

Science

Inside a lab where scientists are working urgently to fight the coronavirus outbreak



Stuart Weston, a research fellow in microbiology and immunology at the University of Maryland School of Medicine, works with the new coronavirus inside a secure laboratory. (Robert Haupt/University of Maryland School of Medicine)

By **Carolyn Y. Johnson**

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BALTIMORE — The [novel coronavirus](#) at the center of a widening global public health emergency arrived here last Friday in two thumb-size vials, nested in dry ice and multiple layers of protective packaging.

The samples, from the Centers for Disease Control and Prevention in Atlanta, remained in deep freeze until Monday afternoon, when virologist Matthew Frieman at the University of Maryland School of Medicine got clearance from an internal biosafety committee to open the tubes in his secure laboratory and begin experiments.

[Live updates: [Coronavirus cases surge again in China; more than 1,700 medical workers infected](#)]

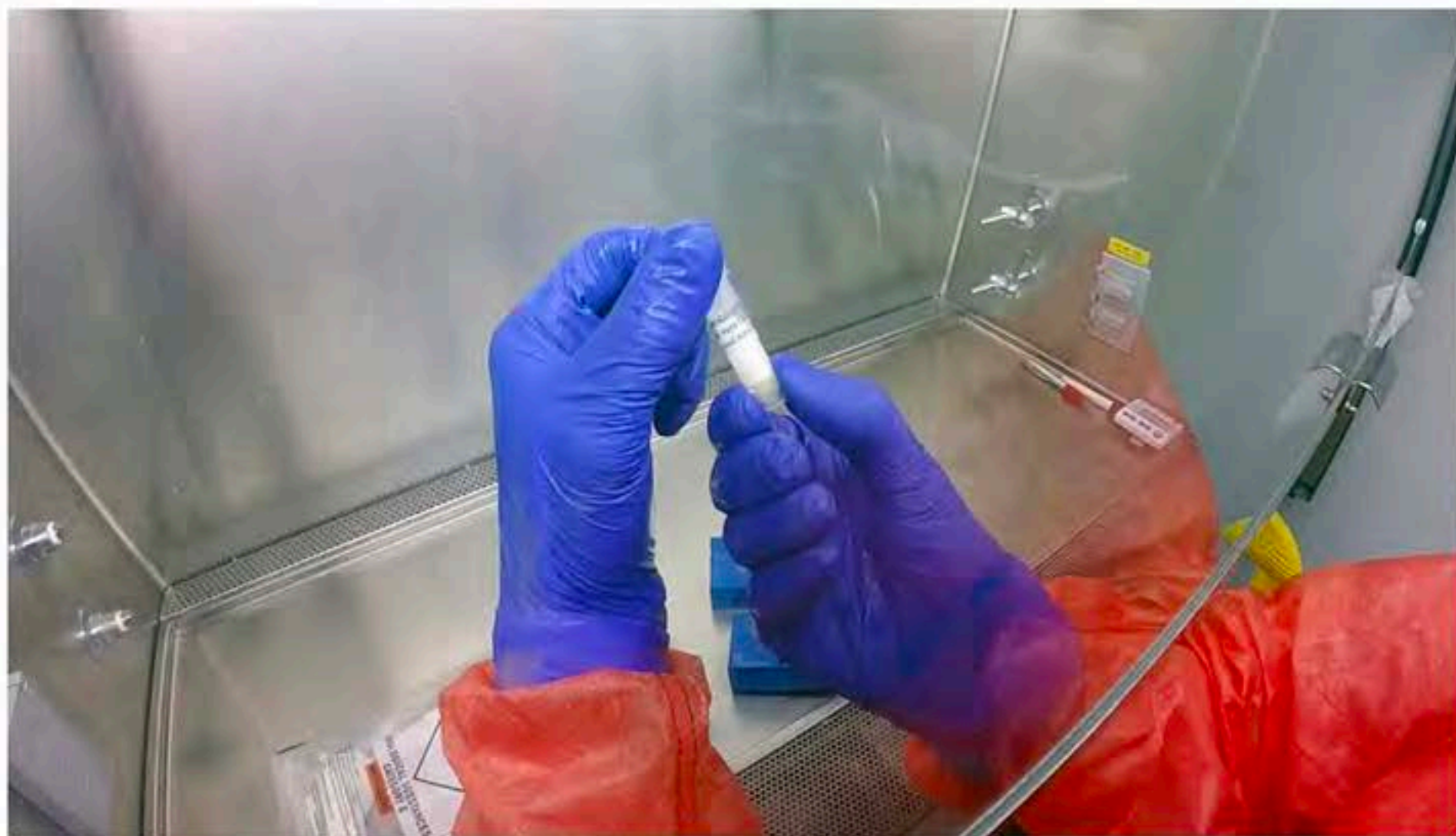
While the number of cases of the coronavirus [continues to grow](#) — to more than 60,000 cases, nearly all in China — the virus is also beginning to multiply in laboratories around the world. A select group of U.S. researchers have now received samples of the virus derived from the first U.S. case, a 35-year-old man in Snohomish County, Wash., who recovered. Others have ordered the virus and are waiting.

As the virus [rages in China](#) and infectious-disease experts nervously monitor [infections that could seed other outbreaks](#) in at least two dozen other countries, it's the scientific work in these laboratories that may lead the way to a therapy or vaccine that could help save lives and fight this outbreak — or the next one. Studying the virus is the first step toward discovering new ways to stop it: by testing potential drugs, developing animal versions of the disease and probing fundamental questions about how it makes people sick.

Wearing head-to-toe protective suits and breathing air pumped and purified by respirators mounted on their belts, Frieman and colleagues have already begun infecting monkey kidney cells with the new coronavirus in clear laboratory flasks and letting it do what viruses do best — replicate.

"A handful of us that have been talking a lot over the last month, just slack-jawed at the pace of what's going on, both in our labs, and where we're trying to plan — as well as what this outbreak is really doing out in the world," Frieman said. "I think we're going to do everything we can do to help this outbreak, without knowing what this outbreak looks like after today."

Frieman plans to test two dozen drugs that showed promise against two previous lethal coronaviruses, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS), to see if they work against the new coronavirus. Because those drugs have already been tested in humans and approved for other conditions, such as cancer, they could be rapidly put into use. He's also partnering with companies that need the expertise of a laboratory that works directly with the virus to test new therapeutics or [vaccines](#).



Researchers work on a sample of the new coronavirus. (Robert Haupt/University of Maryland School of Medicine)

Regeneron Pharmaceuticals, which created an [Ebola medicine](#), is already working with the federal government's Biomedical Advanced Research and Development Authority to develop a drug that could be used against the novel coronavirus.

Leonard Schleifer, chief executive of Regeneron, said that an experimental drug that blocks the virus from entering cells could be ready for human testing within three to six months. The company is using harmless “pseudoviruses” that mimic aspects of the virus to develop their experimental drug, but they will eventually work with Frieman to test their compound against the real thing.

At the University of North Carolina at Chapel Hill, researchers are focused on testing drugs that they hope could work for this outbreak — or the next coronavirus to leap from animals into humans. A major bottleneck in creating a drug for a new pathogen is the time it takes; often, by the time the drug is ready to be tested in humans, the threat has subsided. One solution is to create broad-acting drugs that could be ready to use against multiple pathogens, and remdesivir — a Gilead Sciences drug that is already being used in a clinical trial in China — is a candidate that they plan to test, because it has performed well in animal and laboratory tests against SARS and MERS.

Another drug that works similarly to remdesivir is being developed by researchers at a nonprofit company, Drug Innovation Ventures at Emory (Drive), owned by Emory University. That drug was initially developed as a possible treatment for influenza, but it could also work on the coronavirus and other viruses that are made up of genetic material called RNA.

“Across any given time on Earth, about 86 percent of the disease burden is estimated to be from RNA virus infections,” said George Painter, chief executive of Drive. “The idea was to find a broad-spectrum drug that would answer the public health need for treatments for a lot of emerging and re-emerging infectious diseases, as well as biodefense threats.”

Testing lots of different drugs on cells and animals infected with the virus is conceptually simple, but science can be finicky and laborious. For example, the coronavirus that causes SARS successfully infects mice but doesn’t make them ill, so researchers had to modify the virus to create a lethal mouse strain of SARS. MERS didn’t even infect mice, so researchers had to genetically tweak the mice so that they were susceptible to it. An early study found that an existing strain of [laboratory mouse](#) can be infected by the new coronavirus, but researchers still need to see whether it works in their hands.

Timothy Sheahan, a virologist at the University of North Carolina, said that the [science is moving so fast](#) and early results are emerging so quickly that it has been hard at times to know which experiments to prioritize, and even [which results to trust](#). The benefit of scientists openly sharing results is that people aren’t slowing down research efforts by withholding information, but it adds a new challenge — the research is coming out so fast it may not be vetted or have been repeated multiple times to make sure it is right.

“The pace of research is so fast, your top priority today could vanish into thin air the next day,” Sheahan said. “People are posting pilot experiments; they’re writing papers on single studies that probably haven’t been repeated or reproduced or done with the same rigor you normally would do your science. It’s hard to know what to believe.”



Graduate student Robert Haupt and research fellow Stuart Weston don protective gear before entering a U-Md. lab. (Graduate student Robert Haupt and research fellow Stuart Weston don protective gear before entering a U-Md. lab. Mark Teske/University of Maryland School of Medicine)

The circle of experts with knowledge and the laboratory setups to research coronaviruses is relatively small, in part because funding for the field has fluctuated. Interest spikes when a lethal outbreak occurs, such as SARS in 2002, but then attenuates as the danger subsides. Not every laboratory can study lethal coronavirus, which requires a high level of biosafety protection. Frieman's lab door carries a yellow biohazard warning. Behind one securely locked door is an anteroom, where scientists suit up with personal protective equipment. Air pressure in the laboratory is kept lower than the outside air, to make sure no harmful airborne pathogens escape. Any equipment or garbage that leaves Frieman's laboratory must go through a special door that looks like a submarine hatch, where a pressurized, high-temperature sterilization cycle melts down Petri dishes and other waste.

Keeping such a lab afloat is like running a small business, and before the coronavirus outbreak, Frieman was considering shifting more of his lab to studying influenza. That uncertainty has affected others in the field, too.

Anthony Fehr, a University of Kansas virologist, started out studying herpes and was initially hesitant to move into the coronavirus field. When he was choosing which lab to complete his postdoctoral work in, there was a dip in interest; SARS had burned itself out and MERS had not yet emerged.

“At that point, funding for SARS and coronavirus had started to dwindle,” Fehr said. “I was a little tepid about my future career opportunities in this field. ... I took the chance.”

Fehr now thinks that recent history has taught us that coronavirus research should be a priority, and he is gearing up to screen about 400,000 potential drugs to see if any show promise.

Painter moved to the nonprofit Drive after a successful career developing drugs at pharmaceutical and biotechnology companies. After working on HIV and hepatitis B, he wanted to create a solution for diseases that are unlikely to interest companies because novel infections may flare up and create worldwide alarm, but then burn out before a drug is approved.

Many researchers are caught between the desire to help people during this outbreak and the hope that the virus dies down faster than the science moves forward. But one thing is sure: even if it abates, it’s only a matter of time before another threat emerges. This virus could return in the fall, or a different lethal coronavirus could jump from animals to humans.

“I think it’s very clear this is not the last time we’ll see a new coronavirus emerging in the world,” Frieman said. “So we are going to do our best to make sure we have a therapeutic on the shelf for someone to use in the future, whether it’s for this outbreak or future outbreaks.”