

New study finds strong immune response following COVID-19 vaccination

- 237 healthcare workers tested for antibody and T cell responses, as part of the largest and most in-depth study on the immune response following COVID-19 vaccination
- First findings from DHSC-funded PITCH study shows one dose of the Pfizer vaccine generates robust T cell and antibody responses in 99% of people
- Study shows people who have previously had COVID-19 generate stronger T cell and antibody responses following one dose of the Pfizer vaccine

A new study led by Sheffield and Oxford Universities with support from the UK Coronavirus Immunology Consortium has found that 99% of people generate a robust immune response against COVID-19 after just one dose of the Pfizer vaccine.

The Protective Immunity from T cells to COVID-19 in health workers study (PITCH) examined how the immune system responds to COVID-19 after one dose of the Pfizer vaccine among people who have been infected by COVID-19 before and those who have not.

It suggests one dose of the vaccine protects against severe disease, supporting the decision to delay the second dose and provide protection to as many higher-risk groups as possible by providing more first doses. The study showed after 2 doses levels of protection were even stronger, underlining the importance of people coming forward for their second dose.

Between 9 December 2020 and 9 February 2021, researchers from the Universities of Sheffield, Oxford, Liverpool, Newcastle and Birmingham analysed blood samples from 237 healthcare workers to understand their T cell and antibody responses following vaccination from the Pfizer vaccine.

The study also sheds light on the impact of previous infection from COVID-19 on people's immune response to vaccination. It found people who had previously been infected with COVID-19 showed higher T cell and antibody responses after one dose of the Pfizer vaccine compared with people who had never had COVID-19 before and had one dose of the vaccine.

The researchers discovered that among people who had had COVID-19 in the past, the T cell response expanded after vaccination to recognise more regions of the COVID-19 spike protein – which attacks the immune system and causes severe disease. This means, even in those already infected, vaccination from the Pfizer jab provides better protection and an enhanced immune response to COVID-19 than the immune response from natural infection.

It is not yet known how long T cell and antibody response lasts following infection. The first dose of both the Pfizer and AstraZeneca vaccine offer good levels of protection, but to get maximum protection it is vital everyone gets a second dose when invited as 2 doses of the vaccine will provide

longer-lasting protection from the virus.

Health and Social Care Secretary Matt Hancock said:

The PITCH study presents further proof that vaccines provide excellent protection against the virus. Thanks to the incredible efforts of our vaccination programme, over half of all adults in the UK have had the jab, and we remain on track to offer all adults a vaccine by the end of July.

A second vaccine jab is crucial for longer-term protection, regardless of whether you have previously had COVID-19 or not, and I urge everyone to make sure they attend their second appointment – to keep themselves and those around them safe.

Health Minister Lord Bethell said:

These findings from the PITCH study are crucial to increasing our understanding of the immune response to COVID-19 and how the Pfizer vaccine is working to protect people across the UK already.

I urge everyone to come forward to be vaccinated when invited and to take up both doses of the vaccine as both are vital to ensuring long-term protection from COVID-19.

Key findings from the PITCH study

- Among individuals who had not had COVID-19 in the past and had received 2 doses of the Pfizer vaccine, T cell response was as strong as people who had had previous COVID-19 infection and one vaccine dose.
- After one dose of the Pfizer vaccine, individuals who had previous COVID-19 infection showed higher antibody and T cell responses compared with people who had not been infected before. Antibody responses were 6.8 times higher and T cell responses 5.9 times higher.
- Among individuals who had not had COVID-19 in the past and had received one dose of the Pfizer vaccine, antibody and T cell responses were at a similar or higher level compared to those who had previously been infected but not been vaccinated.
- There was a 10-fold greater spike-specific T cell responses following vaccination in people with previous infection compared to those who had no prior infection.

- There was no link between age and levels of T cell/antibody response.

An effective vaccine is one that that saves lives and reduces hospitalisations. Both the Pfizer and Oxford-AstraZeneca vaccines have been shown to be highly effective in reducing COVID-19 infections among older people aged 70 years, according to previously published research carried out by Public Health England. In the over 80s, data suggest that a single dose of either vaccine is more than 80% effective at preventing hospitalisation, around 3 to 4 weeks after the jab.

Further research will continue to deepen our understanding of the immune responses over the longer term and what it means for protection against COVID-19 in the real world.

Even after vaccination everyone must continue to follow the rules – remembering Hands, Face, Space – as it may still be possible to pass the virus on to others after having the jab.

Dr Thushan de Silva, study author from the University of Sheffield, said:

Our study is one of the largest and most comprehensive accounts of the immune response to one dose of Pfizer/BioNTech vaccine comparing previously infected and infection-naïve individuals. Our results demonstrate that T cell and antibody responses induced by natural infection are boosted significantly by a single dose of vaccine. While the response to a single dose was lower in infection-naïve individuals, it was still equivalent or better than the immunity in previously infected individuals before it is boosted by vaccination.

Professor Susanna Dunachie, PITCH study lead from the University of Oxford, said:

Our study highlights the importance of studying both aspects of immune protection when trying to understand the underlying mechanisms of the immune response to COVID-19 vaccination. Interestingly, we also found that vaccination improves the breadth of T cell responses generated in previously infected individuals. In immunology, this is a good thing as it means that you are more likely to maintain protection against new mutations of the virus, and further work will assess how long these vaccine responses last. It's still important that everyone follows NHS guidelines to get 2 doses of the vaccine, even if you think you may have previously had COVID-19.

The PITCH study has been a great opportunity to work collaboratively across 5 university hospitals and with Public Health England to look at T cell responses to SARS-CoV-2 at greater scale and depth than a single research centre can. By building on

the national SIREN Study and putting our heads together, we are contributing towards illuminating the role of T cells in protection against COVID-19 from vaccines and previous infection.

Professor Paul Klenerman, PITCH study lead from the University of Oxford, said:

T cells are an important component of immunity to viruses – but typically much harder to measure than antibodies. To set this up at scale across the UK in the midst of a pandemic was a big challenge but the very clear data found by PITCH show just how informative this approach can be.

Background information

[See the pre-print report on T cell and antibody responses available on the Lancet website](#)

This study formed part of the [PITCH Study \(Protective Immunity from T-cells in Healthcare workers\)](#), which was funded by the UK's Department of Health and Social Care. A contribution was also made from the [UK Coronavirus Immunology Consortium](#) (funded by UK Research and Innovation and the National Institute for Health Research).

Of the 237 healthcare workers, 113 had previously been infected with COVID-19 compared to 124 healthcare workers who had not. For those who had not previously had COVID-19, 103 were given one dose of the vaccine and 21 were given 2 doses, with a gap of 23 days between doses. The researchers took blood samples from participants prior to and 28 days after vaccination to measure various aspects of the immune response, including antibodies and T cells.

A range of analyses were used to examine aspects of the T cell response including the magnitude of response and the response to different proteins from SARS-CoV-2. Carrying out these T cell analyses is much more complex than antibody studies and difficult to undertake at scale – but this study is the largest and most in depth in the world to date in this field.

References

- Polack et al. Safety and efficacy of the BNT162b2 mRNA Covid-19 Vaccine. *New England Journal of Medicine* 2020; 383(27): 2603-15.
- Hall et al. Do antibody positive healthcare workers have lower SARS-CoV-2 infection rates than antibody negative healthcare workers? Large multi-centre prospective cohort study (the SIREN study), England: June to November 2020. *medRxiv* 2021: 2021.01.13.21249642.