Advancing Infection and Disease Treatment in San Antonio and Beyond

Infectious disease research, medical mycology research, drug development and vaccine development are thriving at UTSA

By Md Mohsin

Glioblastoma multiforme (GBM) is typically recognized as the most aggressive brain cancer. Drug development researchers at UTSA are developing small-molecule drugs to treat GBM.

Tularemia is caused by a bacterium that can be used as a bioweapon. There's currently no vaccine against tularemia, but UTSA's infectious disease researchers are developing one.

No vaccine against fungal infections has ever been invented. Mycologists at UTSA are developing vaccines against the fungal infection valley fever.

UTSA is at the core of San Antonio's thriving biomedical research ecosystem, in collaboration with the Texas Biomedical Research Institute (Texas Biomed), Southwest Research Institute (SwRI) and UT Health San Antonio. Researchers in these institutions are working on at least two novel vaccines and several small-molecule drugs. UTSA and UT Health San Antonio jointly set up the Center for Innovative Drug Discovery (CIDD), which has been in operation now for 11 years, to tackle small-molecule drug discovery research.

"We work in the areas of cancer, infectious diseases, rare and neglected diseases, and non-opioid pain management," said Stanton McHardy, the CIDD director and an associate professor in the Department of Chemistry at UTSA. "Multidisciplinary collaborations are essential in drug discovery and development," said McHardy, who has pharmaceutical experience working with Pfizer. "Bringing that experience to the CIDD and building successful teams has been amazing."

McHardy and collaborators are developing a small-molecule drug against Glioblastoma multiforme (GBM), the most aggressive and lethal brain cancer. "We are developing molecules that are capable of crossing the blood-brain barrier, engaging our desired biological target and shrinking the GBM tumor in animal models."

While drugs are created to treat diseases after the infection, vaccines are another important public health tool because they can prevent illness. Karl Klose, the director of the South Texas Center for Emerging Infectious Diseases (STCEID) and a professor in the Department of Molecular Microbiology and Immunology, is developing a vaccine against tularemia. This disease, also known as "rabbit fever," is caused by the bacterium *Francisella tularensis*. This organism is dangerous because it can be used as a bioweapon. "If we can develop a vaccine to prevent people from getting sick and dying, then it will no longer be a scary bug," said Klose.

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Chiung-Yu Hung, associate professor, Department of Molecular Microbiology and Immunology

The tularemia vaccine that Klose is developing uses crippled live bacteria closely related to *F. tularensis* that can replicate–and therefore train our immune system—but cannot cause disease. "We cannot protect against tularemia through antibodies alone, like most vaccines do," explained Klose. "You actually have to stimulate a different arm of your immune response, which is your T-cells, and the T-cells specifically are stimulated by the live organisms in our vaccine."

UTSA mycologist Chiung-Yu Hung, associate professor in the Department of Molecular Microbiology and Immunology, is proud of the university's role in medical mycology. "We are very competitive in the medical mycology field," said Hung. "There are very few research institutions that have so much expertise in medical mycology on one campus or in one city. We have it here in San Antonio."

Hung is developing an mRNA vaccine for coccidioidomycosis, which is also called valley fever and is caused by the fungus *Coccidioides*. The way mNRA vaccines work is by taking by taking a small piece of genetic material which encodes a protein antigen found in the microbe to trigger an immune response that confers protection against the pathogen.

Hung established the National Institutes of Health-funded San Antonio–based Coccidioidomycosis Collaborative Research Center (SA-CCRC). "There's no clinically approved antifungal vaccine," said Hung, who has filed two patents. "And hopefully, we will understand the protective mechanisms better for those patented vaccines, and then our next step will be to conduct a clinical trial."

Hung is also collaborating with Jose Lopez-Ribot, endowed chair in the Department of Molecular Microbiology and Immunology and an expert in the discovery of antifungal drugs to develop better chemotherapy against valley fever. The UTSA team is also working with Tom Patterson–Director of the San Antonio Center for Medical Mycology and Chief, Division of Infectious Diseases, at UT Health San Antonio–to understand why the fungal pathogen becomes resistant to current drug treatments. "We have lots of antibacterial drugs or antibiotics, but currently, only four classes of antifungal drugs are available," said Hung. "For valley fever, the most common drug is fluconazole. More than 30% of clinical *Coccidioides* isolates display resistance to fluconazole." Hung's uses is called the "screening and repurposing" approach, which is to screen and identify existing drugs approved for other diseases to see how effective they are against fungi. "If we identify one, downstream development will be much easier," noted Hung. "We already have several new antifungal candidates we are studying in the lab."

The Romo lab participated in #FaceOfScience, a social media campaign that celebrates inclusivity in the scientific community.

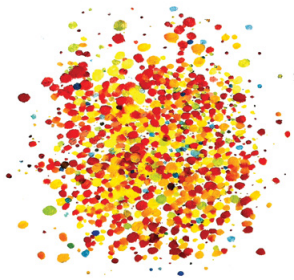
McHardy explains a synthesis route to UTSA students at the Center for Innovative Drug Discovery.

Fungi and bacteria research are not always performed independently of each other. Jesús A. Romo, an assistant professor in the Department of Molecular Microbiology and Immunology (MMI), studies how fungi and bacteria interact with each other and their host in the mammalian gastrointestinal tract and how these interactions impact human health. His laboratory also studies polymicrobial biofilms composed of fungi and bacteria. “When you step into a river and you feel slimy rock, that’s a biofilm,” said Romo. Biofilms are everywhere—both inside and outside of humans. It can be problematic when biofilms form on implanted devices such as catheters, pacemakers and prosthetics. “More than 80% of chronic and recurrent infections are caused by biofilms,” said Romo. Most of the time, there is no alternative but to remove the device.

Romo is a first-generation college graduate originally from Mexico. “I’m the first one in my family to go to high school,” he said. “A lot of my journey is defined by my mentors and the support that they provided for me. And now it’s my job to give back and help other students that came from similar backgrounds. That’s why I love UTSA. A lot of students are who I was.”

Drawing on the university’s solid foundations in medicinal chemistry, infectious disease and mycology research, UTSA created the Molecular Microbiology and Immunology (MMI) Ph.D. program in 2022. “We say molecular microbiology and immunology, but the students are learning a wide range of cutting-edge techniques: molecular biology, animal models, drug discovery, tissue culture and many more,” said Romo. Texas Biomed is a partnering institute in the MMI Ph.D. program.

“Our graduate students that come to UTSA to get master’s and Ph.D. degrees are in the best place to study infectious diseases,” said Klose.



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