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COVID-19 Mortality and Progress Toward Vaccinating Older Adults — World Health Organization, Worldwide, 2020–2022

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After the emergence of SARS-CoV-2 in late 2019, transmission expanded globally, and on January 30, 2020, COVID-19 was declared a public health emergency of international concern.* Analysis of the early Wuhan, China outbreak (*1*), subsequently confirmed by multiple other studies (*2*,*3*), found that 80% of deaths occurred among persons aged ≥60 years. In anticipation of the time needed for the global vaccine supply to meet all needs, the World Health Organization (WHO) published the Strategic Advisory Group of Experts on Immunization (SAGE) Values Framework and a roadmap for prioritizing use of COVID-19 vaccines in late 2020 (*4*,*5*), followed by a strategy brief to outline urgent actions in October 2021.† WHO described the general principles, objectives, and priorities needed to support country planning of vaccine rollout to minimize severe disease and death. A July 2022 update to the strategy brief§ prioritized vaccination of populations at increased risk, including older adults,¶ with the goal of 100% coverage with a complete COVID-19 vaccination series** for

* https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)

† https://www.who.int/publications/m/item/strategy-to-achieve-global-covid-19-vaccination-by-mid-2022

§ The strategy brief outlined updated goals, steps, targets, and operational priorities to guide countries, policy makers, civil society, manufacturers, and international organizations in their ongoing efforts through 2022. https://www.who.int/publications/m/item/global-covid-19-vaccination-strategy-in-a-changing-world--july-2022-update

¶ Older adult definitions vary by country, ranging from persons aged ≥45 years to those aged ≥65 years.

** Definition of complete primary series might vary among countries and by vaccine product. National authorities have ultimate authority on scheduling decisions within their jurisdictions; however, WHO makes recommendations for COVID-19 vaccine products that have undergone Emergency Use Listing review. Vaccine fact sheets including these definitions according to WHO recommendations can be found at https://extranet.who.int/pqweb/vaccines/vaccinescovid-19-vaccine-eul-issued.

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at-risk populations. Using available public data on COVID-19 mortality (reported deaths and model estimates) for 2020 and 2021 and the most recent reported COVID-19 vaccination coverage data from WHO, investigators performed descriptive analyses to examine age-specific mortality and global vaccination rollout among older adults (as defined by each country), stratified by country World Bank income status. Data quality and COVID-19 death reporting frequency varied by data source; however, persons aged ≥60 years accounted for >80% of the overall COVID-19 mortality across all income groups, with upper- and lower-middle–income countries accounting for 80% of the overall estimated excess mortality. Effective COVID-19 vaccines were authorized for use in December 2020, with global supply scaled up sufficiently to meet country needs by late 2021 (*6*). COVID-19 vaccines are safe and highly effective in reducing severe COVID-19, hospitalizations, and mortality (*7,8*); nevertheless, country-reported median completed primary series coverage among adults aged ≥60 years only reached 76% by the end of 2022, substantially below the WHO goal, especially in middle- and low-income countries. Increased efforts are needed to increase primary series and booster dose coverage among all older adults as recommended by WHO and national health authorities.

Comparative analysis of COVID-19 deaths and mortality rates by age group during 2020–2021 was conducted using three publicly available WHO data sources: 1) daily country-specific number of reported cases and deaths (aggregate surveillance); 2) weekly country-specific age, sex, and health care worker status of disaggregated cases and deaths (detailed reporting)[††]; and 3) WHO-modeled COVID-19 excess mortality estimates[§§] (*9*). Because the quality of reported data on COVID-19 deaths appeared to vary among countries by income group, the country-specific ratio of excess mortality estimates to total aggregate reported deaths was mapped geographically to reflect the difference in number of deaths by data source. Because the excess mortality model included all countries and accounted for variability in death reporting, it was used to examine mortality rate[¶¶] and relative risk for persons aged ≥60 years, stratified by World Bank income group (high, upper-middle, lower-middle, and low), independent of potential data quality differences. Percent coverage with a completed

[††] Age groups reported by countries are evenly redistributed to match the age groups used in the mortality model.

[§§] COVID-19 excess mortality estimates were derived using a statistical regression model developed in collaboration with the United Nations Department of Economic and Social Affairs and an appointed Technical Advisory Group for COVID-19 Mortality Assessment. Mortality estimates include deaths attributable directly to COVID-19 that were not reported, and deaths indirectly associated with COVID-19 attributable to other causes and diseases. WHO defines excess mortality as the mortality above what would be expected based on the noncrisis mortality rate in the population of interest. https://www.who.int/data/stories/global-excess-deaths-associated-with-covid-19-january-2020-december-2021

[¶¶] Mortality rates by World Bank income groups were calculated using United Nations population sizes for the countries in each of those income groups. https://www.who.int/data/sets/global-excess-deaths-associated-with-covid-19-modelled-estimates

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COVID-19 vaccination series for the overall population and for older adults were drawn from reporting countries through the WHO electronic Joint Reporting Form COVID-19 module and WHO Regional Office reporting systems. The definition of older adult varied by country; therefore, older adult vaccination coverage was calculated using each country's definition and dividing the doses reported administered to those older adults by the United Nation's Population Division age-specific population figures. The 40 countries that did not report vaccination coverage for older adults in 2021 and 2022 were excluded from analysis. WHO data were accessed through the COVID-19 Vaccine Delivery Partnership Information Hub.[***,†††] Data were analyzed and visualized using R statistical software (version 4.1.1; The R Foundation). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§§§]

During January 2020–December 2021, daily aggregate surveillance and weekly detailed reporting recorded 5.4 million and 2.5 million COVID-19–associated deaths, respectively; the WHO model estimated 14.9 million excess deaths (Table). COVID-19 mortality rates increased markedly in older age groups: persons aged ≥60 years accounted for 80% of COVID-19–associated deaths reported through weekly detailed surveillance and 82% of estimated deaths from the WHO excess mortality model. Among 73% of low-income countries and 31% of lower-middle–income countries (mostly in the WHO African, Eastern Mediterranean, and European regions), the estimated excess mortality exceeded the total reported deaths through aggregate surveillance by more than tenfold, whereas this difference was less than twofold in most higher-income countries (Figure 1). Despite the difference in reporting completeness by income group, cumulative deaths and mortality were higher among older age groups in all income groups. Upper- and lower-middle–income countries accounted for 81% of the global excess mortality among persons aged ≥60 years[¶¶¶] (Table). Lower-middle–income countries accounted for 52% of excess deaths worldwide among persons aged ≥60 years, with an annual excess mortality rate of 1,039 per 100,000 persons.

As of December 2022, among 194 countries, 154 (79%) had reported both overall and older adult COVID-19 vaccination coverage at least once to WHO; ≥78% of countries in all

*** https://infohub.crd.co

††† Disaggregated data on booster dose coverage remain limited. As a result, these data are not included in the current analysis. Recording booster dose coverage by dose (i.e., first booster and second booster) will be critical to continued monitoring of the COVID-19 vaccine rollout.

§§§ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

¶¶¶ Approximately 70% of the global population of persons aged ≥60 years live in middle-income countries.

TABLE. Reported and estimated excess COVID-19–associated deaths, by age group and COVID-19–associated deaths for persons aged ≥ 60 years by World Bank income groups — worldwide, 2020–2021

	Data source (no. of countries)					
	Daily aggregate surveillance (194)		Weekly detailed surveillance (147)*		Excess mortality model (194)	
Characteristic	Cumulative no. of deaths	Mortality rate†	Cumulative no. of deaths (% of total)	Mortality rate†	Cumulative estimated deaths (% of total)	Estimated excess mortality rate§
Age group, yrs						
0–39	No age disaggregated data		114,179 (5)	1	5,393 (<1)	<1
40–49			123,713 (5)	6	658,114 (4)	34
50–59			265,046 (11)	16	1,988,989 (13)	119
60–69			478,599 (19)	40	4,097,508 (27)	345
70–79			614,762 (25)	96	4,145,706 (28)	654
≥80			889,647 (36)	303	4,014,500 (27)	1,365
Total for all ages	**5,430,652**	**35**	**2,485,946**	**16**	**14,910,210**	**96**
Persons aged ≥60 years						
World Bank income group¶ (no. of countries)						
High (58)	No age disaggregated data		1,077,394 (54)	183	1,815,098 (15)	308
Upper-middle (55)			757,692 (38)	89	3,581,994 (29)	423
Lower-middle (45)			145,689 (7)	24	6,340,756 (52)	1,039
Low (34)			859 (<1)	1	519,895 (4)	752
Total for persons aged ≥60 years			**1,981,634**	**94**	**12,257,743**	**579**

* Only 147 countries submitted a detailed weekly report at least once during the 2-year period. Average reporting frequency by income groups was 86% for high-income, 66% for upper-middle–income, 38% for lower-middle–income, and 28% for low-income countries, out of 104 total expected weekly reports.

† Deaths per 100,000 persons per year.

§ Excess deaths per 100,000 persons per year.

¶ Two countries do not have World Bank income status (Niue and Cook Islands). https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

income groups reported coverage during the last three months of 2022.**** The median overall completed primary series COVID-19 vaccination coverage was 59%, ranging from a low of 21% (low-income countries) (50% [upper-middle–income] and 51% [lower-middle–income]) to a high of 74% (high-income countries). Only high-income countries' median coverage surpassed the global target of 70% for the overall population. Among older adults, the median completed primary COVID-19 vaccination series coverage was 76%, ranging from 33% (low-income countries) to 90% (high-income countries). Median coverage among older adults in lower-middle– and upper-middle–income countries was 73% and 70%, respectively. Reported coverage among both the overall population and among older adults varied among countries within and among different income groups (Figure 2). Coverage among older adults was the same or lower than that in the overall population in 36 (23%) countries, including four high-income, eight upper-middle–income, 14 lower-middle–income, eight low-income, and two nonclassified countries.††††

Discussion

The impact of COVID-19 during the last 3 years has been substantial, and COVID-19 mortality is an important outcome indicator for monitoring the pandemic. These COVID-19 deaths and excess mortality estimates showing that persons aged ≥60 years accounted for more than 80% of total COVID-19 deaths even when controlling for income levels are consistent with the initial SARS-CoV-2–related mortality patterns described in China and subsequently by other countries (*1*–*3*). The large disparity observed between reported deaths and estimated excess mortality, especially in upper-middle–, lower-middle–, and low-income countries, makes ascertaining true COVID-19–associated mortality challenging. Given the bias in reported numbers of age-disaggregated COVID-19 deaths by income group, excess mortality estimates based on modeling might provide a more accurate measure of the impact of the pandemic.§§§§ The modeled estimates accounted for limited testing and country-specific reporting of causes of death, particularly as many low- and middle-income countries were known to have faced higher numbers of COVID-19–associated deaths because of insufficient health care capacity. Based on the modeled estimates, persons aged ≥60 years in lower-middle–income countries accounted for more than one half of the global estimated COVID-19 mortality and experienced the highest mortality rate.

COVID-19 vaccines, which have received WHO Emergency Use Listing,¶¶¶¶ were introduced in December 2020, <1 year after the first COVID-19 cases were reported. These vaccines have been found to be safe and highly effective in reducing severe COVID-19, hospitalizations, and mortality; however, despite available evidence on effectiveness (*7*,*8*), reported COVID-19 vaccination coverage among older adults has not yet come close to the WHO goal of 100% in many parts of the world. Approximately one quarter of countries reported lower coverage among older adults compared with that in the overall population; many of these countries are in the upper- and lower-middle–income groups, with the highest mortality estimated by the excess mortality model. Further, because of limitations in access to vaccines in many low- and middle-income countries and limited capacity to rapidly roll out COVID-19 vaccines, middle- and low-income countries are taking longer to reach the recommended targets for primary series and booster dose coverage as recommended by WHO and national health authorities.***** As the fourth year of the pandemic begins, vaccine booster doses have been shown to restore or enhance protection against infection, symptomatic disease, and severe disease, beyond that originally afforded by the primary series (*10*). This is particularly important because most countries have ended most mandated public health and behavioral measures to mitigate the spread of SARS-CoV-2.

The findings in this report are subject to at least two limitations. First, age-disaggregated mortality and vaccination data were self-reported by countries with different reporting frequencies, limited data verification processes, and varying capacity for reporting up-to-date information. As a result, reported vaccination coverage rates included in the analysis might be lower than the countries' published figures because of nonreporting to WHO. Second, the WHO-modeled excess mortality data included all countries and age groups available for 2020 and 2021, but not yet for 2022. Thus, direct association between COVID-19 mortality and vaccination coverage among older adults was not examined in this analysis. Future analyses could be conducted with more regular reports and more availability of detailed data, including vaccination status for reported deaths.

With both timely and reliable data necessary for accurate monitoring of global targets, countries need to be able to strengthen COVID-19 surveillance and vaccination reporting

**** Proportions among reporting countries that reported COVID-19 primary vaccination series completion among older adults in the last 3 months of 2022 (October–December 2022) were 90% (high-income), 79% (upper-middle–income), 86% (lower-middle–income), and 78% (low-income).

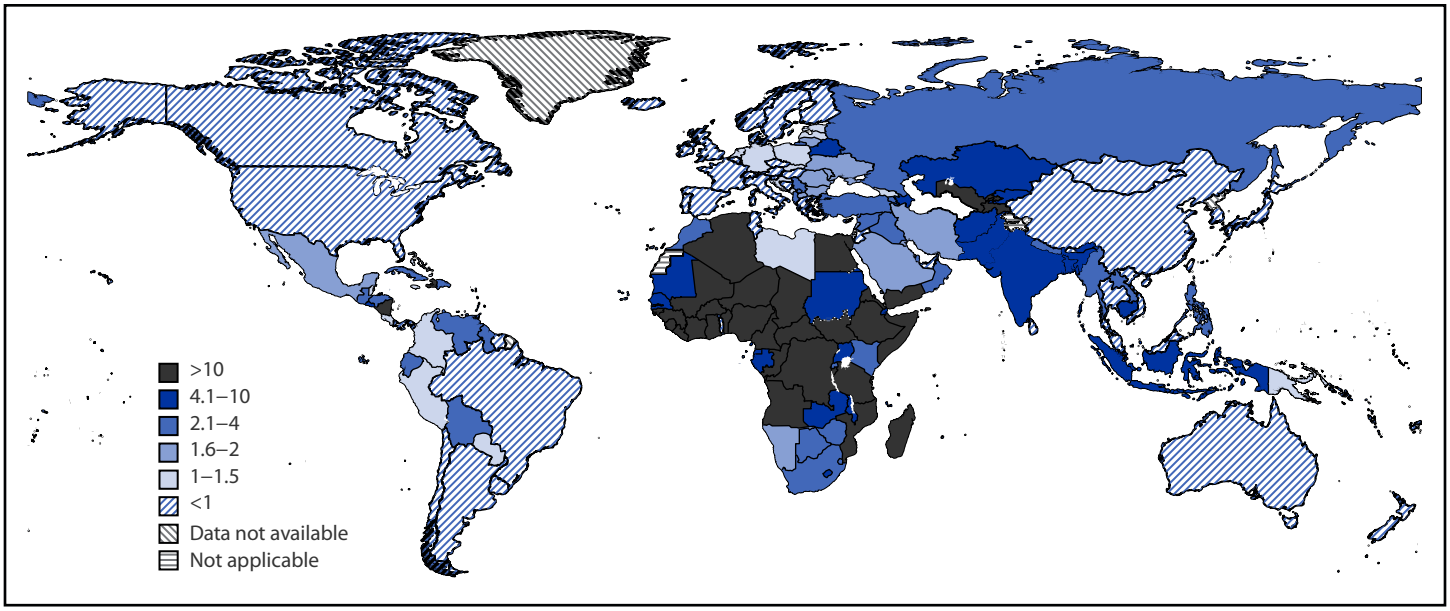
†††† Two countries do not have World Bank Income status (Niue and Cook Islands). https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

§§§§ https://www.who.int/data/stories/the-true-death-toll-of-covid-19-estimating-global-excess-mortality

¶¶¶¶ https://extranet.who.int/pqweb/vaccines/vaccinescovid-19-vaccine-eul-issued

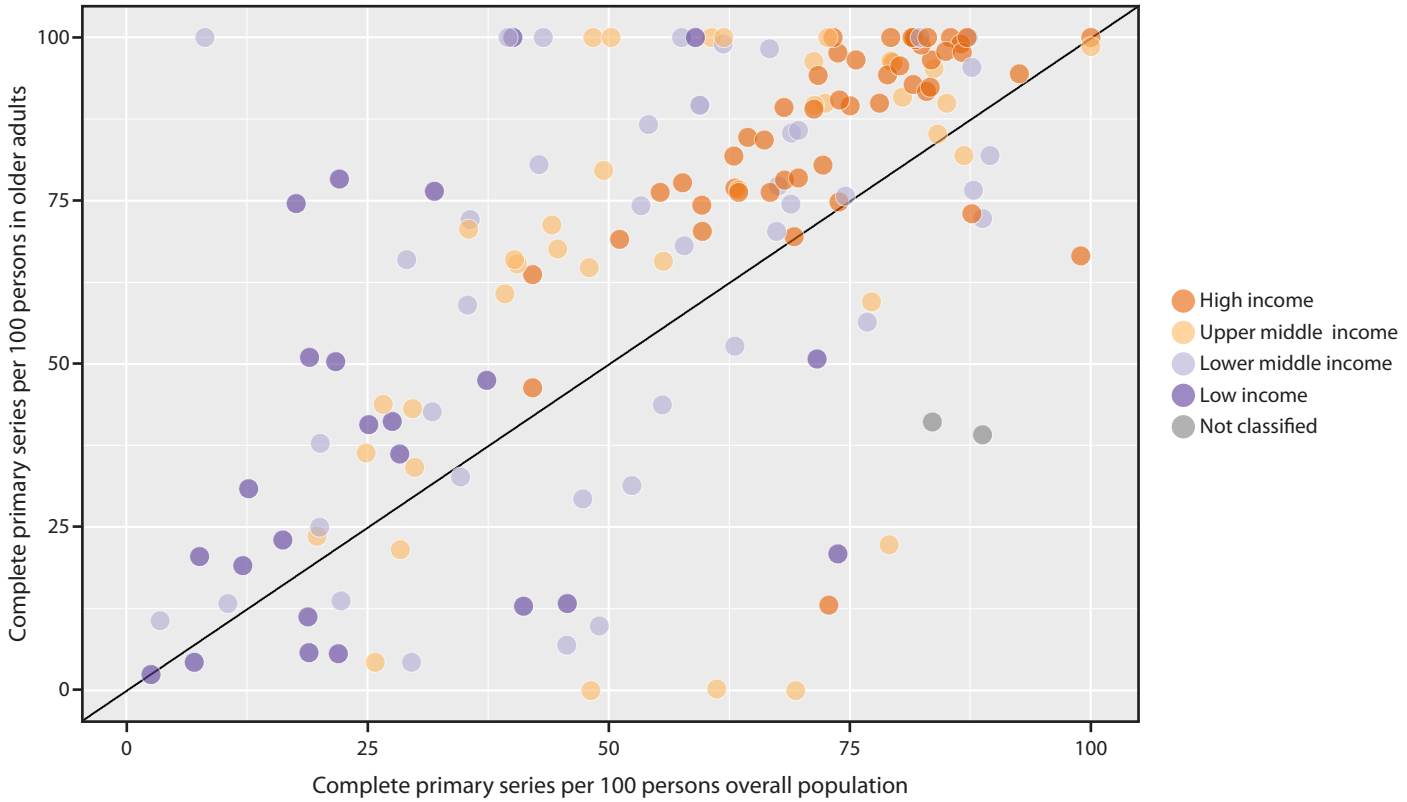
***** https://www.who.int/publications/m/item/covid-19-vaccine-delivery-partnership-september-2022

FIGURE 1. Ratio of excess COVID-19 mortality estimates to aggregate number of reported deaths* — World Health Organization, worldwide, 2020–2021



* The ratio of estimated excess mortality to aggregate reported deaths identified the proportion of deaths that were potentially underreported by countries because of limited testing or nonreporting of causes of death. Model-estimated excess mortality was used in the comparison because it represents a more objective and comparable measure for COVID-19 mortality. Higher ratios represent larger disparities between reported and estimated deaths. https://www.who.int/data/stories/global-excess-deaths-associated-with-covid-19-january-2020-december-2021

FIGURE 2. Completed COVID-19 primary vaccination series coverage* reported by countries† among overall population and among older adults, by World Bank income group — World Health Organization, worldwide, December 30, 2022



* Figure shows coverage among older adults was the same or lower than that in the overall population in 36 (23%) countries, including four high-income, eight upper-middle–income, 14 lower-middle–income, eight low-income, and two nonclassified countries.
† The proportions of countries that reported vaccination coverage for older adults at least once during the 2-year period is 83% (48) for the high-income group, 69% (38) for the upper-middle–income group, 96% (43) for the lower-middle–income group, and 68% (23) for the low-income group.

Summary

What is already known about this topic?

COVID-19 vaccines are safe and reduce COVID-19 mortality. The World Health Organization (WHO) recommends that countries prioritize populations at increased risk, e.g., older adults, for COVID-19 vaccination with a goal of 100% coverage with a completed primary series for populations at-risk.

What is added by this report?

COVID-19–associated mortality among persons aged ≥60 years exceeded 80% of total COVID-19 mortality in 2020 and 2021 across all income groups; however, the median reported completed primary series coverage among older adults in 2022 was 76%, substantially below the WHO goal, especially in middle- and low-income countries.

What are the implications for public health practice?

Efforts are needed to increase COVID-19 primary series and periodic booster dose coverage among older adults as recommended by WHO and national health authorities.

systems to provide better and more detailed data to guide public policies. The collection of accurate disaggregated data by age, and by vaccination dose (i.e., primary series and booster doses), will be critical to monitoring progress in achieving coverage targets among older adults at highest risk for COVID-19–associated death. Because vaccination rates among older adult populations remain below the recommended global vaccination target of 100%, efforts are needed to understand and address the reasons that target populations are not reached by current vaccination programs, while integrating COVID-19 vaccination into primary care systems to facilitate completion of a primary COVID-19 vaccination series and receipt of booster doses recommended by WHO and national health authorities for all older adults.

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Early Estimates of Bivalent mRNA Booster Dose Vaccine Effectiveness in Preventing Symptomatic SARS-CoV-2 Infection Attributable to Omicron BA.5– and XBB/XBB.1.5–Related Sublineages Among Immunocompetent Adults — Increasing Community Access to Testing Program, United States, December 2022–January 2023

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The SARS-CoV-2 Omicron sublineage XBB was first detected in the United States in August 2022.* XBB together with a sublineage, XBB.1.5, accounted for >50% of sequenced lineages in the Northeast by December 31, 2022, and 52% of sequenced lineages nationwide as of January 21, 2023. COVID-19 vaccine effectiveness (VE) can vary by SARS-CoV-2 variant; reduced VE has been observed against some variants, although this is dependent on the health outcome of interest. The goal of the U.S. COVID-19 vaccination program is to prevent severe disease, including hospitalization and death (*1*); however, VE against symptomatic infection can provide useful insight into vaccine protection against emerging variants in advance of VE estimates against more severe disease. Data from the Increasing Community Access to Testing (ICATT) national pharmacy program for SARS-CoV-2 testing were analyzed to estimate VE of updated (bivalent) mRNA COVID-19 vaccines against symptomatic infection caused by BA.5-related and XBB/XBB.1.5-related sublineages among immunocompetent adults during December 1, 2022–January 13, 2023. Reduction or failure of spike gene (*S*-gene) amplification (SGTF) in real-time reverse transcription–polymerase chain reaction (RT-PCR) was used as a proxy indicator of infection with likely BA.5-related sublineages and *S*-gene target presence (SGTP) of infection with likely XBB/XBB.1.5-related sublineages (*2*). Among 29,175 nucleic acid amplification tests (NAATs) with SGTF or SGTP results available from adults who had previously received 2–4 monovalent COVID-19 vaccine doses, the relative VE of a bivalent booster dose given 2–3 months earlier compared with no bivalent booster in persons aged 18–49 years was 52% against symptomatic BA.5 infection and 48% against symptomatic XBB/XBB.1.5 infection. As new SARS-CoV-2 variants emerge, continued vaccine effectiveness monitoring is important. Bivalent vaccines appear to provide additional protection against symptomatic BA.5-related sublineage and XBB/XBB.1.5-related sublineage infections in persons who had previously received 2, 3, or 4 monovalent vaccine doses. All persons should stay up to date with recommended COVID-19 vaccines, including receiving a bivalent booster dose when they are eligible.

ICATT is designed to increase access to SARS-CoV-2 testing in areas with high social vulnerability† through testing at selected pharmacy- and community-based testing sites nationwide.§ ICATT VE methods have been described previously (*3*,*4*). Briefly, at test registration, adults report information on vaccination history,¶ current COVID-19–like illness symptoms, previous positive SARS-CoV-2 test results, and underlying medical conditions. Adults receiving testing at participating sites during December 1, 2022–January 13, 2023, who reported one or more COVID-19–like illness symptoms were included. For this analysis, eligible tests were those performed at a commercial laboratory that used the real-time RT-PCR TaqPath COVID-19 Combo Kit (ThermoFischer Scientific); quantitative results were reported as cycle threshold (Ct) values for each of three SARS-CoV-2 gene targets (*S*, *N*, and *ORF1ab*). Specimens with missing Ct values for *N* or *ORF1ab* were excluded. SARS-CoV-2–positive specimens with either null or reduced amplification of the spike *S*-gene (Ct for *S*-gene >4 cycles from the average of *N* and *ORF1ab* Ct values) were considered to have SGTF (*5*); SARS-CoV-2–positive

* https://outbreak.info

† The Social Vulnerability Index (SVI) is a tool that uses U.S. Census Bureau data on 16 social factors to rank social vulnerability by U.S. Census Bureau tract. The scale is from zero to 1; higher SVIs represent more vulnerable communities. Tests with missing SVI data (<1% of total) were excluded from all analyses. https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html

§ https://www.cdc.gov/icatt/index.html

¶ Test registrants who report receiving COVID-19 vaccines were asked to report the total number of doses and manufacturers of vaccines received and, for the most recent dose, month and year of receipt; therefore, the number of months between a vaccine dose and testing is a whole number calculated as the difference between the month and year of testing and the month and year of receipt of the vaccine dose. For doses received in the same month or the month before SARS-CoV-2 testing, an additional question was asked to specify whether the dose was received ≥2 weeks before testing; only those doses received ≥2 weeks before testing were included.

specimens without SGTF were considered to exhibit SGTP. SGTF or SGTP can serve as a proxy marker of SARS-CoV-2 lineages and sublineages with or without a deletion of amino acids 69–70 in the N-terminal domain of the spike protein, respectively (*5*). Currently circulating SARS-CoV-2 variants were classified by SGTF (BQ.1.1, BQ.1, BF.7, and other BA.4 and BA.5 sublineages) and SGTP (XBB.1.5, XBB, BN.1, and other BA.2 sublineages). During the week ending December 3, 2022, approximately 13% of specimens sequenced nationwide were BA.2 sublineages, including 2.4% XBB.1.5 (95% CI = 0.6%–6.2%) and 5.0% XBB (95% CI = 3.7%–6.6%); by the end of the analytic period, these proportions had risen to approximately 41%, including 37.2% XBB.1.5 (95% prediction interval [PI] = 26.8%–49.0%) and 4.0% XBB (95% PI = 3.3%–4.7%).**

Case-patients were persons who received a positive laboratory-based NAAT result classified as SGTF (BA.5-related) or SGTP (XBB/XBB.1.5-related); control-patients were those who received a negative NAAT result. Tests among persons fulfilling any of following criteria were excluded from analyses: 1) presence of an immunocompromising condition††; 2) unvaccinated or receipt of only 1 COVID-19 vaccine dose; 3) receipt of a non-mRNA COVID-19 vaccine; 4) receipt of >4 monovalent mRNA doses if aged ≥50 years or >3 monovalent doses if aged 18–49 years; or 5) receipt of only 2 mRNA doses, with the second dose received <4 months before the SARS-CoV-2 test. Persons reporting an mRNA booster dose on or after September 1, 2022, were assumed to have received a bivalent dose because monovalent mRNA doses were not authorized for use as booster doses at that time.§§ In addition, tests from persons who reported a positive SARS-CoV-2 test result during the preceding 90 days¶¶ were excluded to avoid analyzing multiple tests for the same illness episode or reinfections within a relatively short time frame. Relative VE of a bivalent booster dose was calculated by comparing odds of receipt of a bivalent booster dose with those of no bivalent booster dose among persons who had received 2–4 monovalent vaccine doses. Odds ratios (ORs) were estimated using multivariable logistic regression***; VE was calculated separately based on SGTF/SGTP status as (1 – OR) x 100.

As of January 16, 2023, genomic sequencing data were available for a random subset of ICATT specimens with SGTP and collection dates through January 2, showing an increase in XBB.1.5 prevalence over time. During December 1, 2022–January 2, 2023, XBB.1.5 comprised 33% (495) of specimens exhibiting SGTP. During the interval December 11–January 2, XBB.1.5 accounted for 38% of sequenced ICATT specimens with SGTP (377), and during the interval December 18–January 2, XBB.1.5 accounted for 43% of sequenced ICATT specimens with SGTP (252)(*2*). As XBB.1.5 has continued to increase nationwide, true proportions of XBB.1.5 in the analytic dataset, which included tests through January 13, were likely higher, but sequencing results were not yet available for specimens collected during the whole period. Sensitivity analyses were conducted using two intervals, December 11, 2022–January 13, 2023, and December 18, 2022–January 13, 2023, to assess the effect of different proportions of the XBB.1.5 sublineage among SGTP cases during early December. Analyses were conducted using R software (version 4.1.2; R Foundation). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.†††

Among 29,175 NAAT results among persons with COVID-19–like illness symptoms eligible for this analysis, 13,648 (47%) were positive for SARS-CoV-2, including 10,596 (78%) with SGTF (BA.5-related) and 3,052 (22%) with SGTP (XBB/XBB.1.5-related) (Table 1). More control-patients who received negative SARS-CoV-2 test results reported having received a bivalent COVID-19 mRNA booster (34%) than did case-patients with positive SARS-CoV-2 test results (SGTF = 22%; SGTP = 21%). Among those who had received only monovalent vaccine doses, 45% reported a positive SARS-CoV-2 test result >90 days before the current test, compared with 34% among those who received a

** As of January 21, 2023. Variant proportions for the most recent 3 weeks are model-based projections using the Nowcast. These projections can be uncertain or fluctuate within a wide prediction interval when a variant is just beginning to spread (i.e., has a low number of sequences and has a growth rate that is unstable). A prediction interval is an estimate of an interval in which a future observation will fall, based on what has already been observed. https://covid.cdc.gov/covid-data-tracker/#variant-proportions

†† Test registration forms asked persons to report whether they had an immunocompromising condition and provided the following examples: immunocompromising medications, solid organ or blood stem cell transplant, HIV, or other immunocompromising conditions.

§§ https://www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html

¶¶ https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/testing.html

*** Multivariable logistic regression models were controlled for age (adjusting for single year of age), gender, race, ethnicity, SVI of the testing location (<0.5 versus ≥0.5), underlying conditions (presence versus absence), U.S. Department of Health and Human Services region of testing location, local incidence (cases per 100,000 by individual county and state during the 7 days preceding test date), and date of testing. The following underlying conditions were included on the test registration questionnaire: heart conditions, high blood pressure, overweight or obesity, diabetes, current or former smoker, kidney failure or end stage renal disease, cirrhosis of the liver, and chronic lung disease (such as chronic obstructive pulmonary disease, moderate to severe asthma, cystic fibrosis, or pulmonary embolism).

††† 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

bivalent dose. Among those who had received only monovalent vaccine doses, the median interval since the last dose was 13 months (IQR = 11–17) for case-patients and 13 months (IQR = 11–18) for control-patients.

Across age groups, VE was generally similar against BA.5-related infections and XBB/XBB.1.5-related infections. VE against symptomatic BA.5-related infection was 52% among persons aged 18–49 years, 43% among persons aged 50–64, and 37% among those aged ≥65 years (Table 2). VE against symptomatic XBB/XBB.1.5-related infection was 49% among persons aged 18–49, 40% among persons aged 50–64 years, and 43% among those aged ≥65 years. Evidence of waning VE by 2–3 months after receiving a bivalent dose based on point estimates was minimal, although estimates were imprecise. Sensitivity analyses did not show a meaningful change in VE by different analytic period start dates (Table 3).

TABLE 1. Characteristics of patients with SARS-CoV-2 nucleic acid amplification tests, by *S*-gene target status (N = 29,175) — Increasing Community Access to Testing program, United States, December 1, 2022–January 13, 2023

Characteristic	No. (Col. %)		
	SARS-CoV-2 control-patients with negative test results	SARS-CoV-2 case-patients with positive test results	
		SGTF (likely BA.5-related)	SGTP (likely XBB/XBB.1.5-related)
All tests	**15,527**	**10,596**	**3,052**
Age group, yrs			
18–49	9,907 (64)	6,353 (60)	1,860 (61)
50–64	3,218 (21)	2,639 (25)	784 (26)
≥65	2,402 (15)	1,604 (15)	408 (13)
Gender			
Female	9,951 (64)	6,214 (59)	1,771 (58)
Male	5,495 (35)	4,347 (41)	1,269 (42)
Other	81 (1)	35 (0.3)	12 (0.4)
Race and ethnicity			
Black or African American, NH	1,897 (12)	1,216 (11)	417 (14)
Hispanic or Latino	3,047 (20)	2,558 (24)	742 (24)
White, NH	7,576 (49)	4,629 (44)	1,260 (41)
Other, NH	2,100 (14)	1,539 (15)	433 (14)
Unknown	907 (6)	654 (6)	200 (7)
HHS testing site region*			
Region 1	1,280 (8)	583 (6)	383 (13)
Region 2 – New York and New Jersey only	1,498 (10)	870 (8)	693 (23)
Region 2 – Puerto Rico only	107 (1)	115 (1)	43 (1)
Region 3	913 (6)	538 (5)	232 (8)
Region 4	3,043 (20)	1,899 (18)	535 (18)
Region 5	3,330 (21)	2,355 (22)	412 (13)
Region 6	1,738 (11)	1,168 (11)	254 (8)
Region 7	326 (2)	204 (2)	35 (1)
Region 8	400 (3)	228 (2)	45 (1)
Region 9	2,673 (17)	2,524 (24)	410 (13)
Region 10	219 (1)	112 (1)	10 (0.3)
SVI, mean (SD)†	0.5 (0.3)	0.5 (0.3)	0.5 (0.3)
History of self-reported SARS-CoV-2 positive test result			
None	7,556 (49)	7,546 (71)	1,921 (63)
Positive >90 days before current test	7,971 (51)	3,050 (29)	1,131 (37)
Self-reported ≥1 chronic underlying condition§			
No	9,376 (60)	6,323 (60)	1,899 (62)
Yes	6,151 (40)	4,273 (40)	1,153 (38)
Among persons who received only monovalent mRNA doses, no. of monovalent doses¶			
2	5,131 (50)	3,933 (47)	1,125 (47)
3	4,415 (43)	3,754 (45)	1,111 (46)
4**	692 (7)	594 (7)	162 (7)
Received bivalent booster dose			
No	10,238 (66)	8,281 (78)	2,398 (79)
Yes	5,289 (34)	2,315 (22)	654 (21)
Among persons who received a bivalent mRNA dose, no. of monovalent doses			
2	580 (11)	248 (11)	69 (11)
3	3,427 (65)	1,433 (62)	427 (65)
4**	1,282 (24)	634 (27)	158 (24)

Abbreviations: HHS = U.S. Department of Health and Human Services; ICATT = Increasing Community Access to Testing program; NH = non-Hispanic; SGTF = *S*-gene target failure; SGTP = *S*-gene target presence; SVI = Social Vulnerability Index.

* Regions are defined by HHS and include only states and territories with ICATT sites. U.S. Virgin Islands (Region 2) and American Samoa, Federated States of Micronesia, Guam, Marshall Islands, Northern Mariana Islands, and Palau (Region 9) were not included because they did not have pharmacies participating in ICATT. States included in each region are available at https://www.hhs.gov/about/agencies/iea/regional-offices/index.html. For purposes of this analysis and because of the regional pattern of XBB-lineage infections, HHS Region 2 was split into "Region 2 – New York and New Jersey only" and "Region 2 – Puerto Rico only."

† SVI is a tool that uses U.S. Census Bureau data on 16 social factors to rank social vulnerability by U.S. Census Bureau tract. The scale is from zero to 1; higher SVIs represent more vulnerable communities. Tests with missing SVI data (<1% of total) were excluded from all analyses. https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html

§ Underlying conditions included on the test registration questionnaire were heart conditions, high blood pressure, overweight or obesity, diabetes, current or former smoker, kidney failure or end stage renal disease, cirrhosis of the liver, and chronic lung disease (e.g., chronic obstructive pulmonary disease, moderate to severe asthma, cystic fibrosis, or pulmonary embolism).

¶ Test registrants who reported receiving COVID-19 vaccines were asked to report the total number of doses and manufacturers of vaccines received and for the most recent dose, month, and year of receipt; therefore, the number of months between a vaccine dose and testing is a whole number calculated as the difference between the month and year of testing and the month and year of the vaccine dose. Persons reporting an mRNA booster dose on or after September 1, 2022, were assumed to have received a bivalent dose because no monovalent mRNA doses were authorized for use as booster doses at that time. For doses received in the same month or the month before SARS-CoV-2 testing, an additional question was asked to specify whether the dose was received ≥2 weeks before testing, and only doses received ≥2 weeks before testing were included.

** Persons aged <50 years without moderate or severe immunocompromise were not eligible for a fourth monovalent (second booster) dose.

TABLE 2. Relative vaccine effectiveness* of a single bivalent mRNA COVID-19 booster received after 2–4 monovalent vaccine doses against symptomatic SARS-CoV-2 infection, by age group and *S*-gene target status — Increasing Community Access to Testing program, United States, December 1, 2022–January 13, 2023

		SARS-CoV-2 negative test results	SARS-CoV-2–positive test results by *S*-gene target status			
			SGTF (likely BA.5-related)		SGTP (likely XBB/XBB.1.5-related)	
Age group, yrs/mRNA dosage pattern†	Total no of tests	No. (row %)	No. (row %)	VE (95% CI)	No. (row %)	VE (95% CI)
18–49						
Received 2–3 monovalent doses only (Ref)§	13,921	7,043 (51)	5,326 (38)	—	1,552 (11)	—
Overall (≥2 weeks since bivalent booster dose)	4,199	2,864 (68)	1,027 (24)	52 (48–56)	308 (7)	49 (41–55)
0–1 month since bivalent booster	1,056	716 (68)	262 (25)	51 (43–58)	78 (7)	50 (36–61)
2–3 months since bivalent booster	3,143	2,148 (68)	765 (24)	52 (48–56)	230 (7)	48 (39–55)
50–64						
Received 2–4 monovalent doses only (Ref)	4,603	2,036 (44)	1,983 (43)	—	584 (13)	—
Overall (≥2 weeks since bivalent booster dose)	2,038	1,182 (58)	656 (32)	43 (36–49)	200 (10)	40 (28–50)
0–1 month since bivalent booster	538	336 (62)	149 (28)	54 (43–63)	53 (10)	45 (25–60)
2–3 months since bivalent booster	1,500	846 (56)	507 (34)	39 (30–46)	147 (10)	38 (24–50)
≥65						
Received 2–4 monovalent doses only (Ref)	2,393	1,159 (48)	972 (41)	—	262 (11)	—
Overall (≥2 weeks since bivalent booster dose)	2,021	1,243 (62)	632 (31)	37 (28–44)	146 (7)	43 (29–55)
0–1 month since bivalent booster	381	260 (68)	94 (25)	55 (42–65)	27 (7)	50 (24–68)
2–3 months since bivalent booster	1,640	983 (60)	538 (33)	32 (21–40)	119 (7)	42 (26–54)

Abbreviations: Ref = referent group; SGTF = *S*-gene target failure; SGTP = *S*-gene target presence; VE = vaccine effectiveness.

* VE = (1 – adjusted odds ratio) x 100. Odds ratios were calculated using multivariable logistic regression, adjusting for single year of age, gender, race, ethnicity, Social Vulnerability Index of the testing location (<0.5 versus ≥0.5), underlying conditions (presence versus absence), U.S. Department of Health and Human Services region, local incidence (cases per 100,000 by individual county and state in the 7 days before test date), and testing calendar date.

† For doses received in the same month or the month preceding SARS-CoV-2 testing, an additional question was asked to specify whether the dose was received ≥2 weeks before testing, and only doses received ≥2 weeks before testing were included.

§ Persons aged <50 years without moderate or severe immunocompromise were not eligible for a fourth monovalent (second booster) dose, so the Ref for this age stratum includes only those who received 2–3 monovalent doses.

Discussion

This report provides the first estimates of bivalent mRNA COVID-19 VE against symptomatic SARS-CoV-2 infection with XBB-related sublineages. These preliminary estimates from national pharmacy testing conducted during December 1, 2022–January 13, 2023, showed relative bivalent booster dose VE (compared with 2–4 monovalent doses) to be similar for XBB/XBB.1.5 sublineage–related infections and BA.5 sublineage–related infections. VE estimates for both sublineages included in this analysis were similar to estimates from the same ICATT network published during a period of Omicron BA.5, BQ.1, and BQ.1.1 sublineage circulation in fall 2022 (*6*).

Early immunogenicity studies indicating lower neutralizing activity against XBB compared with other Omicron sublineages after receiving a bivalent booster dose compared with that against other Omicron sublineages (*7*) have raised concerns about potential reduction in VE against these emerging variants. Bivalent boosters contain mRNA encoding the *S*-gene from the SARS-CoV-2 ancestral strain and Omicron BA.4/BA.5 sublineages (*8*); XBB and XBB.1.5, however, are descendants of the Omicron BA.2 sublineage.§§§ Findings from this study suggest that bivalent booster doses are continuing to provide additional protection against symptomatic infection for at least the first 3 months after vaccination in persons who had previously received 2, 3, or 4 monovalent vaccine doses, which supports recommendations to continue to increase bivalent booster coverage.

The SGTP data in these analyses include infections with a mix of XBB, XBB.1.5, and other BA.2-related sublineages. Among specimens collected during December 1, 2022–January 2, 2023, with SGTP and with genomic sequencing results available, XBB accounted for 26%, and XBB.1.5 accounted for 33%. Together XBB/XBB.1.5 accounted for >50% of specimen sequences, which is a typical threshold considered for variant predominance in ecologic studies of variant VE (*8*). XBB.1.5, which is gaining predominance nationwide, includes one additional change in the spike receptor-binding domain compared with XBB, but it is currently unclear how this mutation might affect VE. Sensitivity analyses that assessed a subset of data from later in the analytic period when XBB.1.5 represented a larger proportion of SGTP specimens did not show differences in VE; however, because circulating variants in the United States continue to change, VE should continue to be monitored.

The findings in this report are subject to at least four limitations. First, vaccination status, previous infection history, and underlying medical conditions were self-reported and might be

§§§ https://www.who.int/news/item/27-10-2022-tag-ve-statement-on-omicron-sublineages-bq.1-and-xbb

TABLE 3. Sensitivity analyses of relative vaccine effectiveness* of a single bivalent mRNA COVID-19 booster dose received after 2–4 monovalent vaccine doses against symptomatic SARS-CoV-2 XBB/XBB.1.5 infection, by age group during two time intervals — Increasing Community Access to Testing program, United States, December 11, 2022–January 13, 2023, and December 18, 2022–January 13, 2023

		SARS-CoV-2–negative test results	SARS-CoV-2 positive test results with SGTP (likely XBB/XBB.1.5-related)	
Age group, yrs/Interval/mRNA dosage pattern†	Total no. of tests§	No. (row %)	No. (row %)	VE (95% CI)
18–49				
Dec 11, 2022–Jan 13, 2023				
Received 2–3 monovalent doses only (Ref)¶	**10,335**	5,213 (50)	1,334 (13)	—
Overall (≥2 weeks since bivalent booster dose)	**3,262**	2,216 (68)	261 (8)	51 (43–58)
Dec 18, 2022–Jan 13, 2023				
Received 2–3 monovalent doses only (Ref)	**7,901**	4,005 (51)	1,129 (14)	—
Overall (≥2 weeks since bivalent booster dose)	**2,503**	1,709 (68)	218 (9)	51 (42–58)
50–64				
Dec 11, 2022–Jan 13, 2023				
Received 2–4 monovalent doses only (Ref)	**3,433**	1,494 (44)	505 (15)	—
Overall (≥2 weeks since bivalent booster dose)	**1,555**	890 (57)	177 (11)	40 (26–51)
Dec 18, 2022–Jan 13, 2023				
Received 2–4 monovalent doses only (Ref)	**2,612**	1,144 (44)	428 (16)	—
Overall (≥2 weeks since bivalent booster dose)	**1,209**	697 (58)	146 (12)	42 (27–53)
≥65				
Dec 11, 2022–Jan 13, 2023				
Received 2–4 monovalent doses only (Ref)	**1,839**	903 (49)	227 (12)	—
Overall (≥2 weeks since bivalent booster dose)	**1,547**	940 (61)	128 (8)	42 (26–55)
Dec 18, 2022–Jan 13, 2023				
Received 2–4 monovalent doses only (Ref)	**1,441**	708 (49)	194 (13)	—
Overall (≥2 weeks since bivalent booster dose)	1,204	732 (61)	111 (9)	41 (23–55)

Abbreviations: Ref = referent group; SGTF = *S*-gene target failure; SGTP = *S*-gene target presence; VE = vaccine effectiveness.

* VE = (1 – adjusted odds ratio) x 100. Odds ratios were calculated using multivariable logistic regression, adjusting for single year of age, gender, race, ethnicity, Social Vulnerability Index of the testing location (<0.5 versus ≥0.5), underlying conditions (presence versus absence), U.S. Department of Health and Human Services region, local incidence (cases per 100,000 by individual county and state in the 7 days before test date), and testing calendar date.

† For doses received in the same month or the month before SARS-CoV-2 testing, an additional question was asked to specify whether the dose was received ≥2 weeks before testing; only doses received ≥2 weeks before testing were included.

§ Total tests include those that returned positive results for SARS-CoV-2 and had SGTF but are not included in this table. Row totals do not sum to 100%.

¶ Persons aged <50 years without moderate or severe immunocompromise were not eligible for a fourth monovalent (second booster) dose, so the Ref for this age strata includes only those who received 2–3 monovalent doses.

subject to recall bias. Self-reported frequency of previous infections differed by vaccination status, test result positivity, and SGTF status, but statistical power was not adequate to stratify by presence of previous infection >90 days earlier. Further, previous infection is likely underreported (*9*). Previous infection provides some protection against repeat infection (*10*); therefore, VE estimates in this study might be biased toward no effect. Second, bivalent booster dose coverage to date has been low (6%–39% among persons aged ≥18 years among different age groups as of January 14, 2023),¶¶¶ which could bias results if persons getting vaccinated earlier are systematically different from those vaccinated later. Third, data on SARS-CoV-2 exposure risk and mask use were not collected; biases might also arise because of differences in testing behaviors between vaccinated and unvaccinated persons, which might result in residual confounding. Finally, this analysis did not control for time since last monovalent dose; however, because monovalent VE against symptomatic infection with Omicron sublineages wanes quickly (*4*), this likely had a minimal effect on results.

Findings from this analysis of national pharmacy testing data show that a bivalent mRNA booster dose provided added protection against symptomatic XBB/XBB.1.5 infection for at least the first 3 months after vaccination in persons who had previously received 2, 3, or 4 monovalent vaccine doses. All persons should stay up to date with recommended COVID-19 vaccines, including receiving a bivalent booster dose when eligible.

¶¶¶ https://covid.cdc.gov/covid-data-tracker/#vaccination-demographics-trends

Summary

What is already known about this topic?

The SARS-CoV-2 Omicron BA.2-related sublineage XBB.1.5 is gaining predominance nationwide. Vaccine effectiveness against XBB and XBB.1.5 is unknown.

What is added by this report?

Using spike (*S*)-gene target presence as a proxy for BA.2 sublineages, including XBB and XBB.1.5, during December 2022–January 2023, the results showed that a bivalent mRNA booster dose provided additional protection against symptomatic XBB/XBB.1.5 infection for at least the first 3 months after vaccination in persons who had previously received 2–4 monovalent vaccine doses.

What are the implications for public health practice?

As new SARS-CoV-2 variants emerge, continued vaccine effectiveness monitoring is important. All persons should stay up to date with recommend COVID-19 vaccines, including receiving a bivalent booster dose when eligible.

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Spike Gene Target Amplification in a Diagnostic Assay as a Marker for Public Health Monitoring of Emerging SARS-CoV-2 Variants — United States, November 2021–January 2023

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Monitoring emerging SARS-CoV-2 lineages and their epidemiologic characteristics helps to inform public health decisions regarding vaccine policy, the use of therapeutics, and health care capacity. When the SARS-CoV-2 Alpha variant emerged in late 2020, a spike gene (*S*-gene) deletion (Δ69–70) in the N-terminal region, which might compensate for immune escape mutations that impair infectivity (*1*), resulted in reduced or failed *S*-gene target amplification in certain multitarget reverse transcription–polymerase chain reaction (RT-PCR) assays, a pattern referred to as *S*-gene target failure (SGTF) (*2*). The predominant U.S. SARS-CoV-2 lineages have generally alternated between SGTF and *S*-gene target presence (SGTP), which alongside genomic sequencing, has facilitated early monitoring of emerging variants. During a period when Omicron BA.5–related sublineages (which exhibit SGTF) predominated, an XBB.1.5 sublineage with SGTP has rapidly expanded in the northeastern United States and other regions.

As part of the Increasing Community Access to Testing (ICATT) program,* specimens collected at a national pharmacy chain were tested at a commercial laboratory that exclusively used the TaqPath COVID-19 Combo Kit (ThermoFisher Scientific) (*3*). Real-time RT-PCR cycle threshold (Ct) results for three gene targets (*S*, *N*, and *ORF1ab*) were reported to U.S. Department of Health and Human Services (HHS) Protect† during November 1, 2021–January 14, 2023. The proportion of SGTF or SGTP§ (*2*) results was calculated weekly at the national and HHS regional levels¶; SGTF data were reported on a public dashboard.** CDC also collects genomic sequencing data from the National SARS-CoV-2 Strain Surveillance program,†† contracted commercial laboratories, and partners that label sequencing results in public repositories as baseline surveillance (*4*). Sequencing data are used to calculate variant proportions, which are published weekly on CDC's COVID Data Tracker.§§ Genomic sequencing results lag 2–3 weeks behind specimen collection, which necessitates nowcasting estimates (*4*) for the most recent 3 weeks (December 25, 2022–January 14, 2023). Geographic representativeness and median interval from specimen collection to result were calculated for both data sources. Trends were assessed in SGTP proportions, variant proportions, and nowcast estimates; all were weighted to represent RT-PCR–positive specimens by state (*4*). Genomic sequencing results, including for a random sample of ICATT specimens, were assessed by SGTF/SGTP status. This activity was conducted consistent with applicable federal law and CDC policy.¶¶

During November 1, 2021–December 24, 2022, national weekly SGTF and SGTP results ranged from 3,104 to 83,805 (median = 102; IQR = 327 per jurisdiction***) and genomic sequencing results ranged from 6,313 to 69,280 (median = 195; IQR = 460 per jurisdiction†††). During December 25, 2022–January 14, 2023, the national weekly average number of SGTF/SGTP and sequencing results were 5,005 and 847, respectively. After specimen collection, SGTF/SGTP results were available sooner (median = 2 days; IQR = 1) than were genomic sequencing results (median = 16 days; IQR = 10).

Trends in SGTP proportions aligned with genomic sequencing results classified by SGTF and SGTP (Figure). For the week ending December 24, 2022, the latest week that weighted variant proportions were available from genomic sequencing, SGTP lineages accounted for 21.5% (XBB.1.5 = 11.8%; XBB = 4.4%; other BA.2-related sequences = 5.3%) of genomic sequences, while the weighted SGTP estimate from

* https://www.cdc.gov/icatt/AboutICATT.html

† CDC's HHS Protect is a secure decision-making and operations platform for the whole-of-government response to the COVID-19 pandemic and serves to collect, integrate, and share COVID-19 data across federal agencies and with state, local, territorial, and tribal partners. https://www.cdc.gov/ncezid/hhs-protect/index.html

§ Specimens with missing Ct values for *N* or *ORF1ab* were excluded. SGTF was defined as a SARS-CoV-2-positive specimen with amplification of the *N* and *ORF1ab* genes along with either a failure or reduced amplification of the *S* gene (*S* Ct value >4 cycles from the average of *N* and *ORF1ab* Ct values). SARS-CoV-2–positive specimens that were not SGTF were considered SGTP.

¶ https://www.hhs.gov/about/agencies/iea/regional-offices/index.html

** At the time of publication, the dashboard is not showing the SGTF proportions, but this functionality is expected to return in the near future. https://www.walgreens.com/businesssolutions/covid-19-index.jsp

†† https://www.cdc.gov/coronavirus/2019-ncov/variants/cdc-role-surveillance.html

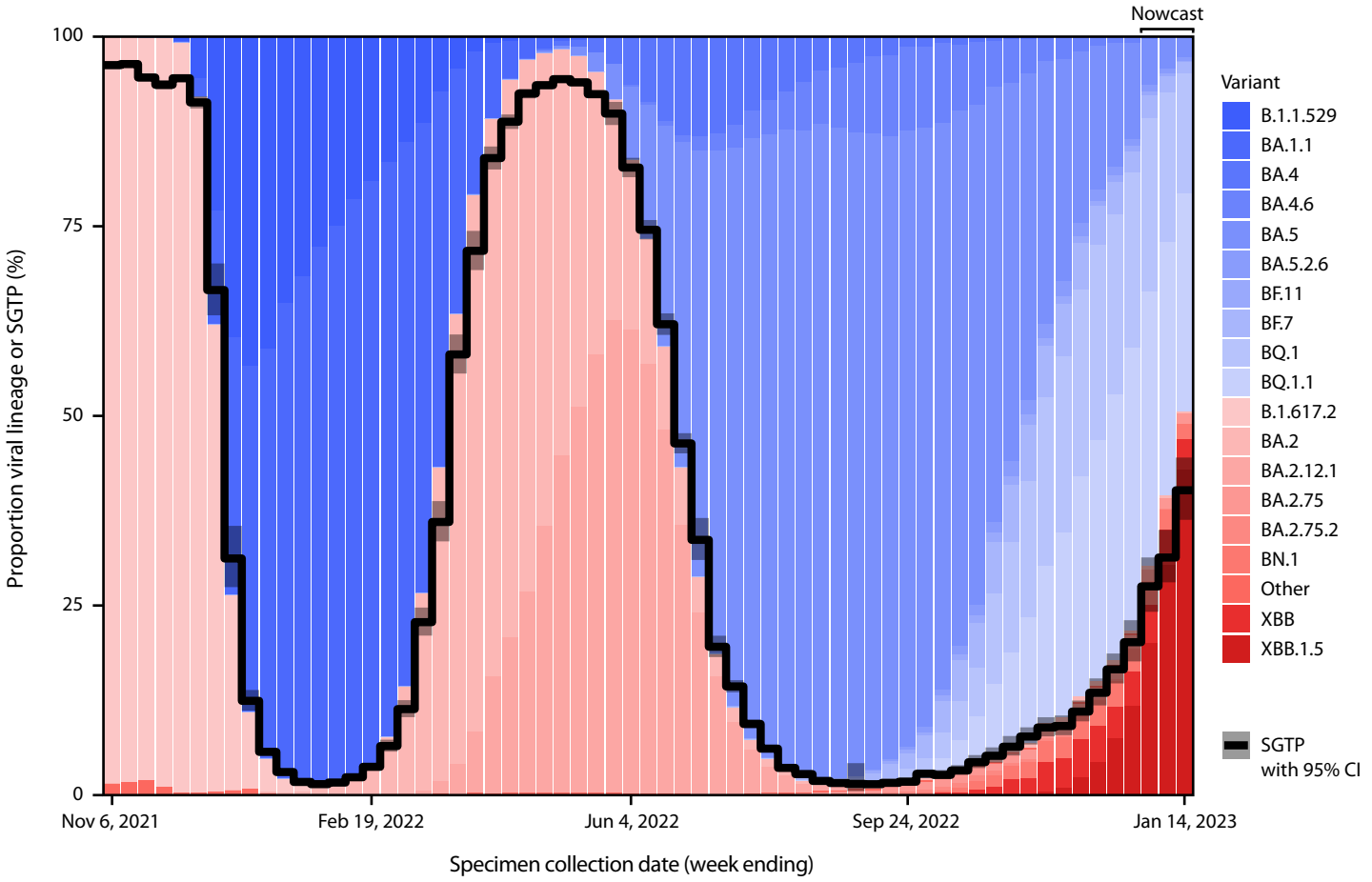
§§ https://covid.cdc.gov/covid-data-tracker/#variant-proportions

¶¶ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect.241(d); 5 U.S.C.0 Sect.552a; 44 U.S.C. Sect. 3501 et seq.

*** Forty-seven states, the District of Columbia, and Puerto Rico.

††† Fifty states, the District of Columbia, and five territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands).

FIGURE. Trends in estimated proportions of SARS-CoV-2 reverse transcription–polymerase chain reaction test results with *S*-gene target presence and variant proportions and nowcast projections from genomic surveillance classified by *S*-gene target presence or *S*-gene target failure* — United States, November 1, 2021–January 14, 2023



Abbreviations: *S*-gene = spike gene; SGTF = *S*-gene target failure; SGTP = *S*-gene target presence.

* Estimates of variant proportions and nowcast projections (for the most recent 3 weeks) are shown. The Delta (B.1.617.2) variant exhibited SGTP; the Omicron (B.1.1.529) variant and BA.1.1 sublineage exhibited SGTF; the Omicron BA.2 and BA.2.12.1 sublineages exhibited SGTP; Omicron BA.4 and BA.5 sublineages (which have the same spike sequence), BA.4-related (BA.4.6) and BA.5-related sublineages (BA.5.2.6, BQ.1, BQ.1.1, BF.7, and BF.11) exhibited SGTF; and BA.2-related sublineages (BA.2.75, BA.2.75.2, BN.1, XBB, and XBB.1.5) exhibited SGTP. The spike deletion (Δ69-70) that results in SGTF is not 100% penetrant in a lineage; SGTF/SGTP classification was made based on a 50% threshold. Most BA.2-related sublineages exhibit >99% SGTP.

ICATT was 20% (95% CI = 18%–23%). For the week ending January 14, 2023, the SGTP estimate from ICATT was 40% (95% CI = 36%–45%); SGTP lineages from sequencing comprised 50.6% (XBB.1.5 = 43.0%; XBB = 3.9%; other BA.2-related sequences=3.7%) of lineages in the nowcast projections reported on January 13, 2023 and 45.5% (XBB.1.5 = 37.2%; XBB = 4.0%; other BA.2-related sequences=4.3%) of lineages in revised nowcast projections for the same week, subsequently reported on January 20, 2023%.[§§§] SGTP accounted for >50% of specimens in HHS regions 1–3 and >20% in all other regions, except Region 10, where the estimated precision was low (Supplementary Figure; https://stacks.cdc.gov/view/cdc/123810). Among genomic sequences from ICATT specimens collected through January 2, 2023, 412 (99%) of 415 XBB-related sequences exhibited SGTP; among those collected during December 1, 2022–January 2, 2023, 294 (59%) of 495 SGTP specimens were XBB-related lineages.

SGTF/SGTP monitoring relies on diagnostic RT-PCR, which is less expensive, permits higher throughput, and faster turnaround of results than sequencing. Using SGTF/SGTP for early studies of emerging variants obviates the need to wait for sequencing results or >50% variant predominance. Limitations are that SGTF/SGTP monitoring is assay-dependent; presumes SARS-CoV-2 lineage classification, requiring further

[§§§] For data on variant proportions for the week ending January 14, 2023, nowcast estimates and 95% prediction intervals (95% PI) reported on the January 13, 2023, were 43.0% (26.4%–61.1%) for XBB.1.5 and 3.9% (95% PI = 3.0%–5.1%) for XBB. For the same week, nowcast estimates reported on January 20, 2023, were 37.2% (95% PI = 26.8%–49.0%) for XBB.1.5 and 4.0% (95% PI = 3.3%–4.7%) for XBB. Composite prediction intervals for other BA.2-related lineages were unavailable.

validation by genomic surveillance; cannot discriminate mutations beyond Δ69–70 (i.e., BA.2-related sequences or even between BA.4 and BA.5); and relies on continued changing SGTF/SGTP patterns compared with predominant lineages. SARS-CoV-2 sequencing remains the standard for genomic surveillance because it allows definitive classification of viral lineages and identification of emerging strains for further characterization.

When early nowcast estimates of rapidly emerging variants lacked precision and geographic resolution because of lags in genomic sequencing results, SGTF/SGTP estimates were used as complementary data by CDC and the SARS-CoV-2 Interagency Group to support guidance on the use of monoclonal antibody therapies.¶¶¶ SGTF/SGTP data were also used as proxy markers in several early studies of vaccine effectiveness and severity of emerging variants (*3*,*5*,*6*). Continued monitoring of SGTF/SGTP patterns will likely serve as a useful complement to genomic surveillance of SARS-CoV-2 lineages.

¶¶¶ https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-classifications.html

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Information for Persons Who Are Immunocompromised Regarding Prevention and Treatment of SARS-CoV-2 Infection in the Context of Currently Circulating Omicron Sublineages — United States, January 2023

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On January 27, 2023, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

As of January 20, 2023, >90% of circulating SARS-CoV-2 variants in the United States, specifically Omicron BQ.1, BQ.1.1, XBB, and XBB.1.5 sublineages, are unlikely to be susceptible to the combined monoclonal antibodies, tixagevimab and cilgavimab (Evusheld) used for preexposure prophylaxis against SARS-CoV-2 infection (*1*). The Food and Drug Administration announced on January 26, 2023, that Evusheld is not currently authorized for preexposure prophylaxis against SARS-CoV-2 infection in the United States (*2*). It is important that persons who are moderately to severely immunocompromised,* those who might have an inadequate immune response to COVID-19 vaccination, and those with contraindications to receipt of COVID-19 vaccines, exercise caution and recognize the need for additional preventive measures (Box). In addition, persons should have a care plan that includes prompt testing at the onset of COVID-19 symptoms and rapid access to antivirals if SARS-CoV-2 infection is detected.

COVID-19 vaccination remains the most effective way to prevent SARS-CoV-2–associated serious illness, hospitalization, and death. All persons, including those who are immunocompromised and their household members and close contacts, should stay up to date with COVID-19 vaccination, and receive the updated (bivalent) booster dose, when eligible.† Although persons who are moderately to severely immunocompromised might not mount a strong vaccine-mediated immune response, staying up to date with COVID-19 vaccination§ does provide some protection (*3*,*4*). A recent CDC study of preliminary data showed that a bivalent booster dose provided additional protection against symptomatic SARS-CoV-2 infection among immunocompetent persons who had previously received 2, 3, or 4 monovalent vaccine doses (*4*).

Despite evidence of vaccine effectiveness, coverage with the bivalent booster dose across the United States remains low. As of January 18, 2023, 15.3% of persons aged ≥5 years had received a bivalent booster dose (*5*). CDC recommends that all eligible persons aged ≥6 months receive 1 bivalent booster dose. Persons are eligible for a bivalent booster dose if they are aged 6 months–5 years and have completed a Moderna COVID-19 primary series ≥2 months earlier. Persons aged 6 months–4 years and who received a 2-dose Pfizer COVID-19 primary series ≥8 weeks earlier can receive the bivalent booster as their third dose.

Among persons with immunocompromise and their household members and close contacts, prevention measures¶ including wearing a high-quality and well-fitting mask,** maintaining physical distance from others (≥6 ft [1.8 m]), improving indoor ventilation,†† practicing frequent handwashing, and developing a care plan,§§ should be considered in addition to receipt of a bivalent booster dose. It is important to wear a mask and maintain physical distance from others if it is not possible to avoid crowded indoor spaces. In addition, simple interventions should be used to improve ventilation in buildings and decrease SARS-CoV-2 transmission by improving air flow. CDC has developed interactive tools¶¶ to help identify ways to improve ventilation in the home. In-duct ultraviolet germicidal irradiation lights can also be added to home heating ventilation and air conditioning systems to inactivate SARS-CoV-2 as air passes through the system.*** Frequent handwashing with soap and water is the best way to eliminate germs in most situations. If soap and water are not readily available, an alcohol-based hand sanitizer containing ≥60% alcohol is a good alternative. Also, it is important for persons who are immunocompromised to develop a care plan in consultation with their physician, in the event that they develop COVID-19.

Persons with mild to moderate symptoms of COVID-19 who 1) are aged ≥50 years, 2) have an underlying health

* https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-who-are-immunocompromised.html#
† https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html
§ https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/immuno.html
¶ https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html
** https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/types-of-masks.html
†† https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/improving-ventilation-home.html
§§ https://www.cdc.gov/coronavirus/2019-ncov/downloads/332440-A_FS_COVID_Plan_FINAL.pdf
¶¶ https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/interactive-ventilation-tool.html
*** https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html

BOX. Prevention measures against SARS-CoV-2 for persons who are immunocompromised, their household members, and close contacts in the context of currently circulating Omicron sublineages — United States, January 2023

Because Evusheld is not currently authorized for preexposure prophylaxis against SARS-CoV-2 infection in the United States, it is important that persons who are moderately to severely immunocompromised,* those who might have an inadequate immune response to COVID-19 vaccination, and those with contraindications to receipt of COVID-19 vaccines, exercise caution and recognize the need for additional preventive measures to protect themselves from SARS-CoV-2 infection. Persons with immunocompromise, their household members, and close contacts can use the following steps and precautions to help prevent SARS-CoV-2 infection and mitigate COVID-19 illness if they become infected.

COVID-19 vaccines, booster doses, and staying up to date*

- COVID-19 vaccines remain the best way to protect against severe COVID-19. COVID-19 vaccines help the body develop protection against SARS-CoV-2 infection. Although vaccinated persons sometimes get infected with SARS-CoV-2, staying up to date with COVID-19 vaccines significantly lowers the risk for severe illness, hospitalization, or death from COVID-19.
- CDC recommends that all persons who are eligible, especially those who are immunocompromised or have weakened immune systems,† get an updated (bivalent) booster dose and stay up to date with their COVID-19 vaccines.

Personal COVID-19 action plan§

- Persons should consider how to protect themselves and others around them should they become ill with COVID-19 or if the community COVID-19 transmission level changes. The plan should include:
  - ways to protect oneself and others including considerations in case of illness, such as finding a room in which to isolate
  - actions to take in case of exposure or symptom onset
  - what to do in the event of receipt of a positive SARS-CoV-2 test result
- Persons should share their COVID-19 plan with their family, friends, and health care providers so they can support prevention and preparation steps. CDC suggests that persons consider how others can help them if they get ill. It is important to adhere to treatment plans, keep routine health care appointments, and ensure that prescriptions are filled. Persons should make alternative plans for work, child care, and other responsibilities that might cause stress if they become ill.

Masks or respirators¶

- Masks are made to contain droplets and particles that persons breathe, cough, or sneeze. A variety of masks are available. Some masks provide a higher level of protection than others. Wearing a mask with the best fit and comfort provides the best protection.**
- Respirators (e.g., N95 and NIOSH-approved KN95) provide higher protection than masks.†† Respirators are made to protect persons by fitting closely on their face to filter out particles, including SARS-CoV-2. They can also block droplets and particles that a person breathes, coughs, or sneezes out to limit transmission to others. NIOSH approves many types of filtering facepiece respirators. The most widely available are N95 respirators, but other types (N99, N100, P95, P99, P100, R95, R99, and R100) offer the same or better protection as an N95 respirator.

Physical distancing

Small particles that persons breathe out can contain virus particles. The closer a person is to other persons, the higher the risk for exposure to SARS-CoV-2. Persons can minimize risk of exposure by avoiding indoor crowded areas or maintaining a ≥6 ft (1.8 m) distance from others. Such actions must be balanced against risks of avoiding such activities.

Ventilation§§

- Opening windows and doors to bring as much fresh air into the home as possible (weather permitting) can improve ventilation.
- Portable high-efficiency particulate air cleaners are useful if a home is not outfitted with an HVAC system.
- Exhaust fans and other fans can improve air flow.
- In homes where the HVAC fan operation can be controlled by a thermostat, the fan should be set to the "on" position instead of "auto" when others are visiting. This allows the fan to run continuously, even if heating or air conditioning is not on, to ensure the HVAC system provides continuous airflow and filtration.

See box footnotes on the next page.

BOX. (*Continued*) Prevention measures against SARS-CoV-2 for persons who are immunocompromised, their household members, and close contacts in the context of currently circulating Omicron sublineages — United States, January 2023

Time outdoors

Spending time outdoors, when possible, instead of indoors, can also help reduce transmission. Viral particles spread between persons more readily indoors than outdoors.

Handwashing

Frequent handwashing with soap and water, preferably, or using a hand sanitizer that contains ≥60% alcohol can reduce risk for many illnesses, including COVID-19.

Testing for SARS-CoV-2[¶¶]

- Persons should get tested if they have COVID-19 symptoms. Viral tests are used for SARS-CoV-2 detection. There are two types of viral tests: rapid tests and laboratory tests. These tests might use nasal, throat, or saliva samples. Persons can take actions to reduce further transmission if they are aware of their SARS-CoV-2 infection.
- Free at-home tests[***] are available. Persons should check with their health insurance, Medicaid, or Medicare plan to learn what tests are available.[†††] Persons with a disability can receive help from the Disability Information and Access Line[§§§] to access a test or identify an accessible test location.
- Persons should be aware of free or low-cost testing locations[¶¶¶] that are near their homes.

COVID-19 Treatment[****]

- Persons should contact their health care provider, health department, or community health center[††††] to learn about treatment options. Treatment must be started within 5–7 days after symptoms develop to be effective.
- Community Test to Treat locations[§§§§] can be accessed if or when persons cannot reach their health care provider or do not have one. These sites offer testing and prescriptions from a health care provider (either onsite or by telehealth) and dispense medications.
- Antiviral treatments are available for persons with mild to moderate COVID-19 symptoms who are at high risk for progression to severe disease, hospitalization, and death. Persons are at high risk of disease if they
  - are aged ≥50 years
  - have an underlying health condition,[¶¶¶¶] especially moderate to severe immunosuppression
  - are unvaccinated
- Persons who are immunocompromised should discuss a treatment plan with their doctor and identify which COVID-19 treatment would be best for them. Some persons with COVID-19 who are immunocompromised or receiving immunosuppressive treatment might benefit from a convalescent plasma treatment.[*****]
- CDC recommends that immunocompromised persons with COVID-19 isolate for ≥10 days and check with their health care provider before ending isolation.[†††††]

Abbreviations: HVAC = heating, ventilation, and air conditioning; NIOSH = National Institute for Occupational Safety and Health.

* https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html
† https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html
§ https://www.cdc.gov/coronavirus/2019-ncov/downloads/needs-extra-precautions/FS_COVID_Plan_FINAL.pdf
¶ https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/types-of-masks.html
** Persons who are deaf or hard of hearing may request a clear mask to assist with lipreading or seeing facial expressions. Persons with sensory disorders or intellectual and developmental disabilities might be unable to wear masks and should consider face shields.
†† Persons with severe respiratory impairment (e.g., shortness of breath with minimal exertion or supplemental oxygen use) should consult with a health care provider regarding N95 respirator usage. Some N95 respirators might contain latex. Persons with natural rubber latex allergies should consult the manufacturer's website for information about the specific model.
§§ https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/Improving-Ventilation-Home.html; https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html
¶¶ https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/testing.html
*** https://special.usps.com/testkits
††† https://www.cms.gov/how-to-get-your-at-home-OTC-COVID-19-test-for-free
§§§ https://acl.gov/DIAL
¶¶¶ https://www.hhs.gov/coronavirus/community-based-testing-sites/index.html
**** https://www.cdc.gov/coronavirus/2019-ncov/your-health/treatments-for-severe-illness.html
†††† https://data.hrsa.gov/data/reports/datagrid?gridName=FQHCs
§§§§ https://covid-19-test-to-treat-locator-dhhs.hub.arcgis.com/
¶¶¶¶ https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html
***** https://www.fda.gov/media/136798/download
††††† https://www.cdc.gov/coronavirus/2019-ncov/your-health/isolation.html

condition[†††] (especially moderate to severe immunosuppression), or 3) are unvaccinated are at risk for severe COVID-19–associated outcomes. Irrespective of vaccination status, symptomatic persons who are immunocompromised, their household members, and their close contacts should be tested for SARS-CoV-2 infection as soon as possible and receive treatment within 5–7 days of symptom onset. Early outpatient treatment of mild to moderate COVID-19 with a recommended first-line therapy, ritonavir-boosted nirmatrelvir (Paxlovid) or remdesivir (Veklury), or the second-line therapy, molnupiravir (Lagevrio), have been shown to reduce the risk for severe COVID-19, including hospitalization and death.[§§§] These medications are expected to retain activity against the currently circulating Omicron sublineages (*6*) and are widely available.[¶¶¶] Available COVID-19 treatment does not supplant the need for persons to stay up to date on their COVID-19 vaccinations, which are highly effective at preventing COVID-19–related morbidity and mortality.

[†††] https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html

[§§§] https://www.covid19treatmentguidelines.nih.gov/management/clinical-management-of-adults/

[¶¶¶] https://aspr.hhs.gov/TestToTreat/Pages/default.aspx

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QuickStats

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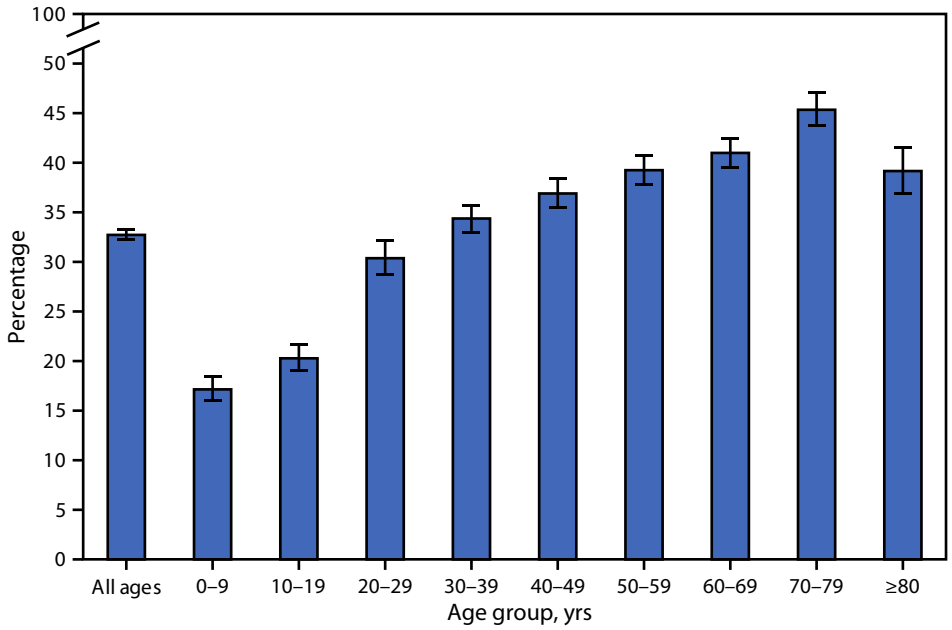
Percentage* of Persons Who Used Telemedicine During the Past 12 Months,† by Age Group — National Health Interview Survey, United States, 2021§



* With 95% CIs indicated by error bars.
† Based on a positive response to the question, "In the past 12 months, have you [has child] had an appointment with a doctor, nurse, or other health professional by video or by phone?"
§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population.

In 2021, approximately one third (32.8%) of persons of all ages had a telemedicine appointment with a doctor, nurse, or other health professional during the past 12 months. The percentage with a telemedicine appointment increased with age, from 17.2% among children aged <10 years to 45.5% among adults aged 70–79 years, and then decreased to 39.3% among adults aged ≥80 years. Telemedicine use among adults aged ≥80 years was similar to that among adults aged 40–49, 50–59, and 60–69 years.

Source: National Center for Health Statistics, National Health Interview Survey, 2021. https://www.cdc.gov/nchs/nhis.htm

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