

What to Know About Breakthrough Infections and the Delta Variant

Scientific understanding of the coronavirus variant is changing quickly. Here's a recap of the most important findings.



By Apoorva Mandavilli

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Citing new evidence that vaccinated Americans with so-called breakthrough infections can carry as much coronavirus as unvaccinated people do, the Centers for Disease Control and Prevention last month urged residents of high-transmission areas to wear masks in public indoor spaces, regardless of their vaccination status.

The announcement reversed the agency's recommendation in May that vaccinated people could forgo masks. The vaccines remain highly effective at preventing severe illness and death, but the highly contagious Delta variant and persistent vaccine refusal have taken the country in an unexpected direction. Infections have spiked to the highest levels in six months.

"If the war hadn't changed, I wouldn't have felt the need to take such a widely unpopular action," Dr. Rochelle Walensky, the C.D.C.'s director, said in an email.

Dr. Walensky has repeatedly said that breakthrough infections are extremely rare. But the agency does not tally national figures on breakthrough infections that don't result in hospitalization or death, and, in any event, its numbers lag by a few weeks. The exact incidence of these infections, as well as their outcomes, is unknown.

Breakthrough infections seemed to be vanishingly rare when previous versions of the coronavirus dominated in the United States. But recent outbreaks suggest that the numbers may be higher with the arrival of the Delta variant.

"A modest percentage of people who are fully vaccinated will still get Covid-19 if they are exposed to the virus that causes it," Dr. Walensky said in the email.

Still, most vaccinated people with a breakthrough infection are likely to have mild symptoms. And they may even benefit, in the long run: Every exposure to the virus is an opportunity for the immune system to strengthen its defenses against variants that may emerge in the future.

Understand the Delta Variant

- **What We Know:** The variant is spreading rapidly worldwide and fueling new outbreaks in the U.S., mainly among the unvaccinated. Here's what scientists understand about it so far.
- **Guidance for the Vaccinated:** The rise of the Delta variant of the coronavirus has raised new questions about how the vaccinated can stay safe and avoid breakthrough infections. We asked the experts for advice.
- **Who Is Being Hospitalized:** People with compromised immune systems and the unvaccinated make up a high percentage of patients who end up in the hospital in N.Y.C.
- **Delta Variant Map:** The patchwork nature of the coronavirus vaccination campaign in the United States has left people in many parts of the country still vulnerable to the virus and the fast-spreading Delta
- **Delta and Schools:** Classrooms are opening their doors to a different pandemic. Here is how to think about risk.

Booster shots and mild natural infections can both increase the immunity initially gained from the vaccines, said Dr. Michael Mina, an epidemiologist at the Harvard T.H. Chan School of Public Health. "This is why young adults and adults don't get sick — it's because as a kid you get an opportunity to see these pathogens over and over and over," he said.

The vaccines were designed to prevent severe illness, not infection.

The vaccines were intended to prevent hospitalization and death, the worst outcomes of infection, in large part the result of damage to the lungs and other organs. The vaccines produce antibodies in the blood that prevent the coronavirus from taking root in those organs.

But the infection begins when people inhale or ingest the virus through the nose or the throat. Some antibodies produced by the vaccines do seem to be present in nasal secretions and saliva, and were probably enough to thwart previous variants of the virus. Delta offers a tougher challenge.

Early in the infection, when people are most likely to be contagious, the Delta variant seems to replicate in amounts that are perhaps 1,000 times as much as those seen in people infected with other variants, defeating immune defenses in the nose and throat.

"It's just way more virus that's going to potentially overwhelm that initial firewall," said Jennifer Gommerman, an immunologist at the University of Toronto.

To prevent both severe illness and infections, the vaccines would need to produce long-lasting antibodies in the blood and the nose. "That's a really tall ask for

a vaccine,” Dr. Gommerman said.

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Breakthrough infections are likely to be uncommon, but data is lacking.

It's unclear exactly how common breakthrough infections are; most estimates rely on figures predating the Delta variant's rise in the United States. There is also too little testing in the country to get an accurate assessment.

“I think that if we started to test people just randomly on the street, we would find a lot more people who test positive,” said Dr. Abraar Karan, an infectious diseases fellow at Stanford.

Some experts believe breakthrough infections are likelier after exposure to the Delta variant than to prior forms of the virus. Even when more recent data becomes available, however, it still is likely to show that a vast majority of hospitalizations and deaths from Covid-19 occur in unvaccinated people.

“Epidemiologically and clinically, I've still not seen really any severe cases among fully vaccinated people who are immunocompetent,” Dr. Karan said. “The pattern that I'm seeing is still primarily unvaccinated who are making it to the I.C.U.”

The C.D.C. reports that as of Aug. 2, more than 7,500 people with breakthrough infections had been hospitalized or had died. And a New York Times analysis of data from 40 states shows that fully immunized people accounted for less than 5 percent of hospitalizations and very few deaths from Covid-19.



Covid-19 testing at a Unidos En Salud community vaccination and testing site in the Mission District of San Francisco. Mike Kai Chen for The New York Times

The real danger from breakthrough infections is to the unvaccinated.

Breakthrough infections are unlikely to pose a serious health threat to most people who are fully immunized. The risk is greater for people around them who are unprotected — either because they are unvaccinated, or because their immune defenses are weakened by age or certain medical conditions.

Vaccinated people are certainly less likely than the unvaccinated to become infected. But on those occasions, vaccinated people can carry as much virus in their nose and throat as unvaccinated people, according to new data from the C.D.C.

The virus should not last very long, because antibodies and immune cells will quickly rally to suppress it. But infected people can transmit the virus to others very early, even before they feel symptoms.

So breakthrough infections could contribute to viral spread in a community, if less often and for a shorter period of time than infections in unvaccinated people. It's just one more way for the virus to find unvaccinated people.

In some rare cases, breakthrough infections may lead to persistent symptoms.

“Long Covid” is a poorly understood set of symptoms that can plague people for several months after an active infection has ended. While those symptoms eventually resolve in many patients, “there are this subset of people who have long Covid who just aren't able to recover at all,” said Akiko Iwasaki, an immunologist at Yale University.

Only a couple of small studies have investigated how common or severe long Covid may be after breakthrough infections. It is likely to be rare, some experts say, because breakthrough infections are uncommon to begin with and shorter in duration.

In one study in Israel, about seven of 36 people with breakthrough infections had persistent symptoms for more than six weeks. And in a survey of Covid-19 survivors, 24 of 44 people with a symptomatic breakthrough infection reported lingering problems.

“We really need a wider national or even international survey,” Dr. Iwasaki said.

Breakthrough infections may offer an unexpected advantage.

If you get through a breakthrough infection relatively unscathed, you are likely to walk away with more robust protection against variants. The infection essentially acts as a booster shot, researchers say, strengthening your immune system’s ability to recognize and fight the virus.

Studies have shown that when people who recover from Covid-19 receive even one dose of a vaccine, their antibody levels skyrocket. “I expect similar things would happen when you have a breakthrough infection,” Dr. Iwasaki said.

The vaccines train the immune system to recognize a piece of the original virus, a strategy that may leave us vulnerable to future variants. But every exposure broadens the repertoire of immunity, Dr. Mina said.

Eventually, through booster shots or through repeated infections, our bodies will gain an education in the virus sufficient to counter versions with new mutations, he said, adding, “But we’re not there yet.”