

# MILITARY PROGRAMS AIMING TO END PANDEMICS FOREVER

Bill Whitaker reports on the Pentagon projects that helped combat COVID-19 and may help end pandemics forever.

2021 CORRESPONDENT  
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It might surprise you to learn that many of the innovations deployed to counter the coronavirus were once obscure Pentagon-funded projects to defend soldiers from contagious diseases and biological weapons. The life-saving vaccine developed in record time owes a debt to these programs. To learn more, we met the man who has been leading the rapid vaccine effort, retired Colonel Matt Hepburn. An army infectious disease physician, he spent years with the secretive defense advanced research projects agency or DARPA, working on technology he hopes will ensure COVID-19 is the last pandemic.

Dr. Matt Hepburn: If we wanna say we can never let this happen again, we're gonna have to go even faster next time.

Eight years ago, Dr. Hepburn was recruited by DARPA.

Dr. Matt Hepburn: The DARPA director was very clear. "Your mission is to take pandemics off the table."

Bill Whitaker: It sounds impossible.

Dr. Matt Hepburn: Of course, and that was the beauty of the DARPA model. We challenge the research community to come up with solutions that may sound like science fiction. And we're very willing to take chances with high-risk investments that may not work. But if they do, we can completely transform the landscape.

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Dr. Matt Hepburn

More than 60 years ago, DARPA was born, after President Eisenhower was caught off guard when Russia launched the first satellite, "Sputnik", into orbit.

The small Defense Department agency was given a single purpose: prevent surprises like that from ever happening again. So Dr. Hepburn finds academics, companies, inventors working in garages -- and pushes them to deliver.

Dr. Matt Hepburn: What we don't do -- we don't say, "Okay, here's our problem. Here's your blank check. Come back to us in three to five years, we'll see how you do.

Bill Whitaker: You're on them?

Dr. Matt Hepburn: Active program management is what we call it. Okay? (LAUGH)

Dr. Hepburn showed us a few current projects, some sound like they're from an episode of "Star Trek." Consider a ship like the USS Theodore Roosevelt -- hobbled last year when 1,271 crew members tested positive for the coronavirus. What if everyone on board had their health monitored with this subdermal implant, now in late-stage testing. It's not some dreaded government microchip to track your every move, but a tissue-like gel engineered to continuously test your blood.

Dr. Matt Hepburn: It's a sensor.

Bill Whitaker: This tiny green thing in there?

Dr. Matt Hepburn: That tiny green thing in there, you put it underneath your skin and what that tells you is that there are chemical reactions going on inside the body and that signal means you are going to have symptoms tomorrow.

Bill Whitaker: Wow. There's an-- an actual transmitter in that--

Dr. Matt Hepburn: Yeah. It's like a "check engine" light.

Bill Whitaker: Check this sailor out before he infects other people?

Dr. Matt Hepburn: That's right.

Sailors would get the signal, then self-administer a blood draw and test themselves on site.

Bill Whitaker: Look at that.

Dr. Matt Hepburn: We can have that information in three to five minutes.

Dr. Matt Hepburn: As you truncate that time, as you diagnose and treat, what you do is you stop the infection in its tracks.

The coronavirus has infected more than 250,000 Defense Department personnel and their dependents around the world. With the death toll rising, the Pentagon has been jumpstarting programs that might save lives.

Dr. Matt Hepburn: This is a filter that you can put on a dialysis machine.

"Patient 16", a military spouse, was in the ICU, near death with organ failure and septic shock when she was entered into a Defense Department COVID-19 study. Her family allowed us to witness the experimental 4-day treatment.

Dr. Gaeta: She's liberated from vaso-active medications and her septic shock resolved. We also see improvements in her markers of inflammation. Those are all positive prognostic signs.

Bill Whitaker: You pass someone's blood through this--

Dr. Matt Hepburn: You pass it through--

Bill Whitaker: --it takes the virus out

Dr. Matt Hepburn: Takes the virus out, and puts the blood back in.

Within days, Patient 16 made a full recovery. The FDA has authorized the filter for emergency use. So far, doctors have used it to treat nearly 300 critically ill patients.

Dr. Joel Moncur with correspondent Bill Whitaker

Dr. Joel Moncur: These are all of the COVID-19 autopsy samples that we've received-- since the pandemic began.

DARPA isn't the only Pentagon agency on the frontlines. Colonel Joel Moncur, directs the Joint Pathology Institute in D.C. He leads an elite group of medical detectives, who study tissue samples from soldiers and sailors infected with pathogens all over the world. Like the damaged lung of a recent COVID-19 victim.

Dr. Joel Moncur: This is something we call diffuse alveolar damage. And it really interferes with the ability for them to get enough oxygen in their lungs.

The institute's century-old repository, the world's largest, houses tens of millions of tissue blocks preserved in wax, thin-sliced for close observation on glass slides. This biomedical treasure trove is being digitized using artificial intelligence.

Dr. Joel Moncur: Amongst these are tissue samples from people who died from the Spanish flu pandemic.

Dr. Moncur is examining the current pandemic through the lens of the past. The 1918 Spanish Flu took more American soldiers' lives in World War I than were killed in combat.

The military never forgot.

Bill Whitaker: This is from the 1918 pandemic. My god.

Dr. Joel Moncur: It is. And the scientific community needed to understand why it was so deadly. And this tissue was invaluable-- because it allowed us to characterize the virus at a genetic level-- and from there some incredible experiments happened that allowed the virus to actually be reconstructed.

In 2005, scientists at the tissue repository, Mt. Sinai School of Medicine and the CDC, made headlines around the world when they resurrected the deadly 1918 virus. That's when Dr. James Crowe, an infectious disease researcher at Vanderbilt, joined the team. He went looking for survivors of the 1918 flu, hunting for live human antibodies -- the proteins manufactured by our bodies to fight disease.

Dr. James Crowe: And lo and behold, if we took blood cells out of these-- nearly 100-year-old people, they still had immune cells that were circulating in their body that had reacted to the 1918 influenza. That was one of those moments for me when I just said, "Wow, that-- that's very powerful and interesting."

Bill Whitaker: So you find the antibodies in survivors who are almost 100 years old or more. Then what?

Dr. James Crowe: Well, once we have the genetic sequence, which is the DNA sequence, it's a string of letters that encodes the antibody, essentially, we have the recipe to make it again. And-- now we have a drug substance that we can use to prevent or treat that infection.

Dr. Crowe and CDC scientists infected lab animals with the deadly 1918 virus and cured them.

Bill Whitaker: And what happened?

Dr. James Crowe: Well, the antibody, like a heat-seeking missile, floats around in the animal, finds the virus, latches onto the virus and inactivates. Stops it-- in its tracks -- for us, after we had done that, we realized, "Wow, your body is a library of everything you've ever seen. Then we started thinking, as medical researchers, we could find the cure to virtually anything that had ever occurred-- on the planet.

Dr. James Crowe

In 2017, Dr. Crowe entered a DARPA grant competition to produce antibody antidotes fast enough to stop a pandemic. Dr. Matt Hepburn described the program at a TED Talk last year.

Dr. Matt Hepburn at Ted Talk: 20,000 doses in 60 days. Basically, we're talking about engineering antibodies that are so effective that you get near-immediate protection once

they're administered and you interrupt transmission in those communities. If you can interrupt it then potentially you can head off the Pandemic."

Dr. James Crowe: When we first saw the grant call that was inviting people to respond (LAUGH) we thought it was ridiculous-- (LAUGH) We were getting antibodies in six to 24 months, which we thought was pretty spectacular. And-- and they put the call out for 60 days-- and we just said, "That can't be done."

Dr. Matt Hepburn: For us, at DARPA, if the experts are laughing at you and saying it's impossible, you're in the right space.

Bill Whitaker: So are you actually sitting there with, you know, 60 days? (MAKES NOISE) Set a, set a stopwatch

Dr. Matt Hepburn: Yes. We say, "Here's your money. But then here's the stopwatch. We're gonna do a capability demonstration." Jargon words, but what it means is, stopwatch and show us how fast you can go.

Don't be fooled by that smile, Dr. Hepburn is a hard taskmaster. Stopwatch in hand, he set up a simulated Zika virus outbreak. He gave Dr. Crowe \$28 million and his first challenge: test every cell in a vial of survivor's blood and find a cure. They did, in 78 days.

Dr. James Crowe: We're used to getting all As. And, you know, Matt was kinda giving us a C for effort. We were preparing to do a simulated sprint number two. And in the middle of that COVID happened. And so DARPA turned to us and said, "No more simulations. This is real. We need you to deliver antibodies for COVID."

Dr. Crowe's team at Vanderbilt quarantined in the lab and worked 'round the clock to find lifesaving antibodies in the blood of COVID survivors.

Dr. James Crowe: We-- have to do experiments that are a little bit like looking for a needle in a haystack. We take their blood and we look through millions and millions of cells.

Dr. James Crowe: You have a library of immunity in your body to everything you've ever seen. So we have to look through those and find the ones for the particular virus of interest and pull them out.

Bill Whitaker: That's the needle in the haystack.

Dr. James Crowe: That's the needle, exactly.

Dr. Crowe's lab delivered an antibody treatment to drugmaker AstraZeneca in a record 25 days. Others funded by the government's pandemic response program also shattered Matt Hepburn's 60-day mark, including biotech company AbCellera, working with Eli Lilly and Regeneron, which was used to treat President Trump.

Dr. James Crowe: This is the new normal. It's gonna be 60 days from here on out.

Well not quite yet - currently, antibodies are grown in a bioreactor like one at this Defense Department Rapid Response Plant in Florida. It'll take three weeks for this to produce 7,500 doses.

Dr. James Crowe: And so-- a lot of scientists are trying to figure out, can this be done faster?

Dr. Crowe has successfully tested a faster way: RNA, the genetic tool DARPA helped pioneer that was used to make the coronavirus vaccine in record time. In the next outbreak -- RNA would allow factories like this to churn out millions of doses a day.

Dr. James Crowe: We would start from-- a blood sample from a survivor and be done with all of this and be giving you an injection of the cure within the 60 days.

With their promise of speed, immediate protection, and a cure, Dr. Hepburn says RNA antibodies could stop the next Wuhan-like outbreak cold.

Dr. Matt Hepburn: It's really beyond vaccines, That's our future. That's our next step.

Bill Whitaker: Shoot for the moon.

Dr. Matt Hepburn: Shoot for the moon.

Some Pentagon researchers are shooting higher. With the spread of dangerous new coronavirus variants, the Army's Dr. Kayvon Modjarrad is testing a revolutionary approach to stop them all.

Dr. Kayvon Modjarrad

Dr. Kayvon Modjarrad: We're trying to not just make a vaccine for this virus, we're trying to make a vaccine for the whole family of coronaviruses. This is the core of our vaccine. We engineer the spike so that we can attach it to this protein.

If his concept, now in clinical trials, proves successful, Dr. Modjarrad says in five years a single vaccine could defeat all coronaviruses: that means many common colds, the deadly strain causing this pandemic and thousands of others.

Bill Whitaker: Is that at this point-- a dream?

Dr. Kayvon Modjarrad: This is not science fiction, this is science fact. We have the tools, we have the technology, to do this all right now.

Bill Whitaker: And you think we can, at some point, inoculate the world against these killer viruses.

Dr. Kayvon Modjarrad: Killer viruses that we haven't seen or even imagined, we'll be protected against.

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