Joint Department of

BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

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IN THIS ISSUE

LETTER FROM THE CHAIR

Nancy Allbritton

DEAR BME ALUMNI AND FRIENDS:

Welcome to the Spring/Summer 2018 edition of the UNC/NC State Biomedical Engineering Newsletter, and congratulations to the recently graduated BME Class of 2018. Back in 2015, UNC Chancellor Carol Folt was asked about her top six accomplishments to date. In her reply, she included: "Championed a new Joint Biomedical Engineering bachelor of science degree with NC State University for a department considered an exemplar of de-siloing in US higher education." The creation of the joint BME B.S. degree was a significant action item specified in the department's strategic plan. The May 2018 commencement signified another major strategic milestone as it marked BME's first class of UNC/NC State undergraduates to all be offered the Joint Biomedical Engineering bachelor of science degree, conveyed by the authorities of both Universities.

With this achievement the Joint BME Department completes a 15-year process to be seamlessly integrated within both UNC-Chapel Hill and NC State Universities. All UNC/NC State BME faculty, staff, post-doctoral associates, graduate students, and now undergraduate students are appointed at both institutions. All joint BME diplomas now bear the signatures of Trustees, Chancellors, and Deans representing both institutions; and the official seals of both schools. The completion of the Department's "jointness" is well represented by this issue's cover story (and graduation picture) of father-and-son BME graduates Tim and David Calhoun. Father Tim earned his degree in the undergraduate program and did his research predominantly at NC State. Son David earned his degree in the brand new joint bachelor's program and did his work predominantly at UNC-Chapel Hill. And just as it is done in their now alma mater department, you can see how easily they share the accessories of both schools.

The mission of UNC/NC State BME is to combine medicine, science, and engineering to improve life. Completing the joining of all of our research and educational functions well serves this mission by establishing inter-institutional collaboration in all academic endeavors. I invite you to explore this story, and all the stories within this newsletter, and see for yourself the work and results making the UNC/NC State Joint Department of Biomedical Engineering a department on the rise.

Sincerely,

Nancy Allbritton MD, PhD

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New therapeutic gel shows promise **against cancerous tumors**

SCIENTISTS IN BME AND AT THE UNC SCHOOL OF MEDICINE have created an injectable gel-like scaffold that can hold combination chemo-immunotherapeutic drugs and deliver them locally to tumors in a sequential manner. The results in animal models so far suggest this approach could one day ramp up therapeutic benefits for patients bearing tumors or after removal of the primary tumors.

The research, published in *Science Translational Medicine*, focused on two specific types of melanoma and breast cancer, but this approach could work in other tissue types. Also, the research showed that this localized delivery of combination therapy significantly inhibited the recurrence of cancer after the primary tumor was surgically removed.

"We've created a simple method to use chemotherapy while leveraging the biology of the tumor and our natural defense against foreign invaders to beat back tumor development with limited side effects," said senior author Dr. Zhen Gu, associate professor in BME. "We have a lot more work to do before human clinical trials, but we think this approach holds great promise."

In our bodies right now, there are normal cells mutating from their typical form and function. Thankfully, as our immune system lets normal cells move along and perform important biological functions, mutated cells are recognized and destroyed. Unfortunately, though, these cells can hijack the system designed to dispatch them. If that happens, these cancerous cells become virtually undetectable, free to multiply unabated, and able to form tumors.

Immunotherapy tries to reset our immune response to recognize these hijacker cancer cells. For example, immune checkpoint blockade (ICB) therapies target the cellular pathway that programs cell death; the therapies trigger the pathway so cancer cells are killed. This kind of therapy has shown incredible potential to treat various forms of cancer, such as melanoma, kidney cancer, head and neck cancer, bladder cancer and non-small cell lung cancer. But there can be troublesome side effects, including kick-starting the immune system to attack healthy tissue. And often this immunotherapy does not work because many tumors lack the specific

characteristics needed in order for the immunotherapy to recognize and attack the cancer cells as enemies. These sorts of tumors are called low-immunogenic tumors.

Doctors have achieved better results with immunotherapy if they attack the tumors with chemotherapy first. But still, this approach is not sufficient for patients with low immunogenic tumors. Scientists, therefore, have been engineering various methods to make immunotherapy more effective. For example, scientists are utilizing delivery systems to transport drugs and immunotherapy directly to the tumor site to enhance treatment efficacy and decrease toxicity in other parts of the body.

To this end, researchers at UNC and NC State developed what they call a bioresponsive scaffold system. Essentially, it's a hydrogel – a polymeric network that can be loaded with therapeutics.

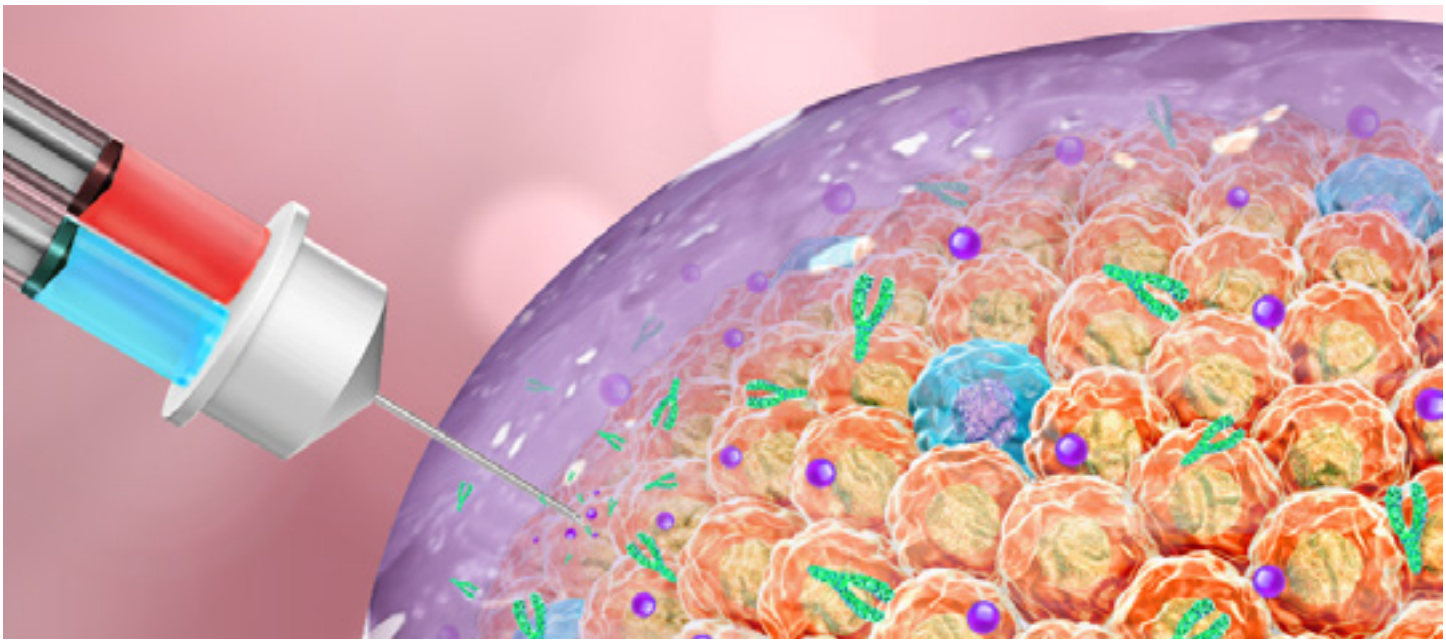
"The trick is that the gel can be formed quickly inside the body once a biocompatible polymer and its crosslinker are mixed together," said Dr. Jinqiang Wang, a postdoctoral researcher in the Gu lab. "We made sure that one of these agents can be cleaved apart by reactive oxygen species, or ROS – a natural chemical byproduct of cell metabolism." In the context of cancer, a high level of ROS is a major player in tumor development and growth.

Researchers loaded the hydrogel scaffold with a chemotherapeutic gemcitabine and an immunotherapeutic agent – anti-PD-L1 blocking antibody. When injected into the tumor, the gel promotes the kinds of tumor characteristics that immunotherapies can identify. Then, in response to the highly abundant ROS in the tumor, the scaffold gradually breaks down, releasing gemcitabine first, and then anti-PD-L1.

"The cytotoxic chemotherapy can first kill some cancer cells and enhance the sensitivity of the tumor toward ICB therapy, which then stimulates the effectiveness of the ICB therapy," said co-author Dr. Gianpietro Dotti, MD, professor of microbiology and immunology at the UNC School of Medicine and member of the UNC Lineberger Comprehensive Cancer Center. "With degradation of the gel, the ROS level in the tumor site can be reduced, which also helps inhibit tumor growth."

The UNC/NC State scientists tested this therapeutic gel-mediated approach against two cancers – B16F10 melanoma and 4T1 breast cancer, the latter being low immunogenic. The method was effective at making the tumor microenvironments susceptible to treatment. And when the payload was released, tumors decreased significantly. The researchers then conducted experiments to have the hydrogel scaffold form at the surgical site after removal of primary tumors. They witnessed a remarkable inhibition of cancer recurrence.

"Regarding the potential of this approach, scientists should further investigate the biocompatibility of using the gel scaffold for clinical benefit," Gu said. "Meanwhile, we will optimize the dosages of combination drugs as well as treatment frequencies." •



Dr. George T. Ligler joins department

DR. GEORGE LIGLER has joined the Joint BME Department as Dean's Eminent Professor of the Practice. A member of the National Academy of Engineering, Ligler comes to the Joint Department most recently as the 30-year proprietor of his consulting firm GTL Associates. Prior to starting his own company, Ligler directed a 450-person engineering organization within the Burroughs Corporation, was president of a small computer graphics company, and served as a vice-president of Computer Sciences Corporation. Via GTL Associates, he provided consulting in telecommunications, computer system and hardware/software engineering and information management services to more than 40 clients in the United States, Europe and Asia. In addition, since 2015 Ligler has served ably on BME's Industrial Advisory Board.

He is a leader in the area of systems integration/engineering and product management services. A selection of his accomplishments include Rhodes Scholar; Furman University's Alumni Hall of Fame; Member of National Research Council; Radio Technical Commission for Aeronautics (RTCA) Lifetime Achievement Awards 2006 and 2017; Secretary of Commerce appointee to Census Expert Panel 2008; and current chair, National Academies of Sciences, Engineering, and Medicine Committee on Assessing Risks of Unmanned Aircraft Systems (UAS) Integration.

Ligler will act as a senior statesperson for the UNC/NC State BME Department. In this role, he will assist in the development of the Joint Department in the following ways: mentoring BME faculty members and students; serving as a catalyst to initiate collaborative interactions within BME and between the department and industry; providing guidance in research, entrepreneurship, patent law, project management, contract negotiation, etc.; and operating as an international spokesperson for UNC/NC State BME. •

Stuck on you: Nanogel capsule **helps cardiac stem cells** stay put

CARDIAC STEM CELL THERAPY is a promising treatment for damaged hearts. However, researchers are still working on two major issues with the therapy – how to keep the stem cells in place and how to prevent rejection when the stem cells are not from the patient's own body. A new approach from BME researcher Dr. Ke Cheng and a team of international collaborators may solve both of these problems.

The heart is a powerful muscle. That's great if you're running a marathon, but if you're trying to inject stem cells into the heart with the hopes that they'll stay put, it's a problem. One of the major drawbacks of cardiac stem cell therapy is simply that the cells do not stick to the injured heart tissue.

Enter a thermosensitive nanogel that is liquid at room temperature but becomes a thick, sticky gel as it warms. Cheng, associate professor of molecular biomedical sciences at NC State's College of Veterinary Medicine and associate professor in BME, partnered with chemical engineers from the University of Adelaide and cardiac specialists from the University of Zhengzhou and UNC-Chapel Hill to test the nanogel as a delivery mechanism for cardiac stem cells.

The nanogel, poly(N-isopropylacrylamine-co-acrylic acid), or P(NIPAM-AA) for short, had another property that made it appealing for use: In its thickened state it had porous openings large enough for a stem cell's healing factors to escape, but not large enough for immune cells to enter. And it could be adjusted to slowly degrade over time, giving stem cells enough time to repair a damaged heart before dissolving away.

"Autologous stem cells – grown from a patient's own cells – are ideal to use in therapies, but that isn't always practical," Cheng says. "For one thing, growing the cells takes time, which a patient may not have. For another, the heart cells themselves may be affected by disease, so stem cells taken from that source would not be useful.

"That's why we're working on allogeneic stem cell therapies, but whenever you introduce cells from an outside source into the body, the immune system will attack them. The nanogel delivery method keeps the cells in place, protects them from the body's immune response, and allows the regenerative factors released by the stem cells to reach the heart."

Cheng and his collaborators tested the nanogel delivery system in mice and pigs with hearts damaged by a heart attack. Without the nanogel, only about one percent of injected stem cells stayed in the heart. With the gel, up to 15 percent of the stem cells stayed put. They also found that in both animal models heart function improved three to four weeks after treatment. Mice showed a greater improvement than pigs, but in both models heart function was maintained and did not decrease.

"We are pleased with these results," Cheng says. "The nanogel is a safe, cost-effective way to deliver the cells directly to the affected area, and the large animal (pig) data is promising, which may lead to a human clinical trial in the future."

Cheng's work appears in the journal *ACS Nano*, and was supported by the NIH and by NC State's Chancellor's Faculty Excellence Program and Chancellor's Innovation Fund. •

Smart insulin patch may aid future therapies

YANQI YE, a Ph.D. student in biomedical engineering, was home in China last year when her BME professor, Dr. Zhen Gu, asked if she could present a paper at a conference there. It became an "ah-ha" moment for Ye, helping her to see what a difference her research project could have in the lives of diabetics.

Ye talked about the research she has been working on in biomedical engineering: using a smart insulin patch to detect glucose levels and administer insulin in mice. Once translated for humans, it could eliminate the need for constant blood testing and help diabetics maintain a more consistent level of blood glucose. Though the project is still in animal trials, the idea impressed one man at the conference so much that he invited his diabetic father to come to the conference to meet Ye.

"His dad has very serious diabetes — late stage diabetes. He suffered a lot from leg pain, one of the diabetic complications. His doctor forced him to inject the insulin, but he didn't like that," Ye said.

The man's father wanted to know when the smart insulin patch might be ready for human use. Though human trials are still years away, meeting a person who would actually benefit from her research inspired Ye.

The smart insulin patch that Ye is studying in mice combines the nanotechnology of tiny pyramid-shaped microneedles with pancreatic cells that detect glucose levels. The needles in the patch — each 800 micrometers long and thinner than a human hair — penetrate only the top layer of skin, making it painless. She carries a sample of the mouse patch in a petri dish; it is about the size of a fingernail, with an array of needles, in rows 11 x 11.

A patch for human use would be larger — with 30 x 30 rows of needles that could be conical or pyramid-shaped. The pancreatic cells in the patch detect a person's glucose levels, then administer insulin through the skin if required.

"In a healthy body, pancreatic cells regulate the hormone insulin. Diabetics can't produce enough insulin, so they have high glucose levels because of low insulin," Ye said.

Other technologies, like insulin pumps, require diabetics to monitor their own blood sugar levels. "It's hard to control the accurate insulin injection," Ye said. "A higher or lower dose can cause complications, like seizures, brain damage or death. If insulin gets too low, it can cause blindness or kidney failure."

There is also a therapy for diabetics that involves transplanting pancreatic cells into the body to help regulate insulin, but the procedure is expensive and invasive for the patient. The patch allows for the same type of therapy — using pancreatic cells to regulate insulin — but the pancreatic cells remain outside the body in the smart patch.

Ye came to NC State originally as an undergraduate in a

College of Textiles' exchange program. Even then, she had an interest in biomedical fibers and medical devices. She had always wanted to visit the United States, urged on by her father, a businessman, who had traveled here.

While finishing her undergraduate degree, she learned about the Joint BME program. The program combines the strengths of NC State's College of Engineering with the human medicine programs at UNC. The resources from both campuses contribute to the strength of the biomedical engineering programs, Ye said.

When Ye first approached Gu about joining his lab in 2013, the program consisted of four graduate students and two postdocs. "I showed him what I had been doing in textiles, then I volunteered in his lab for a semester. He thought I was ready (for graduate school)," she said.

Today, Gu's lab staff and research program have grown, supporting six graduate students and five postdocs, Ye said. Though she's been with the lab for about four years, Ye calls herself, "the grandmother" in the graduate program.

In fact, the research has been so successful that Gu has cofounded a Research Triangle Park company called Zenomics Inc. aimed at commercializing the technology and making it available around the world. Zenomics has received substantial investments from the Chinese company MicroPort Scientific.

Ye's achievements in graduate school extend beyond the lab. In December 2016, the Analytical Instrumentation Facility chose her paper, "Microneedles Integrated with Pancreatic Cells and Synthetic Glucose-Signal Amplifiers for Smart Insulin Delivery," as one of two "best papers" for 2016. The paper was originally published in *Advanced Materials*.

A year ago, she was one of five NC State graduate students to receive conference awards from the Graduate Student Association. Ye attended the 2016 AlChE Annual Meeting in San Francisco. She also earned an honorable mention for a research image she submitted to a scientific art competition of the Research Triangle Nanotechnology Network, a partnership between NC State, Duke University and UNC-Chapel Hill.

In addition to the smart insulin patch, Ye is working on a cancer immunotherapy patch using melanin against melanoma, a skin tumor that is usually cancerous. The treatment patch was applied to the skin of healthy mice. Even after tumor cells were introduced to the treated mice, all of the test mice survived for at least two months, and 87 percent did not develop any tumors. This work has been accepted for publication by the journal *Science Immunology*.

The patch could also be used to deliver immunotherapeutic drugs directly to the skin tumor, through microscopic needles that are conical-shaped, a therapy that appears to be effective in mice, Ye said.

The cancer research is personal for Ye. Before she left China to come to NC State as an undergraduate, her grandmother was hospitalized, and later died from late-stage metastatic cancer.

"She suffered a lot," Ye said. "It ignited my passion to study biomedical engineering."

Ye's mother, a high school teacher in China, always wanted Ye to become a doctor. Ye believes that her studies in biomedical engineering are fulfilling her mother's desire for her to work in medicine — and she's proud of where her research is heading.

Clinical trials in humans for both of these technologies are still years away, Ye acknowledges. But meeting the diabetic man in China has strengthened her commitment to her research.

"Of course, I hope to see the translation of this technology (to human medicine)," Ye said. "The most impressive memory for me is definitely the conversation between me and that diabetic patient. It really ignited my passion for translating that technology to really benefit the patient.

"Right now, we're just doing the research in the lab, and we don't have a chance to communicate with the patient," Ye said. "I really want to see one day that we can work with an industrial company to put this into the market for the patient to actually use it."

"One day" for Yanqi Ye could mean continuing her research as a postdoc or in an industrial lab to translate the technology for human medicine. And one day, maybe she will meet a patient whose life is changed through her research efforts. •

Student startup aims to save lives

WHEN A CLASS ASSIGNMENT challenged five BME students based on the UNC campus to find and solve a problem in health care, they chose to focus on premature infants suffering from necrotizing enterocolitis — a disease that damages intestinal tissue and poses a devastating 30 to 50 percent mortality rate.

Their solution came in the form of a medical device that could accurately monitor necrotizing enterocolitis symptoms to catch complications before it's too late.

"It wasn't that there are no treatments that exist," said Megan Anderson, a BME senior. "There are treatments, both surgical and non-surgical, but we're not getting patients to the treatments in time, which is particularly frustrating because we have the tools we need to save their lives but we can't get the diagnosis we need."

Taking that challenge head-on, the five students created a prototype for a device that simultaneously monitors four external symptoms of the disease using bio-sensors to accurately alert physicians whenever there is a significant chance of necrotizing enterocolitis.

With the mission of saving babies' lives, the project evolved into something more than just a class assignment. It became one of UNC's most recent student startups, Watchdog Medical.

The students of Watchdog Medical represented BME at the third annual ACC InVenture Prize competition on April 5 and 6, competing against the top student innovators from each university in the Atlantic Coast Conference.

Held annually at Georgia Tech, the ACC InVenture Prize is an innovation competition in which students from each university pitch their inventions to a panel of judges. The winning team receives $15,000.

DEVELOPING A SOLUTION

The concept for Watchdog developed as the team spent time at UNC Hospitals' Neonatal Intensive Care Unit researching the problems that kept newborns there the longest.

"We found this niche in health care that's being completely overlooked," said Anderson. "There's a huge market for NICU monitoring in general, but nothing that specific and that's where providers are left on their own."

Sifting through multiple, generic symptoms and determining the possibility of necrotizing enterocolitis can be time-consuming. It can ultimately become a generalized guess. But since the onset can be as quick as overnight, the diagnosis must be fast enough to intervene with treatment.

Watchdog Medical's prototype can help physicians by indicating the earliest signs of necrotizing enterocolitis.

"It watches out for these infants to make sure that they don't fall victim to NEC," said Dhruv Shankar, a senior and a member of Watchdog Medical. "What else does that? A watchdog."

"We found this niche in health care that's being completely overlooked"

- Biomedical student Megan Anderson

IDEA TO COMPETITION

By competing in the ACC InVenture Prize competition, the team hoped to leave their mark on Carolina.

"Engineers don't usually get a spotlight like this, so this is really exciting for us," said Anderson. "We've worked so hard these last four years and it's finally culminating to something bigger."

The Watchdog Medical team was excited about the innovative environment that the competition provides. Just preparing for the InVenture Prize has already benefited the young startup, they said.

"It has forced us to consider other perspectives outside of science," said Shankar. "Engineering isn't just a scientific venture; it incorporates business, it incorporates empathy and it incorporates really just understanding what do people want, why do they want something and how do you convince people you've got something worth selling." •

Timothy Calhoun and his son David both graduated in May with degrees from the Joint BME Department.

TIMOTHY CALHOUN AND HIS SON DAVID both graduated in May with degrees from the Joint BME Department.

"Here's your headline," Tim said. "'Dead guy goes to school because of his son.'"

"That's not the whole story," David said.

A REMARKABLE OCCURRENCE

From the age of three, David told anyone who would listen that he was going to UNC-Chapel Hill to become a doctor. "I come from a family of over-achievers," he said. His mother, Dr. Linda Calhoun, is a cardiologist at New Hanover Regional Medical Center in Wilmington, NC. At the time, Tim was a pharmaceutical executive with a career history that included financial analyst and flight test engineer.

Two days after Tim's 42nd birthday, he suffered sudden cardiac death in his sleep. "My wife's asleep in bed next to me, and she wakes up — for whatever reason — and realizes that something is wrong."

Linda immediately began CPR, called paramedics and also called her neighbor, who is a nurse. They took turns performing chest compressions until an ambulance arrived. It took emergency respondents seven shocks with a defibrillator to get Tim's heart into a life-sustaining rhythm. He arrived at the hospital in a coma that lasted for days.

"I slept right through it," said David, who was seven years old at the time of his father's cardiac episode. "I don't remember if they told me the next day that my father had died. I do remember I had piano practice."

THE ROAD BACK

Tim's recovery was surprising. "You have to look at the prognoses of people who have sudden cardiac death. My situation is not normal." He remains amazed at his luck. "A coma is basically a last ditch effort for your brain to save itself. I went back to work a month later and still remembered my password to get into my computer."

Still, Tim suffered some cognitive setbacks. "I would

A father, a son and a **joint graduation**

type something and could have sworn it made perfect sense, but when I went back to read it, words would be missing. I wasn't able to do calculations in my head like I used to."

Tim's symptoms were still present just four years ago, when it was time for David to go to college.

OFF TO SCHOOL

David still had his heart set on becoming a doctor until his freshman orientation at UNC Chapel Hill. "We were going around to different departments hearing what people had to say, and when I got to BME they said all the wrong things. 'Your GPA will suffer, you'll have no social life, say goodbye to free time.' I basically thought, 'Sign me up.'"

"Imagine my surprise," Tim said. "My son wants to do something the hard way."

Inspired by David, Tim researched the BME program and discovered a kindred interest. He started with classes at a community college to make sure he was ready, then transferred into the BME program at NC State. "I needed to do something exceedingly difficult to get my brain back, and it's absolutely done that for me. I would say I'm back to normal."

"Whatever that is," said David.

The program is notoriously challenging. Both Calhouns lived on their respective campuses, and often spent all weekend in the lab. "My mom would visit us on the weekends when she wasn't working," said David. "This is just a 24-7 program."

Other shared experiences include the Helping Hand Project, which uses 3D printers to make prosthetic hands for children. The two have even shared professors and classes, though not the same section. "I think the professors are nicer to the UNC kids," Tim said.

"You really have to buckle down and do the work," said David. He spread his fingers on the table as though on a piano keyboard. "It's like music. When I'm finally able to commit the notes to memory, I feel so accomplished," he said.

THE NEXT CHAPTER

Now the job hunt begins. Tim and David have swapped war stories from the interview process. Both are open to relocating for the right opportunity, though David would like to stay in North Carolina.

Tim is passionate about lifesaving devices and the renewed future they can offer patients like himself. "I have an ICD (internal cardio defibrillator) inside me now. It's never fired, and I hope it never will. But it's there if I need it."

David shared a different perspective. "I'm less about coming up with novel devices than I am about quality engineering. I just want to make sure everything runs smoothly."

Both father and son graduated at a joint ceremony at the Carolina Theater, in an auditorium filled with red and blue gowns. Linda was in the audience.

"Want to know what's cool? David was sitting in front of me," said Tim. "Even on that day, I was still following in his footsteps." •

FACULTY NEWS

Altis Biosystems receives NC IDEA SEED Grant

Dr. Nancy Allbritton

Dr. Scott Magness

Altis Biosystems, a company co-founded by BME Chair Dr. Nancy Allbritton and BME faculty member Dr. Scott Magness, has received an NC IDEA SEED grant. Altis was chosen from a pool of more than 150 applicants as a result of its great potential for growth, employment, and additional economic impact. The company has developed a stem cell technology called RepliGut, which recreates human intestinal epithelium for drug testing and microbiome research. The sponsoring company, NC IDEA, is a private foundation with a mission to maximize the economic potential of the people of North Carolina by supporting the formation and fruition of high-growth entrepreneurial endeavors in the state.

Article celebrates anniversary of Ligler's groundbreaking biosensors

New Year's Eve has a special meaning for Dr. Fran Ligler – it was on that day, 26 years ago, that she received the patent for her revolutionary portable optical biosensors.

Since then, the biosensors have been used in food safety applications, pollution studies, and most notably, by the U.S. military to detect hazardous materials (such as toxins and biohazards). IPWatchdog has released an article commemorating Ligler, the work behind this great achievement and what the future may hold for this awesome technoloagy.

Find the article at **bit.ly/2vZ2xnt**.

Dr. Fran Ligler

BME shines in *The Daily Tar Heel*

The Joint Biomedical Engineering department shines again — this time in UNC's newspaper, *The Daily Tar Heel*.

An article in the student-run publication discusses the perks of the one-of-a-kind program, including students gaining full access to both UNC and NC State facilities. Marrying the top-ranked College of Engineering at NC State and the first-rate School of Medicine at UNC has provided students and faculty members alike with the opportunity to pursue hands-on solutions to real-world problems.

You can read the article at **dailytarheel.com/article/2018/02/bme-0207**.

Gallippi receives competitive renewal R01 from National Institutes of Health

Dr. Caterina Gallippi has been awarded a competitive renewal R01 award from the National Heart, Lung, and Blood Institute to continue developing ultrasound-based imaging methods for delineating carotid atherosclerotic plaque risk.

The project, Transcutaneous

Dr. Caterina Gallippi

ARFI Ultrasound for Differentiating Carotid Plaque with High Stroke Risk, is aimed at the development and testing of noninvasive acoustic radiation force ultrasound-based imaging technology to better identify patients at high risk of stroke. With this technology, doctors may be able to administer appropriate and timely intervention to prevent or reduce the risk of stroke. The project will be conducted with collaborators in neurology, vascular surgery, vascular radiology, pathology and cardiology.

Dr. Zhen Gu

Gu Lab featured in NIH director's blog, *UNC Healthcare News*

Dr. Zhen Gu was interviewed by UNC Healthcare about two studies being undertaken in his lab. The first, "Smart Artificial Beta Cells Could Lead to New Diabetes Treatment," features Dr. Gu's promising research on smart artificial beta cells — cells that mimic natural pancreatic beta cells that could automatically control blood glucose levels in diabetics. The video can be seen at **bit.ly/2r7Kw1u**.

The second study, "Researchers use a skin patch, infrared light, and melanin to battle melanoma," focuses on a melanin-enhanced cancer immunotherapy technique that can also serve as a vaccine. The video can be seen at **bit.ly/2rbk1Ic**.

In addition, National Institutes of Health's Director Dr. Francis Collins has featured Dr. Gu's work with artificial beta cells on his blog. Read the post at **bit.ly/2hiyFvx**.

Raleigh television station WRAL has featured Gu's use of microneedle patches to fight diabetes in a more natural, body-responsive way than what is currently available. For diabetes, this means that the microneedles are laden with insulin that is released when the body sends chemical signals — no user intervention required.

Read the article at **bit.ly/2vWwBA5**.

New BME faculty member Wesley Legant featured in *Nature*

New BME faculty member Dr. Wesley Legant has been featured in *Nature* for his work with DIY microscopes.

Not finding a microscope that allowed him to take the readings he needed, Legant instead decided to develop his own using light-sheet microscopy. His work in BME will focus on both cell biology and microscope design, and he will continue to study exactly how cells move — with the help of his very own microscope.

Read the article at **go.nature.com/2AddORE**.

Taylor discovers protein that returns neural connections to normal after injury

Dr. Anne Marion Taylor

Head injuries occur often in a myriad of situations — car crashes, falls, sports — and now BME faculty member Dr. Anne Marion Taylor and her team are one step closer to understanding how to reverse the negative consequences of such events.

Outlined in a study published in *Nature Communications* earlier this year, Taylor has discovered that decreased neural connections caused by trauma can lead to over-excitability of the affected neurons. While some over-excitement can be beneficial to restoring inter-neural communication, too much can have the opposite effect, leading to neuritic death. The team was able to help stem the loss of neural connections by treating injured neurons with a specific protein called netrin-1; as a result, the injured neurons returned to almost normal condition. Taylor hopes that netrin-1 will help in the creation of a new therapy for brain injury patients, and BME is proud to support her in this endeavor.

Read more about the study at **bit.ly/2w5bSdc**.

Technology and Innovation profiles Ligler

Technology and Innovation featured Dr. Fran Ligler in a National Academy of Inventors Fellow profile. In it, Ligler expounds upon her exciting new work in microfluidics and tissue-on-chip, as well as the innovative research and collaborations happening in the Joint Department.

T&I is a journal edited and published by the National Academy of Inventors and describes itself as a forum for presenting information encompassing the entire field of applied sciences, with a focus on transformative technology and academic innovation.

Read the profile at **bit.ly/2vZ1YKg**.

In addition, Ligler was invited by Furman University's president and provost to provide the University's commencement address on May 5th. She earned her bachelor's degree from Furman, located in Greenville, SC.

Dayton elected to AIMBE College of Fellows

Election to the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows is among the highest professional distinctions accorded to a medical and biological engineer. Dr. Paul Dayton has been awarded that distinction for his work with high-resolution, non-invasive ultrasound technology that uses sound to detect cancer by taking advantage of the unusual bendiness, or tortuosity, of blood vessels supplying tumors. In one of these novel technologies, called "acoustic angiography," researchers bounce sound waves off microbubbles that are flowing through the blood vessels. Those sound waves can be distinctly interpreted and translated into images, which show differences between healthy and cancerous tissue.

The College of Fellows is comprised of the top two percent of medical and biological engineers and membership honors those who have made "outstanding contributions to engineering and medical research, practice, or education" and to "the pioneering of new and developing fields of technology, making major advancements in traditional fields of medical and biological engineering, or developing / implementing innovative approaches to bioengineering education.

Department moves up in *U.S. News & World Report* graduate rankings

The Joint Department advanced in the 2018 *U.S. News & World Report* rankings of the best graduate biomedical/bioengineering programs.

The UNC/NC State Joint Department of Biomedical Engineering was ranked 16th among public universities. This four-place advancement from the previous year moves the UNC/NC State joint program well into the top 20 among its peer institutions.

More information about the 2018 *U.S. News & World Report* rankings can be found at **usnews.com/best-graduate-schools/top-engineering-schools/biomedical-rankings**.

Four new NC TraCS grants awarded to BME faculty members

Dr. Xiaogang Hu

Dr. Yevgeny Brudno

Dr. Paul Dayton

Dr. Matt Fisher

Four BME faculty members have been awarded new grants from the North Carolina Translational and Clinical Sciences (NC TraCS) Institute at the University of North Carolina at Chapel Hill: Drs. Xiaogang Hu, Yevgeny Brudno, Paul Dayton, and Matt Fisher.

Hu, partnered with NC State's Dr. Yong Zhu, receives his award to develop and validate a real-time hand kinematic tracking glove for stroke survivors, which can be used to register the extent and quality of hand usage during daily activities.

Brudno and Dayton will be researching how to target glioblastoma recurrence by utilizing ultrasound-enabled refillable drug depots. Their project also features UNC collaborators Drs. Shawn Hingtgen, Kim Brouwer and Tom Egan.

Lastly, Fisher, partnered with UNC's Dr. Paul Weinhold, will be investigating the use of an angiogenic suture for tendon healing simulations. •

STUDENT NEWS

2018 Lucas Scholars named

BME named four students as 2018 Lucas Scholars. The scholars and their mentors are:

Neil Cornwell, mentored by Dr. Scott Magness
Jamie Lebhar, mentored by Dr. Nancy Allbritton
James Cahoon, mentored by Dr. Nancy Allbritton
Jackson Richards, mentored by Dr. Jason Franz

The department thanks Dr. Carol Lucas for her inspiration and support of the program. The program was named to honor her contribution to the Biomedical Engineering Department as UNC's founding chair and also to recognize her contributions to the field of biomedical engineering. When the funds for the Lucas Scholars program were cut, her generosity allowed it to continue. Thanks also to the mentors who have agreed to host a scholar in their lab this summer.

Archibong receives AIMBE travel award

Dr. Edikan Archibong

Post-doctoral researcher Dr. Edikan Archibong has received an AIMBE travel award to attend the Public Policy Institute's Rising Leaders conference. Held in Washington, DC, the conference offers training in regulatory science and public health policy and provides attendees the opportunity to speak with world-wide regulatory leaders, public policy experts, health care advocates, top government officials and industry leaders. Archibong is co-mentored by Drs. Frances Ligler and Zhen Gu.

Young honored at American Chemical Society national meeting

Ashlyn Young

BME graduate student Ashlyn Young was selected to receive the Division of Polymer Chemistry's Excellence in Graduate Polymer Research Award. All awardees presented their research at an ACS President's Highlighted Symposia. The award and symposium recognizes outstanding graduate students in all fields of polymer science and engineering. In addition, the presented research was selected to participate in Sci-Mix, a symposia of the best abstracts from all divisions.

Soha Bazyar

Graduate student wins first place in UNC Lineberger poster competition

BME graduate student Soha Bazyar was a first-place winner in the UNC Lineberger Annual Retreat poster session in October. Mentored by Dr. Yueh Lee, assistant professor in the Department of Radiology

at UNC School of Medicine, Bazyar's poster was titled "Efficacy of Combined Microbeam Radiotherapy and Immunotherapy on Melanoma." The award came with a small stipend to acknowledge the hard work put into the presentation.

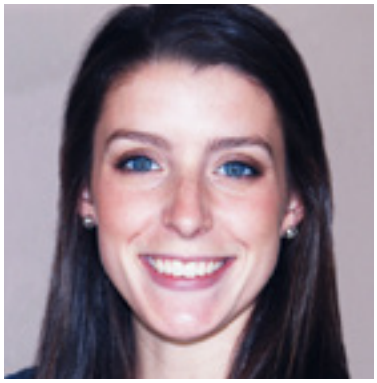
Hubbard Lab seniors receive honors thesis research funding

Students Alexa Romero, Ian Voos and Keerthi Anand won UNC honors thesis research awards. Roughly 350 Honors Carolina students cap their undergraduate experience with a senior honors thesis, partnering with a faculty mentor to develop original research or creative work.

The research awards help to cover the costs of honors thesis-related expenses, such as lab supplies and equipment. Romero and Anand both received Tom and Elizabeth Long Research Awards for their projects "A Low-Cost, Non-Contact, Optical Imaging Pulse-Oximeter System" and "Analysis of Burn Wounds Through Exploration of Parameter Space for Two Active Contour Methods," respectively, while Voos received a Gump Family Undergraduate Research Award for "Optical Measurement of Forearm Plethysmography."

All three of these outstanding students are members of Dr. Devin Hubbard's lab.

Mihalko named NC State GAANN Molecular Biotechnology Fellow

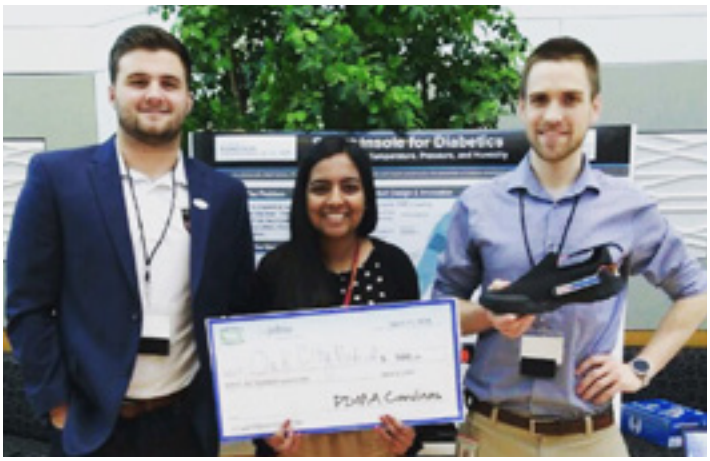


Emily Mihalko

BME graduate student Emily Mihalko has been named as a 2018 NC State GAANN Molecular Biotechnology Fellow.

This prestigious Fellowship is provided through the Graduate School by the U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN) Program. Fellowship selection is based upon a student's outstanding academic record, their demonstrated interest in molecular biotechnology, and upon a stellar recommendation from their academic department.

Senior design team awarded scholarship from Innovate Carolina



Oak City Medical

Oak City Medical, a BME senior design team, has been awarded a scholarship from Innovate Carolina.

The team aims to develop an affordable at-home device for early detection of foot ulcers in diabetic adults to prevent expensive treatment and life-altering amputation. Team members are BME seniors Michael Iasiello, Anupama Amarnath, Philip Barker, and Matt Hetrich.

Kristina Rivera

Rivera selected as keynote speaker, wins second place at research symposium

BME graduate student Kristina Rivera was selected to be one of 12 keynote speakers at the World Biosensors Congress in June.

The selections were based on evaluations of more than 1,000 abstracts, each of which was read by at least three members of the international organizing committee. The abstracts selected for Keynote Presentations are judged to be the best of all those submitted.

Rivera also took home second place for her work "Controlling Oxygen Levels in Vascularized 3D Gut-on-Chip" at the Bayer CropScience Research Symposium

held in September at Bayer CropScience Division Headquarters in Research Triangle Park. Poster awards were administered to the most innovative research as determined by a panel of Bayer CropScience scientists and engineers.

She is mentored by Dr. Michael Daniele and Dr. Scott Magness.

Wrona, Reed selected for 2018 Adams Apprenticeship program

Kristin Reed

Emily Wrona

In 2018, the Adams Apprenticeship program at UNC accepted less than half of its applicants. The apprenticeship, aimed at encouraging student entrepreneurship by providing resources and opportunities such as training, advisors, conferences and local and national networking events, accepted just 14 graduate students and 18 undergraduate students. Among those were BME graduate student Emily Wrona and undergraduate student Kristin Reed, selected as a result of their talent, drive, and ambition to make an impact as entrepreneurial leaders. In addition to receiving the assistance mentioned above, the students will participate in entrepreneurial trips to San Francisco and New York City. •

Please share your personal and professional milestones with us!

To submit an item for the newsletter, send your information to **jpodaly@unc.edu**. Be sure to include your name and class year.

Joint Department of
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UNC/NC State Private Giving Opportunities

The UNC/NC State Joint Department of Biomedical Engineering seeks private investment to capitalize on the collegial and fertile inter-institutional environment between UNC-Chapel Hill and NC State to become the best BME department worldwide. Private gifts will enable the Department to make strategic investments to bring in and keep the best people, launch bold new research and academic programs, and seed a culture of innovation through state-of-the-art labs on both campuses. With this investment, UNC/NC State BME will expand three core Department-wide initiatives.

INITIATIVE 1: Be the world-renowned leader in research

We have created an unprecedented collaborative environment that promotes seamless exchange among engineers, clinicians and scientists.

PROMOTE COLLABORATION AND RESEARCH

To attract world-class scientists and engineers to North Carolina and expand our high-impact research and training programs, the Department seeks to add six endowed professorships (three at NC State and three at UNC). The Department will also showcase its research and faculty, the universities and the state by sponsoring an international scientific meeting (held in North Carolina), as well as a distinguished lecture series.

INITIATIVE 2: Recruit and educate exceptional students

BME is committed to educate a new generation of biomedical engineers expressly equipped to meet the complex yet vital societal challenges impacting the health of our nation.

INVEST IN EDUCATION AND ENTREPRENEURSHIP

To increase educational competitiveness, BME seeks funds to provide graduate and undergraduate fellowships and scholarships to students. Funds supporting our international exchange program will support our students to gain global experiences so that they are "market ready" upon graduation.

INITIATIVE 3: Translate technology into economic growth

Our goal, which permeates every function of BME, is to create and translate practical solutions to health care needs. Students are taught not only the skills of the life sciences and engineering, but are also provided with hands-on experience in interdisciplinary teamwork. Faculty members collaborate with companies and also start new ones.

Seed technology transfer

To enhance technology translation and speed the transition of new technologies to the marketplace, BME seeks funding to increase the department's capacity to move new product designs out of the laboratories and to encourage greater entrepreneurship among faculty and students. In addition, a new BME Innovation Fund will be endowed to fund new faculty members and student research projects, departmental initiatives including international conferences, student and faculty professional development and ongoing department-wide strategic planning.

For more information about these and other opportunities to invest in UNC/NC State BME's mission to unite engineering and medicine to improve lives, please contact Laura Schranz at **lschranz@unc.edu** or **919.962.6212**.