- Vaccination

What are the Covid vaccines' side effects?

It's common to feel lousy after a vaccine. But what do we know about these side effects and what are the more serious ones to watch out for. By Sherryn Groch and Rachel Clun.

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Humans evolved under attack. Not just from ancient predators such as sabre-toothed tigers and cave lions but from tiny microscopic invaders too – the bacteria, fungi and viruses that surround us.



Over millennia, a molecular arms race between pathogen and immune system has sharpened our body's defences and most of these ''foreign agents'' are killed before they can get very far. But Covid-19 emerged in people only in late 2019 and so modern medicine has swung into action to shortcut evolution and manufacture immunity in a bottle instead.
Within a year of the pandemic beginning, a number of vaccines had already passed clinical trials, safe and more effective than most scientists dared hope. But what do we know about how the Covid shots affect the body? And what are the side effects?
Why do vaccines cause side effects?
When your body spots an intruder, such as a virus, it has two main lines of defence. The first is its generic attack, known as your innate immunity, that springs into action at the first sign of trouble. Often that's enough.
But, the rest of the immune system develops a specialised second wave of attackers, just in case. This is your adaptive immunity – antibodies made to fit the exact shape of the virus and ''gum it up'' so it can't hack into cells, and T-cells to kill those cells already infected. Some will remember that shape so they're primed to attack next time, says Australian National University (ANU) immunological researcher Professor David Tscharke.
Vaccines work by training your body to mount this adaptive defence without you actually having to catch the virus. In the case of Covid-19, they introduce your body to a tiny piece of the virus (the signature spike protein it uses to break into our cells). This won't make you sick but, like a mugshot, it helps your body hunt the real virus fast if it ever arrives on the scene.

Of course, that only works if your body actually thinks it's under attack, Tscharke says. Imagine vaccines as a kind of reverse Trojan horse, harmless but dressed up to look dangerous. When the immune system is tripped, white blood cells are immediately called to the injection site to investigate, causing inflammation. ''That's why just about everyone gets a sore arm,'' Tscharke says.

In fact, many symptoms of viruses are caused by our immune system launching into attack mode, which is why many viruses feel similar – and why vaccine side effects often do, too. Turning up the heat with a fever, for example, can make it harder for viruses and bacteria to replicate in your body.

The Covid vaccines do come with a higher chance of these mild effects than your standard flu shot. But they also have impressively high efficacy rates compared to many of the inoculations already out there – not quite as effective as polio and measles but generally better than shots for chickenpox, mumps and the flu. That means they are great at activating your immune system.

Side effects are a ''good sign that the immune system is responding to the vaccine'', says paediatric immunologist Professor Peter Richmond. They are usually mild, though he says roughly one in five people will feel ill enough to need a day off work. ''For the AstraZeneca vaccine [they tend to come] after the first dose, whereas from Pfizer it tends to be after the second,'' he says.

Common side effects for Covid vaccines (including Pfizer and AstraZeneca, two of the three vaccines provisionally approved by New Zealand's Medsafe; only Pfizer has been approved by Cabinet) are injection-site pain, fatigue, headache, nausea, muscle ache and joint pain, dizziness, fever.

So if I don't get side effects, does that mean the vaccine hasn't worked?

No. In trials of the Pfizer and Moderna mRNA vaccines, more than 90 per cent of people developed protective immunity against a symptomatic case of Covid but only half reported side effects, most of them mild. And further testing has shown that people vaccinated without side effects have still developed the virus-killing antibodies they need.

As Tscharke explains, these common vaccine side effects are generally associated with the body's innate immune response but we don't necessarily need a huge innate response to wake up the second, adaptive, response. (That takes about two weeks to develop after being vaccinated.) ''There's a threshold, and for some people that local response, the sore arm, might be enough to start the second.''

It's the same reason some people might shrug off a cold that floors others. So far, young people, whose immune systems tend to be particularly robust, and those who have already had Covid, somewhat more mysteriously, seem the most likely to get these common effects from the vaccines.

With vaccines being closely surveilled in the community, at least in the developed world, there's also a higher chance that rare complications linked to the shots will be picked up. All complications are significant, though they have been ''vanishingly rare'', says virologist Professor Gary Grohmann, who used to run vaccine testing at Australia's medical regulator, the Therapeutic Goods Administration (TGA), and now consults for WHO. ''But it's good we're finding them.''

Tscharke adds: ''That risk of something happening is there for all vaccines and all pharmaceuticals, any new food you put in your mouth really.''
The Covid vaccines came along at record speed because the world saw a record investment and focus on their development – not because safety standards were cut. And while the mRNA vaccines are new to the market, for example, public health physician Professor Nathan Grills at Melbourne University says their technology has been researched and developed for the past 20 years.
What are some of the more serious side effects?
Some side effects do require medical attention. The most high-profile complication to emerge is thrombosis with thrombocytopenia syndrome or TTS. It's linked to the AstraZeneca vaccine and, in smaller numbers, to the Johnson & Johnson shot, which both use the same platform (a harmless adenovirus) to deliver the spike needed for immunity.
TTS causes blood clots to develop alongside a low platelet count. In these rare cases, the immune system sends out antibodies that not only recognise Covid but also platelets (blood cells controlling bleeding). This sends the platelets into overdrive, dropping their overall count as they clump together in clots.
''It's not linked to the usual clotting risk factors like being on the Pill, being a stroke risk, or a history of deep vein thrombosis,'' says epidemiologist Professor Michael Toole. ''It's a different clotting mechanism. They can't seem to find any major predictor except age and a gender [skew] to women. It just happens sometimes.''
Symptoms of TTS usually start between four and 30 days after vaccination but are most common two weeks after the first dose. They include a severe or persistent headache, blurred
vision, confusion, seizures, shortness of breath, chest pain, leg swelling or persistent abdominal pain; and unusual bruising or round spots beyond the injection site.
It can be mild or severe. Severe cases appear to be more common among women in younger age groups. Serious cases involving a clot in an unusual location (such as the brain or abdomen) have been twice as likely to occur in women than in men.
Researchers calculate the odds of dying from TTS after a vaccine at about one in a million (less than being struck by lightning). But if you're young, the risk is higher. That's why Pfizer is considered the preferred vaccine for people under 60..
For the families of those who have died from the complication, or those suffering a severe case, rarity is no comfort. But for the rest of us weighing up whether to get the jab, Grills says the
level of risk matters. ''It's very safe compared to other common medications we take regularly. For example, aspirin carries a much higher risk if you take it every day to prevent heart attacks and stroke.''
Compared to Covid, which itself carries a much higher risk of clotting than the vaccine, the danger shrinks again. ''If you're 50, and got diabetes you've got a much higher chance of dying from Covid than the vaccine, full stop,'' says Grohmann.
Another unusual side effect from the AstraZeneca vaccine is immune thrombocytopenia, a type of low platelet count, this time linked to bleeding.

Symptoms include unusual bruising or clusters of red or purple spots that don't fade when pressed, and unusual bleeding from the nose or mouth or blood in urine and stools. Many cases are mild. Up to a third of people who develop this syndrome experience no symptoms, but
roughly 5 per cent of cases develop severe bleeding.
A serious complication has been linked to the Pfizer and Moderna mRNA vaccines, too. In rare cases, people have developed inflammation of the heart muscle (myocarditis) or inflammation of the lining of the heart (pericarditis).
But Toole notes the condition is ''generally not fatal, most recover very quickly''. Covid, again, carries a much higher risk of this heart inflammation than the vaccines do; and when it happens from the virus, the TGA says it is usually much more severe and can damage the heart.
As with all vaccines or medications, a tiny number of people may also develop a severe allergic reaction known as anaphylaxis. ''But the risk is a lot, lot lower than, say, eating peanuts,'' Tscharke says. ''Anaphylaxis happens fast, generally the first 15 minutes after vaccination, which is why they make you wait around for a little while after your shot.''
What about long-term side effects?
Vaccines are not designed to stay in our body long, Tscharke says. Once they've fired up the immune response, almost all of them (including the new Covid vaccines) will break down harmlessly and leave your system.
That's why scientists don't expect to see a sudden surge of complications months or years down the line. Our immune systems are designed to act fast when they spot a pathogen (or a vaccine masquerading as one).
For some people, including those in trials, it's already been more than a year since their shot – and the safety data looks good. ''We still don't have data on the long-, long-term effects of these vaccines and there's nothing sinister in that,'' says Grohmann. ''There just hasn't been enough time yet, but it's something we'll keep an eye on.''
Experts held out for more data before recommending the vaccines for pregnant women, for example – a standard pro cedure – but now, after millions of doses, no safety concerns have emerged (though Covid itself can again be particularly dangerous for pregnant women).
Some people believe – wrongly – the coronavirus spike delivered by the vaccine to build immunity will behave the same way as the virus itself, Tscharke says. ''Covid is made of [29] different proteins, all working together to harm you and replicate in your body. The spike protein is just one of them. It's the key that unlocks our cells but on its own it can't do any harm.''
That's why the new vaccines are so clever, he says – turning the virus' trusty lock pick against it.