The Big Idea

Q. What can laboratories do when they can't get the supplies they need to process COVID-19 tests?

A. Bring in magnetic beads. And robots.

By Lynette Lobban

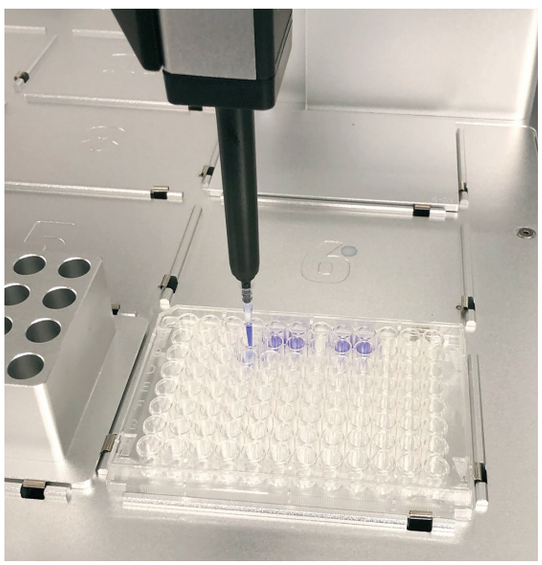
Just as there are shortages of masks, gowns and other personal protective equipment, a shortage of test kits is hampering the nation's ability to fight the coronavirus pandemic to the best of its ability, says Sean Bauman, CEO of Immuno-Mycologics Inc. (IMMY), an Oklahoma company with international impact that manufactures, markets and distributes diagnostic tests and reagents for infectious diseases. Now an unprecedented collaboration of scientists, laboratories, universities and robots may alleviate the anxiety at testing centers that are waiting on the supplies they need.

Headquartered in Norman, Okla., IMMY was founded in 1979 by the late University of Oklahoma alumnus Stan Bauman. His son Sean, who has earned three degrees from OU–including a Ph.D. in microbiology and immunology–finds his company at the epicenter of innovative research that could change the future of diagnostic testing.

"We had the capability and were ready to begin COVID-19 testing," says Bauman, "but we were waiting on materials and equipment from commercial suppliers."

Bauman contacted a network of microbiologists and researchers at OU. Jimmy Ballard, chair of the Department of Microbiology and Immunology, donated a qPCR instrument, which was crucial in giving IMMY's lab the ability to start testing while they waited on their own equipment delivery. Along with Ballard, one of the first to answer Bauman's call was longtime friend Bradley Stevenson, associate professor of microbiology.

"Because our campus was shut down, I reached out across the OU community to researchers in molecular biology and asked if they had any spare testing kits," says Stevenson. "I gathered them up, brought them to IMMY, and the scientists there were able to establish an extraction protocol and get it validated so they could extract genetic material from the swab samples to do the tests."



Pictured is one of the four liquid-handling robots purchased by IMMY that can do repetitive laboratory tasks, such as pipetting and prepping sample trays, at least 10 times faster than a human being.

But once Bauman and Stevenson began talking about challenges in the supply chain, Stevenson realized that although OU resources helped in a pinch, the lack of a reliable and consistent source of materials was going to be an ongoing problem, not just for IMMY, but for labs worldwide. Stevenson joined forces with IMMY's research and development team, including OU alumni Brandon Neary, vice president of product development, and Scott Maddox, project manager and IMMYLabs technical supervisor.

"The entire world is trying to extract this genetic material right now," says Stevenson. "As soon as a kit is approved and comes on the market, it's impossible to get because everyone is competing for it."

IMMY offered lab space to Stevenson and Ph.D. student Emily Junkins to continue their research into a new type of test that uses magnetic beads instead of the more convention-

IMMY offered lab space to Bradley Stevenson, OU associate professor of microbiology, and his Ph.D. student Emily Junkins to continue their research into a new type of COVID-19 test that uses magnetic beads for the extraction of genetic material.

al, column-based nucleic acid extraction kits. Stevenson and his team make the beads in his lab and had enough on hand to perform 10,000 tests. If they could establish or find a protocol to use the beads in COVID-19 testing, they could effectively eliminate dependency on an outside supply chain.

"Other laboratories performing COVID-19 testing could also benefit from the efforts of Brad and Emily," says Bauman. "Early evidence suggests that their efforts will be successful."

Stevenson explains how the process works. The beads, which are about a micrometer in diameter, are added to a solution containing a person's nasal swab sample. The genetic material binds to the beads, which are collected with magnets and then washed to remove anything researchers don't need. Because the virus's genome is made from a single strand of RNA, the RNA is extracted and used in a process known as reverse transcriptase, quantitative polymerase chain reaction (RT-qPCR).

It is called "reverse" because a catalyst enzyme (a transcriptase) more often is used to create RNA from DNA, not the other way around, Stevenson explains. But copies of DNA (cDNA) are needed to determine if a cell is healthy or has been compromised. The coronavirus RNA cannot reproduce on its own, but once it infiltrates a healthy cell it overrides the system like a computer hacker, turning the host cell into a virus factory. The polymerase chain reaction creates thousands of copies of the cDNA for testing. If the cDNA contains RNA from the virus, the test for COVID-19 is positive. All of this process is done at IMMY.

But human beings can only work so fast. That is when robots came to the rescue.

"IMMY needed to increase the throughput of our COVID-19 testing," says Bauman. "We decided to invest in robotics to help increase the scale of our testing capacity."

The four liquid-handling robots, purchased for about $10,000 each, can outperform a human by a factor of 10 in repetitive laboratory tasks like pipetting and prepping sample trays. "Until now, I was the robot," says Junkins, who has been hands-on with the new automated workforce since it arrived at IMMY.

"Scientists all over the world are using liquid-handling robots." says Stevenson. "IMMY bought them from a company called Opentrons, which operates an open-source platform. Scientists put their protocols online for others to use. Everyone is sharing their successes and failures, which has been very helpful in times of crisis like these.

"Everyone's silo has been removed. We're working with industry and government. It is amazing how quickly a strand of RNA wrapped inside a shell of a few proteins and some lipid can change everything."

Although the number of Oklahomans being tested for COVID-19 is on the rise, 99 percent of the state's residents are still a blank slate—including those who are asymptomatic, but contagious—according to figures compiled by the COVID Tracking Project. "The more testing we can get done, the better we will understand where we are and where the resources need to go," says Stevenson.

"It's wonderful to be a part of this, but there's also an enormous amount of pressure," he adds. "These are our friends and family and neighbors who are going to be tested. We can't fail them."