

# What is a breakthrough infection? Six questions answered about catching COVID-19 after vaccination

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If you've been fully vaccinated against COVID-19, maybe you figured you no longer need to worry about contracting the coronavirus. But along

with the [rising number of new COVID-19 cases globally](#) and growing concern about [highly transmissible strains like the delta variant](#) come reports of fully vaccinated people testing positive for COVID-19.

Members of the [New York Yankees](#), U.S. Olympic gymnast [Kara Eaker](#) and U.K. health secretary [Sajid Javid](#) are some of those diagnosed with what is called a "breakthrough infection."

As scary as the term may sound, the bottom line is that the existing COVID-19 vaccines are still [very good at preventing symptomatic infections](#), and [breakthrough infections](#) happen very rarely. But just how common and how dangerous are they? Here's a guide to what you need to know.

## What is 'breakthrough infection?'

No [vaccine](#) is 100% effective. Dr. Jonas Salk's polio vaccine was [80%-90% effective](#) in preventing paralytic disease. Even for the gold standard measles vaccine, the efficacy was [94% among a highly vaccinated population](#) during large outbreaks.

Comparably, clinical trials found the mRNA vaccines from [Pfizer](#) and [Moderna](#) were 94%–95% effective at preventing symptomatic COVID-19—[much more protective than initially hoped](#).

A quick reminder: A vaccine efficacy of 95% does not mean that the shot protects 95% of people while the other 5% will contract the virus. Vaccine efficacy is a measure of relative risk—you need to compare a group of vaccinated people to a group of unvaccinated people under the same exposure conditions. So consider a three-month study period during which 100 out of 10,000 unvaccinated people got COVID-19. [You'd expect five vaccinated people](#) to get sick during that same time. That's 5% of the 100 unvaccinated people who fell ill, not 5% of the

whole group of 10,000.

When people get infected after vaccination, scientists call these cases "breakthrough" infections because the virus [broke through the protective barrier the vaccine provides](#).

## How common is COVID-19 infection in the fully vaccinated?

Breakthrough infections are [a little more frequent than previously expected](#) and are probably increasing because of [growing dominance of the delta variant](#). But infections in vaccinated people are still very rare and usually cause [mild or no symptoms](#).

For instance, [46 U.S. states and territories](#) voluntarily reported [10,262 breakthrough infections](#) to the U.S. Centers for Disease Control and Prevention between Jan. 1 and April 30, 2021. By comparison, there [were 11.8 million](#) COVID-19 diagnoses in total during the same period.

Beginning May 1, 2021, the CDC stopped monitoring vaccine breakthrough cases unless they resulted in hospitalization or death. Through July 19, 2021, there were [5,914 patients with COVID-19 vaccine breakthrough infections](#) who were hospitalized or died in the U.S., out of more than 159 million people fully vaccinated nationwide.

One study between Dec. 15, 2020, and March 31, 2021, that included 258,716 veterans who received two doses of the Pfizer or Moderna vaccine, counted [410 who got breakthrough infections](#)—that's 0.16% of the total. Similarly, a study in New York noted [86 cases of COVID-19 breakthrough infections](#) between Feb. 1 and April 30, 2021, among 126,367 people who were fully vaccinated, mostly with mRNA vaccines. This accounts for 1.2% of total COVID-19 cases and 0.07% of the fully

vaccinated population.

## How serious is a COVID-19 breakthrough infection?

The CDC [defines a vaccine breakthrough infection](#) as one in which a nasal swab can detect the SARS-CoV-2 RNA or protein more than 14 days after a person has completed the full recommended doses of an FDA-authorized COVID-19 vaccine.

Note that a breakthrough infection doesn't necessarily mean the person feels sick—and in fact, [27% of breakthrough cases reported to the CDC were asymptomatic](#). Only 10% of the breakthrough-infected people were known to be hospitalized (some for reasons other than COVID-19), and 2% died. For comparison, during the spring of 2020 when vaccines were not yet available, over [6% of confirmed infections were fatal](#).

In [a study at U.S. military treatment facilities](#), none of the breakthrough infections led to hospitalization. In another study, after just [one dose of Pfizer vaccine](#) the vaccinated people who tested positive for COVID-19 had a quarter less virus in their bodies than those who were unvaccinated and tested positive.

## What makes a breakthrough infection more likely?

Nationwide, on average more than 5% of COVID-19 tests are coming back positive; in [Alabama, Mississippi and Oklahoma, the positivity rate is above 30%](#). Lots of coronavirus circulating in a community pushes the chance of breakthrough infections higher.

The likelihood is greater in situations of close contact, such as in a [cramped working space](#), party, restaurant or stadium. Breakthrough infections are also [more likely among health care workers](#) who are [in](#)

[frequent contact with infected patients](#).

For reasons that are unclear, [nationwide CDC data](#) found that women account for 63% of breakthrough infections. Some smaller studies [identified women as the majority](#) of breakthrough cases as well.

Vaccines trigger a [less robust immune response among older people](#), and the chances of a breakthrough infection get [higher with increasing age](#). Among the breakthrough cases tracked by the CDC, [75% occurred in patients age 65 and older](#).

[Being immunocompromised](#) or having underlying conditions such as [high blood pressure](#), diabetes, heart disease, chronic kidney and lung diseases [and cancer increase the chances of breakthrough infections](#) and can lead to severe COVID-19. For example, fully vaccinated organ transplant recipients were [82 times more likely to get a breakthrough infection](#) and had a [485-fold higher risk of hospitalization and death](#) after a breakthrough infection compared with the vaccinated general population in one study.

## How do variants like delta change things?

Researchers developed today's vaccines to ward off earlier strains of the SARS-CoV-2 virus. Since then [new variants have emerged](#), many of which are [better at dodging the antibodies](#) produced by the currently authorized vaccines. While existing vaccines are still very effective against these variants for preventing hospitalization, they are less effective than against previous variants.

[Two doses of the mRNA vaccines were only 79% effective](#) at preventing symptomatic disease with delta, compared with 89% effective in the case of the earlier alpha variant, according to Public Health England. A single dose was [only 35%](#) protective against delta.

About [12.5% of the 229,218 delta variant cases](#) across England through July 19 were among fully vaccinated people.

Israel, with high vaccination rates, has reported that full vaccination with the Pfizer vaccine might be only [39%-40.5% effective at preventing delta variant infections](#) of any severity, down from [early estimates of 90%](#). Israel's findings suggest that within six months, COVID-19 vaccines' efficacy at preventing [infection](#) and symptomatic disease declines. The good news, though, is that the vaccine is still highly effective at protecting against [hospitalization \(88%\)](#) and [severe illness \(91.4%\)](#) caused by the now-dominant [delta variant](#).

## So how well are vaccines holding up?

As of the end of July 2021, [49.1% of the U.S. population](#), or just over 163 million people, are fully vaccinated. Nearly 90% of Americans over the age of 65 have received at least one dose of a vaccine.

Scientists' models suggest that vaccination may have [saved approximately 279,000 lives](#) in the U.S. and prevented up to 1.25 million hospitalizations by the end of June 2021. Similarly, in England about [30,300 deaths, 46,300 hospitalizations and 8.15 million infections](#) may have been prevented by COVID-19 vaccines. In Israel, the high vaccination rate is thought to have caused a [77% drop in cases and a 68% drop in hospitalizations](#) from that nation's pandemic peak.

Across the U.S., only 150 out of more than 18,000 deaths due to COVID-19 in May were of people who had been fully vaccinated. That means nearly all COVID-19 deaths in U.S. are [among those who remain unvaccinated](#).

The U.S. is becoming "[almost like two Americas](#)," as Anthony Fauci put it, divided between the vaccinated and the unvaccinated. Those who have



not been fully vaccinated against COVID-19 remain at risk from the coronavirus that has so far killed more than 600,000 people in the U.S.

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