

The Vermont Department of Health analyzed Vermont's COVID-19 cases and hospitalizations by vaccination status to evaluate vaccine effectiveness from April 2021 through January 2022. This work is similar to that completed by [New York State](#). Vaccine effectiveness is a measure of how well vaccination protects people against outcomes such as infection and hospitalization.

Methodology

This analysis combined weekly Vermont adult COVID-19 case data for new test-confirmed infections and hospitalizations with immunization data from the Vermont Immunization Registry. Reinfections are not included.ⁱ Vermont adults were separated into three groups: fully vaccinated for COVID-19 but without a booster dose, fully vaccinated with a booster dose, and unvaccinated. Adults who were partially vaccinated (for example, one dose of Pfizer or Moderna) were excluded. The fully vaccinated group included those who completed a primary COVID-19 vaccine series (two doses of Pfizer, Moderna or AstraZeneca, or one dose of Johnson & Johnson) at least 14 days prior to the infection or hospitalization. The number of people unvaccinated was computed by subtracting the number of people vaccinated from the total population as projected into 2021 (based on the 2011-2019 population trends).

Four comparisons were made: (1) fully vaccinated adults – including some with a booster dose compared to unvaccinated adults (**this is the focus of the first results [section](#)**), (2) fully vaccinated adults who did **not** receive a booster dose compared to unvaccinated adults, (3) adults who received a booster dose compared to unvaccinated adults, (4) adults fully vaccinated who received a booster dose compared to fully vaccinated adults who did **not** receive a booster dose. **The latter three comparisons are included in the effectiveness of booster doses [analysis](#).**

Only Vermont residents ages 18 and older were included in the analysis. The analysis split the population into three broad age groups, 18-49 years, 50-64 years, and 65 years and older. The case rates (per person-week of exposure) were estimated for each age group and then combined, adjusting for the overall (age 18+) state population age structure.ⁱⁱ [Vaccine effectiveness](#) is calculated as 100% minus the ratio of the case rate of the more vaccinated group to the case rate of the comparison group (the less-vaccinated group).ⁱⁱⁱ Vaccine effectiveness is calculated for both cases and hospitalizations, separately.

Because of Vermont's small population we combined the case data into periods of 4 weeks each. We analyzed the small numbers of COVID-19 hospitalizations in 4 broad time periods of different lengths, roughly corresponding to the 2021 summer decrease in COVID-19 cases, the arrival of the Delta variant, the late fall surge in cases, and finally the surge of the Omicron variant.

KEY POINTS

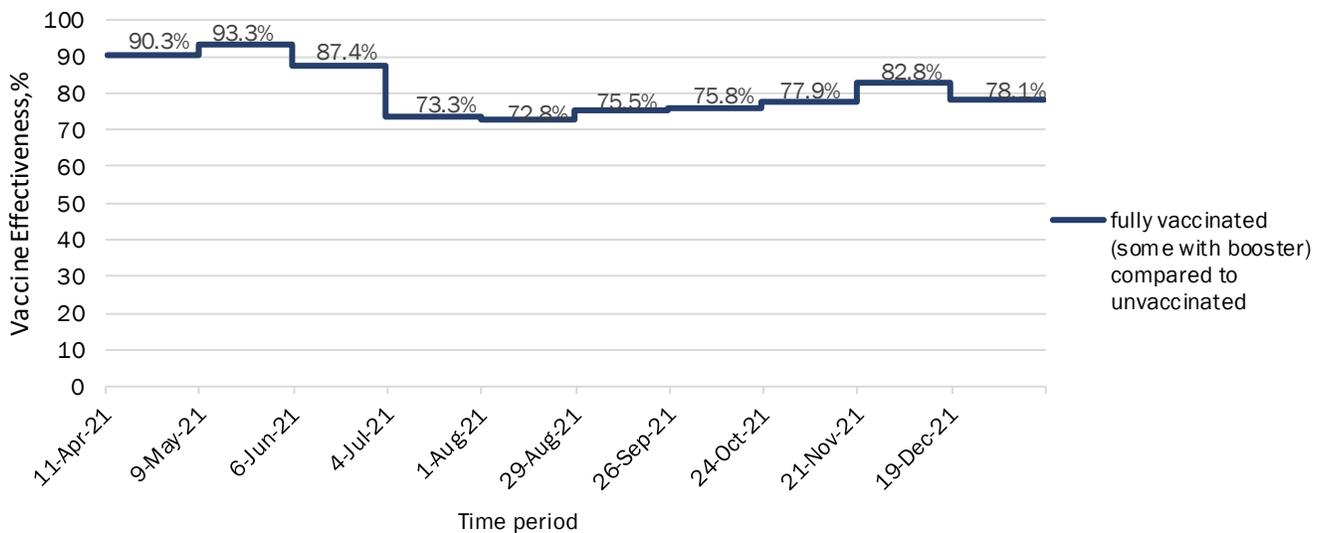
- **COVID-19 vaccines were effective against infections and hospitalizations from April 2021 – Jan. 22, 2022.**
- **Vaccine effectiveness of a primary vaccine series against COVID-19 infection cases was 87% or higher through July 3, 2021 but decreased into the 73%-77% range from July 4 – Nov. 20, 2021. Vaccine effectiveness then increased for those who received a booster dose.**
- **COVID-19 vaccine effectiveness against hospitalizations was consistently above 90% during this period.**

Cases - comparing fully vaccinated (including some with boosters) to unvaccinated

Vaccines were highly effective at preventing infection, but that effectiveness decreased over time but remained above 72% throughout the study period.

- COVID-19 vaccines were highly effective (about 90%) in preventing COVID-19 cases from April 11 through July 3, 2021.
- Vaccine effectiveness significantly decreased and ranged from 73% to 78% between July 4 and November 20, 2021. During this time period the Delta variant became the dominant strain in Vermont. That could be both due to waning protection over time against the same variant of the virus, and less protection against new variants.
- In the 4 weeks leading up to December 18, 2021, vaccine effectiveness significantly increased to about 83%. This increase may be due to the booster doses, which will be analyzed [below](#).
- In the next 4 weeks, leading up to January 15, 2022, vaccine effectiveness decreased somewhat to about 78%. This was during the surge of the Omicron variant.
- Changes between each of these broad ranges mentioned above are statistically significant.

Vaccine effectiveness for fully vaccinated (some with a booster) adult Vermonters aged 18+ against COVID-19 cases decreased after July 3, 2021 and increased after Nov. 20, 2021. Vaccine effectiveness decreased again after Dec. 18, 2021.



Data sources: Vermont Immunization Registry; Vermont Department of Health COVID-19 Health Surveillance Case and Lab Data

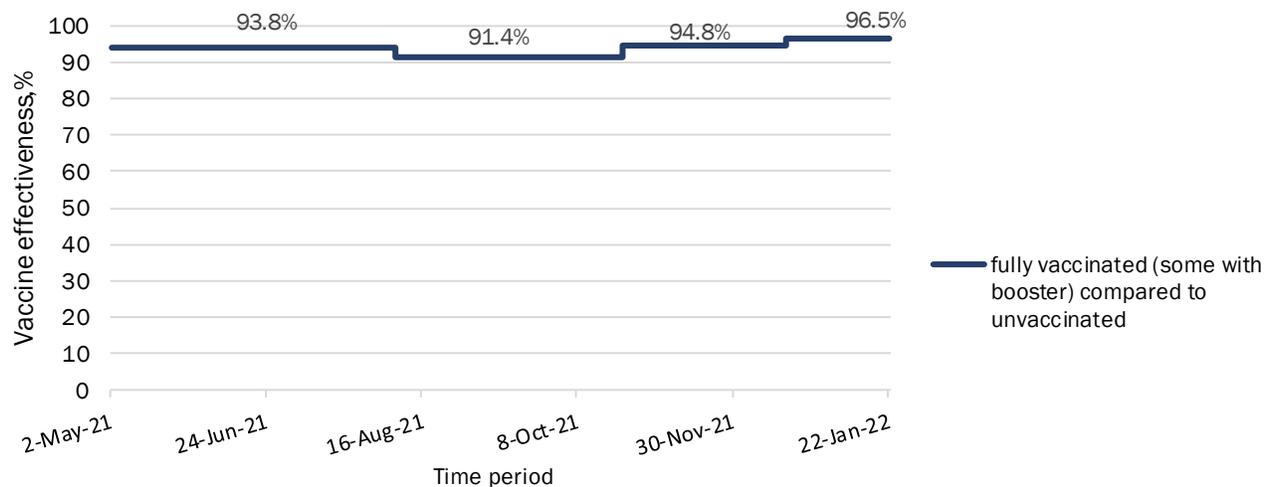
Additional data can be found in the [Appendix](#).

Hospitalizations - comparing fully vaccinated (including some with boosters) to unvaccinated

COVID-19 vaccines were found to be consistently more than 90% effective at preventing hospitalizations in those who were fully vaccinated (including some with boosters) compared to those who were unvaccinated.

- COVID-19 vaccine effectiveness against hospitalizations was higher than against infections.
- This effectiveness does not appear to be decreasing over time.
- These results are similar to what the [New York State](#) study found.
- COVID-19 vaccine effectiveness for those fully vaccinated (some with a booster) in preventing hospitalizations was consistently above 90% for adult Vermonters aged 18+ from May 2021 through January 2022.

COVID-19 vaccine effectiveness for those fully vaccinated (some with a booster) in preventing hospitalizations was consistently above 90% for adult Vermonters aged 18+ from May 2021 through January 2022.



Data sources: Vermont Immunization Registry; Vermont Department of Health COVID-19 Health Surveillance Case and Lab Data.

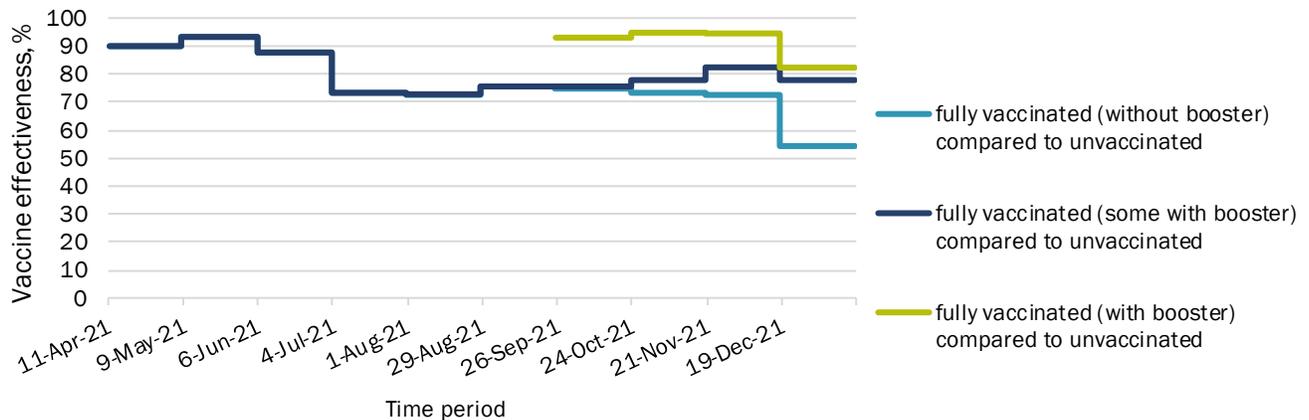
The practical impact of vaccine effectiveness is to consider a hypothetical example of how the number of people hospitalized would have differed if all adult Vermonters in this analysis had been fully vaccinated or all were unvaccinated.

- For example, in the period between Oct. 24 – Dec. 18, 2021, there were 330 hospitalizations within the population included in the analysis.
- The results indicate that had everyone within that population been fully vaccinated, the number of hospitalizations may have been less than half, or 142 people hospitalized.
- If they had all been unvaccinated, the number of hospitalizations may have increased eight-fold to 2,739 people hospitalized.^{iv}

Cases: comparing fully vaccinated with a booster to unvaccinated and comparing fully vaccinated without a booster to unvaccinated

- The effectiveness for those fully vaccinated with a booster dose compared to those unvaccinated against infections was about 95% from Oct. 24-Dec. 18, 2021, and 82% in the following several weeks.
- The effectiveness for those fully vaccinated adults who did not receive a booster dose against infections was 72%-74% range from Oct. 24-Dec. 18, 2021 and was only 54% in the following several weeks.

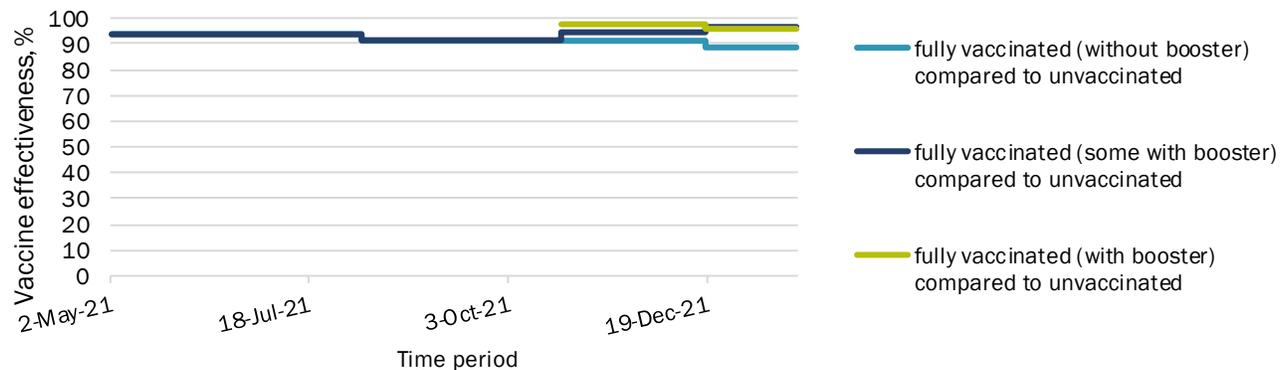
COVID-19 vaccine effectiveness in preventing cases for adult Vermonters aged 18+ who received primary series was about 90% through July 3, 2021, but declined over time. Vaccine effectiveness increased again for those who received a booster dose.



Data sources: Vermont Immunization Registry; Vermont Department of Health COVID-19 Health Surveillance Case and Lab Data.

Hospitalizations: comparing fully vaccinated with a booster to unvaccinated and comparing fully vaccinated without a booster to unvaccinated

Since October 24, 2021, COVID-19 vaccine effectiveness in preventing hospitalization remained around 90% or higher for adult Vermonters aged 18+ who were fully vaccinated, with or without a booster dose.



Data sources: Vermont Immunization Registry; Vermont Department of Health COVID-19 Health Surveillance Case and Lab Data.

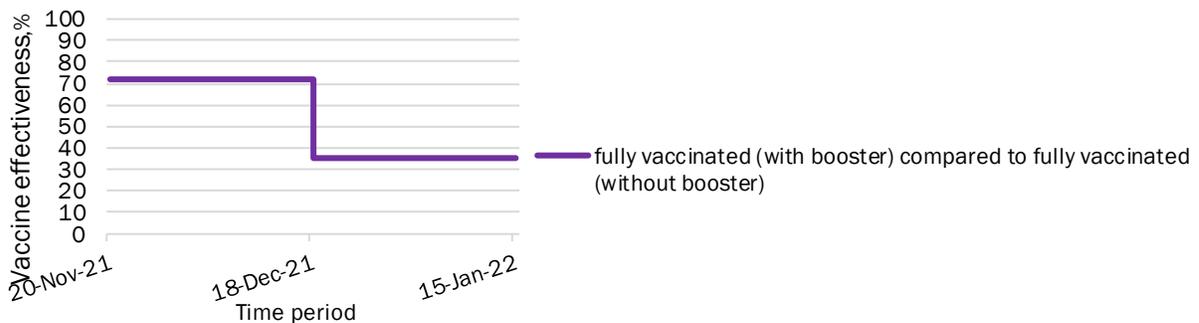
COVID-19 Vaccine Effectiveness

- The effectiveness for those fully vaccinated who received a booster dose compared to those unvaccinated against hospitalizations was about 98% from Oct. 24-Dec. 18, 2021, and 96% in the following several weeks.
- The effectiveness for those fully vaccinated who did not receive a booster dose against hospitalizations was about 94% in May and 89% since Dec. 18, 2021.

Cases: comparing fully vaccinated with booster to fully vaccinated without booster

This section focuses on comparing two fully vaccinated groups (one with and one without boosters) against each other to see the effectiveness of booster doses. It does not compare against those who are unvaccinated.

As compared with those fully vaccinated who did not receive a booster dose, the effectiveness of a booster dose against infections was about 72% from Oct. 24-Dec. 18, 2021, and 35% in the following several weeks.

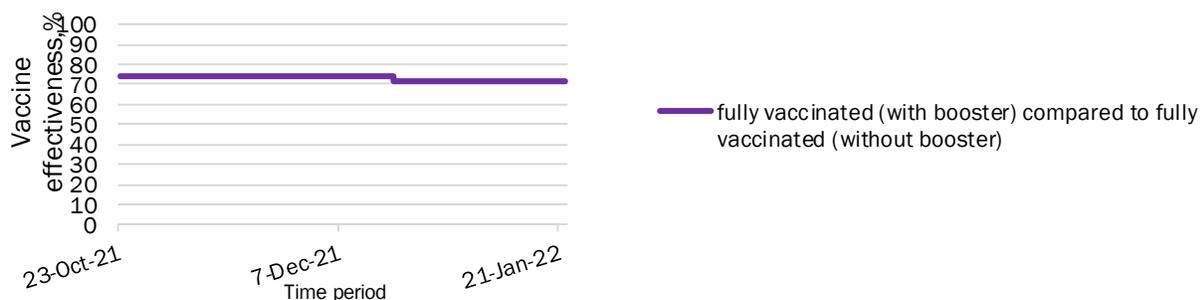


Data sources: Vermont Immunization Registry; Vermont Department of Health COVID-19 Health Surveillance Case and Lab Data.

In both time periods, the difference between the two groups (those with or without a booster) was statistically significant.

Hospitalization: comparing fully vaccinated with booster to fully vaccinated without booster

Covid-19 vaccine booster doses provided over 71% additional protection against hospitalizations for adult Vermonters aged 18+ from Oct. 23, 2021 to Jan. 22, 2022.



Data sources: Vermont Immunization Registry; Vermont Department of Health COVID-19 Health Surveillance Case and Lab Data.

COVID-19 Vaccine Effectiveness

- As compared with those fully vaccinated who did not receive a booster dose, the booster dose provided about 74% effectiveness as additional protection against hospitalizations, in the 8 weeks ending Dec. 18, 2021, and 71% (statistically the same) in the following several weeks. This is the additional protection due to the booster.
- Vaccine effectiveness relative to the unvaccinated was around 90% or higher, as shown in the graph [above](#), with or without a booster dose

Key Takeaways

Covid-19 vaccine effectiveness remained high through January 2022, especially for hospitalizations. Boosters provided additional protection against Covid-19.

Limitations

This analysis has several limitations. The population estimates are of limited accuracy, which affects the estimates of the number unvaccinated adults. The 2020 Census numbers are not yet available, so we had to use population projections based on older data. The number of Vermont residents vaccinated may not be precise due to incorrect residency data in the Vermont Immunization Registry. Conversely, some vaccinations (for example, people vaccinated out of state) may not be reported to the Vermont Immunization Registry. The analysis does not include the partially vaccinated. The time since one received their vaccine was not accounted for in the analysis and therefore may impact the results. The case data is only representative of those who have been tested for COVID-19. Confirmed and probable cases are included according to [CDC case definitions](#). At home self-tests are not included. The case data was matched to the Vermont Immunization Registry to determine vaccination status, but some people may not have matched due to differences in spelling of names between the systems.

For more information: VDH COVID Vaccination Data, AHS.VDHHSCOVIDVaccinationData@vermont.gov

ⁱ Vermont adult COVID-19 reinfections are not included because they may have additional protection against the virus, which may make it difficult to identify the effect of the vaccine.

ⁱⁱ The population within each age and vaccination status group was projected for each week. For each week, the number of people in each vaccination status and age group as of that week are counted in the denominator for that group. These numbers are added over the different weeks in each analysis period to get the person-weeks of exposure, which is the denominator for calculating the rate for that vaccination status and age group. The age specific rates for each time period were computed by dividing the number of cases (infections or hospitalizations) by the person-weeks denominator. For example, if the computed rate is 100 per 100,000 person-weeks, the chance of each person becoming a case during any single week is 1 in 1000. Over multiple weeks that chance increases accordingly.

ⁱⁱⁱ Four comparisons were made in the analysis, and thus the definition of more vaccinated and less vaccinated depends on the specific comparison group under investigation. For example, when comparing fully vaccinated adults (including some with a booster dose) to unvaccinated adults, the more vaccinated group refers to fully vaccinated adults (including some with a booster dose) whereas the less vaccinated group refers to unvaccinated adults.

^{iv} The hypothetical number of hospitalizations is computed by applying the hospitalization rate (for the vaccination status) to the overall person-weeks in the analysis. In the 8-week period from Oct. 24 to Dec. 18, 2021, there were 3,860,631 person-weeks in the analysis. During that time, the hospitalization rates were 3.7/100,000 person-weeks for adults fully vaccinated (some with a booster) and 71.0/100,000 person-weeks for those unvaccinated. The hypothetical number of hospitalizations if everyone in the analysis was fully vaccinated (142) can be estimated by multiplying 3.7/100,000 person-weeks by 3,860,631. The hypothetical number of hospitalizations if everyone was unvaccinated (2,739) can be estimated by multiplying 71.0/100,000 person-weeks by 3,860,631.

Appendix

Rate (per 100,000 person-weeks) of COVID-19 cases among fully vaccinated (including some with boosters) and unvaccinated Vermonters aged 18+, and estimated vaccine effectiveness (Apr. 11, 2021 - Jan. 15, 2022)

Time period	Number of cases	Case rate, fully vaccinated	Case rate, unvaccinated	Vaccine Effectiveness (VE)	95% Confidence Interval of VE
Apr. 11 - May 8, 2021	1394	13.1	135	90.3%	87.5% - 92.5%
May 9 - June 5, 2021	391	4.1	60.9	93.3%	90.8% - 95.1%
June 6 - July 3, 2021	93	1.9	15.3	87.4%	81.4% - 91.5%
July 4 - July 31, 2021	515	17.6	66.0	73.3%	69.5% - 76.7%
Aug. 1 - Aug. 28, 2021	2304	78.8	290	72.8%	71.0% - 74.5%
Aug. 29 - Sep. 25, 2021	3333	112	456	75.5%	74.2% - 76.7%
Sep. 26 - Oct. 23, 2021	3630	125	518	75.8%	74.6% - 77.0%
Oct. 24 - Nov. 20, 2021	5591	188	855	77.9%	77.0% - 78.8%
Nov. 21 - Dec. 18, 2021	6630	210	1218	82.8%	82.1% - 83.4%
Dec. 19 '21 - Jan. 15 '22	15221	547	2494	78.1%	77.5% - 78.6%

Rate (per 100,000 person-weeks) of hospitalizations with COVID-19 among fully vaccinated (including some with boosters) and unvaccinated Vermonters 18+, and estimated vaccine effectiveness (May 2, 2021 - Jan. 22, 2022)

Time period	Number of hosp.	Hosp. rate, fully vaccinated	Hosp. rate, unvaccinated	Vaccine Effectiveness (VE)	95% Confidence Interval of VE
May 2 - Aug. 7, 2021	82	0.4	6.5	93.8%	90.4% - 96.0%
Aug. 8 - Oct. 23, 2021	352	3.1	35.8	91.4%	89.8% - 92.7%
Oct. 24 - Dec. 18, 2021	330	3.7	71.0	94.8%	93.8% - 95.6%
Dec. 19, '21 - Jan. 22, '22	163	2.7	78.3	96.5%	95.5% - 97.3%