Scientists find new way of predicting COVID-19 vaccine efficacy

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The early immune response in a person who has been vaccinated for COVID-19 can predict the level of protection they will have to the virus over time, according to analysis from Australian mathematicians,

clinicians, and scientists, and published today in *Nature Medicine*.

The researchers from UNSW's Kirby Institute, the Peter Doherty Institute for Infection and Immunity, and the University of Sydney have identified an 'immune correlate' of [vaccine](#) protection. This has the potential to dramatically cut development times for new vaccines, by measuring neutralizing [antibody levels](#) as a 'proxy' for immune protection from COVID-19.

"Neutralizing [antibodies](#) are tiny Y-shaped proteins produced by our body in response to infection or vaccination. They bind to the virus, reducing its ability to infect," says Dr. Deborah Cromer from the Kirby Institute.

"While we have known for some time that neutralizing antibodies are likely to be a critical part of our immune response to COVID-19, we haven't known how much antibody you need for immunity. Our work is the strongest evidence to date to show that specific antibody levels translate to high levels of protection from disease."

The researchers analyzed data from seven COVID-19 vaccines to examine the how the response measured soon after vaccination correlated with protection. They then used [statistical analysis](#) to define the specific relationship between immune response and protection. Their analysis was remarkably accurate and was able to predict the efficacy of a new vaccine.

Dr. Cromer said that this finding has the potential to change the way we conduct COVID-19 vaccine trials in the future.

"Antibody immune levels are much easier to measure than directly measuring vaccine efficacy over time. So, by measuring antibody levels across the range of new vaccine candidates during early phases of

clinical trials, we can better determine whether a vaccine should be used to prevent COVID-19."

Vaccine boosters likely to be required within a year

Another crucial application of this analysis is its ability to predict immunity over time. The researchers predict that immunity to COVID-19 from vaccination will wane significantly within a year, with the level of neutralizing antibodies in the blood dropping over the first few months following infection or vaccination.

"Vaccination works very well to prevent both symptoms and severe disease in the short to medium term, but efficacy is predicted to decline over the first few months for most of these vaccines," says Dr. David Khoury, also from the Kirby Institute.

"However, it is very important to understand the difference between immunity against infection and protection from developing severe disease. Our study found that a 6-fold lower level of antibodies is required to protect against severe disease. So even though our analysis predicts that we will start losing immunity to mild infection in the first year after vaccination, protection from severe infection should be longer lived," says Dr. Khoury.

"But ultimately, for optimal protection against moderate disease and transmission of COVID-19, these findings suggest we may be looking at annual vaccine boosters, just like what we have with the flu vaccine."

Applying the model in the real word

A major global challenge is the evolution of the virus and the emergence of new variants. There is a growing concern, based on laboratory studies,

that antibodies developed against the dominant strains are less effective at neutralizing these new variants.

"An added advantage of our work is that allows us to predict how protective an immune response will be against different variants," says Professor Jamie Triccas from the University of Sydney's Marie Bashir Institute and Faculty of Medicine and Health.

"This analysis shows a very good correlation between the immune response—which is very easy to test for—and the efficacy of a vaccine in preventing infection, which is incredibly hard to test for. This means we can predict how protective an immune response will be against different variants, without having to determine efficacy against each variant in large and costly clinical trials.

"This work can facilitate decision making by providing the necessary data much earlier on in the vaccine development pipeline and in a far more efficient way."

A limitation of this study is that it analyzes the relationship between early immune responses to infection and vaccination and protection from infection (the data that is currently available), and uses this relationship to project how immunity will change in the future and in the response to different viral variants. Future studies should aim to confirm these predictions as data becomes available.

More information: David S. Khoury et al. Neutralizing antibody levels are highly predictive of immune protection from symptomatic SARS-CoV-2 infection, *Nature Medicine* (2021). DOI: 10.1038/s41591-021-01377-8

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