

# COVID-19 vaccines have prevented 20 million deaths worldwide in the first year of the vaccine program

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COVID-19 vaccines reduced the potential global death toll during the pandemic by more than half in the year following their implementation,

a mathematical modeling study published today in *The Lancet Infectious Diseases* estimates.

In the first year of the vaccination program, 19.8 million out of a potential 31.4 million COVID-19 deaths were prevented worldwide according to estimates based on excess deaths from 185 [countries](#) and territories.

The study estimates a further 599,300 lives could have been saved if the World Health Organization's target of vaccinating 40% of the population in each country with two or more doses by the end of 2021 had been met.

Dr. Oliver Watson, lead author of the study, from Imperial College London, said: "Our findings offer the most complete assessment to date of the remarkable global impact that vaccination has had on the COVID-19 pandemic. Of the almost 20 million deaths estimated to have been prevented in the first year after vaccines were introduced, almost 7.5 million deaths were prevented in countries covered by the COVID-19 Vaccine Access initiative (COVAX). This initiative was set up because it was clear early on that global vaccine equity would be the only way out of the pandemic. Our findings show that millions of lives have likely been saved by making vaccines available to people everywhere, regardless of their wealth. However, more could have been done. If the targets set out by the WHO had been achieved, we estimate that roughly 1 in 5 of the estimated lives lost due to COVID-19 in low-income countries could have been prevented."

Since the first COVID-19 vaccine was administered outside of a clinical trial setting on 8 December 2020, almost two thirds of the world's population has received at least one dose of a COVID-19 vaccine (66%). The COVID-19 Vaccine Access initiative (COVAX) has facilitated access to affordable vaccines for [lower income countries](#) to try to reduce

inequalities, with an initial target of giving two vaccine doses to 20% of the population in countries covered by the commitment by the end of 2021. The World Health Organization expanded this target by setting a global strategy to fully vaccinate 70% of the world's population by mid-2022, with an interim target of vaccinating 40% of the population of all countries by the end of 2021.

Despite the incredible speed of the vaccine roll-out worldwide, more than 3.5 million COVID-19 deaths have been reported since the first vaccine was administered in December 2020.

Several studies have sought to estimate the impact of vaccination on the course of the pandemic. These studies have focused on specific regions, such as [individual countries](#), states, or cities. The latest study is the first to estimate the impact of COVID-19 vaccinations on a global scale and the first to assess the number of deaths averted both directly and indirectly.

Mr Gregory Barnsley, co-first author of the study, from Imperial College London, said: "Quantifying the impact that vaccination has made globally is challenging because access to vaccines varies between countries, as does our understanding of which COVID-19 variants have been circulating, with very limited genetic sequence data available for many countries. It is also not possible to directly measure how many deaths would have occurred without vaccinations. Mathematical modeling offers a useful tool for assessing alternative scenarios, which we can't directly observe in real life."

To estimate the impact of global vaccination programs, the researchers used an established model of COVID-19 transmission using country-level data for officially recorded COVID-19 deaths occurring between 8 December 2020 and 8 December 2021. To account for under-reporting of deaths in countries with weaker surveillance systems, they carried out

a separate analysis based on the number of excess deaths recorded above those that would have been expected during the same time period. Where official data was not available, the team used estimates of all-cause excess mortality. These analyses were compared with an alternative hypothetical scenario in which no vaccines were delivered.

The model accounted for variation in vaccination rates between countries, as well as differences in vaccine efficacy in each country based on the vaccine types known to have been predominately used in those areas. Notably, China was not included in the analysis owing to its large population and very strict lockdown measures, which would have skewed the findings.

The team found that, based on officially recorded COVID-19 deaths, an estimated 18.1 million deaths would have occurred during the study period if vaccinations had not been implemented. Of these, the model estimates that vaccination has prevented 14.4 million deaths, representing a global reduction of 79%. These findings do not account for under-reporting of COVID-19 deaths, which is common in lower income countries. The team did a further analysis based on total excess deaths during the same time period to account for this. They found that COVID-19 vaccination prevented an estimated 19.8 million deaths out of a total of 31.4 million potential deaths that would have occurred without vaccination, a reduction of 63%.

More than three quarters (79%, 15.5 million/ 19.8 million) of deaths averted were due to the direct protection against severe symptoms provided by vaccination, leading to lower mortality rates. The remaining 4.3 million averted deaths were estimated to have been prevented by indirect protection from reduced transmission of the virus in the population and reduced burden on healthcare systems, thereby improving access to medical care for those most in need.

Vaccine impact changed over time and in different areas of the world as the pandemic progressed, the study found. In the first half of 2021, the greatest number of deaths averted by vaccination was seen in lower middle-income countries, resulting from the significant epidemic wave in India as the Delta variant emerged. This subsequently shifted to the greatest impact being concentrated in higher income countries in the second half of 2021, as restrictions on travel and social mixing were eased in some areas leading to greater virus transmission.

Overall, the number of estimated deaths prevented per person was greatest in high income countries, reflecting the earlier and wider roll out of vaccination campaigns in these areas (66 deaths prevented per 10,000 people in [high-income countries](#) vs 2.711 deaths prevented per 10,000 people in low-income countries). High and upper-middle income countries accounted for the greatest number of deaths averted (12.2 million/ 19.8 million), highlighting inequalities in access to vaccines around the world.

For the 83 countries included in the analysis that are covered by the COVAX commitment to affordable vaccines, an estimated 7.4 million deaths were averted out of a potential 17.9 million (41%). However, failure to meet the COVAX target of fully vaccinating 20% of the population in some countries is estimated to have resulted in an additional 156,900 deaths. Though this figure represents a small proportion of the total global deaths, these preventable deaths were concentrated in 31 African nations, where 132,700 deaths could have been averted if the target had been met.

Similarly, the shortfall in the WHO target of fully vaccinating 40% of the population of each country by the end of 2021 is estimated to have contributed to an additional 599,300 deaths worldwide that could have been prevented. Lower-middle income countries accounted for the majority of these deaths (347,500/599,300 [59.7%]). Regionally, most

of these deaths were focused in the Africa and Eastern Mediterranean regions (348,900/599,300 [58.2%] and 126,800/599,300 [21.2%] respectively). If the 40% target had been met in all [low-income countries](#), the number of deaths averted by vaccination in these areas would have more than doubled (200,000 additional deaths prevented on top of the 180,300 deaths estimated to have been averted under current vaccination rates).

Prof Azra Ghani, Chair in Infectious Disease Epidemiology at Imperial College London: "Our study demonstrates the enormous benefit that vaccines had in reducing deaths from COVID-19 globally. Whilst the intense focus on the pandemic has now shifted, it is important that we ensure the most vulnerable people in all parts of the world are protected from ongoing circulation of COVID-19 and from the other major diseases that continue to disproportionately affect the poorest. Ensuring fair access to vaccines is crucial, but requires more than just donating vaccines. Improvements in vaccine distribution and infrastructure, as well as coordinated efforts to combat vaccine misinformation and improve [vaccine](#) demand, are needed. Only then can we ensure that everyone has the opportunity to benefit from these life-saving technologies."

The authors note several limitations to their findings. Notably, their model is based on a number of necessary assumptions, including the precise proportions of which [vaccine](#) types have been delivered, how they were delivered and the precise timing of when new virus variants arrived in each country. They also assumed that the relationship between age and the proportion of COVID-19 deaths occurring among infected individuals is the same for each country. More broadly, the findings from the study should be considered in the context of uncertainty in calculating the true [death](#) toll of the pandemic owing to the difference in country-level reporting of COVID-19 mortality.

Writing in a linked Comment, Professor Alison Galvani, who was not involved in the study, from Yale University School of Public Health, U.S., said: "The saving of more than 19 million lives by the unprecedented rapidity of development and roll-out of COVID-19 vaccines is an extraordinary global health feat. Nonetheless, millions of additional lives could be saved by more equitable distribution of vaccines."

She added: "High coverage in an individual country not only benefits that country but contributes to worldwide reduction in transmission and emergence of novel variants. An enduring collective response is both pragmatic and ethically imperative."

**More information:** Global impact of the first year of COVID-19 vaccination: a mathematical modelling study, *The Lancet Infectious Diseases* (2022). [DOI: 10.1016/S1473-3099\(22\)00320-6](https://doi.org/10.1016/S1473-3099(22)00320-6)

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