Joint Department of

BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

Celebrating 20 YEARS of BREAKTHROUGHS

CHRONIC WOUNDS

Researchers in the Joint Department are battling highly drug-resistant bacterial infections by improving drug delivery through biofilms.

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CAR-T CELLS

A new implant seeks to improve CAR-T Cell therapy by decreasing the time to develop a patient's cells from weeks to just a matter of days.

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MICROBUBBLES

UNC-affiliated startup uses nanoparticle technology to use the power of sound to provide scientists with rapid, high-quality sample analysis.

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LETTER FROM THE CHAIR

Paul A. Dayton

Department Head and Chair

William R. Kenan Jr. Distinguished Professor

I am excited to announce that the **Joint Department of Biomedical Engineering is kicking off the celebration of our 20th anniversary as a department.** Two decades of dedication to innovation, collaboration and translation have produced countless breakthroughs at the intersection of engineering and medicine.

While the foundations of our department existed as a standalone biomedical engineering program since the 1960s, it wasn't until August 2003 that the formal partnership between the School of Medicine at UNC-Chapel Hill and the College of Engineering at NC State formed a Joint Graduate Program. A few short months later, the Joint Department was established. The graduate students admitted to Joint BME in the fall of 2003 were the first to be recognized as graduates from both institutions, and our undergraduate program followed when it was officially established in 2015. From our first year as an established department, we grew from 16 faculty members to 54 members today. Our undergraduate student body in 2015 was 318 students, but this year, our sophomore to senior program consists of an impressive 540 students. Due to this growth, our department is one of the largest bachelor's degree-granting biomedical engineering programs in the country, with substantial student interest to continue to grow in the coming years.

We hope you'll take a moment to celebrate how far we've come in our development through this special edition of our newsletter, which highlights some of our most dynamic research to date. Our recent accomplishments include improving drug delivery for chronic wound infections, revolutionizing cancer treatment customization through CAR-T cell advancements and advancing entrepreneurship goals from undergraduates, graduate students and faculty. Our department has also been focused on addressing public health challenges involving renal transplant health, determination of malignancy in breast tumors and development of long-acting HIV therapies. The work featured in this special edition also emphasizes our goal of making an impact through the implementation of technology in the commercial space, as well as providing an educational foundation to the next generation of biomedical engineers who will lead this process.

As we reflect on our achievements and growth, we also want to acknowledge our faculty, students, staff, advisory board members and donors who have supported our mission and goals since our inception. The collaborative spirit that defines our department has been instrumental in our growth and development over the years.
To commemorate our 20-year journey, we will be hosting a retreat that will bring together all 700+ students and members of our department together in one location. We will be organizing seminars, exhibitions and other activities to showcase our achievements, foster connections and envision the future of biomedical engineering. We couldn't think of a better way to honor our 20th birthday than to spend it together with an optimistic vision towards what the next 20 years may bring. Together, we look forward to the next chapter of innovation, discovery and positive impact on engineering and medicine. Thank you for being an integral part of our success story!

JOINT BME PROGRA

AT A GLANCE

Uniting Engineering & Medicine to Improve Lives

A guest instructor for the department MedTech Program teaches students about injection molding

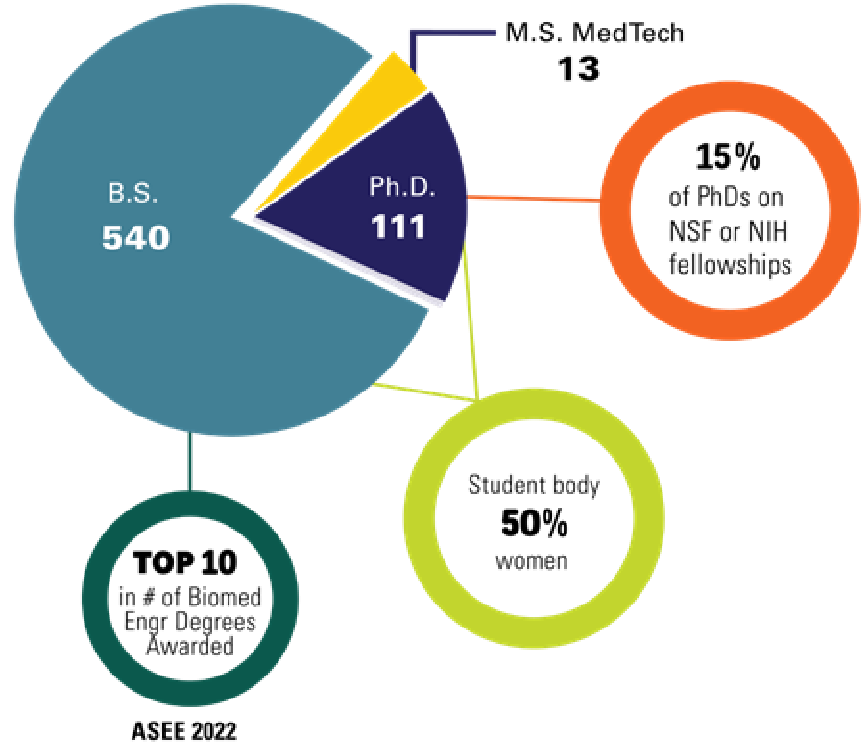
Our professional MedTech master's curriculum is an 11-month program for students interested in acquiring the skills necessary to lead early-stage biomedical ventures or to drive new product development in healthcare industries.

M

Student Design Team Devicentrics demos their project device at the Joint BME Student Design Symposium in April 2023

Undergraduate students showcase what they've learned throughout the year at our annual Symposium. The Devicentrics team designed an additional base support for the standard walker to increase stability and reduce incidents of falls.

FACTS & FIGURES



#15 **Globally ranked** in Biomedical Engineering and top 10 in the U.S.

ShanghaiRanking 2022-2023

#4 **Public school** among national universities

UNC-CH - U.S. News & World Report 2024

#2 Nationwide in active **licenses and options** and #5 for startups launched

NC State - AUTM 2023

#7 **Best Medical School** in primary care and a top 10 public medical school for research

UNC-CH -- U.S. News & World Report 2023

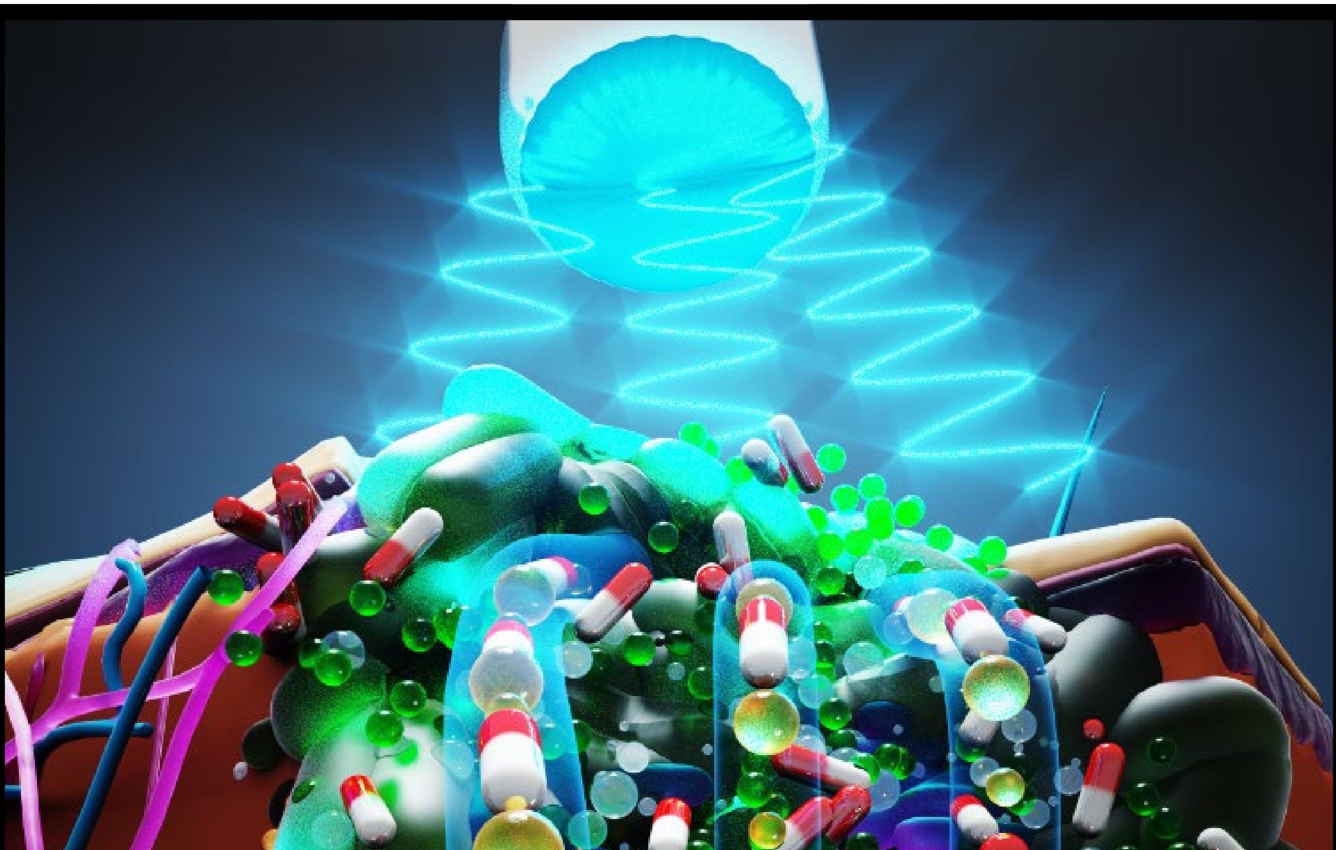
CHRONIC WOUNDS

RESEARCH

Chronic wounds are open sores or injured tissue that fail to heal properly. These types of wounds are notoriously challenging to treat because of bacterial infections like Staphylococcus aureus or S. aureus. Additionally, bacterial infections that are highly resistant to antibiotics, such as methicillin-resistant S. aureus (MRSA), are one of the main causes of life-threatening infections in hospital patients. To defend itself from our immune system and other threats, S. aureus can band together, creating a slick, slimy forcefield – or biofilm – around itself. The biofilm barrier is so thick that neither immune cells nor antibiotics can penetrate through and neutralize the harmful bacteria.

Researchers at the UNC School of Medicine and the Joint Department of Biomedical Engineering have developed a new method that combines palmitoleic acid, gentamicin, and non-invasive ultrasound to help improve drug delivery in chronic wounds that have been infected with S. aureus. Using their new strategy, researchers were able to reduce the challenging MRSA infection in the wounds of diabetic mice by 94%. They were able to completely sterilize the wounds in several of the mice, and the rest had significantly reduced bacterial burden. Their results were published in Cell Chemical Biology.

When bacteria are not completely cleared from chronic wounds, it puts the patient at high risk for the infection recurring or of developing a secondary infection," said senior



The cover art illustrates ultrasound-mediated drug delivery into a biofilm-infected wound.
Illustration by Ella Marushchenko

Breaking Through Bacterial Barriers in Chronic Treatment-Resistant Wounds

Researchers in the Joint Department of Biomedical Engineering, together with the Department of Microbiology and Immunology, have developed a new strategy to improve drug delivery into chronic wound infections.

author Sarah Rowe-Conlon, Ph.D., a research associate professor in the Department of Microbiology and Immunology. "This therapeutic strategy has the potential to improve outcomes and reduce relapse of chronic wound infections in patients. We are excited about the potential of translating this to the clinic, and that's what we're exploring right now."

Biofilms act as a physical barrier to many classes of antibiotics. Virginie Papadopoulou, Ph.D., a research assistant professor in the UNC-NCSU Joint Department of Biomedical Engineering, was curious to know if non-invasive cavitation-enhanced ultrasound could create enough agitation to form open spaces in the biofilm to facilitate drug delivery.

Liquid droplets, which can be activated by ultrasound, called phase change contrast agents (PCCA), are applied topically to the wound. An ultrasound transducer is focused on the wound and turned on, causing the liquid inside the droplets to expand and turn into microscopic gas-filled microbubbles, which then move rapidly.

The oscillation of these microbubbles agitates the biofilm, both mechanically disrupting it as well as increasing fluid flow. Ultimately, the combination of the biofilm disruption and the increased permeation of the drugs through the biofilm allowed the drugs to come in and kill the bacterial biofilm with very high efficiency.

"Microbubbles and phase change contrast agents act as local amplifiers of ultrasound energy, allowing us to precisely target wounds and areas of the body to achieve therapeutic outcomes not possible with standard ultrasound," said Dayton, the William R. Kenan Jr. Distinguished Professor and Department Chair of the UNC-NCSU Joint Department of Biomedical Engineering. "We hope to be able to use similar technologies to locally deliver chemotherapeutics to stubborn tumors or drive new genetic material into damaged cells as well."

When the bacterial cells are trapped inside the biofilm, they are left with little access to nutrients and oxygen. To conserve their resources and energy, they transition into a dormant or sleepy state. The bacteria, which are known as persister cells in this state, are extremely resistant to antibiotics.

Researchers chose gentamicin, a topical antibiotic typically ineffective against S. aureus due to widespread antibiotic resistance and poor activity against persister cells. The researchers also introduced a novel antibiotic adjuvant, palmitoleic acid, to their models.

Palmitoleic acid, an unsaturated fatty acid, is a natural product of the human body that has strong antibacterial properties. The fatty acid embeds itself into the membrane of bacterial cells, and the authors discovered that it facilitates the antibiotic's successful entry into S. aureus cells and is able to kill persister cells and reverse antibiotic resistance.

Overall, the team is enthusiastic about the new topical, non-invasive approach because it may give scientists and doctors more tools to combat antibiotic resistance and lessen the serious adverse effects of taking oral antibiotics.

"Systemic antibiotics, such as oral or IV, work very well, but there's often a large risk associated with them such as toxicity, wiping out gut microflora and C. difficile infection," said Rowe-Conlon. "Using this system, we are able to make topical drugs work, and they can be applied to the site of infection at very high concentrations without the risks associated with systemic delivery."

SWEETNER CHEMICAL **DAMAGES DNA**

A new study finds a chemical formed when we digest a widely used sweetener is "genotoxic," meaning it breaks up DNA.

RESEARH

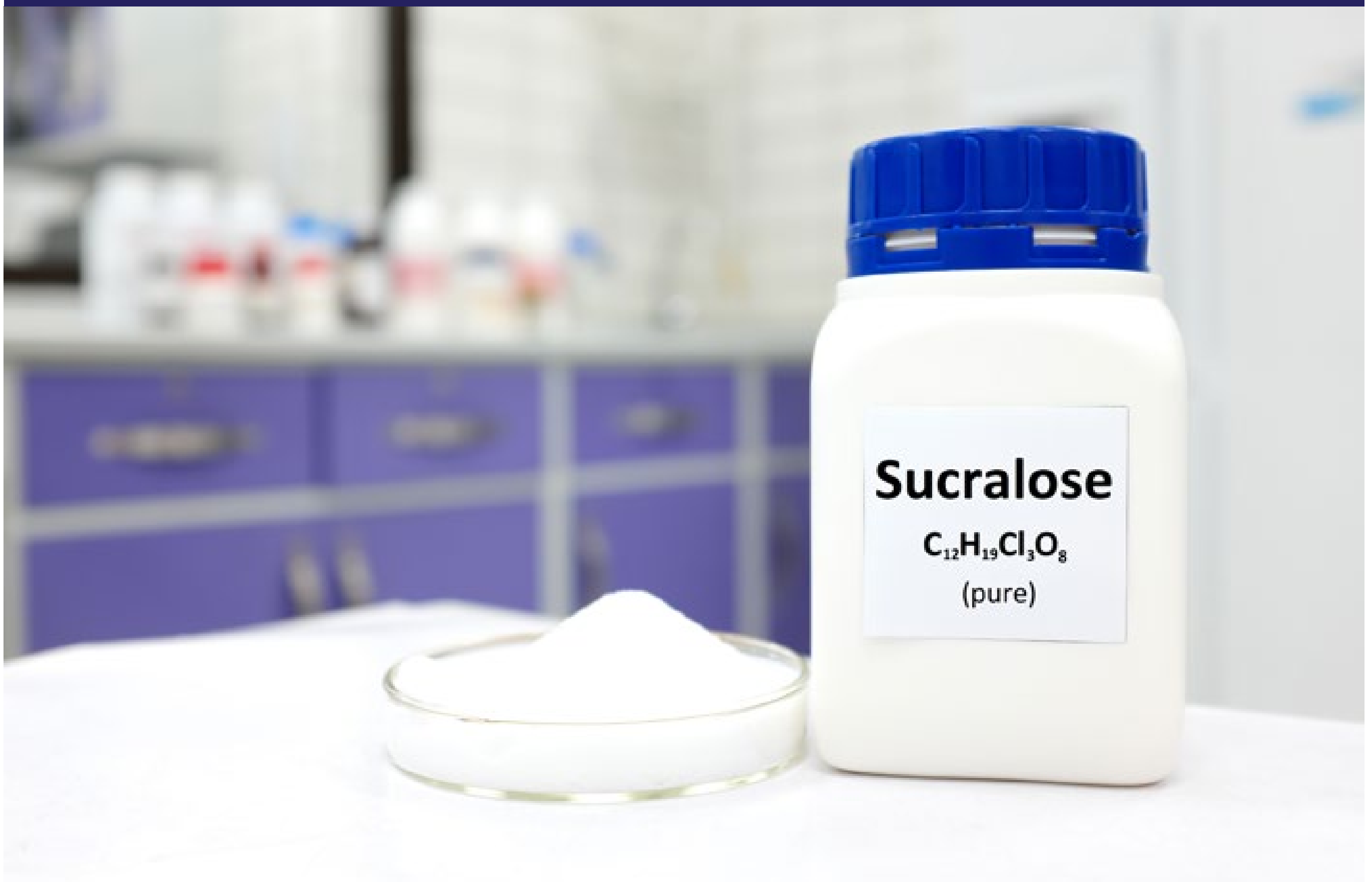
At issue is sucralose, a widely used artificial sweetener sold under the trade name Splenda®. Previous work by the same research team established that several fat-soluble compounds are produced in the gut after sucralose ingestion. One of these compounds is sucralose-6-acetate.

"Our new work establishes that sucralose-6-acetate is genotoxic," says Susan Schiffman, corresponding author of the study and an adjunct professor in the joint department of biomedical engineering at North Carolina State University and the University of North Carolina at Chapel Hill. "We also found that trace amounts of sucralose-6-acetate can be found in off-the-shelf sucralose, even before it is consumed and metabolized." To put this in context, the European Food Safety Authority has a threshold of toxicological concern for all genotoxic substances of 0.15 micrograms per person per day," Schiffman says. "Our work suggests that the trace amounts of sucralose-6-acetate in a single, daily sucralose-sweetened drink exceed that threshold. And that's not even accounting for the amount of sucralose-6-acetate produced as metabolites after people consume sucralose."

For the study, researchers conducted a series of in vitro experiments exposing human blood cells to sucralose-6-acetate and monitoring for markers of genotoxicity. "In short, we found that sucralose-6-acetate is genotoxic, and that it effectively broke up DNA in cells that were exposed to the chemical," Schiffman says.

The researchers also conducted in vitro tests that exposed human gut tissues to sucralose-6-acetate.

Troy Nagle, Distinguished Professor of Biomedical Engineering

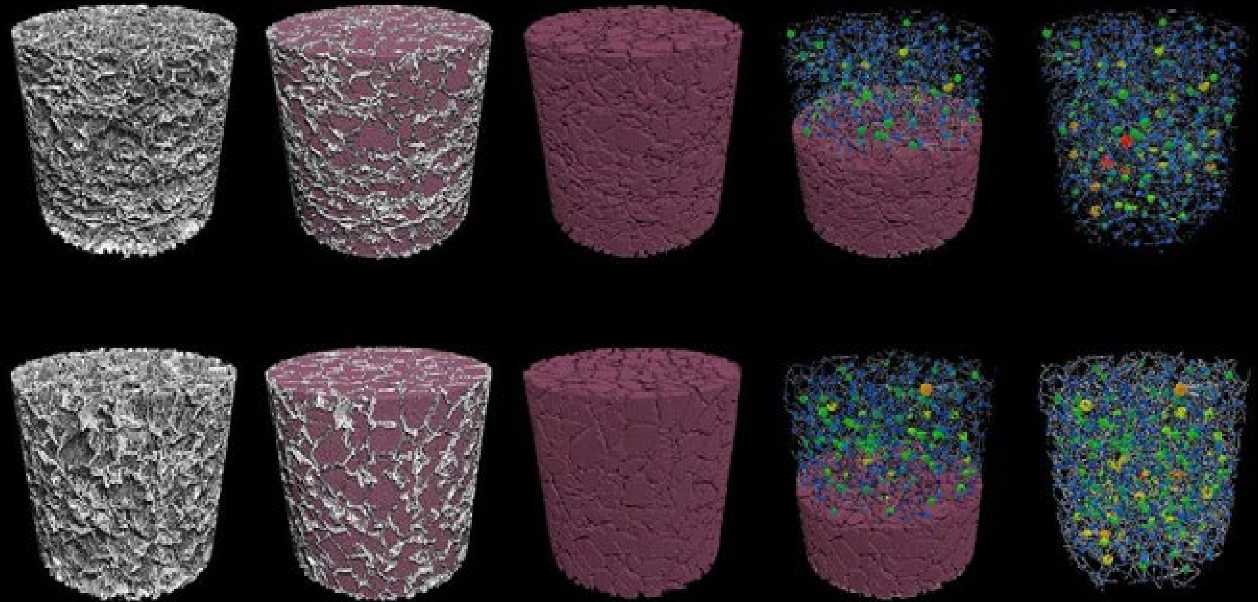


"Other studies have found that sucralose can adversely affect gut health, so we wanted to see what might be happening there," Schiffman says. "When we exposed sucralose and sucralose-6-acetate to gut epithelial tissues – the tissue that lines your gut wall – we found that both chemicals cause 'leaky gut.' Basically, they make the wall of the gut more permeable. The chemicals damage the 'tight junctions,' or interfaces, where cells in the gut wall connect to each other. "A leaky gut is problematic, because it means that things that would normally be flushed out of the body in feces are instead leaking out of the gut and being absorbed into the bloodstream."

The researchers also looked at the genetic activity of the gut cells to see how they responded to the presence of sucralose-6-acetate. "We found that gut cells exposed to sucralose-6-acetate had increased activity in genes related to oxidative stress, inflammation and carcinogenicity," Schiffman says. "This work raises a host of concerns about the potential health effects associated with sucralose and its metabolites. It's time to revisit the safety and regulatory status of sucralose, because the evidence is mounting that it carries significant risks. If nothing else, I encourage people to avoid products containing sucralose. It's something you should not be eating."

The paper, "Toxicological and pharmacokinetic properties of sucralose-6-acetate and its parent sucralose: in vitro screening assays," is published in the Journal of Toxicology and Environmental Health, Part B. The paper was co-authored by Troy Nagle, Distinguished Professor of Biomedical Engineering at NC State and UNC and Distinguished Professor of Electrical and Computer Engineering at NC State; Terrence Furey, professor of genetics and biology at UNC; and Elizabeth Scholl, a former researcher at NC State who is currently at Sciome LLC.

CAR T-CE



Engineering a technology that could produce a life-saving cancer treatment, which normally takes weeks to customize per patient, down to just a matter of days.

The Chancellor's Innovation Fund (CIF) awards research projects that meet criteria for eventual commercialization. The hope is that these projects will directly impact the community by being brought to market.

Starting this year, Bill Spruill, an investor and philanthropist from Goldsboro, North Carolina, will provide additional support to annual awardees of the CIF through the 2ndF Research Commercialization Fund.

The CIF, established in 2010, awards support to short-term, commercially focused research projects. Each year, a select few promising proposals are chosen based on their likelihood of market success and their potential societal benefits. To date, the CIF has granted nearly $4.5 million to 75 projects, attracting over $78 million in follow-on funding. These projects have led to 34 startup companies, 63 commercialization agreements and $2.5 million in licensing revenue. The Joint Department of Biomedical Engineering's Yevgeny Brudno and Pritha Agarwalla have been awarded this prestigious fund for their research on CAR T-Cell scaffolds, which could drastically cut the costs of this cutting-edge cancer treatment.

Implantable CAR T-Cell Scaffolds

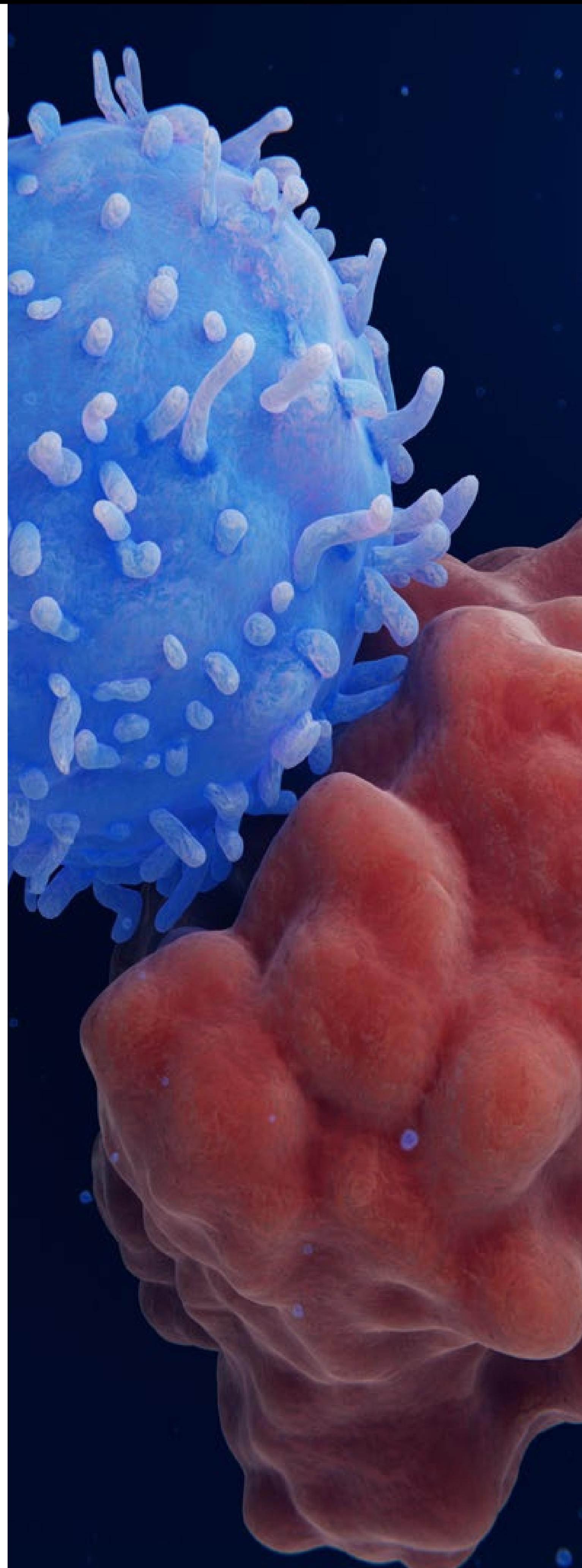
Chimeric antigen receptor targeted (CAR T) cell therapy is a revolutionary cancer treatment that's already in use against lymphomas. However, still in its early days, the therapy's price remains too high for the average patient to afford. Part of the problem is the CAR T-cell manufacturing process is time-intensive and complex.

LLS

CAR-T Cell Therapy Implant Developed in Joint BME Receives NC State Chancellor's Innovation Fund

Currently, CAR T-cells are custom-manufactured in a lab and then infused into the bloodstream. Yevgeny Brudno and Pritha Agarwalla, faculty in the Joint Department of Biomedical Engineering, aim to dramatically change things by making the body a CAR T-cell factory of its own. Their technology could eventually turn what now takes weeks into days. If everything goes according to plan, doctors will be able to one day deliver the treatment through an outpatient surgery in which they implant an algae-based "scaffold" — a piece of spongey biocompatible material roughly the size of a mini marshmallow — designed to reprogram the body's natural T cells into CAR T-cells, which then find and destroy cancer cells.

The CIF supported the precursor to this technology in 2021. And last year, Brudno, Agarwalla and researchers from UNC-Chapel Hill published a paper that found — in a proof-of-concept study involving lymphoma in mice — the implantable alternative was faster and more effective than conventional CAR T-cell cancer treatment. However, further pre-clinical trial data is required to ensure the scaffold's safety and efficacy. CIF support will help the team address FDA feedback in hopes of moving toward clinical trials. Specifically, the goal will be to demonstrate that the scaffold can be produced in a GMP-compliant facility.



Joint-BME affiliated startup Triangle Biotechnology amplifies the power of sound to give scientists rapid, higher-quality sample analysis capabilities—and clinicians hope to pinpoint the right treatments for patients faster and earlier.

MICROBUBBLE **TECHNOLOGY**

Photography by Sarah Daniels
Innovate Carolina

The 'ah-ha' go-to-market moment didn't happen for Paul Dayton in his UNC-Chapel Hill lab. It didn't occur when other scientists on campus expressed interest in using the technology that he co-developed with colleague Samantha Pattenden. Even after publishing findings in an academic journal, he still wondered: Is there commercial appeal?

But one phone call—from a multinational company—immediately transformed his uncertainty into confidence. "When our first paper came out, a large ag-tech company reached out and said, 'Hey, this technology we just read about sounds awesome. How can we use it in our facility?" recalled Dayton, William R. Kenan Distinguished Professor and Chair of the Joint Department of Biomedical Engineering at UNC and NC State. "That indicated real market traction, because companies were reading our paper and asking for our product."

The technology—which Dayton developed with Pattenden, an associate professor of chemical biology and medicinal chemistry at the Eshelman School of Pharmacy—arose from a problem in Pattenden's lab: extracting chromatin, a mixture of DNA and its associated proteins, from the cell nucleus. It's a challenging, time-intensive job that scientists traditionally try to solve by placing samples in sonicators, devices that deliver ultrasound to biological samples placed in liquid. The energy creates tiny bubbles that break up tissues and cells, releasing molecules for scientists to analyze. Too often, however, the heat and lengthy time required damage the DNA and other cellular contents, limiting scientists' ability to analyze them.

Dayton invented a reagent—a substance that causes a chemical reaction—in the form of nano-sized particles to solve this problem, an issue that vexes many scientists trying to analyze cells or other biological samples. The reagent, which Pattenden says "gets into little cracks

Triangle Biotechnology startup members:
Paul Dayton, Samantha Pattenden, and Sunny Kasoji

and crevices of samples," became the core technology of Triangle Biotechnology, a startup that Dayton and Pattenden co-founded with biotech executive Joe McMahon. The AAMP technology, named for its ability to amplify sound energy for fast, high-quality sample processing, is already used by several customers and will launch to the market in late 2023.

"Imagine these reagents being nano-sized particles suspended in a liquid solution. When you add the reagent and then sonicate the sample with ultrasound, these particles shake violently like microscopic jackhammers in your sample. They release mechanical energy intensely on a microscopic level and can shear apart macromolecules: cell walls, cell membranes, DNA," said Sunny Kasoji, CEO of Triangle Biotechnology, who helped develop the reagent technology as a biomedical engineering doctoral student in

SOLUTIONS

REMOVING BOTTLENECKS

Improving the speed of diagnostics and tuberculosis treatments

Beyond its initial product launch, Kasoji sees immense potential for Triangle Biotechnology to streamline molecular diagnostics. He believes it can remove a bottleneck at the sample preparation stage when scientists try to lyse (or break up) the cells of microbes like multi-drug resistant, gram-positive bacteria that have "very protective cell walls, like marbles."

For such diseases—Kasoji points to tuberculosis as an example—better treatment involves rapid diagnosis and identification of the bacterial substrain so that doctors can prescribe the most effective antibiotic. Using traditional culturing methods, identifying the substrain can take weeks to months. In the interim, doctors can only take a scattershot approach, prescribing a concoction of drugs, some of which can counteract with one another. In

Dayton's lab. "If you follow this same process without the reagent, the energy delivery to the sample is much less efficient. By adding the reagent, you get a boost of mechanical energy and more effective extraction of molecules or shearing of DNA."

The technology does exactly what scientists want. "The reagent breaks up the specimen, but doesn't destroy it," Pattenden said. "So, we don't have a problem with heating or extended sonication times that damage samples." The team found that the technology could be used for a variety of samples—and that processing could happen much faster and more efficiently than previously possible.

"We realized if we can do this with cells, we can we do this with other specimens. For example, everyone wants to do high-throughput DNA sequencing inexpensively, but we found that fragmentation of DNA was a massive bottleneck," said Pattenden. "We saw that if we add our nanodroplets to a sample, we can break up the DNA easily and consistently—the same way every time at the same sonication time. We also proved that we could process 96 samples in parallel, so we're increasing throughput."

Triangle Biotechnology is partnering to develop a custom, low-cost sonicator tailored to its nanodroplet technology to bring new high-throughput processing capabilities for many applications to market: DNA shearing for next-generation sequencing, chromatin fragmentation for chromatin-based assays and fixed-tissue processing.

"Processing 96 samples in parallel has been considered the holy grail for over a decade, and no one has been able to accomplish it," said Kasoji. "There's nothing like it on the market, so this will be the first of its kind."

David Allison, PhD, chief scientific officer of Triangle Biotechnology, works in the lab. The company's reagent technology amplifies the shearing force created during sonication, making biological sample prep faster and more efficient.

contrast, molecular diagnostics can provide a rapid turnaround—taking only 24 to 48 hours to identify the substrain—but only if enough DNA can be extracted from the sample bacteria to run the diagnostic.
"The bottleneck with traditional lysis techniques is that you don't get enough DNA out of samples, so you can't effectively do molecular diagnostic tests," said Kasoji. "This is where our technology really helps. We can get enough DNA out of the samples to enable molecular diagnostics and the characterization of TB and the substrain. This way, clinicians can select the appropriate treatment regimen for the patient as early as a few days, without waiting months."
While traditional techniques extract only 1% of DNA from bacteria samples, Triangle Biotechnology's product has shown up to a 100-fold increase in DNA extraction. "This allows tuberculosis screening and substrain identification to happen faster and cheaper, making it accessible for low-and-middle income countries," Kasoji said.

MEETING PUBLIC HEALTH **CHALLENGES**

Caterina Gallippi, Ashley Brown and Rahima Benhabbour received National Institutes of Health (NIH) Research Project Grants (R01s) - this grant type is awarded for independent research and provides financial support for up to five years for ideas that have a direct benefit for public health.

RESEARCH

Caterina Gallippi

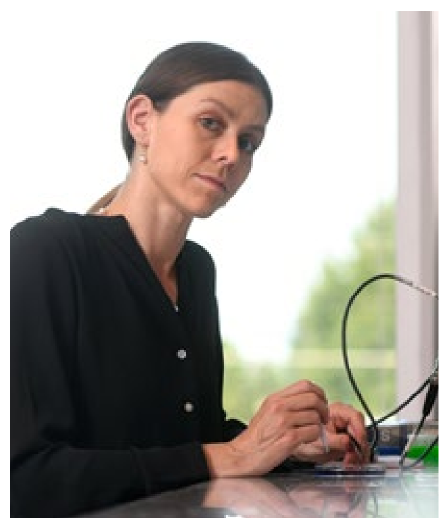
Kidney Monitoring, Determination of Breast Tumor Malignancies and a Training Grant to Prepare Students with Research and Commercialization Skills in Ultrasound

Caterina Gallippi, professor in the Joint Department, received two NIH R01 grants for her research projects focusing on renal transplant health and improving the determination of malignant breast tumors.

The first grant from the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) will go to monitoring renal transplant health. Gallippi's lab is developing novel ultrasound elasticity imaging methods to enable earlier detection of antibody-mediated rejection (AMR) in kidney transplant patients. They hope that by doing so, interventions can be delivered earlier and more effectively to extend transplant life. Their collaborators are Melissa Caughey in JBME, Randy Detwiler and Emily Chang in Nephrology, Tim Nichols in Cardiology and Pathology and Laboratory Medicine, and Elizabeth Merricks and Rani Sellers in Pathology and Laboratory Medicine.

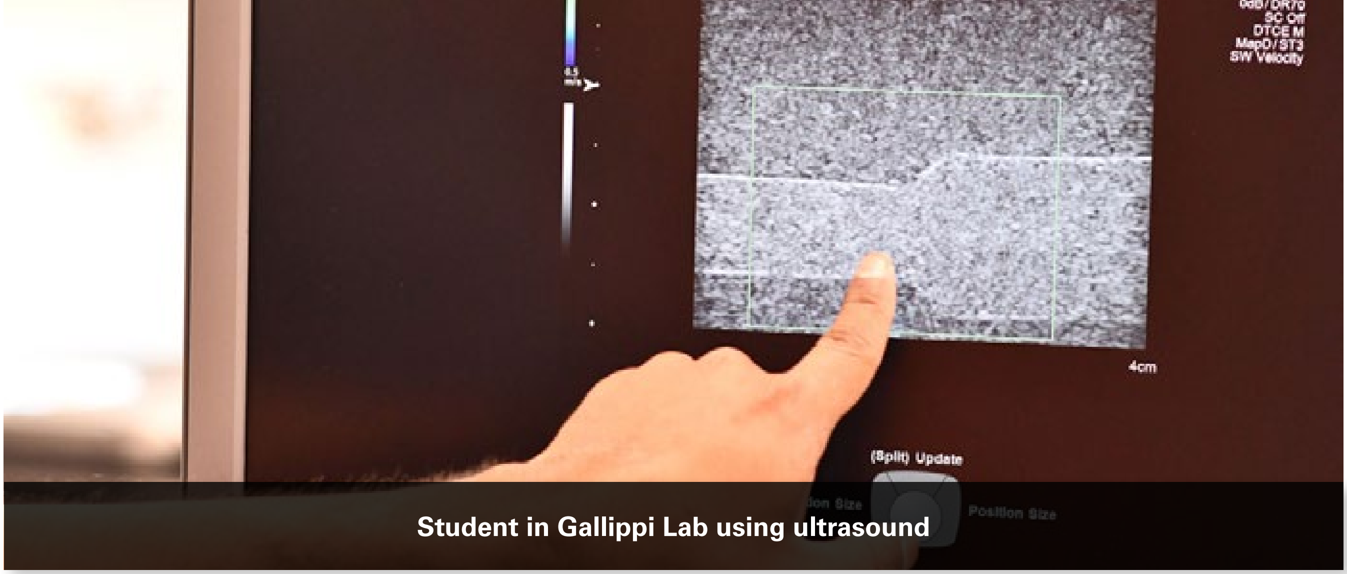
The second grant from the National Cancer Institute (NCI) will go to improve the discrimination of malignant from benign breast masses. The award will go to the development of novel ultrasound elasticity imaging methods to enable noninvasive differentiation of malignant from benign breast masses in patients with suspicious lesions to reduce the burden of an invasive biopsy. They will also apply their imaging methods to monitor response to neoadjuvant chemotherapy in patients with breast cancer, with the goal of expediting differentiation of response versus non-response to treatment. Their collaborators are Melissa Caughey in JBME, Cherie Kuzmiak in Radiology, Emily Ray in Oncology, Ben Calhoun in Pathology and Laboratory Medicine, and Melissa Troester in the Gillings School of Public Health.

In addition to these two R01s, Gallippi was awarded a Unified Medical Ultrasound Technology Development (UnMUTeD) T32 grant to train predoctoral students in medical ultrasound technology development. This grant will prepare predoctoral students with the collaborative, technical and commercialization skills necessary to transition their work from advanced research and development of medical ultrasound technologies to commercially available ultrasound products that meaningfully impact patient care. Gallippi is the program director, and Xiaoning Jiang in MAE at NC State and Omer Oralkan in ECE at NC State are associate directors.



Ashley Brown

$2.3 Million to Develop Platelet-Like Particles for Wound Healing in Traumatic Brain Injury



Student in Gallippi Lab using ultrasound

Ashley Brown, associate professor in the Joint Department, was awarded an R01 Grant of $2.3 million to continue her research project involving platelet-like particle development and use for clot formation and wound healing in traumatic brain injury with hemorrhage.

Uncontrolled bleeding following trauma represents a significant clinical problem and is the major cause of death in both civilian and battlefield traumas. Wound repair following trauma can be impeded by several complications, including infection, keloid formation, insufficient blood flow and a compromised immune system. Traumatic brain injury also frequently occurs concurrently with hemorrhage and is associated with high risks of infection. Infections are a leading cause of mortality, morbidity, and economic disruption around the world, highlighting the need for better methods to achieve hemostasis and improve wound healing following trauma. Clot formation is critical to the cessation of bleeding and involves the formation of platelets embedded within a fibrin mesh. Platelets bind multiple fibrin fibers and actively apply forces to contract the network, thereby stabilizing the developing clot.

The long-term goal of this project is to develop intravenous platelet-like particles that are triggered by the body's native clotting mechanisms to augment wound healing. It is hypothesized that the combination of platelet-like particles and the delivery of antimicrobial nanosilver will significantly improve wound healing following traumatic injury by providing mechanical stimulation to surrounding cells, which can prevent or treat infection.

Rahima Benhabbour

R01 Grant to Fund Research on Long-acting HIV Therapies

Rahima Benhabbour, associate professor in the Joint Department, received an R01 from The National Institute of Allergy and Infectious Diseases to provide funding to further her lab's work to develop long-acting HIV Therapies. The benefit of long-acting therapies that can replace daily pills for people living with HIV is significant. Ultra-long-acting formulations providing steady release over several months of combination antiretroviral drugs can potentially increase accessibility and compliance to HIV treatment regimen and transform the HIV treatment landscape. The overarching goal of this proposal is to develop and evaluate a biodegradable and highly tunable polymeric solid implant that can contribute to curbing the HIV epidemic.

Current methods of HIV drug therapy rely on combination antiretroviral therapy to effectively suppresses HIV replication to virtually undetectable levels, which dramatically reduces the incidence of AIDS. Today, however, an estimated 73% of people living with HIV have access to combination therapy, leaving ~10 million people without access to treatment. Standard delivery for this medication is in the form of a pill that needs to be taken daily. However, as with other chronic conditions, adherence to daily medications remains a challenge for many individuals living with HIV due to structural, behavioral and social barriers.

Benhabbour's research looks at the impact of using an implant to provide durable and continuous antiviral medication. An implant would prevent non-adherence to treatment, preventing the emergence of drug resistance and the potential loss of treatment effectiveness. The Benhabbour lab will also evaluate user compliance, sustained HIV viral suppression, ease of implant removal and other reactions that may be associated with implant use.

Robotic Prosthetic Ankles Improve 'Natural' Movement, Stability

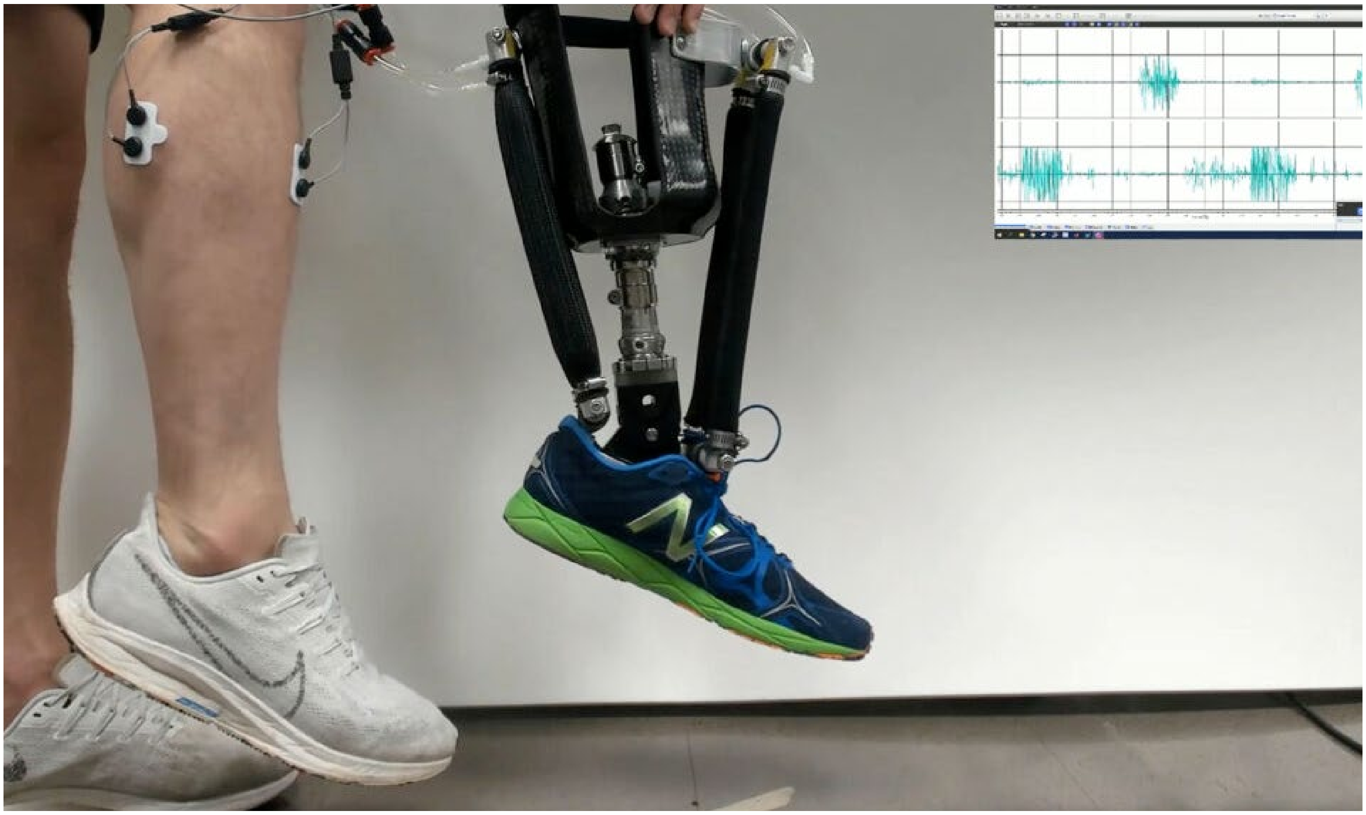
ROBOTIC PROSTHETICS

Robotic prosthetic ankles that are controlled by nerve impulses allow amputees to move more "naturally," improving their stability, according to a new study from North Carolina State University and the University of North Carolina at Chapel Hill.

"This work focused on 'postural control,' which is surprisingly complicated," says Helen Huang, corresponding author of the study and the Jackson Family Distinguished Professor in the Joint Department of Biomedical Engineering at NC State and UNC. She is also a co-founder of Avex Motion, a company that focuses on portable exoskeleton-based rehabilitation systems.

"Basically, when we are standing still, our bodies are constantly making adjustments in order to keep us stable. For example, if someone bumps into us when we are standing in line, our legs make a wide range of movements that we are not even necessarily aware of in order to keep us upright. We work with people who have lower limb amputations, and they tell us that achieving this sort of stability with prosthetic devices is a significant challenge. And this study demonstrates that robotic prosthetic ankles, which are controlled using electromyographic (EMG) signals, are exceptionally good at allowing users to achieve this natural stability." EMG signals are the electrical signals recorded from an individual's muscles.

The new study builds on previous work, which demonstrated that neural control of a powered prosthetic ankle can restore a range of abilities, including standing on challenging surfaces and squatting. For this study, the researchers worked with five people who had amputations below the knee on one



leg. Study participants were fitted with a prototype robotic prosthetic ankle that responds to EMG signals that are picked up by sensors on the leg.

“Basically, the sensors are placed over the muscles at the site of the amputation,” says Aaron Fleming, co-author of the study and recent Ph.D. graduate from NC State. “When a study participant thinks about moving the amputated limb, this sends electrical signals through the residual muscle in the lower limb. The sensors pick these signals up through the skin and translate those signals into commands for the prosthetic device.”

The researchers conducted general training for study participants using the prototype device so that they were somewhat familiar with the technology. Study participants were then tasked with responding to an “expected perturbation,” meaning they had to respond to something that might throw off their balance. In everyday life, this could be something like catching a ball or picking up your groceries. However, in order to replicate the conditions precisely over the course of the study, the researchers developed a mechanical system designed to challenge the stability of participants.

Study participants were asked to respond to the expected perturbation under two conditions: using the prosthetic devices they normally used and using the robotic prosthetic prototype. “We found that study participants were significantly more stable when using the robotic prototype,” Fleming says. “They were less likely to stumble or fall.”

“Specifically, the robotic prototype allowed study participants to change their postural control strategy,” says Huang. “For people who have their intact lower limb, postural stability starts at the ankle. For people who have lost their lower limb, they normally have to compensate for lacking control of the ankle. We found that using the robotic ankle that responds to EMG signals allows users to return to their instinctive response for maintaining stability.” In a separate portion of the study, researchers asked study participants to sway back and forth while using their normal prosthetic and while using the prototype robotic prosthetic. Study participants were equipped with sensors designed to measure muscle activity across the entire lower body.

“We found that muscle activity patterns in the lower body were very different when people used the two different prostheses,” Huang says. “Basically, muscle activation patterns when using the prototype prosthetic were very similar to the patterns we see in people who have full use of two intact lower limbs. That tells us that the prototype we developed mimics the body’s behavior closely enough to allow people’s ‘normal’ neural patterns to return. This is important because it suggests that the technology will be somewhat intuitive for users.

“We think this is a clinically significant finding because postural stability is an important issue for people who use prosthetic devices. We’re now conducting a larger trial with more people to both demonstrate the effects of the technology and identify which individuals may benefit most.”

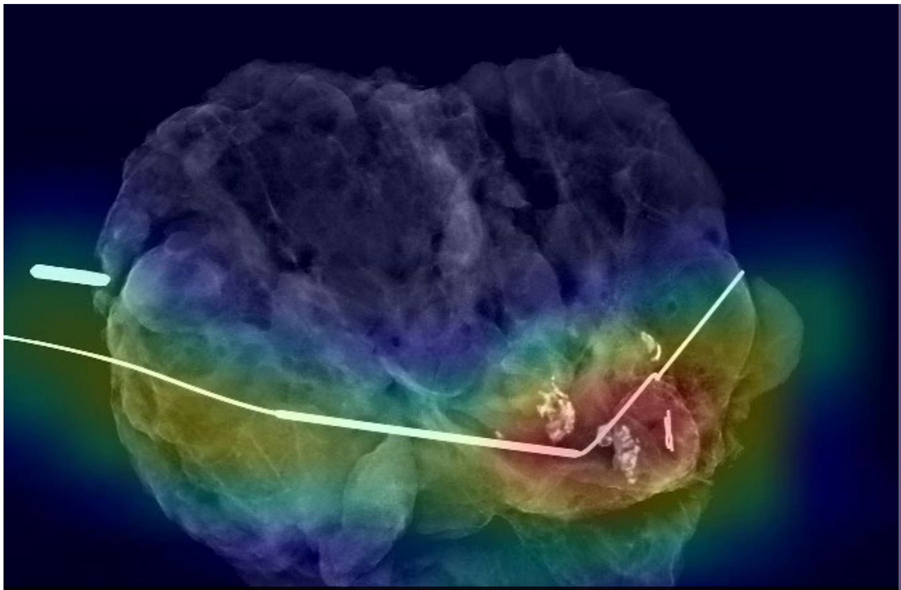
AI MODELS FOR BETTER TUMOR REMOVAL

Kristalyn Gallagher, DO, Kevin Chen, MD and Shawn Gomez, EngScD, in the UNC School of Medicine, have developed an AI model that can predict whether or not cancerous tissue has been fully removed from the body during breast cancer surgery.

RESEARCH

Artificial intelligence (AI) and machine learning tools have received a lot of attention recently, with the majority of discussions focusing on proper use. However, this technology has a wide range of practical applications, from predicting natural disasters to addressing racial inequalities and now assisting in cancer surgery.

A new clinical and research partnership between the UNC Department of Surgery, the Joint Department of Biomedical Engineering at UNC-Chapel Hill and NC State, and the UNC Lineberger Comprehensive Cancer Center has created an AI model that can predict whether or not cancerous tissue has been fully removed from the body during breast cancer surgery. Their findings were published in Annals of Surgical Oncology.

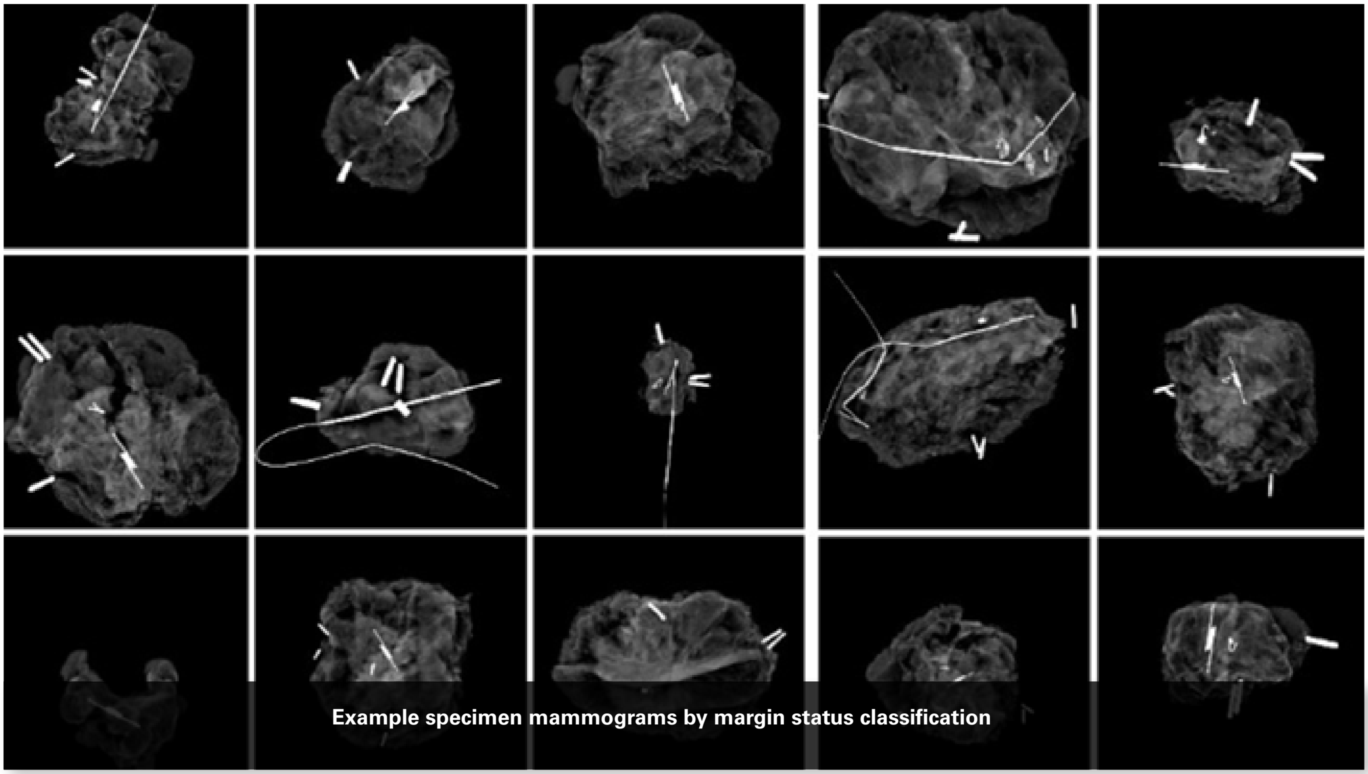


Analysis of pixel importance for radiology-specific and general models.
Red/yellow indicated higher importance.

"Some cancers you can feel and see, but we can't see microscopic cancer cells that may be present at the edge of the tissue removed. Other cancers are completely microscopic," said senior author Kristalyn Gallagher, DO, section chief of breast surgery in the Division of Surgical Oncology and UNC Lineberger member. "This AI tools would allow us to more accurately analyze tumors removed surgically in real-time and increase the chance that all of the cancer cells are removed during the surgery. This would prevent the need to bring patients back for a second or third surgery."

During surgery, the surgeon will resect the tumor (also referred to as a specimen) and take a small amount of surrounding healthy tissue in an attempt to remove all of the cancer in the breast. The specimen is then photographed using a mammography machine and reviewed by the team to make sure the area of abnormality was removed. It is then sent to pathology for further analysis.

The pathologist can determine whether cancer cells extend to the specimen's outer edge or pathological margin. If cancer cells are present on the edge of the tissue removed, there is a chance that additional cancer cells still remain in the breast. The surgeon might have to perform additional surgery to remove additional tissue to ensure



Example specimen mammograms by margin status classification

the cancer has been completely removed. However, this can take up to a week after surgery to process fully, while specimen mammography, or photographing the specimen with an X-ray, can be done immediately in the operating room.

To “teach” their AI model what positive and negative margins look like, researchers used hundreds of these specimen mammogram images, matched with the final specimen reports from pathologists. To help their model, the researchers also gathered demographic data from patients, such as age, race, tumor type and tumor size.

After calculating the model’s accuracy in predicting pathologic margins, researchers compared that data to the typical accuracy of human interpretation and discovered that the AI model performed as well as humans, if not better.

“It is interesting to think about how AI models can support doctor’s and surgeon’s decision-making in the operating room using computer vision,” said first author Kevin Chen, MD, general surgery resident in the Department of Surgery. “We found that the AI model matched or slightly surpassed humans in identifying positive margins.”

According to Gallagher, the model can be especially helpful in discerning margins in patients that have higher breast density. On mammograms, higher-density breast tissue and tumors appear as a bright white color, making it difficult to discern where the cancer ends and the healthy breast tissue begins.

Similar models could also be especially helpful for hospitals with fewer resources, which may not have the specialist surgeons, radiologists or pathologists on hand to make a quick, informed decision in the operating room.

“It is like putting an extra layer of support in hospitals that maybe wouldn’t have that expertise readily available,” said Shawn Gomez, EngScD, professor of biomedical engineering and pharmacology and co-senior author on the paper. “Instead of having to make a best guess, surgeons could have the support of a model trained on hundreds or thousands of images and get immediate feedback on their surgery to make a more informed decision.”

Since the model is still in its early stages, researchers will keep adding more pictures taken by more patients and different surgeons. The model will need to be validated in further studies before it can be used clinically. Researchers anticipate that the accuracy of their models will increase over time as they learn more about the appearance of normal tissue, tumors and margins.

Shawn Gomez

ENTREPRENEURSHIP **FOCUS**

STARTUP

WOLFPACK INVESTOR NETWORK BACKS SONOVASCULAR AHEAD OF CLINICAL TRIALS

Sr. engineer and Joint BME alum John Ranshaw (left) and Michael Romero, principal engineering technician, demonstrate the thrombectomy.

Joint BME-Affiliated RTP medical company SonoVascular is one step closer to improving treatment for those with venous thromboembolism after securing capital and resources from the Wolfpack Investor Network.

The Wolfpack Investor Network announced its newest investment in SonoVascular, an early-stage medical device company that offers a novel approach for the treatment of pulmonary embolism and deep vein thrombosis caused by blood clots in the lungs or legs.

Venous thromboembolism – deep vein thrombosis and pulmonary embolism – affects about 900,000 Americans each year and costs the U.S. approximately $10 billion. SonoVascular aims to reduce the impact of venous thromboembolism by uniquely combining multiple mechanisms of action: (i) ultrasound, (ii) microbubbles, (iii) low-dose thrombolytic drug, and (iv) mechanical retrieval and aspiration – delivered through an integrated intravascular catheter system in a single treatment. The SonoThrombectomy™ platform can be used in a catheterization lab and requires no ICU stay, and has been designed to enable the safe and effective treatment of all types of blood clots while reducing the number of thrombolytics to levels that optimize safety and effectiveness.

WIN chose a long-term investment in SonoVascular for several reasons, including the product's large total and serviceable addressable market, excellent unit economics, and all-star leadership and technical teams.

The core ultrasound technology, spun out of a collaboration between the Joint Department of Biomedical Engineering and the Department of Mechanical and Aerospace Engineering, is being developed under a leadership team with decades of experience in the MedTech industry. Daniel Estay, founder and CEO, started his career in 1987, working for his father in a family business that developed the Latin American market for leading global medical device companies, including Boston Scientific and St. Jude Medical. Cardiovascular products became Estay's early passion, and he had a successful career in corporate development and commercial operations with Johnson & Johnson and Abbott.

Luke Harada, the COO of SonoVascular, has over 25 years of experience in corporate development and finance in the MedTech industry.

In 2017, while reviewing a vascular medicine journal, Estay read about the research that would eventually lead to the formation of SonoVascular in early 2018. Since then, Estay has assembled a robust technical team with an impressive combined MedTech background to develop and test the technology and secure regulatory approval. The company has also assembled a highly experienced board of directors that is led by Chairman Bill Starling, who is one of the MedTech industry's most successful entrepreneurs. Starling also serves as the chair of the Industry Advisory Board for the Joint BME.

As interest in SonoVascular increased across the Triangle, investments followed. An early partnership with the NC State Office of Research Commercialization led to the development of the business plan and the first license agreement in 2018. In 2019, Innovate Carolina issued SonoVascular a Commercial Award via its Kickstart Venture Services program to develop a prototype and conduct in-vitro bench testing in Professor Xiaoning Jiang's Micro/Nano Engineering Lab at NC State. The sponsored research agreement with NC State led to proof of concept and a new relationship with WIN.

WIN members have invested $410,000 in SonoVascular, supporting the initial phase of the company's development as well as the company's current convertible note financing. To date, SonoVascular has raised over $5 million and is now poised to achieve key product development milestones. The company is planning to raise over $10 million via Series A financing in the fourth quarter of 2023 to support first-in-human clinical studies in New Zealand in the third quarter of 2024, followed by a U.S. clinical study in 2025, which will be required to secure FDA approval for its first clinical indication.

During ongoing development and pre-clinical/clinical trials, WIN will support SonoVascular with its organizational and business development goals to ensure the parallel longevity and success of the company and the technology.

WIN recently partnered with Harbright Ventures to increase its reach and scope. The team approach will increase the investment power of WIN, boost member investment opportunities and help more companies like SonoVascular with counsel and support.

STUDENT DEVICES
MAKE AN IMPACT AT EGAMES

The NC State eGames is an annual student-led competition focusing on entrepreneurship and innovation. Participants can compete in various categories, including design, engineering, social impact and entrepreneurship. Winners receive cash prizes and provide participants with mentorship, networking opportunities and resources to help bring their ideas to life.

BioSensys is a sepsis monitoring device that allows clinicians to monitor patients continuously.

BioSensys offers a noninvasive, continuous lactate monitoring solution for clinicians to manage medical shock and improve patient outcomes. Spun out of a partnership between NC State's MBA program and Joint BME's MedTech curriculum, the team focused on moving the project outside the classroom and into the hands of hospital clinicians.

EnteroFlux is a solution for anastomotic leaks that occur in colon cancer-related colectomies.

A Common life-threatening complication of colectomies is anastomotic leaks (AL). EnteroFlux designed a continuous optical sensing system that noninvasively notifies healthcare providers of an AL as early as 12 hours after the surgery, minimizing the likelihood of complications and repeat surgeries.

SelSym is a startup focused on the development of therapeutics for the treatment of uncontrolled bleeding.

SelSym's signature product, SymClot, is an innovative synthetic platelet capable of improving hemorrhage control and addressing bleeding management and wound healing.

Cascade Medical is a device that performs thoracentesis and thoracoscopy at decreased time and cost with maximized accuracy.

Two procedures, thoracentesis and thoracoscopy, help 1.5 million U.S. patients suffering annually from fluid buildup in the lungs. Cascade Medical provides a concurrent procedure for faster biopsy collection, decreasing time to diagnosis and promoting earlier treatment, reducing life-threatening complications for patients.

ALUMNUS **FEATURE**

Lindsay Miller

Senior Research Associate at CRISPR Therapeutics: CRISPR-X

Lindsay Miller was first exposed to biomedical engineering through her high school AP biology class, but it wasn't until she saw a feature presentation from The Helping Hand Project during an admission session to prospective students that she considered applying to UNC-Chapel Hill. With chapters all over North Carolina, Helping Hand was first started by Joint BME alumni Jeff Powell to provide children with customized 3D-printed prosthetic devices at no cost. Miller got to see up close what students associated with Joint BME were learning and was inspired by that demonstration to join the program.

After being admitted to UNC-Chapel Hill, Miller joined the Joint BME program as a part of a class that piloted a new curriculum within the department. She also joined the same student organization she saw demonstrated in her high school biology class: The Helping Hand Project. Within BME, Miller concentrated on regenerative medicine and did a good deal of work with microscopy and cell lines. Miller also joined assistant professor Imran Rizvi's lab, where the lab focus was on ovarian cancer and photodynamic therapy as a means for treatment, which combines light energy and drug therapy to destroy cancerous cells in a targeted manner. She also assisted in experiments that studied the role of fluid stress on ovarian cancer.

In her senior year, she took a class with Brian Diekman, assistant professor in biomedical engineering, where she got exposed to gene editing, which would later become part of her future career. It was at this point that she became interested in therapeutics research and began pursuing a position in the industry.

"By the time I graduated, I was ready to be back home in California. My top choice for research associate positions was with Mammoth Biosciences, and I was elated that I was able to get the position," stated Miller.

Miller worked with Mammoth Biosciences for two years on teams that engineered new CRISPR systems, which are DNA sequences that can be easily modified to have various functions and to target a specific region of the genome. This position allowed Miller to work with novel CRISPR systems and broader applications of CRISPR, eventually leading to a patent publication, which is valuable experience for any biomedical engineer in the industry.

Earlier in 2023, Miller was hired by CRISPR Therapeutics as a Senior Research Associate in their CRISPR-X group, which focuses on next generation CRISPR therapies that could underlie the next wave of gene editing. CRISPR Therapeutics is one of the original CRISPR companies, founded in 2013 by co-Nobel Prize winner Dr. Emmanuelle Charpentier. The Company recently gained approval for the first ever CRISPR drug in the world in the UK, CasGevy, an alternative treatment for Sickle Cell disease. CRISPR Therapeutics focuses on five main functional research areas: in vivo work, hematology, immunotherapy, regenerative medicine, and CRISPR-X.

Miller stated she was excited to be working "at one of the leading CRISPR companies in the field alongside talented and driven scientists." and where she could lean on the foundational skills in research, gene editing and engineering from the Joint Department. She estimates around 25-30% of her colleagues hold biomedical engineering degrees, proving that work with gene editing can be a dynamic career opportunity for biomedical engineering graduates. "The platform and resources that CRISPR Therapeutic's pipeline provides young scientists like me is unparalleled, giving me lots of opportunities to contribute, learn and grow," she added.

NEUROMUSCULAR **FEEDBACK**

A recently published research study explores the integration of ultrasound with functional electrical stimulation (FES), which is traditionally used to manage drop foot, a condition that results in an unnatural gait to avoid tripping or falling.

The research was led by Nitin Sharma, associate professor in the Joint Department of Biomedical Engineering and principal investigator of the Neuromuscular Control and Robotics Lab, and Qiang Zhang, a Ph.D. student at the time the studies were conducted.

Zhang is now a postdoctoral research fellow in the Closed Loop Engineering for Advanced Rehabilitation (CLEAR) Core.

RESEARCH

Drop foot is sometimes seen in people with multiple sclerosis, stroke or some people with incomplete spinal cord injury, which is noted by weakened ankle muscles and may cause the foot to drag while walking. To correct for drop foot, FES is used to apply electrical stimulation across skeletal muscles to provide orthotic-like support at the ankle joint. These electrical impulses mimic the natural electrical currents our bodies perform to produce muscle contractions.

"Current FES systems largely rely only on tilt or movement sensors to control functional electrical stimulation timing to correct ankle function. However, these sensors miss the actual physiological state of the muscle. The use of ultrasound, unlike surface electromyography, will allow direct visualization of muscle state," stated Nitin Sharma, principal investigator on the project. "When combined with algorithms, this feedback improves preview of muscle's current and future state and facilitates proactive adjustment of the FES parameters."

An additional study conducted by researchers from the Neuromuscular Control and Robotics Lab examined the use of ultrasound paired with surface electromyography in an "assist as-needed"(AAN) framework for exoskeleton movement. Surface electromyography (sEMG) is a process that measures and records the electrical output of a muscle, which can provide feedback to a device in order to guide its function. The proposed framework paves a foundation for using multimodal biological signals to enhance rehabilitative or assistive robots.

The results of the study concluded that the AAN control approach using ultrasound paired with sEMG produced higher accuracy of human motion intent, less ankle joint trajectory tracking error and less robotic assistance than the sEMG-based method alone. Overall, the addition of ultrasound improves a rehabilitation exoskeleton's performance and increases voluntary participation from those wearing the device.

"Future directions include scaling the work to monitor multiple muscles via wearable ultrasound transducers," stated Sharma, who also founded MyoMech in 2023. The company's focus is to bring the transducers to market, translating his research with ultrasound to gait rehabilitation.

While the study focused on analyzing participants with no disabilities, the results have implications for further focus on those who have weakened muscles due to neurological disorders. "Our proposed research methods lay the foundation for future FES controllers for improving the gait of people with various neurological disorders, including spinal cord injury, hemiparesis due to stroke, and multiple sclerosis," said Sharma.

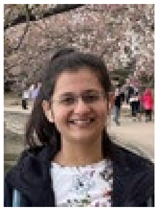
ACHIEVEMENT **AWARDS**

Amy Adkins - Assistant Teaching Professor

Award for teaching and mentoring undergraduates, as well as contributing to ABET curriculum development

Andreea Biehl - PostDoc

Award for teaching and mentoring undergraduates in Joint BME



Sharda Pandit - PostDoc

Award for research in the field of CAR-T cell generation

Changjia Cai - Ph.D. Student

Award for research in experimental neurosciences

Xinrui Ma - Ph.D. Student

Award for research in molecular imaging probes and techniques

Laura Rohrbaugh - University Program Associate

Award for service to the Closed-Loop Engineering for Advanced Rehabilitation (CLEAR) Core

Stephanie Teeter - Research Technician

Award for service in managing 5 Joint BME labs, along with leadership in STEM outreach

AWARDS FOR **EXCELLENCE**

Jennifer Sollinger
Laboratory Manager

Laura Rohrbaugh
CLEAR Coordinator

The joint department's NC State CLEAR Coordinator **Laura Rohrbaugh** and Laboratory Manager **Jennifer Sollinger** are Biomedical Engineering's selections for the 2023 Awards for Excellence. They were recognized, respectively, as Joint BME's SHRA and EHRA Awards for Excellence selections at a College of Engineering ceremony held on May 2, 2023. This award recognizes the outstanding accomplishments and contributions of individual BME employees who do not hold faculty rank and who go above and beyond an employee's normal job responsibilities. Awards are given to SHRA and EHRA non-faculty employees who carry out a wide range of activities in support of our mission.

Laura's and Jennifer's selection this year by Joint BME was based on their Excellence in Outstanding State Government Service. The outstanding state government service category recognizes candidates who demonstrate "unselfish devotion to duty far and above the normal requirements and contributes significantly to the advancement of state service to the citizens of North Carolina." (NC State Human Resources).

INVESTING IN THE FUTURE

Research and Education Pilot Program

The Joint Department of Biomedical Engineering provides two award programs to sponsor upcoming research projects and educational initiatives. The goal of these programs is to encourage collaboration between previously unconnected partners in research or education across the department.

The award program was developed to assist the department in supporting novel research alliances between Joint BME members, so they may generate new ideas and receive funding to acquire preliminary results that are sufficient to propose to either conventional federal research grant programs (i.e. The National Institutes of Health or Department of Defense), or to major national foundations, such as the American Heart Association.

The **Research Innovation Pilot Award** was developed to support new research projects and collaborations with the goal of increasing research grant submissions from the joint department.

The **Educational Innovation Pilot Award** was created to seed new (or improve existing) educational initiatives within Joint BME. The award will provide education-specific opportunities that include supporting faculty in their process to apply competitively for education grants, providing support for presenting at conferences, disseminating materials at sister institutions, and developing advancements to enhance cross-campus education opportunities.

Research Innovation Pilot Award: Bone Microenvironment

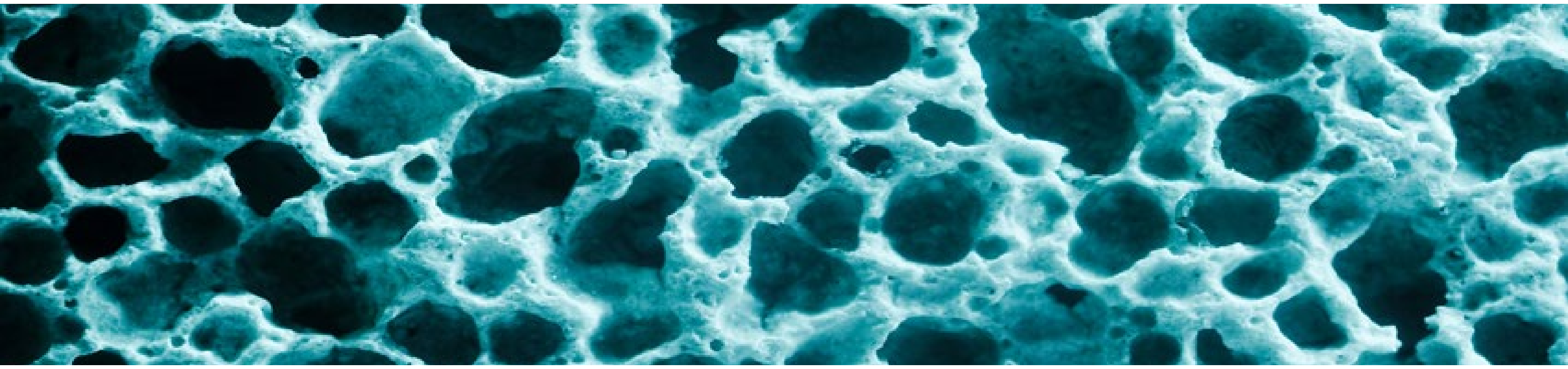
Jacque Cole (pictured) and Victoria Bautch also received a Research Innovation Pilot Award for their research in "Investigating Inflammatory-Stimulated Changes in the Post-Stroke Bone Microenvironment."

Their project looks to develop vascularized bone microdevices in order to better understand bone loss that occurs in ischemic stroke patients. Currently, the cause of this stroke-related bone loss is linked to prolonged bed rest during recovery. However, circulating inflammatory factors are also elevated from days to months following a stroke, and these same factors are known to contribute to bone loss or damage in other conditions, such as arthritis. Cole and Bautch will examine the mechanisms underlying the inflammatory response in bone cells by simulating a post-stroke bone microenvironment, analyzing the environment through a new microdevice, and understanding new pathways between bone and vascular connections in the hopes that it will better inform clinical decision-making in stroke patients.

Research Innovation Pilot Award: Balance Control

A Research Innovation Pilot Award was presented to Nitin Sharma (pictured), Helen Huang (pictured) and Xiaoning Jiang for their research on: "Innovative Neuroprosthetics Interfaces and Advanced Data-Driven Control Mechanisms for Balance Control Post Spinal Cord Injury."

This project will focus on building neuroprosthetic technology that provides postural balance and ambulation to people with spinal cord injuries. Historically, technologies for neuroprosthetics focused on developing the walking function of the prosthesis but did little to alleviate anxiety around maintaining balance and preventing falls in the wearer. The collaboration will combine implanted electrodes with neuroprosthetics to enable fall prevention and provide more versatile and precise-on-demand walking for patients.



Educational Innovation Pilot Award: Technical Writing

Educational Innovation Pilot Award was presented to Amy Adkins and Naji Husseini for "Enhancing Technical Writing Instruction for BME Students with Online Instructional Modules and Artificial Intelligence."

Adkins and Husseini have proposed to formalize a technical writing program in Joint BME that is integrated across the core undergraduate curriculum. Many programs or universities address technical writing instruction through specific courses that are provided on a one-time basis and may not always be targeted specifically to biomedical engineering students. The piloted implementation of the program will include online instruction developed by Adkins and Husseini, along with instruction on using AI software as an on-demand feedback tool for students to use as they develop their writing. Through this integrated process, Adkins and Husseini aim to directly support our undergraduate BME students' mastery and self-confidence in technical writing.

AWARDS AND **RECOGNITION**

Jaqueline Cole

2023 Michael Dickey Outstanding Research Mentor Award

Aryssa Simpson

Accepted as a 2023 Purdue University College of Engineering Trailblazers Fellow

Helen Huang

Editor in Chief of IEEE Transactions on Neural Systems and Rehabilitation Engineering Journal

Naji Husseini

Class of 1996 Award for Advising Excellence at UNC-Chapel Hill

Woolim Hong

Switzer Fellowship Award - National Institute on Disability, Independent Living, and Rehabilitation Research

Ashley Brown

Elected as a Fellow of the American Heart Association and Georgia Tech's 2023 Forty Under Forty

Brian Diekman Receives a $3.1 Million NIH Grant to Investigate the Role of DNA Damage and Cellular Senescence in Osteoarthritis Pathophysiology

The 5-year grant is funded through the National Institute of Health's (NIH); National Institute on Aging (NIA). Chondrocytes accumulate high levels of DNA damage with age and this may lead to a higher risk of developing osteoarthritis.

This research project seeks to understand how DNA damage leads to a particular type of cellular dysfunction known as senescence. The work will also explore whether activating more efficient DNA damage repair would be sufficient to slow the development of age-related osteoarthritis.

Dr. Diekman is an assistant professor in Biomedical Engineering and the UNC co-investigators for the project include Drs. Richard Loeser, Jeremy Purvis, Morika Williams and Becki Cleveland.

NIH Awards: F30s and F31s

AWARDEES

The NIH National Research Service Awards are a series of prestigious grants that provide funding to support research training and career development at various stages of academic and professional careers.

These awards are sponsored by the National Institutes of Health (NIH) and are available to individuals pursuing careers in biomedical, behavioral and social science research. The NRSA program is highly competitive, and applicants are evaluated based on their academic and research achievements and their potential to become independent researchers. The program aims to support the development of a diverse and highly skilled biomedical research workforce.

Jospeh Berman

Development of a Novel EMG-Based Neural Interface for Control of Transradial Prostheses with Gripping Assistance

Emily Eichenlaub

The Proactive and Reactive Neuromechanics of Instability in Aging and Dementia with Lewy Bodies

Nina Moiseiwitsch

Colloidal microporous surgical sealant, which assists with improving outcomes for pateints during surgical procedures

Andy Shelton

The Effects of Muscle Fatigability on Gait Instability in Aging and Age-Related Falls Risk

Keerthi Anand

New ultrasound imaging technology that can provide information on plaque morphology for stroke prevention

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SUPPORT **JOINT BME**

“Better Together” is the motto of the Joint BME Department and also the ethics we stand by. Our Joint Department of Biomedical Engineering is committed to community, mentorship, research and providing students with hands-on practical experience in addressing some of the world’s most urgent health needs.

Hunter Reavis ‘16

“After graduation in 2016, I worked as a research technician studying DNA damage and repair in the Radiation Oncology Department at the Dana-Farber Cancer Institute.

BME provided me with a unique perspective in cancer biology, and I often use many of the approaches and techniques that I learned at UNC!”

Learn more about how you can support our department by visiting:

bme.unc.edu/engagement/give/