promotion at Bioengineering department.

Renee Cottle | Associate Professor with Tenure

Tyler Harvey | Senior Lecturer

David Karig | Granted Tenure

Joseph Singapogu | Associate Professor with Tenure

AI concept illustration by Olga Reukova, generated with Dall-e

NEW FACULTY SPOTLIGHT

Susana R. Cerqueira, Ph.D.

▲ *Dr. Susana R. Cerqueira*

Susana R. Cerqueira is a neuroscientist and bioengineer who has joined our department with a passion for advancing biomedical research through innovative engineering solutions. Dr. Cerqueira earned her Ph.D. in Tissue Engineering, Regenerative Medicine and Stem Cells from Minho University, Portugal, and completed her postgraduate training at The Miami Project to Cure Paralysis, Miller School of Medicine, at the University of Miami, FL. Throughout her career, Dr. Cerqueira has exemplified collaboration and excellence. Her research not only pushes the boundaries of scientific discovery but also translates fundamental insights into tangible applications that have the potential to revolutionize healthcare.

The ongoing research projects in Dr. Cerqueira's lab focus on developing cell-specific therapies to modulate neuroinflammation and reverse pathological phenotypes present in neurological diseases, utilizing transcriptionally-informed and biomaterial-based approaches. Her expertise lies at the intersection of biomaterial design, drug discovery, computational biology, transcriptomics, and neuroscience.

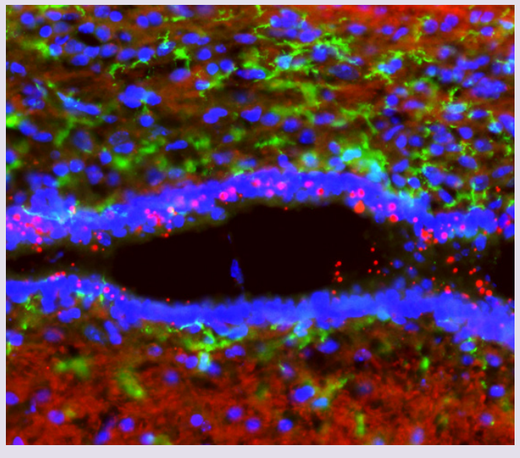
Several prestigious awards have recognized her extensive preclinical research, including the Lone Star Paralysis Collaboration Award 2016, the Woman in Neurotrauma Research Visiting International Scholar (WiNTR-VISA) Award 2017, and the Lois Pope Leaders in Furthering Education Fellowship (LIFE) Award 2019. Earlier this year, Dr. Cerqueira secured three significant grants, including a Clemson Faculty SUCCEEDS Project Initiation/ SEED Funding Award; a South Carolina Research Board Pilot Grant; and a Wings for Life Foundation Research Project. These awards underscore significant research contributions and the high regard her peers have for her future research endeavors.

Dr. Cerqueira has achieved a significant milestone in her career at Clemson University by being appointed as a Faculty Scholar at the Clemson University School of Health Research. Beyond her numerous scholarly achievements, Dr. Cerqueira is a dedicated mentor and educator, known for inspiring and guiding the next generation of bioengineers, and being committed to fostering a supportive learning environment and nurturing talent.

We look forward to her ongoing contributions and the continued impact of her research. Please join us in welcoming Dr. Cerqueira and congratulate her on her remarkable achievements!

Find more about Dr. Cerqueira and her work here:

- https://www.clemson.edu/health-research/faculty/faculty-scholars/cerqueira.html
- https://www.wingsforlife.com/us/research/reversing-persistent-inflammatory-phenotypes-to-repair-the-injured-spinal-cord-us
- https://www.diasporaportuguesa.org/en/profile/susana-cerqueira/



▲ *Fluorescence microscope image of a neuroinflammatory environment.*
(Microglia cells seen in green and cell nuclei in blue.)

Diptee Chaulagain, Ph.D.

▲ *Dr. Diptee Chaulagain*

Bacteria can produce valuable industrial and therapeutic compounds, but they can also cause serious problems for our environment and health. Marine biofouling is one of the serious problems that cost the US Navy billions of dollars in maintenance, fuel costs and equipment failure due to increased drag and material corrosion. Biofouling happens when unwanted organisms stick to underwater surfaces, like boats and submarines. This process begins with bacteria attaching to the surfaces and forming a biofilm, and then higher organisms like algae and invertebrates join in.

In my research, I use synthetic biology and microbiome engineering to harness the good side of bacteria to tackle problems such as biofouling. I use tools from genetics and molecular biology, such as identifying genetic parts from natural bacteria and establishing the desired expression levels of the protein in targeted non-native host bacteria. For instance, bacterial chitinase is a valuable enzyme for industries for food waste processing and the production of medically relevant chitin breakdown products. However, producing it continuously can be harmful to bacterial cells. By using synthetic biology, I established long-term chitinase production in both model and non-model bacteria. Sometimes modifying just one type of bacteria is not enough to address complex problems in the environment, agriculture, and health. That is why I am currently designing a community of synthetic bacteria that work together to prevent biofouling on Unmanned Underwater Vehicles. This new method uses only natural marine microbes, as opposed to using harmful chemicals or genetically modified organisms, making it a next-generation solution to biofouling and other environmental and health issues.

My interdisciplinary educational background in microbiology, biotechnology, and genetics supports me in developing well-rounded problem-solving approaches for my research to design microbes and microbial communities. Before starting my career as a Research Assistant Professor in the Department of Bioengineering in March 2023, I was a postdoctoral fellow in the department, in Dr. David Karig's Laboratory. Prior to my postdoc, I completed my PhD in Genetics at Clemson University, studying a pathway involved in plant-rhizobia symbiosis, where I discovered new genes in the pathway and created mutants to study gene functions. Outside research, I find fun in petting my cats, gardening, and hiking.

Reed Gurchiek, Ph.D.

Dr. Reed Gurchiek

Dr. Reed Gurchiek joined the Clemson University faculty in July 2023 as an Assistant Professor of Bioengineering. He studies human movement biomechanics with application in rehabilitation and human performance. His niche approach combines modeling and simulation with remote monitoring. Remote monitoring involves using wearable sensors to track a person's movement in their free-living environment and presents several advantages over traditional approaches including low-cost technology, increased ecological validity, and continuous observation. He incorporates modeling and simulation to estimate unmeasurable quantities like muscle force during dynamic movement and to answer "what if" scenarios like how a person would walk if a certain muscle were injured.

During his doctoral studies, he developed new techniques for monitoring recovering following knee surgery and for quantifying muscle and joint loads during gait. His approach combined physics-based simulation with machine learning to estimate clinically relevant biomechanical variables. He has been a leader in the field of remote monitoring with applications in a broad range of clinical contexts including orthopedics, Huntington's disease, multiple sclerosis, and children with Duchenne muscular dystrophy. He led a team of seven international scientists in developing guidelines for wearables-based motion capture that was recently published in an International Society of Biomechanics (ISB) Recommendations Paper, a prestigious series from the leading biomechanics society. Given his work in this rapidly growing area, he was invited as a keynote speaker to the European Orthopedic Research Society in Aalborg, Denmark, September 2024, where he will summarize the current state-of-the-art and directions for the future.

Dr. Gurchiek is continuing to advance the field to new frontiers for human movement science. In his first year at Clemson, he instrumented a new laboratory space within which several multi-disciplinary projects have already begun. For example, he is working with the Clemson athletics department to explore the utility of gait analysis and remote monitoring to improve rehabilitation from musculoskeletal injuries (i.e., hamstring strains and anterior cruciate ligament tears). In a collaborative eXort with the Institute for Engaged Aging, he is exploring the eXects of cognitive impairment on gait towards development of new digital biomarkers for early detection of dementia. In a spin-oX undergraduate senior design project, he and his students are working with orthopedic surgeons within PRISMA Health to develop a new orthotic device to assist the hamstring muscles following a strain injury.

Dr. Gurchiek introduced two new courses in his first year, one on the Biomechanics of Human Movement and another Creative Inquiry on Remote Human Movement Analysis. In the fall 2024 semester, he will introduce two more new courses on Musculoskeletal Simulation and another Creative Inquiry on Musculoskeletal Rehabilitation. These courses oXer a more advanced treatment of musculoskeletal biomechanics, give practical experience with cutting edge motion capture technologies, and prepare students for both industry and academic jobs.

Reed was born and raised in Tennessee. He received a B.S. degree in Exercise Science from Cumberland University, Tennessee, with a minor in Mathematics. He went on to Appalachian State University, Boone, NC, to receive two M.S. degrees, one in Exercise Science and the other in Engineering Physics. He worked as a Biomechanical Engineer for Motus Global, a wearable sensor company out of Rockville Centre, NY, before beginning his doctoral studies at the University of Vermont. There he worked with Dr. Ryan McGinnis towards a Ph.D. in Mechanical Engineering and as a Postdoctoral Associate where his work focused on remote gait analysis. He continued his training as a Wu Tsai Human Performance Alliance Postdoctoral Fellow at Stanford University where he worked with Dr. Scott Delp to explore mechanisms and interventions for hamstring strain injuries.

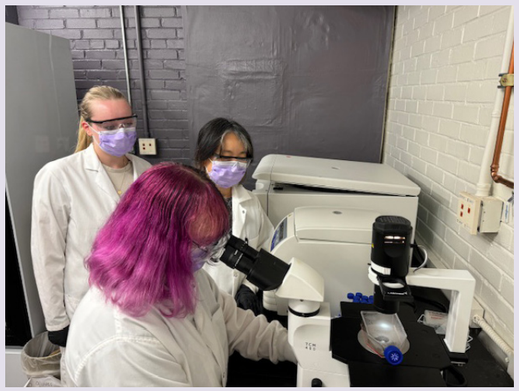
Dr. Gurchiek is working with Clemson athletics on projects to improve rehabilitation of injuries (hamstring strains and anterior cruciate ligament tears). Here his students are using new techniques in computer vision for gait analysis.

Dr. Congyue Annie Peng

Congyue Annie Peng, Ph.D., MB(ASCP)^{CM}

I received a PhD degree in biochemistry and molecular biology in 2015, where I conducted research on engineering spiker silk proteins and fabricated them into scaffolds that support cell growth. Prior to my appointment with the Department of Bioengineering, I was a postdoctoral fellow at the Department of Genetics and Biochemistry and the Eukaryotic Pathogens Innovation Center at Clemson University, where I tackled the antibiotic resistance problems of a neglected opportunistic fungus that causes meningitis. Knowing that I love to teach and would go into academia, I honed my teaching skills through the Department of Education at Clemson University and received a graduate certificate in Engineering and Science Education. This education certificate experience equipped me with many effective teaching tools that I can and will use in my teaching practice. In late 2020, when the COVID pandemic was in full course, I decided to join the Research and Education in Disease Diagnostics and Intervention (REDDI) lab and the Department of Bioengineering. I have been officially on board since February 2021, as a research assistant professor and a laboratory technical leader.

The COVID pandemic was challenging, and it put my learning to the test. I worked synergistically with Dr. Delphine Dean and other REDDI team members to meet the ever-growing testing and variant surveillance needs. To align with the Clinical Laboratory Improvement Amendments (CLIA) regulation, I received the American Society for Clinical Pathology (ASCP) Board Certification on Technologist in Molecular Biology. I was the site leader for Clemson University's first participation in a national clinical trial that assessed the effect of the initial COVID-19 vaccine that was rolled out in 2021. I was the key personnel and molecular biology anchor to the SARS-CoV-2 variant surveillance project supplemental to the South Carolina Translational Research Improving Musculoskeletal Health (SC-TRIMH) NIH Centers of Biomedical Research Excellence (COBRE) grant. This project has allowed me to work in collaboration with faculties from four different departments. This collaboration led us to win the Faculty Collaboration Award in 2022. Built on these accomplishments, I continued to be the molecular anchor on several research proposals, and one was recently funded by the Center for Disease Control (CDC). Other than my efforts in infectious disease, I am continuing my passion for regenerative medicine using stem cells and exploring biomarker development for breast cancer. Two pilot projects on neurodegenerative disease and breast cancer are under development. They are supported by the Prisma Health seed grant, COBRE for Human Genetics, and COBRE for SC-TRIMH. With support from the funding and Clemson University Creative Inquiry, I built a nurturing learning environment to meet the students' desire to address the knowledge gaps. Under my instruction, they have shown tremendous academic and career growth, which is evidenced by their continuation in professional careers such as graduate school and medical school, and the awards given by the University and the professional society.



Dr. Congyue Annie Peng's lab

Damayanthi (Dayan) Ranwala, Ph.D.

▲ *Dr. Dayan Ranwala*

Dr. Dayan Ranwala joined the Bioengineering Department in 2023 as the Director of Research Development, a new position created by the Department. Her primary roles are to assist faculty with various aspects of grant proposal development, including identifying relevant funding opportunities, reviewing and editing proposals, and educating faculty and students on successful grant writing and funding agency policies to increase their research portfolios. She has already implemented new initiatives to increase the Department's visibility in education, research, and innovation at the local, national, and international levels.

Before joining Clemson, Dr. Ranwala was an Associate Professor in the Academic Affairs Faculty at the Medical University of South Carolina. She also served as the Associate Director for the South Carolina Clinical and Translational Research Institute's Pilot Project Program and Team Science Program.

Dr. Ranwala received her B.Sc. with honors from Peradeniya University, Sri Lanka; her M.Sc. from Obihiro University, Japan; her Ph.D. from Clemson University; and pursued post-doctoral training at Cornell University. She became a Research Assistant Professor at Clemson University's Institute for Nutraceutical Research, where she initiated cross-disciplinary translational science collaborations. She was a co-investigator on cross-disciplinary teams that led a head and neck cancer clinical trial, as well as studies on the effects of nutraceuticals on colon cancer and oral health.

Dr. Ranwala is a selected and elected member of the Board of Directors of the International Network for the Science of Team Science. She has been involved in many aspects of team science initiatives at the national level, including team science education and training initiatives for translational science teams, and developing team science competencies for individuals and teams. She served as the Co-Chair for the national Institutional Readiness for Team Science Workgroup and Co-lead for both the Academic Promotion and Tenure Workgroup and the Mapping Team Science Competencies for Translational Science Teams Across the Lifespan Workgroup. Additionally, she was also the Co-chair for the faculty and trainees constituency group responsible for identifying competencies and levels of mastery needed for career progression.

She has served as a faculty advisor, mentor, and scholar for students and staff in interprofessional courses, and pre-doctoral and Medical Scientist Training Programs promoting the concepts of team science. She is a reviewer for the Journal of Clinical and Translational Science. Dr. Ranwala was awarded a position in the competitive Association of American Medical Colleges Early Career Women Faculty Leadership Development Program.

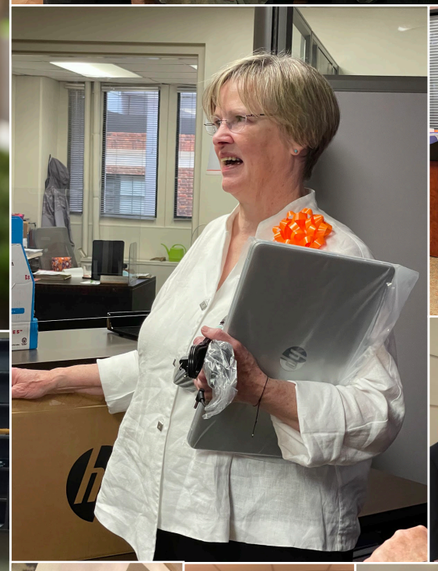
▲ *Dr. Austin Smothers*

Austin Smothers, Ph.D.

I began my Master's degree at Clemson University in August 2019 and began investigating the antiproliferative effects tumor-treating fields (TTFields) on triple-negative breast cancer (TNBC) in vitro under Dr. Brian Booth and in collaboration with Prisma Health Cancer Institute, the Institute for Translational Oncological Research (ITOR), and Quiverent, LLC. We created an in-house device capable of delivering TTFields in vitro and show we were able to selectively combat against the growth of TNBC cells versus human mammary epithelial cells. I received my Master's degree in August 2021 and continued participating in TTField research to pursue my Ph.D. under Dr. Delphine Dean and Dr. Brian Booth. We show that TTField efficacy against TNBC cells could be optimized by modulating the frequency of the fields to address both inter-cell heterogeneity within a tumor population and desensitization of tumor cells to radiotherapy treatment. Finally, we show that TTFields and cisplatin-based chemotherapy can act additively toward the in vitro treatment of TNBC cells via chemosensitization and preventing DNA repair. I received my Ph.D. in May 2023.

In October 2020, I was hired by Dr. Delphine Dean as a graduate laboratory technician for the Research and Education in Disease Diagnosis and Intervention (REDDI) Laboratory. The REDDI Lab was created in response to the COVID-19 pandemic in an effort to provide fast and reliable testing to Clemson University and the surrounding communities. During my time with the REDDI Lab, I participated in research for saliva-based detection of respiratory infections, including variants of SARS-CoV-2, influenza A and B, and much more. I was then promoted to Education and Training Coordinator in March 2021 and mentored undergraduate researchers via Creative Inquiry (CI) projects and trained graduate and undergraduate technicians for the REDDI Lab. During this time, I also began putting together proposals for implementing a medical laboratory scientist (MLS) program at Clemson University. In March 2024, I was promoted to Director of Strategic Operations and work directly alongside Dr. Congyue Peng and Dr. Delphine Dean to oversee the operation of the REDDI Lab as a whole. My duties now include greater-scope clinical laboratory operations, payroll and human resources coordination, lead collaboration with external partnerships, public relations, and budgetary responsibilities.

▼ *The Research and Education in Disease Diagnosis and Intervention Laboratory (REDDI Lab)*



In Memoriam: Jenny Bourne

1952–2024

IN MEMORIAM:

Jenny Bourne, a Legacy of Dedication and Impact

Martine LaBerge

After 20 years of dedicated service to Clemson University, Jenny Bourne retired on March 18, 2022, from her role as Program Administrator for Outreach and Research Services in Bioengineering. Before joining the Department of Bioengineering in December 2005, Jenny had worked at Creative Services and the former College of Engineering and Science. Jenny's retirement was celebrated with heartfelt tributes from colleagues, students, and friends who recounted the profound impact she had on their lives and careers. Though she left her official role, her influence continued to resonate within the halls of Rhodes and Rhodes Annex. Jenny relocated to Fayetteville, Arkansas, where she intended to enjoy her retirement, surrounded by her family and friends and the comfort of her writing desk. However, her life took a sorrowful turn, and on January 13, 2024, she passed away. The news of her passing was met with an outpouring of grief and remembrance from all who had known her. Jenny is remembered for her effervescent and conscientious personality, and her dedication and passion for making a difference. Her career left an indelible mark on the department and the countless lives she touched along the way.

Jenny received a Master of Arts degree in Professional Communication in December 2001 from Clemson University under the supervision of Dr. Kathleen Blake Yancey. Through her creative writing and communication skills, she has been a founding cornerstone of the bioengineering department's journey to preeminence for 15 years. Over the years, she became a pivotal figure in the department, disseminating groundbreaking research, and fostering a culture of communication and outreach. Jenny's work was not confined to administrative tasks; she was deeply involved in mentoring students and young researchers, guiding them through the intricacies of academic writing and research methodology. Her office was a haven for those seeking advice, a testament to her approachable nature and willingness to help others succeed. Jenny served as a guest lecturer for many bioengineering graduate level courses including BIOE 8500 – Communicating Bioengineering, BIOE 8160 – Bioengineering Career Professional Development, BIOE 4150/6150 – Research Principles, and BIOE 4030 – Biomedical Design. She served the undergraduate and graduate students providing consultation and guidance for numerous fellowship applications and grant applications. Her ability to convey complex ideas with clarity and precision made her an invaluable asset as an editor, writer, and communicator for numerous large research projects including NIH Center of Biomedical Research Excellence (COBRE) SC-BioCRAFT for which she provided constant and dedicated research development support. As the editor and of the BIOE Newsletter, she authored numerous articles and stories showcasing Bioengineering's best, further reflecting her deep intellect and insightful perspectives. Her writing was not just a profession but a means of expression, a way to share with constituents the true essence of the department.

Jenny Bourne's legacy is one of dedication, intellectual curiosity, and an unwavering commitment to the betterment of others. She leaves behind articles, stories, methodologies, and processes that continues to inspire and a memory that will be cherished by all who were fortunate enough to know her. Farewell, Jenny! ■

Department of
BIOENGINEERING
Clemson University

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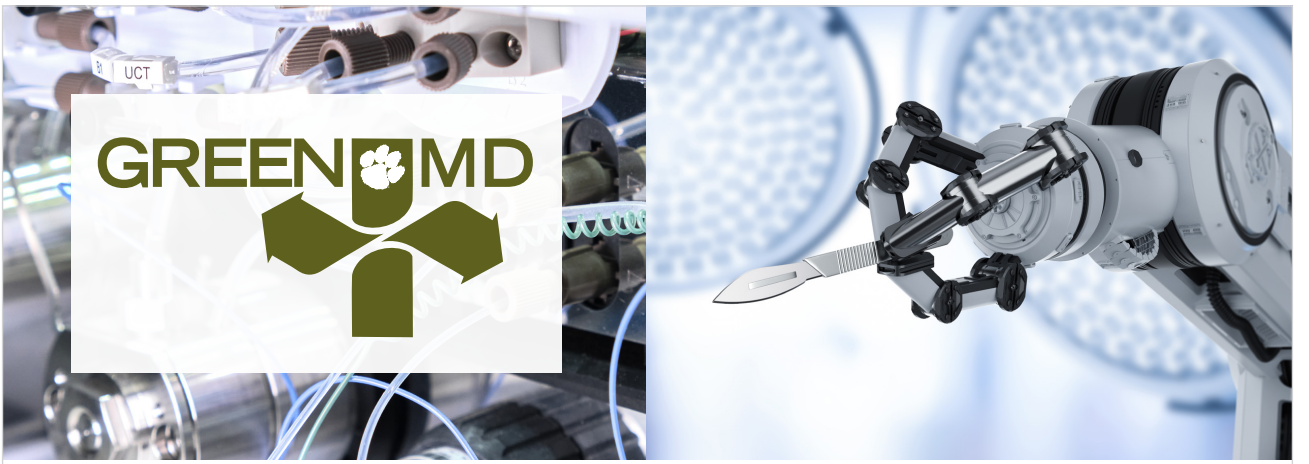
Clemson, SC 29634



M.S. in Medical Device Reprocessing

Offered as an online degree by
the Department of Bioengineering
in collaboration with
the Department of Industrial Engineering

Overview:

The Master of Science in medical device reprocessing, designed by industry experts, educates students from across the STEM disciplines to optimize and validate biomedical technologies supporting safe reuse of medical devices and healthcare products.

- The first advanced engineering degree program in medical device reprocessing in the U.S.
- **"GreenMD"** signifies the medical device industry's aim to achieve sustainability in production and use of healthcare products.

Reprocessing is a regulated practice that involves cleaning, disinfection and sterilization of both reusable and approved single-use medical devices. Specialists must know advanced technologies and specialized process control systems for handling contaminated medical devices and rendering the reprocessed devices safe for reuse.

clemson.edu/cecas/departments/bioe/academics/graduate/mdr.html

Program Goals:

Enhance the readiness of globally engaged students to be innovative industry leaders in sustainable biomedical technology through training in modern reprocessing and sterilization technologies, quality science and human factors in healthcare

Program Outcome:

- Earn a graduate M.S. non-thesis degree online
- Complete experiential learning through an industry internship (BIOE 8900) or mentored medical device reprocessing research (BIOE 8510)