



Can Vaccines Stop Variants? Here's What We Know So Far

By NURITH AIZENMAN • APR 9, 2021



A scientist works on COVID-19 samples to find variations of the virus at the Croix-Rousse Hospital laboratory in Lyon, France, in January.

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It's official: This week U.S. health authorities announced that the mutant strain of the coronavirus first identified in the United Kingdom last winter is now [the predominant strain](#) in the United States. And it's been found in at least 130 other countries as well.

On a reassuring note, officials said there's strong evidence all three vaccines approved for use in the U.S. — Pfizer, Moderna and Johnson & Johnson — offer good protection against this variant, especially against severe disease. There's also similar evidence starting to accumulate when it comes to additional vaccines being used or considered by other countries.

But this strain is just one of three "variants of concern" at large in the U.S. and a broad swath of other countries. One of the other variants, first identified in South Africa and dominant there, has now been found across southern Africa. Another, initially found in people who traveled from Brazil to Japan, is behind [Brazil's current surge in cases](#) and has also been found across the Americas.

So how well do vaccines work against these other two variants?

Scientists say answering that question is one of the hottest topics in biomedical research right now.

"We have seen an explosion — a paper almost every day," said [Salim Abdool Karim](#), an infectious disease researcher who co-chairs the COVID-19 advisory committee for South Africa.

One reason is that there are so many vaccines to check: About a dozen are in varying stages of approval and use across the world — including the aforementioned ones from Pfizer, Moderna and Johnson & Johnson, along with Astra-Zeneca, Russia's Sputnik V, India's Covaxin and China's Sinovac and Sinopharm.

Abdool Karim said it's crucial to test as many of these vaccines as possible against the variant now dominant in his country.

"The South African vaccine strategy calls for a diverse set of candidates," Abdool Karim said. "We don't want to just go with one or two vaccines because if something happens — there's a safety [problem] or diminishing immunity — we don't want to find that we've been compromised because we only had one kind of vaccine."

Clinical evidence: testing it in the real world

To judge which vaccines make most sense for his country, Abdool Karim said ideally he wants to know how the vaccine is performing against South Africa's variant in real-world conditions — what's known as clinical evidence.

"And we've been quite fortunate that we've had several of the vaccines that have been tested in South Africa," he said.

For instance, a large study of Johnson & Johnson's vaccine found it was about 85% effective at preventing severe disease from the variant dominant in South Africa. A smaller study of the Pfizer vaccine suggests it prevents as much as 100% of even mild cases from the variant in South Africa.

But on the less hopeful side: A study of the Novavax vaccine suggests that while it's about 89% effective at preventing mild disease from the original strain, it's about 50% as effective against the variant dominant in South Africa.

"Almost half the efficacy is lost," Abdool Karim said.

Worse still, a study of the AstraZeneca vaccine suggests it may have almost no ability to prevent mild disease from the variant in South Africa. It's unclear how well either AstraZeneca or Novavax prevent serious illness.

Lessons from the lab

Then there are six other vaccines for which there are *no* clinical studies to go by. To assess those, Abdool Karim is looking at laboratory studies.

Scientists take blood from a vaccinated person and extract the antibodies the vaccine generated against the virus. Then they put those antibodies in a petri dish with one of the mutant strains of the virus or a "pseudo-virus" engineered to resemble them.

Essentially, Abdool Karim said, "They look at how much of the antibodies is required to kill the virus."

Several such experiments with the Moderna vaccine suggest that because the antibodies it generates are not as effective against the variant in South Africa, it takes eight times as many to knock out that strain as it does to neutralize the original version of the coronavirus. One study found it took more than 40 times as many antibodies.

But Abdool Karim said he's not too worried.

For one thing, he's concluded the latter study is likely an outlier that is less telling. "These are not standardized assays," he noted. The procedures used to do these experiments and rate the results "vary in lab to lab." So he's inclined to believe the preponderance of the evidence suggesting that up to eight times of Moderna-generated antibodies are needed against the strain in South Africa.

If that's the case, Abdool Karim said, "the Moderna vaccine produces pretty high levels of antibodies — and so there is enough antibody still to neutralize the virus."

Indeed, it's worth noting that lab experiments with antibodies from the Pfizer vaccine have found a similar increase in quantity is needed to quash the variant in South Africa. And in Pfizer's case, of course, there is clinical evidence that the vaccine induces enough antibodies to succeed.

By contrast, an experiment found that for Astra-Zeneca it takes 86 times as many antibodies to neutralize the variant in South Africa compared with the original strain. While there's no hard-and-fast rule, Abdool Karim said when it gets to that point, "I don't know — I'm basically not confident about the vaccine at all."

In fact, he and other officials were so concerned they terminated South Africa's plans to deploy AstraZeneca in their country.

Worries about the variant in Brazil

If the variant first found in South Africa has generated the most consternation among scientists, a close second is a variant that's prevalent in Brazil.

[Kate O'Brien](#), director of the World Health Organization's Department of Immunization, Vaccines and Biologicals, said the issue for that variant is not so much what the studies of vaccine efficacy against it have found so far. Those findings are actually not all that alarming. The concern is that there are still few of these studies to go on.

"There's just not enough information really to draw any substantive conclusions," O'Brien said.

Yet O'Brien also draws hope from what she deems an "important" finding from mid-February by a team that included researchers from Johns Hopkins University and the U.S. National Institutes of Health's National Institute of Allergy and Infectious Diseases.

Instead of focusing on antibodies, these researchers looked at a different part of the immune system, involving "CD8+ T cells" that also play a key role in fighting infections. The team essentially found that T cells in the blood of people who had recovered from the original version of COVID-19 were able to recognize the three mutant strains of the virus to the same degree.

Because T cells get involved after an infection is underway, O'Brien said this suggests that even if a particular vaccine is not good at preventing infection by a variant, it may at least still end up substantially reducing the infection's severity.

O'Brien noted that this could hold implications for AstraZeneca's and Novavax's utility against the variant in South Africa in particular. In both cases, the disappointing clinical studies in South Africa only speak to how well those vaccines prevent mild to moderate infection. Because the studies did not include older people — who are at far more risk of severe disease — it remains unclear whether either of the vaccines might still be quite effective at keeping people out of the hospital.

"We know [that type of protection] would be greater than it is for mild moderate disease," O'Brien said. "And we also know that T cells do play a role, especially for severe disease."

In fact, in the case of the AstraZeneca study, O'Brien noted, the sample size was so small, even the finding that the vaccine was largely ineffective at stopping mild disease carries an asterisk.

In short, "the jury is still out," she concluded. "There's a plausible pathway here where the AstraZeneca product may still be preventing serious disease, hospitalization and death."

All this means it's likely officials may end up adjusting their advice on which vaccines should be used where. If that happens, O'Brien said, it shouldn't shake our confidence in policymakers. When they change their recommendations, she said, "It's not because policymakers got it wrong the first time. It's because new evidence has come in."