VIRGINIA TECH

January 2021

Virginia Tech Innovation Campus, an entirely new force for graduate education in the Washington, D.C., area, page 12

VIRGINIA TECH
RESEARCH AND INNOVATION

Spurred by COVID-19, researcher Linsey Marr evaluates efficacy of sterilized N95 respirators, alternative mask materials.

Photograph taken prior to the COVID-19 pandemic.

AEROSOL SCIENTIST

SINCE MARCH, VIRGINIA TECH civil and environmental engineering professor Linsey Marr, an expert in the airborne transmission of infectious disease, has been testing the efficacy of sterilized N95 respirators and alternative mask materials in filtering out particles.

The rapid science experiments conducted by Marr's team aim to help quantify how well these forms of personal protective equipment and homemade face coverings shield their wearers against COVID-19, especially in the face of shortages.

Dealing with sluggish PPE supply chains, the medical community and the wider public have turned to improvisation. Some hospitals have worked to extend the use of their stores of N95 respirators by sterilizing them. Members of the public, advised by the Centers of Disease Control and Prevention to wear cloth face coverings in places like grocery stores and pharmacies, are also exploring creative problem-solving by sourcing off-the-shelf materials for homemade masks. As these groups adapt, Marr's team is working to supply them with insights grounded in science.

When testing sterilized N95 respirators, Marr and graduate students Jin Pan and Charbel Harb, members of Applied Interdisciplinary Research in Air (AIR2) Laboratory and fellow civil and environmental engineering professor Hosein Foroutan's Applied Interdisciplinary Research on Flow Systems (AIRFlowS) Laboratory, found that the respirators retained their ability to filter particles after up to 10 cycles of sterilization by hydrogen peroxide vapor and by ethylene oxide.

"Since I understand how the coronavirus moves around in air, I knew how important it was for health care workers to have proper respiratory protection," said Marr, the Charles P. Lunsford Professor of Civil and Environmental Engineering. "I knew my lab could help by testing N95s after sterilization to ensure that they could be reused safely. I quickly wrote up a procedure, and my students reconfigured our equipment to start running experiments."

Marr's research looks more broadly at the sources, transformations, and fate of air pollutants. Over the years, she's focused on engineered nano-materials and viral aerosols — mainly those of the flu for the latter — and how they can be physically and chemically transformed in the environment. As she's pivoted in recent months to apply her insights to the novel coronavirus, Marr has weighed in on subjects that have captured national media attention, such as the possibility of transmission by inhalation, the 6-foot distance recommendation for running outside, and how virus particles may or may not land on a person's clothes or other surfaces.

In their look at homemade mask materials, Marr's team has tested items that have emerged in the public eye in recent months. So far, they've tested materials that include Shop-Vac bags, HVAC filters, T-shirts, microfiber cloth, felt, auto shop rags and towels, and coffee filters.

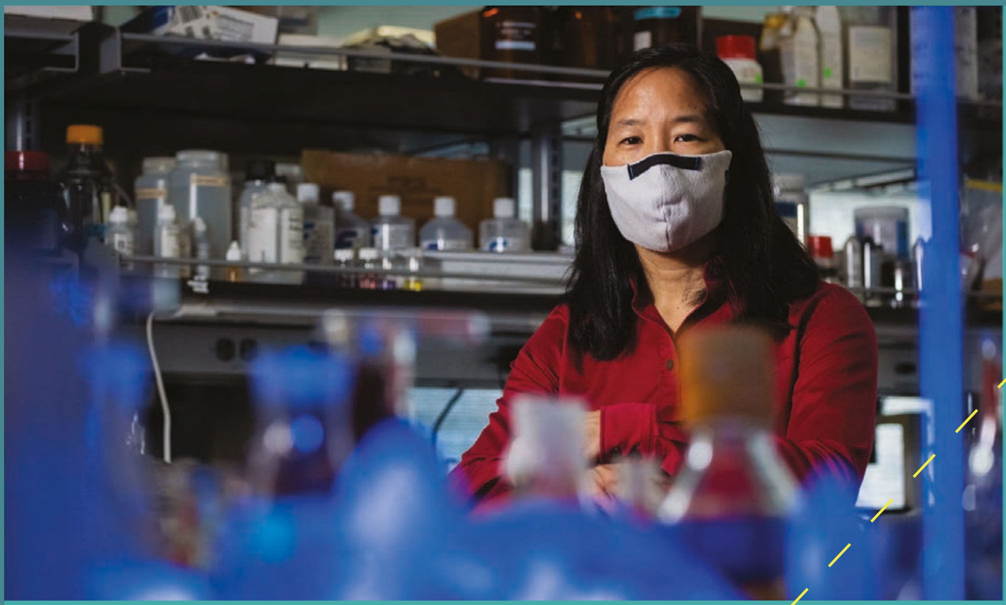
A few top performers and busts emerged from their tests. Microfiber cloth, a material used to clean eyeglasses, filtered out at least 80 percent of particles under optimal conditions, while a heavyweight cotton t-shirt, a shop towel, and a shop rag filtered out only about 10 percent of the hardest particles to remove, and about 50 percent of the larger ones. HVAC filters removed a low of 20 percent of particles; Shop-Vac bags removed at least 60 percent.

The experiments are ongoing, but Marr has been releasing the results in real time on Twitter. She also shared the procedure behind the tests on Twitter (twitter.com/linseymarr), and other aerosol science labs around the United States have since adopted these methods to help test materials in their regions.

REUSE AS A LAST RESORT: TESTING STERILIZED N95 RESPIRATORS

The team's experiments on sterilized N95 respirators were fueled largely by requests from local medical professionals, like Anthony Baffoe-Bonnie, Carilion Clinic's medical director of infection control and an epidemiologist for the hospital, and infection preventionist Maimuna Jatta.

Baffoe-Bonnie's team wanted to know if the hospital's N95 respirators retained their filtration efficacy after up to 10 cycles of sterilization using hydrogen peroxide vapor, a common technique among hospitals. There was added uncertainty in that the Carilion team's machines use a stronger concentration of hydrogen peroxide than the methodology referenced in the publications they read for guidance.



Linsey Marr in her lab at Kelly Hall. Photo: Ryan Young for Virginia Tech

Marr's tests showed that the N95 respirators retained their efficacy post-sterilization with the technique, helping the team solidify their procedure. "With that, we knew we could use what we had," said Baffoe-Bonnie. He said he was grateful to have Marr and her testing resources close by. "I think she's a godsend in that regard," Baffoe-Bonnie said. "We had a student drive the stuff over to her, and we had our results back — it couldn't have been faster."

Marr's lab is set up to evaluate filtration efficacy of porous media for particles ranging in size from 0.04 to 1.0 microns. Within that capacity, the team can assess how well a form of PPE meets the standard for N95 respirators, which are required to block at least 95 percent of particles 0.3 microns in diameter.

To test materials, the team sprays sodium chloride particles from a liquid salt solution into a large bag and measures the number and sizes of the particles in the bag. They then use a vacuum pump to pull air containing the particles through the respirator, mask, or material they're testing, and measure the number and sizes of particles that made it through to the other side.

"The mask or filter removes particles, and we measure hopefully much less than what's in the big bag," explained Marr.

IN A SEA OF HOMEMADE MASK MATERIALS, LEARNING WHICH OPTIONS SINK OR FLOAT

Some of the alternative mask materials arrived in Marr's lab for testing via Matt Hull, a research scientist at the Institute for Critical Technology and Applied Science and Marr's colleague on the institute's NanoEarth team. Hull, who earned his master's and doctoral degrees from Virginia Tech, has worked extensively with Marr and other researchers to understand how nanoscale materials move through the environment and what happens when we're exposed to them.

Hull recognized that amid the COVID-19 pandemic, there would be a strain on supply chains for protective materials with specialized properties, including materials that the medical community might eye for last-resort use in PPE. He searched for products that might reproduce some of the functionality of certified PPE materials, but could be bought off the shelf.

Hull dropped off potential candidates at the Kelly Hall headquarters of the Institute for Critical Technology and Applied Science, where a conference room that, under normal circumstances, would be booked for committee meetings and thesis defenses was transformed into a staging area for piles of material destined for testing in Marr's lab down the hall. Hull and the other researchers would exchange text messages when materials were ready for pickup, cobbling together a socially distanced courier service.

"As a scientist, you work your whole life and you go home a lot of nights, and you think, 'What did I do today?'" said Hull. "'I maybe edited a paper, sent a few emails.' You rarely get the chance to contribute so directly to solving a problem."

Marr's team has also begun testing several leading, open-source 3D-printed mask designs submitted by Chris Williams, a mechanical engineering professor who has helped coordinate a campus-wide effort to test, design, and produce PPE, ventilator components, and other COVID-19 medical supplies. His lab will base their next steps in PPE production on Marr's tests.

Her team will continue to run experiments as new ideas for mask materials surface. "We'll keep testing materials as long as what we're doing hasn't been done by other people," Marr said.

In immediate response to the COVID-19 pandemic, Virginia Tech faculty, staff, and students have initiated numerous research projects with local and global salience. Learn more from the Office of the Vice President for Research and Innovation, ***vt.edu/covidresearch.*** ■

Written by Suzanne Irby and Eleanor Nelsen

MOLECULAR VIROLOGY AND EMERGING INFECTIOUS DISEASE

VIRGINIA TECH'S UNIVERSITY DISTINGUISHED PROFESSOR of Molecular Virology, X.J. Meng, is widely considered one of the world's leading scientists studying hepatitis E virus, porcine circovirus type 2, and porcine reproductive and respiratory syndrome virus. For decades, Meng and his lab at the Virginia-Maryland College of Veterinary Medicine have studied hepatitis E virus (HEV), the causative agent of hepatitis E in humans. Now, with a five-year National Institutes of Health RO1 grant totaling nearly $2 million — Meng's third successful competing renewal — the molecular virologist and his team in the Department of Biomedical Sciences and Pathobiology are aiming to strengthen their life-altering research on HEV.

X.J. Meng

"A very impressive achievement is that this RO1 grant has been successfully and continuously acquired four times for funding," said Ansar Ahmed, a professor of immunology and the veterinary college's associate dean of research and graduate studies. Although this type of a success is difficult to sustain, the fact remains: Meng's work for his HEV research program has been funded continuously by the NIH since 2002.

Annually infecting more than 20 million people worldwide — particularly in developing countries — according to the World Health Organization, HEV causes more than 44,000 deaths per year. Describing the virus as a public health pathogen, Meng said that a significant clinical problem has gained attention in recent years: the development of chronic hepatitis E among immunocompromised people, as well as the high mortality rate, reaching up to 25 percent, among infected pregnant women.

"Scientists just don't understand why," Meng said of his forthcoming research. "Why would the virus infect pregnant women and apparently cause such a high mortality? What are the factors in the host and virus contributing to fulminant hepatitis during pregnancy? Not only does the infected pregnant woman die, but the fetus also dies. This predicament has remained elusive for many years."

In his research, Meng has contributed to the discovery of two novel hepatitis E viruses, including a 1997 finding and identification of the first animal strain of HEV from a pig, a revelation he describes as "serendipitous." Before arriving at the veterinary college, he was working at NIH and wasn't studying the virus at all.

"At the time, I was working on the hepatitis C virus, and then a swine pathologist friend called me and said, 'X.J., I saw that some of the pigs had hepatitis lesions. Mind taking a look at what caused it?' We ended up discovering the swine HEV from the pig. Ever since that discovery, I realized I have to work on this new virus since I am trained both in human medicine and in veterinary sciences."

Meng's discovery of swine HEV brought a paradigm shift in recognizing the virus as a zoonotic virus that can cross species barrier and infect humans. As many discoveries go, Meng said, the recognition of the new virus took a while to accept.

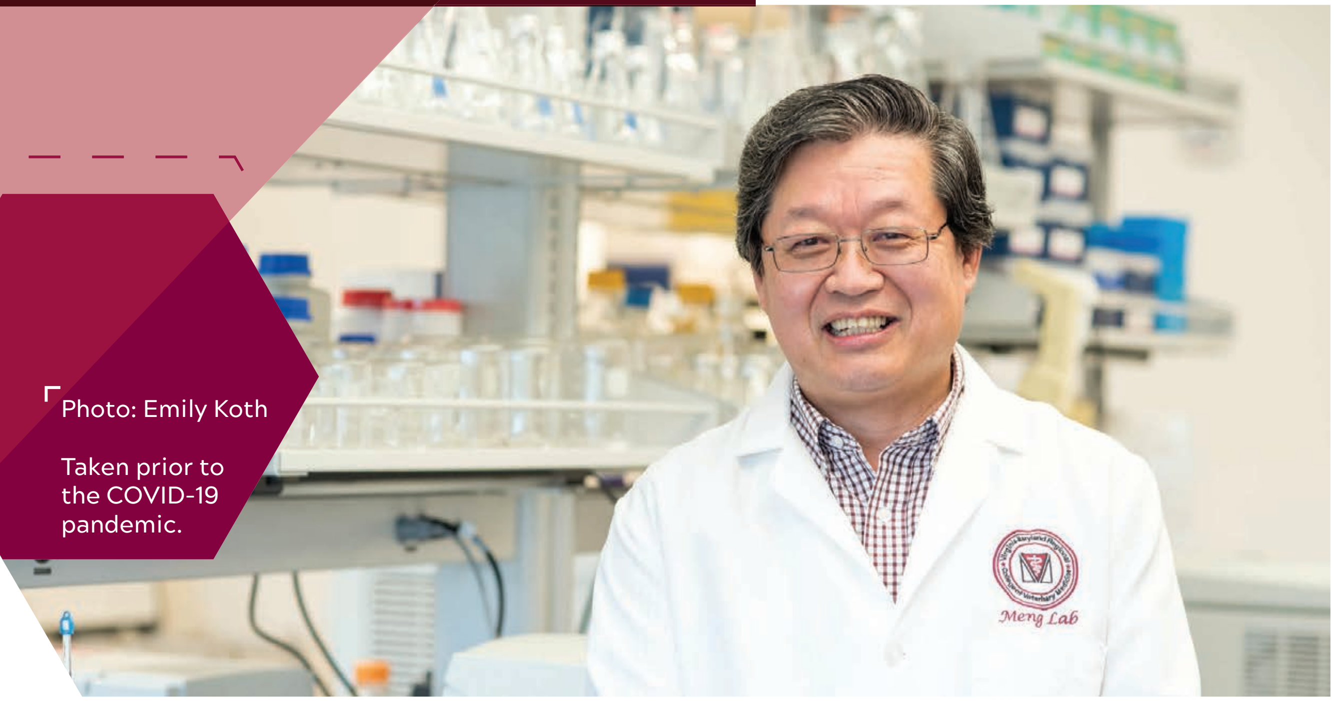


Photo: Emily Koth

Taken prior to the COVID-19 pandemic.

"I remember we tried to publish that first paper initially in this one journal, and it was rejected," Meng said. "They probably thought we were crazy since HEV was not known to be prevalent in the United States in humans, let alone pigs." Since the paper's publication in a different journal, the work has been cited more than a thousand times.

After Meng joined Virginia Tech in 1999, his lab discovered the avian HEV in chickens with hepatitis-splenomegaly syndrome. Meanwhile, since his initial discovery of swine HEV from pigs, more than a dozen other animals have now been identified as reservoirs for the virus, intensifying public health concerns with the potential for foodborne and zoonotic infections.

In 2007, Meng's team researched pig livers sold in U.S. grocery stores and discovered that 11 percent of the livers not only had HEV contamination, but also could infect humans if served undercooked. Since then, in hopes of designing more effective strategies for fighting cross-species HEV infection, Meng has sought to better understand the virus' genetic elements and host factors that allow the virus to transfer from animals to people.

"Dr. Meng's meritorious work at this college continues to draw national and international recognition for achieving breakthroughs in the understanding of zoonotic viral diseases," said Dan Givens, the veterinary college's dean. "As a physician working with animal diseases for the betterment of both, he demonstrates the impact of a One Health approach day-to-day in both his training and scholarship."

Together with his team of co-investigators, including Ahmed, Associate Professor of Theriogenology Sherri Clark-Deener, and Clinical Professor of Anatomic Pathology Tanya LeRoith, along with two new postdoctoral associates and a graduate student, Meng will next examine the underlying mechanism of high mortality among pregnant women caused by HEV, for which there is not yet a widely available vaccine. The team aims to gain information from the project in order to devise effective strategies for the prevention and treatment of HEV-associated fulminant hepatitis failure during pregnancy.

Following the hypothesis that some of the elevated sex hormones may regulate and promote virus replication, leading to more liver damage and thus high mortality, Meng's team will attempt to locate some of the virus mutation in the virus genome, as well as identify potential hormonal factors contributing to the high mortality among pregnant women.

"If we can do that," Meng said, "then we can design a better strategy to prevent the virus from causing this high mortality. In order to do that and to develop a vaccine, we have to understand the why and the how — how the virus causes the disease and why there's such a high mortality. We have to understand some of the basic biology first."

Although Meng said that his team has a long way to go with its HEV research, he described the challenge as a factor that attracts him to "solving some of the problems that cannot be solved yet."

Such tenacity carries much weight among his fellow researchers. "We are fortunate to have Dr. Meng as a leader in infectious disease research," said Margie D. Lee, head of the Department of Biomedical Sciences and Pathobiology. "Not only is he a superior researcher, he is a modest and giving individual and a great mentor for our junior faculty."

Widely considered one of the world's leading scientists studying HEV, porcine circovirus type 2, and porcine reproductive and respiratory syndrome virus, Meng invented the first U.S. Department of Agriculture fully licensed commercial vaccine against porcine circovirus type 2 infections and its associated diseases in pigs — a vaccine that's now used worldwide and has saved the global swine industry hundreds of millions of dollars.

"A lot of scientific discoveries are not planned," Meng said, reiterating a lesson he emphasizes to his mentees. "It's an 'Ah! Something's not right' moment. You see something's not correct, not what you expect, you ask the question 'Why?' and you may have found something very interesting, something completely new."

NEW CENTER FOR EMERGING, ZOONOTIC, AND ARTHROPOD-BORNE PATHOGENS

Meng is also founding director of the university's new Center for Emerging, Zoonotic, and Arthropod-borne Pathogens.

The vision of the center positions Virginia Tech to become a national and international research and training resource that is a leader in advancing transformative science and developing effective countermeasures against emerging infectious diseases.

The center is administratively established in the Fralin Life Science Institute and includes faculty participants from at least seven colleges and more than 25 departments on campus.

"The mission is to foster and promote a cohesive and synergistic environment for interdisciplinary and collaborative research across the Virginia Tech campus in the area of emerging, re-emerging, infectious diseases," said Meng.

The majority of emerging human infectious diseases are of animal origins owing to increasingly close interactions among humans, domestic animals, and wildlife. Many other factors, including climate change, land use and land cover change, intensive farming practice, backyard farming, animal poaching, and bushmeat consumption all bring animal pathogens closer to human habitats, leading to spillover or cross-species infections in humans.

"In keeping with the land-grant mission of Virginia Tech, the Center for Emerging, Zoonotic, and Arthropod-borne Pathogens has several overarching objectives that include translating basic and mechanistic research in infectious diseases into tangible results, such as vaccines, antimicrobial drugs, intelligent infrastructure, and diagnostics that benefit the global society," said Meng, who is also a member of National Academy of Sciences, a Fellow of the National Academy of Inventors, and a Fellow of the American Academy of Microbiology.

The center trains the next generation of infectious disease scientists by providing interdisciplinary research training opportunities for graduate and undergraduate students and recruits top faculty and students in the broad field of infectious diseases. The center also positions Virginia Tech to become more competitive in acquiring large center grants, program grants, and training grants which typically require an extensive team of scientists from different disciplines.

"Given that the mission of the Fralin Life Science Institute is to strategically invest in targeted research areas within the life sciences, we believe the center is an excellent fit within our institute and will provide broad support for Virginia Tech's life science community," said Matt Hulver, executive director of the Fralin Life Sciences Institute.

The center draws upon Virginia Tech's existing expertise of diverse affiliated faculty members in biological, biomedical, medical, engineering, agricultural, veterinary, plant, social, and environmental sciences spanning seven colleges and more than 25 departments. An Advisory Leadership Committee representing different academic units, including biomedical sciences and pathobiology (Virginia-Maryland College of Veterinary Medicine), geography (College of Natural Resources and Environment), civil and environmental engineering (College of Engineering), biological sciences (College of Science), medicine/infectious disease (Virginia Tech Carilion School of Medicine), and biochemistry (College of Agriculture and Life Sciences) has solidified the center's themes and direction. ■

Written by Leslie Jernegan and Kristin Rose Jutras

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DR. MENG'S MERITORIOUS WORK AT THIS COLLEGE CONTINUES TO DRAW NATIONAL AND INTERNATIONAL RECOGNITION FOR ACHIEVING BREAKTHROUGHS IN THE UNDERSTANDING OF ZOONOTIC VIRAL DISEASES."

**DAN GIVENS,
THE VETERINARY COLLEGE'S DEAN.**

REFINING ANTIBIOTIC RESISTANCE

Environmental surveillance can be a highly valuable tool for protecting public health as storms increase in intensity and frequency, water supplies are compromised, and dangerous waterborne diseases spread. In the aftermath of Hurricane Maria, Virginia Tech researchers and collaborators developed a new way to apply metagenomics to track antibiotic resistance in watersheds, identify targets for stopping its spread, and help keep antibiotics working for future generations.

WHEN HURRICANE MARIA MADE LANDFALL

devastating Dominica, St. Croix, and Puerto Rico in September 2017, flooding and power outages wreaked havoc on the debilitated land, resulting in the contamination of waterways with untreated human waste and pathogenic microorganisms.

Six months after the deadly category 5 hurricane, Virginia Tech Civil and Environmental Engineering Professor Amy Pruden led a team of Virginia Tech researchers along with Maria Virginia Riquelme and William Rhoads; then post-doctoral researchers, who packed their bags and lab supplies and headed to Puerto Rico. The island territory of the United States located in the northeast of the Caribbean Sea had been devastated, plunging its 3.4 million inhabitants into crisis. The mass destruction presented a critical opportunity for the researchers to study how wastewater infrastructure damage might contribute to the spread of antibiotic resistance — a growing global public health threat.

In a study published in American Chemical Society's Journal of Environmental Science & Technology, Virginia Tech researchers with international collaborators, have further developed an innovative antibiotic resistance surveillance approach by applying cutting-edge DNA sequencing techniques to detect the spread of disease in watersheds impacted by large-scale storms.

Amy Pruden

"This study is a critical step towards establishing a unified and comprehensive surveillance approach for antibiotic resistance in watersheds," said Pruden, the W. Thomas Rice Professor of Civil and Environmental. "Ideally it can be applied as a baseline to track disturbances and public health concerns associated with future storms."

Over the past decade, Pruden, a microbiologist and environmental engineer, has worked with her students using next-generation DNA sequencing, a specialty of Pruden's, to also examine *Legionella* strains as it operates before, during, after, and outside of Legionnaires' disease outbreaks in various towns and cities across the country, including Flint, Michigan.

With RAPID funding from the National Science Foundation and collaborating with principal investigator Christina Bandoragoda, research scientist at the University of Washington with expertise in watershed modeling and geospatial analysis, Virginia Tech researchers teamed up with Graciela Ramirez Toro, professor and director of the Centro de Educación, Conservación e Interpretación Ambiental, and her research group at the local Interamerican University in San German, Puerto Rico. Together, they identified three sampling sites in watersheds with distinct land-use patterns and levels of wastewater input that were ideal for tracking down geospatial patterns in occurrence of bacterial genes that cause antibiotic resistance.

Pruden's doctoral student and first author of the paper Benjamin Davis used a method called shotgun metagenomic DNA sequencing to detect antibiotic resistance genes in river water samples from three watersheds, including samples collected by hiking to far upstream pristine reaches of the watersheds and downstream of three wastewater treatment plants. Metagenomics is the study of genetic material recovered directly from environmental samples.

Analysis of the data revealed that two anthropogenic antibiotic resistance markers — DNA sequences associated with human impacts to the watershed — correlated with a distinct set of antibiotic resistance genes, relative to those that correlated specifically with human fecal markers.

A clear demarcation of wastewater treatment plant influence on the antibiotic resistance gene profiles was apparent and levels were elevated downstream of wastewater treatment plants, resulting in a high diversity of genes impacting resistance to clinically-important antibiotics, such as beta lactams and aminoglycosides in the watershed samples. Some of the beta lactam resistance genes detected that had been documented were associated with deadly antibiotic-resistant infections in the region and showed evidence of being able to jump across bacterial strains. Beta lactam resistance genes were also noted to be more accurately predicted by anthropogenic antibiotic resistance markers than human fecal markers.

Although baseline levels of antibiotic resistance genes in Puerto Rican watersheds prior to Hurricane Maria are unknown, surveillance methodologies like these could be used to assess future impacts of major storms on the spread of antibiotic resistance, the researchers said.

Many international communities will likely not have access to sophisticated metagenomic-based monitoring tools in the near future, but the identification of single gene targets, such as the anthropogenic antibiotic resistance markers, make watershed surveillance of antibiotic resistance much more accessible. And such genes can be quantified directly by quantitative polymerase chain reaction, yielding cost-effective, rapid results in less than a day.

Davis filters water samples in the InterAmerican University lab. ■

Written by Lindsey Haugh

In Puerto Rico after Hurricane Maria, (from left) Amy Pruden, professor of civil environmental engineering; Ishi Keenum, doctoral student; Maria Virginia Riquelme, post-doctoral researcher; Benjamin Davis, doctoral student; and William Rhoads, post-doctoral researcher identified three sampling sites to test.

Photograph taken prior to the COVID-19 pandemic.

DANIEL SUI

APPOINTED VICE PRESIDENT FOR RESEARCH AND INNOVATION

DANIEL SUI, AN INTERNATIONALLY renowned researcher in the area of GIS-based spatial analysis and modeling for urban, environmental, and public health applications, was appointed Virginia Tech's vice president for research and innovation, effective Nov. 1, 2020.

"Following a nationwide search, I am delighted that Dr. Sui will join the Virginia Tech team to lead our research enterprise," said Executive Vice President and Provost Cyril Clarke. "His scholarly accomplishments, prior experience in university-level research administration, and understanding of the wide range of research and creative activities represented at land-grant universities will enable him to provide critical leadership and oversight to Virginia Tech's research programs. His vision and leadership will further enhance the university's entrepreneurial and innovative culture and commercialization opportunities, in addition to building relationships with industry partners and funding agencies."

A Distinguished Professor of Geography, Sui most recently served as the University of Arkansas' vice chancellor for research and innovation. During his tenure, Sui grew research expenditures to a new historical high of $180 million, which directly contributes to the university's $2.2 billion economic impact for the state of Arkansas.

Virginia Tech President Tim Sands said, "Dan is an exceptional researcher, educator, and academic leader with a focus on today's emerging global challenges and opportunities. I look forward to working with him to expand the impact of our research and elevate Virginia Tech's standing as a top U.S. land-grant research institution. I also want to express my deep appreciation to Don Taylor for his excellent work as interim vice president."

Sui will succeed G. Don Taylor, Virginia Tech's executive vice provost, who has served in the interim capacity since July 2019. Under Taylor's leadership and over the past year, the research enterprise maintained momentum, laying the groundwork for future university-wide research and innovation success. Notably, research expenditures reflect upward progress, in addition to an increase in sponsored awards by 15 percent.

In his role, Sui will directly report to Clarke and will be responsible for supporting and growing Virginia Tech's research portfolio that includes extramural funding. He will also chair two boards for Virginia Tech affiliated corporations: Virginia Tech Intellectual Properties and Virginia Tech Applied Research Corporation.

Sui is an established researcher and invited public speaker who has been published in more than 230 scholarly publications covering various interdisciplinary topics and delivered approximately 70 keynote speeches, endowed, or invited guest lectures over the past five years. He was a Guggenheim Fellow, a Woodrow Wilson Center Fellow, and the recipient of an American Association of Geographers Distinguished Scholar Award.

Virginia Tech is currently ranked in the top 5 percent of universities in the United States for research expenditures and No. 48 with approximately $532 million in research expenditures by the National Science Foundation. ■

Written by Lindsey Haugh

NEW LEADER, INAUGURAL CLASS

THE VIRGINIA TECH INNOVATION CAMPUS reached multiple milestones in the fall of 2020 with the arrival of its new vice president and executive director, the launch of its inaugural class of students, and the announcement of an advisory board of global business and industry leaders.

University leaders have been working toward these goals since the Innovation Campus was announced in November 2018 as part of the state's successful effort to attract Amazon to Northern Virginia. What they could not have predicted was how the spread of COVID-19 would shape both of these events.

"This is a semester like no other, with new challenges and opportunities to make a difference in the world. You are part of something historic, the first class of Virginia Tech's Innovation Campus," Virginia Tech President Tim Sands said in a video message welcoming the students.

When COVID-19 escalated in early March, Lance Collins had recently been named as the Innovation Campus's inaugural executive director. Rather than preparing for his move to Alexandria, he found himself scrambling at Cornell University, where he was wrapping up a decade-long stint as dean of its College of Engineering.

While it made for a busier spring than he anticipated, Collins finished at Cornell and moved to Alexandria last summer. He's living just a few blocks from where the Innovation Campus will eventually be located in North Potomac Yard.

Now, Collins feels that the university's mission in the world has become even more relevant and urgent than it was just a few months ago.

"Virginia Tech's dedication to service and its emphasis on interdisciplinary teams put it in an ideal position to adapt to changing conditions and to build upon the lessons that we're learning during the process," Collins said. "While our new campus in Alexandria won't open until 2024, we aren't waiting to have an impact."

Collins started at Virginia Tech just a few days before the first Innovation Campus Class — 79 students based in the Washington, D.C., region pursuing master's degrees in computer science and computer engineering — started their fall semester.

"These students will help build the foundation of the Innovation Campus as we expand programs and develop a new curriculum," Collins said. "I look forward to working with them to create a new type of graduate program with a strong emphasis on engagement with companies and federal agencies."

The first Innovation Campus cohort includes 26 students enrolled in Virginia Tech's new Master of Engineering in computer science program — the first degree designed specifically for the Innovation Campus. The other three Innovation Campus degree programs are Master of Science in computer science, Master of Science in computer engineering, and Master of Engineering in computer engineering.

Virginia Tech has a long history of graduate education in the Washington, D.C., region, including graduate students in computer science and computer engineering. The Innovation Campus is part of the university's commitment to help double the commonwealth's tech-talent pipeline in the coming decades by increasing the number of graduate students in computer science and computer engineering from roughly 100 students to more than 700 students in the next decade.

Overall, Virginia Tech's graduate student enrollment in computer science and computer engineering is up more than 20 percent this semester compared to last year.

"We are really excited to grow these programs and are encouraged by the increased level of interest and enrollment, despite the uncertainties created by COVID-19," said Julia Ross, the Paul and Dorothea Torgersen Dean of Virginia Tech's College of Engineering.

Virginia Tech's recruiting tactics to drive enrollment in computer science and computer engineering include scholarships to Virginia-based students, articulation agreements with other universities, and adding online courses and skills-based modules to help students fulfill prerequisites for graduate study. The university is also offering a 4+1 master of engineering program that allows undergraduate Virginia Tech students to take credits that count toward a master's degree in their senior year, and then complete a master's degree in just one additional year of full-time study.

The Innovation Campus Advisory Board includes top executives from Qualcomm, Boeing, KPMG, Northrop Grumman, The Carlyle Group, and Hunch Analytics, along with several tech pioneers. The board will provide valuable perspectives and expertise to Sands and Collins.

"Bringing academia, industry, and government together is how we will create impactful programs, tangible research, strong leaders, and the next generation of tech companies," Collins said when the board was announced.

Virginia Tech Innovation Campus faculty offices and course instruction are operating out of Virginia Tech's existing location in Falls Church, Va., while the new campus is being built in Alexandria.

Virginia Tech Innovation Campus launched its HQ start-up space at 3000 Potomac Avenue, suite 101. The new space — adjacent to the future campus location in North Potomac Yard — houses executive offices and features a café-style area for student workgroups, seminars, and community engagement.

The Innovation Campus will make its home in a new mixed-use development and innovation district in North Potomac Yard that JBG SMITH is developing near the future Potomac Yard Metrorail Station.

Approvals from Alexandria City Council last summer and fall cleared the way for construction to begin. The university expects to break ground on the first academic building in 2021 and welcome students, faculty, and staff into the completed building in fall 2024.

We aren't waiting to make an impact — that's why we launched our inaugural class of students this year, hired a new chief operations officer, and are actively recruiting faculty and designing new programs," Collins said. ■

Lance Collins

UNWAVERING IN UNPRECEDENTED TIMES

AS UNIVERSITY GROUPS BEGAN CONSIDERING the potential implications of COVID-19 in late January 2020, global travel was among the primary concerns. About 400 students and faculty members were abroad at the time, and as they returned home, and the virus spread, the university's focus shifted to domestic issues.

The university's Incident Management Team (IMT) scheduled a quick briefing on the topic for the first week in March, but the rapidly evolving situation prompted the group to shift from discussion to action. On March 11, Virginia Tech President Tim Sands announced a six-day spring break extension to facilitate the move to online learning for the remainder of the semester.

That online pivot required a monumental, rapid transition to remote study led by Virginia Tech faculty and staff, some of whom had never before taught online classes. Virginia Tech's Technology-enhanced Learning and Online Strategies (TLOS) team focused on the massive task of moving classes online. Building on two decades of advancements in distance learning, it took the group less than two weeks to facilitate the academic transition, enabling more than 2,400 instructors to teach about 4,500 sections of content remotely.

Across the university, instructors not only maintained their scheduled lessons, but also explored ways to apply the technology to enhance their students' experiences. Professor of biochemistry Glenda Gillaspy turned a course's focus to the molecular biology of SARS/COV-2, and Paolo Scardina recorded lectures from waterways around campus, using real-world examples to illustrate specific concepts and theories.

Virginia Tech stepped up to keep the university community across the country and around the globe informed not just of campus updates, but also of evolving state and federal guidelines via electronic communications, PSAs, social media posts, news releases, and other media. Faculty experts from a wide range of departments shared their perspectives via newspaper stories and appearances on network and cable news shows. University and regional leaders conducted a series of town halls to answer questions, dispel misinformation, and convey the most up-to-date data available regarding a variety of COVID-19-related topics. And previously scheduled events moved online to accommodate the physically distanced

A team of mechanical engineers used 3D printing and laser cutting to create face shields for healthcare workers.

Photo taken by Peter Means

landscape embraced by much of the world. Virginia Tech faculty, students, and alumni around the world boosted outreach efforts and worked hard to keep people connected.

The Fralin Biomedical Research Institute at VTC led an effort to conduct COVID-19 testing locally, providing consistent, reliable results at a time when Virginia was struggling to deploy more tests across the state. Virginia Tech was selected in November as one of three exclusive OneLab Network Tier 2 laboratories to expand COVID-19 testing capacity across Virginia. The university's laboratory will provide capacity to process 600 tests received from Virginia Department of Health districts every day, seven days a week.

"Developing a novel, accurate genetic test for the SARS-CoV-2 virus and establishing a fully operational testing facility in a matter of weeks was a critical part of our plan to protect our campus and communities," said President Sands. "As a Virginia land-grant university, we're proud to have the opportunity to expand this vital service through our partnership with the commonwealth."

A professor of medicine at the Virginia Tech Carilion School of Medicine, who is also Carilion Clinic's chief of pulmonology and critical care medicine, partnered with Virginia Tech engineers to upgrade bilevel positive airway pressure (BiPAP) machines, commonly used for sleep apnea, into makeshift ventilators, helping to relieve potential ventilator shortages. The medical school has also committed volunteer support for contact-tracing with the Medical Reserve Corps in Virginia.

Virginia Tech's COVID-19 response has gained national recognition. In September, Deborah Birx, the White House Coronavirus Task Force coordinator, praised the university's ability to respond quickly and develop its own coronavirus testing facilities.

"This is a university that understood the need, understood the gap, and was willing to self-sacrifice to bring additional testing solutions to the people of this community and this university campus. I am really proud of what they have done here," Birx said. ■