How much does one coronavirus vaccine dose protect you and others?

By Michael Le Page, *New Scientist* (UK weekly), print issue of Jan 30, 2021

ABOUT 70 million doses of vaccines against covid-19 have now been administered worldwide, including in excess of 20 million in the US.

In the UK, where more than 7 million people have received a first dose, most people will be required to wait for about three months before they receive the second dose. This has left many wondering how protected they are, and what measures they still need to take for their safety and that of others. Here's what you need to know.

Am I safe once I have had one dose of a coronavirus vaccine?

The short answer is no. "Don't for a moment imagine you are safe. That would be a horrific thing to do," says Danny Altmann at Imperial College London. "You absolutely can't remotely modify your behaviour until well after your second dose."

The first thing you need to know is that it takes at least two to three weeks for any protection to kick in after the first dose, so during this time you are just as vulnerable.

The second is that it isn't clear how much protection a single dose of any vaccine provides (more on this later), because the trials weren't designed to tell us this. What is certain is that no vaccine provides complete protection even after two doses. With the vaccine from Pfizer and BioNTech, about 1 in 20 people may still get symptomatic infections. With the vaccine made by AstraZeneca and the University of Oxford, as many as 1 in 3 people might still be vulnerable.

Third, your risk of catching the virus depends on how likely you are to be exposed to it. In countries such as the UK, Ireland and the US, levels of infection are currently very high.

"Individuals, even though they have been vaccinated, will be at more of a risk now than they were in the summer," says Matt Keeling at the University of Warwick, UK.

By contrast, countries such as Australia and New Zealand aren't rushing to vaccinate people. With the virus almost entirely eliminated there, people have near zero risk of infection.

If you get covid-19 despite being vaccinated, you can still become seriously ill and die. Some 10 to 20 per cent of infected people also get long covid – lasting symptoms such as fatigue and headaches. We don't yet know if these symptoms will last months, years or even a lifetime, says Altmann. "This is really scary stuff."

And remember, it isn't just about you.

Can I still infect other people once I have been vaccinated?

Yes, there is a high chance that you can. And infecting just one other person might start a chain of infections that leads to many deaths over the coming months and years.

The vaccines' clinical trials were designed to tell if they prevent symptomatic infections. The billion-dollar question is whether vaccinated people who are protected against becoming ill can still get asymptomatic infections and pass the virus on to others.

It could be months before studies give us a clear answer, but other lines of evidence suggest that this is likely. For instance, initial results from a study of healthcare workers by Susan Hopkins at Public Health England and her colleagues found that natural infection provides about 94 per cent protection against symptomatic infections for at least five months, similar to the best vaccines.

However, natural infection only provided 75 per cent protection against asymptomatic infections. At least some reinfected people had high levels of the virus and were probably infectious.

There is also evidence that the B.1.351 and P.1 variants of the coronavirus, that first emerged in South Africa and Brazil, respectively, can partly evade the immune response, meaning that existing vaccines might not be as effective.

The bottom line is that, even after vaccination, you could be infectious without knowing it.

"In public spaces and the workplace, you'd absolutely want to take the same precautions you've been taking until more people are vaccinated," says Angela Rasmussen at Georgetown University in Washington DC.

In countries where it is allowed, however, Rasmussen thinks small meetings with family or friends who have also been vaccinated would be OK. "You could see parents once you've all been vaccinated, for example," she says. "But ideally, you'd still want to take some precautions in these situations."

How much protection would I have after a single dose of a vaccine?

We don't know for sure. According to the clinical trials, the Pfizer/BioNTech vaccine is 52 per cent effective after the first dose, rising to 95 per cent after the second dose. The Oxford/AstraZeneca vaccine is 65 per cent effective after one dose, rising to 70 to 90 per cent.

The one-dose numbers were calculated by counting symptomatic infections in between the first and second dose. However, it takes at least two weeks for the immune system to ramp up in response to the vaccine and for immunity to start to kick in. So the UK's Joint Committee on Vaccination and Immunisation instead calculated one-dose efficacy by only looking at what happened after the first two weeks or so, but before the second dose.

It concluded that once that initial period had been taken out of the calculation, the efficacy of the Pfizer/BioNTech vaccine at preventing symptomatic infections is around 90 per cent, and for the Oxford/AstraZeneca one about 70 per cent. It was because of these numbers that the UK decided to delay second doses so more people can get a first dose.

While this makes sense, the calculations are based on very few cases, so have big uncertainties. We need more data to get a better idea of first-dose efficacy. Studies of this are under way.

In the meantime, there have been reports of a study at the Sheba Medical Centre in Israel finding only 33 per cent efficacy of the Pfizer/BioNTech vaccine at preventing infections two weeks after one dose. Keeling says we don't know enough about the study to draw any conclusions.

However, it seems this study was based on testing regardless of symptoms and counted both asymptomatic and symptomatic infections so even if the findings are correct it doesn't necessarily mean other estimates are wrong.

Is there any way to tell if the vaccine has worked for me?

Yes. Labs can measure the blood levels of the most important type of antibodies, known as neutralising antibodies, which block infection by binding to the part of the coronavirus spike protein that helps it get into cells.

While there is still debate about which aspects of the immune response give us protection, if people have high enough levels of neutralising antibodies, they should be protected from infection, says Altmann. "I would say they would be absolutely, totally safe."

Unfortunately, such tests aren't widely available – they are very different to the cheap, rapid antibody tests used in some places. In principle, though, testing of neutralising antibody levels could be used as the basis for immunity passports.

Such tests would probably have to be repeated at least once a year, because antibody levels fall quite rapidly in the months after infection or vaccination. In most people, they are thought to eventually stabilise rather than continuing to fall.

There is once again discussion about immunity passports, says Altmann, but there are big technical, logistical and ethical issues. "It's an absolute nightmare," he says. Nevertheless, he expects them to arrive in some form.

When will vaccination campaigns allow life to return to normal?

Not any time soon and maybe not fully for years. "Vaccination is not a magic bullet in that its effect will not be instantaneous," says Anne Cori at Imperial College London. "The impact of vaccination will only be seen once we manage to get very high coverage." This depends on how fast we can roll out vaccines and on how many people take them, says Cori, which is why everyone should get vaccinated as soon as they can.

Israel has already given one vaccine dose to about 45 per cent of its population and at least 78 per cent of those over 60. There are hints that this might be starting to make a difference. Not only is the number of cases starting to fall, the number of people becoming critically ill is declining even faster than the number of cases.

However, modelling studies by Cori, Keeling and others point to bleak conclusions. They suggest that even by April, when up to 30 million people in the UK, almost half the population, might be vaccinated, relaxing all restrictions could lead to an even bigger wave of infections than the current one.

In the worst-case scenario, if vaccines provide little protection against asymptomatic infections, there could be up to 6000 deaths a day in such a wave, according to Keeling's results. "This is not a prediction," he stresses.

In fact, even if restrictions are maintained until December, when the vaccination roll-out is complete, there could still be a major outbreak unless vaccination is around 85 per cent effective at blocking transmission. The reason is that vaccines don't protect everyone from covid-19 and not everyone will get vaccinated, so there will still be millions of susceptible people. "You can never get to 100 per cent protection in a population," says Keeling. "There are still dangers unless the vaccine works incredibly well at blocking infections."