

The first line of vaccines was highly effective at restricting COVID-19's damage

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Credit: AI-generated image ([disclaimer](#))

After more than three years of COVID-19, the [World Health Organization](#) (WHO) reports that over 763 million infections, and nearly seven million deaths, have been attributed to SARS-CoV-2.

COVID-19 vaccination was deemed crucial to prevent the continued

spread of the disease, protect those infected from experiencing severe effects, counter the rise of new variants, and ultimately end the pandemic.

The WHO has lifted the Public Health Emergency of International Concern, but ending the ongoing threat of COVID-19 still depends on vaccination and other protective behaviors. Understanding the effectiveness of vaccines remains crucial.

Primary doses and boosters

Today, more than [5.5 billion](#) people (72.3 percent of the world's population) have received at least one dose of a COVID-19 vaccine. A total of [5.09 billion](#) people have completed a primary COVID-19 vaccination series (i.e., two doses of a two-dose vaccine or one dose of a one-dose vaccine).

At the end of 2021, several countries began offering [booster](#) doses in response to research indicating that the effectiveness of the vaccines may diminish over time, especially against the Omicron variant, which emerged in late 2021, and has become [the dominant circulating variant](#).

With this in mind, we sought to answer two questions. First, how well does the primary series of COVID-19 vaccines protect people (against infections, hospitalizations and deaths) four months or more after completing vaccination? Second, how well does the first booster dose protect people three months or more after receiving it?

Answering these questions will provide invaluable information for policymakers to make evidence-based decisions, such as the timing of administering COVID-19 vaccine booster doses.

To answer these questions we sought to identify all studies that:

1. Compared people who were vaccinated (either with the primary series or a booster) to people who were unvaccinated;
2. Followed people for at least 112 days after a primary series, or 84 days after a booster dose, and;
3. Looked at who got infected, was hospitalized or died due to COVID-19.

In total, we identified 68 studies that met these criteria, representing 23 countries. We then combined all the data to better understand how the vaccines' protection changes over time. The results were published in [*Lancet Respiratory Medicine*](#).

Protection against COVID-19, in general

The [WHO](#) has set standards to define whether a vaccine offers adequate protection. Specifically, vaccines should show at least 70 percent protection against infections and 90 percent protection against hospitalizations and deaths.

We found that the primary series offered excellent protection against hospitalizations and deaths in the short term, showing over 90 percent protection against both outcomes within 42 days after vaccination. This protection waned over time, going below the WHO recommendation, but stayed relatively high, at around 80 percent against hospitalizations at eight months post-vaccination, and around 85 percent against deaths at six months post-vaccination.

The primary series also offered good protection against infections in the short term (over 80 percent within the first 42 days), but that protection

fell to around 60 percent after four months, and 50 percent after nine months.

The initial protection of a booster dose was around 70 percent against infections and 90 percent against hospitalizations within the first month after vaccinations. Protection then fell to around 45 percent against infections and to around 70 percent against hospitalizations after four months had passed. Too little data was available to track the long-term effects against deaths.

Overall, the vaccines work at preventing infections, hospitalizations and deaths related to COVID-19, but their effectiveness does decline over time, particularly against infections. Boosters restore protection lost, but may need additional boosting over time.

Protection against the Omicron variant

Vaccines were generally less effective against the Omicron variant, which [emerged in fall 2021](#), about a year after [COVID-19 vaccines were introduced](#).

Within 42 days after vaccination with the original COVID-19 vaccine formulations, the primary series only reached around 60 percent protection against Omicron-based infections, and this dropped to around 30 percent after five months.

The primary series' protection against hospitalization for Omicron infections reached around 70 percent within the first 42 days, but also dropped over time, reaching closer to 50 percent after six months. None of these reached the levels recommended by the WHO.

The boosters did fare better in protecting against Omicron. Within the first 28 days after the booster, protection hovered close to the 70 percent

threshold against infections and 90 percent threshold against hospitalizations recommended by the WHO.

For context, if individuals delayed the administration of the booster by six months after completing the primary series, their protection levels would be around 20 percent against Omicron infections and around 50 percent against hospitalizations right before receiving the booster.

Yet, booster protection also waned over time, falling to about 40 percent against Omicron infections and 70 percent against hospitalizations after four months post-booster. Too little data was available to comment on long-term effects against deaths.

With Omicron, boosters are particularly needed to maintain adequate protection, but this protection also needs additional boosting as it wanes over time.

New formulations of mRNA COVID-19 vaccines that target the Omicron variant were introduced in fall 2022, [and are recommended for booster shots by Canada's National Advisory Commission on Immunization](#). The [Public Health Agency of Canada recommended in March 2023](#) that people at high risk of severe COVID-19 get an additional booster shot.

In May, [the WHO recommended](#) that new formulations of COVID-19 vaccines should target Omicron XBB variants, which are the dominant variants currently circulating.

Behavior-based prevention measures remain necessary

While vaccines provide reasonable protection against COVID-19

infections, hospitalizations and deaths, their effectiveness is imperfect and wanes over time, particularly against the now-dominant Omicron variant for people vaccinated with the original vaccines.

Notably, waning is especially pronounced against infections. This means that although being vaccinated is likely to protect most people against becoming severely ill, vaccinated people are still at risk of catching the virus and transmitting it to others—some of whom will be at higher risk of severe complications from the disease.

That means [measures](#) like wearing a mask, washing one's hands, and staying at home when sick remain essential complements to vaccination. Contrary to vaccines, these measures do not decline in effectiveness over time and are particularly well suited to protect people against infections.

Eliminating the threat of new COVID-19 infections will continue to rely heavily on a combination of vaccination and behaviors, whereas new [vaccine](#) doses will continue to protect those who are infected from severe complications like hospitalizations and deaths.

More information: Nana Wu et al, Long-term effectiveness of COVID-19 vaccines against infections, hospitalisations, and mortality in adults: findings from a rapid living systematic evidence synthesis and meta-analysis up to December, 2022, *The Lancet Respiratory Medicine* (2023). [DOI: 10.1016/S2213-2600\(23\)00015-2](https://doi.org/10.1016/S2213-2600(23)00015-2)

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