Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 72 / No. 2
January 13, 2023

Cholera Outbreak — Haiti, September 2022–January 2023

Denisse Vega Ocasio, PhD[1,2]; Stanley Juin, MD[3]; David Berendes, PhD[1]; Kristen Heitzinger, PhD[1]; Graeme Prentice-Mott, MSPH[1]; Anne Marie Desormeaux, MD[3]; Phaimyr D. Jn Charles, MD[3]; Jonas Rigodon, MD[3]; Valerie Pelletier, MD[3]; Reginald Jean Louis, MD[3]; John Vertefeuille, MD[4]; Jacques Boncy, MD[5]; Gerard Joseph, MD[5]; Valusnor Compère[5]; Donald Lafontant, MD[6]; Lesly L. Andrecy, MD[6]; Edwige Michel, MD[6]; Katilla Pierre, MSc[6]; Evenel Thermidor, MSc[7]; David Fitter, MD[4]; Yoran Grant-Greene, PhD[3]; Matthew Lozier, PhD[1]; Samson Marseille, MD[6]; CDC Haiti Cholera Response Group

On September 30, 2022, after >3 years with no confirmed cholera cases (*1*), the Directorate of Epidemiology, Laboratories and Research (DELR) of the Haitian Ministry of Public Health and Population (Ministère de la Santé Publique et de la Population [MSPP]) was notified of two patients with acute, watery diarrhea in the metropolitan area of Port-au-Prince. Within 2 days, Haiti's National Public Health Laboratory confirmed the bacterium *Vibrio cholerae* O1 in specimens from the two patients with suspected cholera infection, and an outbreak investigation began immediately. As of January 3, 2023, >20,000 suspected cholera cases had been reported throughout the country, and 79% of patients have been hospitalized. The moving 14-day case fatality ratio (CFR) was 3.0%. Cholera, which is transmitted through ingestion of water or food contaminated with fecal matter, can cause acute, severe, watery diarrhea that can rapidly lead to dehydration, shock, and death if not treated promptly (*2*). Haiti is currently facing ongoing worsening of gang violence, population displacement, social unrest, and insecurity, particularly in the metropolitan area of Port-au-Prince, including Belair, Bas-Delmas, Centre-Ville, Martissant, Cité Soleil, Croix-des Bouquets, and Tabarre, creating an environment that has facilitated the current resurgence of cholera (*3*). This report describes the initial investigation, ongoing outbreak, and public health response to cholera in Haiti. Cholera outbreak responses require a multipronged, multisectoral approach including surveillance; case management; access to safe water, sanitation, and hygiene (WASH) services; targeted oral cholera vaccine (OCV) campaigns; risk communication; and community engagement. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.*

*Sect. 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.

Epidemiologic Investigation

On September 30, 2022, DELR was alerted about a pediatric patient with acute watery diarrhea in Haiti's Ouest Department,† who was treated at a health center operated by Doctors Without Borders (Médecins Sans Frontières [MSF]). The patient was from the Carrefour Feuille area in Port-au-Prince, had been seen at an MSF health clinic on September 29, 2022, and died shortly after arrival. Also, on September 29, MSF reported a fatal case of acute, watery diarrhea from Cité Soleil, a densely populated commune of the metropolitan area of Port-au-Prince. On October 2, Haiti's National Public Health Laboratory confirmed these two suspected cholera cases, both in the greater Port-au-Prince area,

†Haiti is divided into 10 departments, which are further divided into 42 arrondissements and 145 communes.

INSIDE

Continuing Education examination available at https://www.cdc.gov/mmwr/mmwr_continuingEducation.html

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

to be *V. cholerae* O1 (El Tor biotype) of the Ogawa serotype by culture and seroagglutination. Subsequent sequencing of one of these patients' stool samples revealed the strains to be very similar to the strain that caused the cholera epidemic in Haiti in 2010, suggesting the resurgence of cholera in Haiti (*4*).

MSPP defined a suspected case of cholera as the occurrence of acute, watery diarrhea, with or without vomiting or dehydration, in a person of any age. Confirmed cases were defined as any suspected case with a positive culture for *V. cholerae* or with an epidemiologic link with a confirmed case. Not all suspected cases undergo confirmatory testing. As of January 3, 2023, MSPP had reported 280 institutional (health care facility) deaths and 177 community deaths through the daily alert-based reporting system[§] (a system through which surveillance officers obtain daily counts of cases and deaths from the reporting facilities); the moving 14-day CFR was 3.0% (Figure 1). As of January 3, Haiti's case-based surveillance system[¶] had detected 20,262 suspected cases, 1,332 (7%) of which were culture-confirmed; 16,019 (79%) patients had been hospitalized. Among reported patients with suspected cholera, 11,580 (57%) are males, and the median age is 21 years (ranging from <1 to 100 years). Approximately one third (36%) of patients with suspected cholera are aged <10 years (Table). The highest proportion of suspected cholera cases (20%) and deaths (17%) occurred among children aged 1–4 years (4,009 and 48, respectively).

The epicenter of the outbreak was the greater Port-au-Prince area, located in Ouest Department; as of January 3, based on Haiti's case-based surveillance system, Port-au-Prince metropolitan area had reported 63% of all suspected cases (12,695) and 51% of all deaths (144) in the country. The peak in suspected cases occurred on November 8, after which case counts have steadily declined. However, *V. cholerae* transmission continues to occur throughout the country. As of January 3, MSPP had reported confirmed cases in nine of 10 departments (all except Nord-Est), and suspected cases have been reported in all 10 departments (Figure 2). The actual number of incident cases is likely substantially higher than that reported, given that incidence[**] to date has closely mirrored reporting from cholera treatment centers, and 79% of all patients with suspected cholera have been hospitalized. This indicates that occurrence of community-based surveillance is limited, which could hinder the ability to detect cholera cases that can propagate transmission.

[§] From alert-based reporting.
[¶] From case-based surveillance reporting.

[**] Cases per 100,000 persons.

The *MMWR* series of publications is published by the Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30329-4027.

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2023;72:[inclusive page numbers].

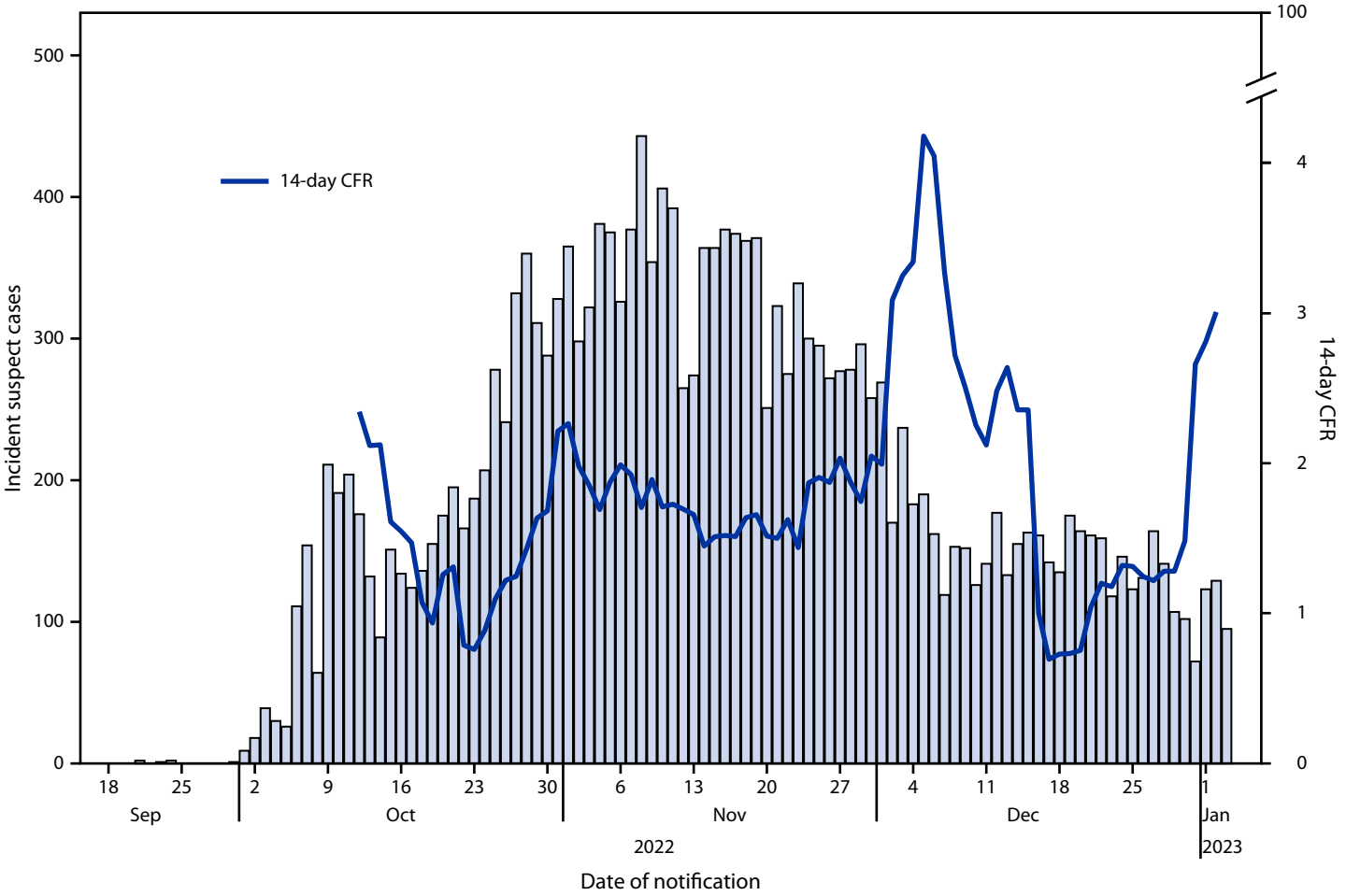
Public Health Response

CDC is working closely with MSPP, the U.S. Agency for International Development, and implementing partners (including MSF and the Pan American Health Organization) to further expand epidemiologic and laboratory surveillance to guide ongoing response needs. These include improving data collection and ensuring that a sufficient number of cholera treatments centers, beds for patient care, and oral rehydration points are available, to reduce morbidity and mortality. Support is also being provided to departmental health directorates to implement local investigations and response activities to contain cholera in areas of high transmission. Efforts are underway to improve access to WASH services and to support risk communication and community engagement nationwide to interrupt community transmission of cholera throughout Haiti. Support was also provided to launch an OCV campaign in mid-December in high-transmission areas.

Discussion

The first cholera outbreak in Haiti was reported in October 2010, 10 months after the catastrophic earthquake that killed >200,000 persons and displaced >1 million. The 2010 outbreak resulted in >820,000 cases and approximately 10,000 deaths (*1*,*2*). Nearly 12 years after the outbreak began, Haiti was declared cholera-free on February 4, 2022, after 3 years without a confirmed case (*1*). Haiti is currently experiencing a resurgence of cholera that affects all parts of the country. The ongoing social unrest has negatively affected public health infrastructure, creating an environment that has facilitated the current resurgence and associated high mortality across the country. In addition, recent fuel shortages have hindered water treatment efforts and other cholera response activities nationwide. These factors have reduced the supply of safe drinking water, forcing an increasing number of residents to rely on unsafe sources and untreated water, substantially worsening the cholera outbreak and hindering the response (*5*,*6*).

FIGURE 1. Date of notification of suspected cholera cases* and 14-day case fatality ratio† — Haiti, September 2022–January 2023



Abbreviation: CFR = case fatality ratio.
* From case-based surveillance reporting.
† From alert-based reporting.

TABLE. Characteristics of cholera outbreak cases — Haiti, September 2022–January 2023*

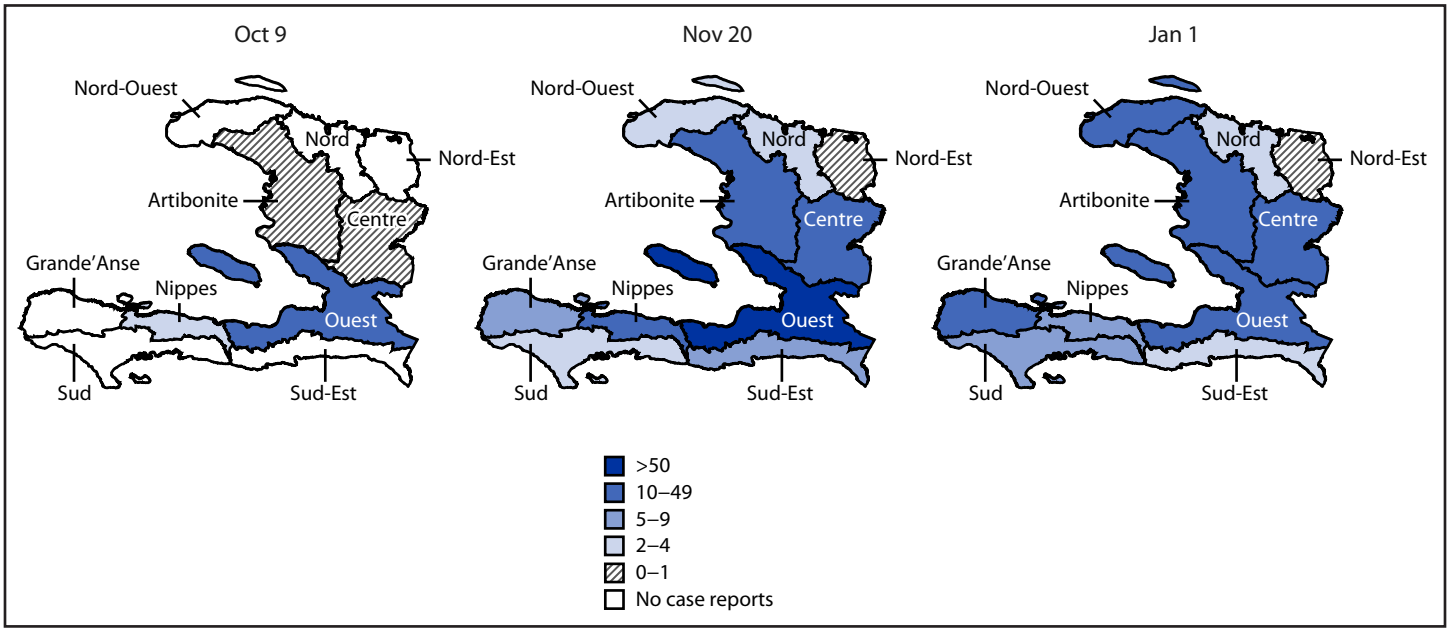
Characteristic	No. (%)	
	Suspected cholera cases†	Cholera deaths
Age group, yrs		
<1	376 (1.9)	2 (0.7)
1–4	4,009 (19.8)	48 (16.8)
5–9	2,890 (14.3)	30 (10.5)
10–14	1,383 (6.8)	13 (4.6)
15–19	1,041 (5.1)	9 (3.2)
20–29	2,970 (14.7)	31 (10.9)
30–39	2,803 (13.8)	26 (9.1)
40–49	1,931 (9.5)	39 (13.7)
50–59	1,378 (6.8)	31 (10.9)
60–69	879 (4.3)	26 (9.1)
70–79	441 (2.2)	19 (6.7)
≥80	161 (0.8)	11 (3.9)
Sex		
Female	8,682 (42.8)	109 (38.2)
Male	11,580 (57.2)	176 (61.8)
Department		
Ouest	14,176 (70.0)	170 (59.6)
Artibonite	3,134 (15.5)	66 (23.2)
Centre	1,250 (6.2)	0 (—)
Nippes	517 (2.6)	7 (2.5)
Nord-Ouest	490 (2.4)	16 (5.6)
Grand'Anse	254 (1.3)	9 (3.2)
Sud-Est	185 (0.9)	10 (3.5)
Nord	155 (0.8)	2 (0.7)
Sud	95 (0.5)	5 (1.8)
Nord-Est	6 (<1.0)	0 (—)

* From case-based surveillance reporting.
† Department was missing for two suspected cases.

Cholera outbreaks, especially in the setting of a complex humanitarian crisis, can spread rapidly, result in many deaths, and quickly become a public health crisis. Mild cases that are not seen in health care facilities can propagate transmission; thus, their detection is critical for monitoring and controlling transmission. Prompt and effective treatment for patients with cholera can reduce mortality rates from >50% to <1% (*6,7*). Primary treatment includes rehydration therapy (prompt restoration of lost fluids and salts); antibiotic treatment is recommended for severe cholera cases only (*8*). A CFR of <1% is the goal for case management interventions. Recent peaks in the 14-day CFR at the beginning of December and January might be elevated because of recent receipts of large numbers of backlogged death reports and because of safety and security concerns making community-based surveillance challenging, thereby limiting the detection of less severe cases of cholera. Efforts to control the outbreak and reduce CFRs should include a combination of surveillance, WASH services, risk communication and community engagement, timely treatment of illness, and OCVs. According to WHO's position paper on cholera vaccines, OCVs should be used in humanitarian crises with high risk for cholera, during a cholera outbreak, and in places with endemic cholera, always in conjunction with other cholera prevention and control strategies (*9*).

The resurgence of cholera in Haiti and the complexity of the response present significant challenges. However, the existing

FIGURE 2. Rolling 14-day cholera incidence (cases per 100,000 population), by department — Haiti, October 2022–January 2023



Summary

What is already known about this topic?

The first cholera outbreak in Haiti was reported in October 2010. Haiti was declared cholera-free in February 2022, after 3 years with no confirmed cases.

What is added by this report?

On October 2, 2022, two cases of *Vibrio cholerae* O1 infection were confirmed in the greater Port-au-Prince area. As of January 3, 2023, >20,000 suspected cholera cases had been reported throughout the country.

What are the implications for public health practice?

Multiple factors, including social unrest, have affected public health infrastructure and facilitated cholera resurgence. Although cases have declined, a multipronged approach, including sufficient and timely case management, strengthened surveillance, emergency water treatment, and targeted oral cholera vaccination campaigns are urgently needed.

technical capacity in Haiti, which was built during the previous cholera response, has provided valuable experience and staffing resources to combat cholera. Lessons learned about how to treat and prevent cholera from the previous response should be leveraged to aggressively respond to this outbreak and ensure effective public health actions. Although cases have declined, a multipronged approach including strengthened surveillance, timely case management, targeted OCV campaigns, risk communication, community engagement, and access to safe WASH services and emergency water treatment are urgently needed.

Acknowledgments

The Haitian government, implementing partners, and staff members who are responding to the cholera outbreak.

CDC Haiti Cholera Response Group

Ashley Andujar, CDC; Alondra Baez-Nieves, CDC; Lucy Breakwell, CDC; Sara Breese, CDC; Joan Brunkard, CDC; Mushtaq Dualeh, CDC; Thomas Handzel, CDC; Christine Lee, CDC; Andrea Martinsen, CDC; Taylor Osborne, CDC; David Shih, CDC; Amanda Tiffany, CDC; Maryann Turnsek, CDC.

Corresponding author: Denisse Vega Ocasio, rhq1@cdc.gov.

[1]Division of Foodborne, Waterborne, and Environmental Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC; [2]Epidemic Intelligence Service, CDC; [3]CDC Haiti Country Office; [4]Global Immunization Division, Center for Global Health, CDC; [5]National Public Health Laboratory, Ministère de la Santé Publique, Port-au-Prince, Haiti; [6]Directorate of Epidemiology of Laboratory Research, Ministère de la Santé Publique, Port-au-Prince, Haiti; [7]Direction Nationale de l'Eau Potable et de l'Assainissement, Port-au-Prince, Haiti.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. DAI. Haiti declared free of Cholera. Bethesda, MD: DAI; 2022. https://www.dai.com/news/haiti-declared-free-of-cholera
2. CDC. Cholera - *Vibrio cholerae* infection: general information. Atlanta, GA: US Department of Health and Human Services, CDC; 2022. Accessed December 19, 2022. https://www.cdc.gov/cholera/general/index.html
3. United Nations. Haiti: UN sounds alarm over worsening gang violence across Port-au-Prince. New York, New York: United Nations; 2022. https://www.ungeneva.org/es/news-media/news/2022/07/haiti-un-sounds-alarm-over-worsening-gang-violence-across-port-au-prince
4. Rubin DHF, Zingl FG, Leitner DR, et al. Reemergence of cholera in Haiti. N Engl J Med 2022;387:2387–9. PMID:36449726 https://doi.org/10.1056/NEJMc2213908
5. Doctors Without Borders. Haiti: shortages of fuel, water and transportation threaten medical care. Toronto, Canada: Doctors Without Borders; 2022. https://www.doctorswithoutborders.ca/article/haiti-shortages-fuel-water-and-transportation-threaten-medical-care
6. World Health Organization. Disease outbreaks news: cholera–Haiti. Geneva, Switzerland: World Health Organization; 2012. https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON415
7. Harris JB, LaRocque RC, Qadri F, Ryan ET, Calderwood SB. Cholera. Lancet 2012;379:2466–76. PMID:22748592 https://doi.org/10.1016/S0140-6736(12)60436-X
8. CDC. Cholera - *Vibrio cholerae* infection: treatment. Atlanta, GA: US Department of Health and Human Services, CDC; 2022. Accessed November 30, 2022. https://www.cdc.gov/cholera/treatment/index.html
9. World Health Organization. Cholera vaccines: WHO position paper–August 2017. Geneva, Switzerland: World Health Organization; 2017. http://apps.who.int/iris/bitstream/10665/258764/1/WER9234-477-498.pdf

Vaccination Coverage with Selected Vaccines and Exemption Rates Among Children in Kindergarten — United States, 2021–22 School Year

Ranee Seither, MPH[1]; Kayla Calhoun, MS[1]; Oyindamola Bidemi Yusuf, PhD[1,2]; Devon Dramann, MPH[1,3]; Agnes Mugerwa-Kasujja, MD[1,2]; Cynthia L. Knighton[1]; Carla L. Black, PhD[1]

State and local school vaccination requirements protect students and communities against vaccine-preventable diseases (*1*). This report summarizes data collected by state and local immunization programs* on vaccination coverage and exemptions to vaccination among children in kindergarten in 49 states† and the District of Columbia and provisional enrollment or grace period status for kindergartners in 27 states§ for the 2021–22 school year. Nationwide, vaccination coverage with 2 doses of measles, mumps and rubella vaccine (MMR) was 93.0%¶; with the state-required number of diphtheria, tetanus, and acellular pertussis vaccine (DTaP) doses was 92.7%**; with poliovirus vaccine (polio) was 93.1%††; and with the state-required number of varicella vaccine doses was 92.8%.§§ Compared with the 2020–21 school year, vaccination coverage decreased 0.8-0.9 percentage points for all vaccines. Although 2.6% of kindergartners had an exemption for at least one vaccine,¶¶ an additional 4.4% who did not have an exemption were not up to date with MMR. Although there has been a nearly complete return to in-person learning after COVID-19 pandemic-associated disruptions, immunization programs continued to report COVID-19–related impacts on vaccination assessment and coverage. Follow-up with undervaccinated students and catch-up campaigns remain important for increasing vaccination coverage to prepandemic levels to protect children and communities from vaccine-preventable diseases.

As mandated by state and local school entry requirements, parents provide children's vaccination or exemption documentation to schools, or schools obtain records from state immunization information systems. Federally funded immunization programs work with departments of education, school nurses, and other school personnel to assess vaccination and exemption status of children enrolled in public and private kindergartens and to report unweighted counts, aggregated by school type, to CDC via a web-based questionnaire in the Secure Access Management system, a federal, web-based system that provides authorized personnel with secure access to public health applications operated by CDC. CDC uses these counts to produce state- and national-level estimates of vaccination coverage among children in kindergarten. During the 2021–22 school year, 49 states and the District of Columbia reported coverage with all state-required vaccines and exemption data for public school kindergartners; 48 states and the District of Columbia reported coverage with all state-required vaccines and exemption data for private school kindergartners.*** Data from cities were included with their state data. State-level coverage and national and median coverage with the state-required number of DTaP, MMR, polio, and varicella vaccine doses are reported. Hepatitis B vaccination coverage is not included in this report but is available at SchoolVaxView (*2*). Twenty-seven states reported the number of kindergartners who were attending school under a grace period (attendance without proof of complete vaccination or exemption during a set interval) or provisional enrollment (school attendance while completing a catch-up vaccination schedule). All counts were current as of the time of the assessment.††† National estimates, medians, and summary measures include only U.S. states and the District of Columbia.

* Federally funded immunization programs are located in 50 states and the District of Columbia, five cities, and eight U.S territories and freely associated states. Two cities reported data, which were also included in data submitted by their state, to CDC. State-level data were used to calculate national estimates and medians. Immunization programs in territories reported vaccination coverage and exemptions; however, these data were not included in national calculations.

† Montana did not report school vaccination data.

§ Arkansas, California, Colorado, Florida, Georgia, Hawaii, Idaho, Iowa, Michigan, Mississippi, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming reported data on the number of students within a grace period or provisionally enrolled at the time of assessment.

¶ All states require 2 doses of a measles-containing vaccine. Seven states (Alaska, Georgia, New Jersey, New York, North Carolina, Oregon, and Virginia) require only 1 dose of rubella vaccine. Alaska, New Jersey, and Oregon require only 1 dose of mumps vaccine; mumps vaccine is not required in Iowa.

** Nebraska requires 3 doses of DTaP, Maryland and Wisconsin require 4 doses, and all other states require 5 doses, unless dose 4 was administered on or after the fourth birthday. The reported coverage estimates represent the percentage of kindergartners with the state-required number of DTaP doses, except for Kentucky, which requires 5 doses of DTaP by age 5 years but reported 4-dose coverage for kindergartners.

†† Two states (Maryland and Nebraska) require only 3 doses of polio vaccine; all other states require 4 doses unless the last dose was given on or after the fourth birthday.

§§ Five states require 1 dose of varicella vaccine; 44 states and the District of Columbia require 2 doses.

¶¶ Colorado, Illinois, Minnesota, and Missouri did not report the number of kindergartners with an exemption but instead reported the number of exemptions for each vaccine, which could have counted some children more than once. For these states, the percentage of kindergartners exempt from the vaccine with the highest number of exemptions by exemption type (the lower bound of the potential range of exemptions) was included in the national and median exemption rates.

*** Twelve states reported coverage and exemption data for at least some homeschooled kindergartners, either separately or included with data from public or private schools.

††† Assessment date varied by state and area. Three states assessed schools on the first day of school; 10 states assessed schools by December 31; 18 states and the District of Columbia assessed schools by some other date, ranging from October 15, 2021, to June 23, 2022; and 18 states assessed schools on a rolling basis.

Vaccination coverage and exemption estimates were adjusted on the basis of survey type and response rate.[§§§] National estimates measure coverage and exemptions among all kindergartners, whereas medians indicate the midpoint of state-level coverage, irrespective of population size. During the 2021–22 school year, immunization programs reported 3,835,130 children enrolled in kindergarten in 49 states and the District of Columbia.[¶¶¶] Reported estimates are based on 3,536,546 (92.2%) children who were surveyed for vaccination coverage, 3,686,775 (96.1%) surveyed for exemptions, and 2,527,578 (65.9%) surveyed for grace period and provisional enrollment status. Potentially achievable coverage with MMR (the sum of the percentage of children who were up to date with 2 doses of MMR and those not up to date but with no documented vaccination exemption) was calculated for each state. Nonexempt students include those who were provisionally enrolled in kindergarten, in a grace period, or otherwise without documentation of complete vaccination. SAS software (version 9.4; SAS Institute) was used for all analyses. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[****]

Vaccination assessments varied by state because of differences in required vaccines and required numbers of doses, vaccines assessed, methods of data collection, and data reported (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/123203). Kindergartners were considered up to date with a given vaccine if they received all doses required for school entry, except in eight states[††††] that reported kindergartners as up to date for any vaccine only if they had received all doses of all vaccines required for school entry. States were asked to report any COVID-19–related impact on kindergarten vaccination measurement and coverage through a combination of structured responses and open-ended questions.

Nationally, 2-dose MMR coverage was 93.0% (range = 78.0% [Alaska] to ≥98.6% [Mississippi]), with coverage of ≥95% reported by 14 states and <90% by nine states and the District of Columbia (Table). DTaP coverage was 92.7% (range = 78.0% [Alaska] to ≥98.6% [Mississippi]); coverage of ≥95% was reported by 15 states and of <90% by 12 states and the District of Columbia. Polio vaccination coverage was 93.1% (range = 77.1% [Alaska] to ≥98.6% [Mississippi]), with coverage of ≥95% reported by 14 states and <90% by 10 states and the District of Columbia. Varicella vaccination coverage nationally was 92.8% (range = 76.1% [Alaska] to ≥98.6% [Mississippi]), with 13 states reporting coverage ≥95% and nine states and the District of Columbia reporting <90% coverage. Coverage decreased in most states for all vaccines compared with the 2020–21 school year (Supplementary Figure, https://stacks.cdc.gov/view/cdc/123205).

Overall, 2.6% of kindergartners had an exemption (0.2% medical and 2.3% nonmedical[§§§§]) for one or more required vaccines (not limited to MMR, DTaP, polio, and varicella vaccines) in 2021–22 (range = 0.1% [Mississippi, New York, and West Virginia] to 9.8% [Idaho]), compared with 2.2% reported during the 2020–21 school year (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/123204). Among 27 states reporting data on provisional kindergarten enrollment or grace period attendance, 2.4% of children were so enrolled (range = <0.1% [Hawaii] to 8.5% [Wisconsin]).

Nationally, MMR coverage for both the 2020–21 and 2021–22 school years was lower than that reported since 2013–14 (Figure 1). Nationwide, 4.4% of kindergarten students were not fully vaccinated and not exempt. Among the 35 states and the District of Columbia with MMR coverage <95%, all but four could potentially achieve ≥95% MMR coverage if all nonexempt kindergartners who were within a grace period, provisionally enrolled, or otherwise enrolled in school without documentation of vaccination were vaccinated (Figure 2).

Twenty-three states reported COVID-19–related impacts on data collection including lower response rates from schools, data collection extensions and delays, and incomplete data from schools that did respond; 30 states reported lingering COVID-19–related impacts on vaccination coverage, mostly related to reduced access to vaccination appointments and local or school level extensions of grace period or provisional enrollment policies (CDC, School Vaccination Coverage Report, unpublished data, 2022).

[§§§] Immunization programs that used census or voluntary response provided CDC with data aggregated at the state or local (city or territory) level. Estimates based on these data were adjusted for nonresponse using the inverse of the response rate, stratified by school type (public, private, and homeschool, where available). Programs that used complex sample surveys provided CDC with data aggregated at the school or county level for weighted analysis. Weights were calculated to account for sample design and adjusted for nonresponse.

[¶¶¶] These totals are the summations of the kindergartners surveyed among programs reporting data for coverage, exemptions, grace periods, and provisional enrollment. Data from cities and territories were not included in these totals.

[****] 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.

[††††] Alabama, Florida, Georgia, Iowa, Mississippi, New Hampshire, New Jersey, and Wisconsin considered kindergartners up to date only if they had received all doses of all vaccines required for school entry. In Kentucky, public schools reported numbers of children up to date with specific vaccines and most private schools reported numbers of children who received all doses of all vaccines required for school entry.

[§§§§] Washington was unable to deduplicate data for students with both religious and philosophical exemptions; therefore, the nonmedical exemption type with the highest number of kindergartners (the lower bound of the potential range of nonmedical exemptions) was included in the national and median exemption rates for nonmedical exemptions.

TABLE. Estimated* coverage† with measles, mumps, and rubella; diphtheria, tetanus, and acellular pertussis; poliovirus; and varicella vaccines; grace period or provisional enrollment§; and any exemption¶, among kindergartners, by immunization program — United States,†† 2021–22 school year**

Immunization program	Kindergarten population§§	Surveyed,¶¶ %	2 Doses MMR,*** %	5 Doses DTaP,††† %	4 Doses polio,§§§ %	2 Doses VAR,¶¶¶ %	Grace period or provisional enrollment, %	Any exemption, %	Percentage point change in any exemption, 2020–2021
National estimate**	3,835,130	92.2	93.0	92.7	93.1	92.8	2.4	2.6	0.4
Median**	—	—	**92.9**	**92.0**	**92.7**	**92.6**	**1.9**	**2.7**	**0.2**
U.S. jurisdictions									
Alabama†††,§§§§	60,332	100.0	≥94.9	≥94.9	≥94.9	≥94.9	NP	1.7	0.4
Alaska§§§§,¶¶¶¶	9,790	76.2	78.0	78.0	77.1	76.1	NR	4.6	0.6
Arizona*****	83,463	97.0	90.6	90.5	90.9	94.6	NR	6.8	1.3
Arkansas†††††	39,358	96.3	92.5	91.3	91.4	91.9	7.5	2.5	0.5
California§§§§,*****,†††††	512,144	98.4	96.3	95.7	96.2	96.0	1.2	0.2	−0.3
Colorado	66,900	97.5	88.4	89.1	88.8	87.6	≥0.6	≥3.2	−1.0
Connecticut†††,§§§§	35,451	100.0	95.7	96.0	96.0	95.5	NP	2.3	−0.3
Delaware§§§§,†††††	11,181	9.5	96.4	96.4	97.1	95.7	NR	1.2	−1.2
District of Columbia †††,§§§§	8,959	100.0	82.0	82.2	84.7	81.0	NR	0.5	0.2
Florida§§§§,§§§§§	229,432	97.8	≥91.7	≥91.7	≥91.7	≥91.7	4.3	3.9	0.8
Georgia†††,§§§§	118,742	100.0	≥83.2	≥83.2	≥83.2	≥83.2	0.4	4.7	1.8
Hawaii§§§§	13,368	6.7	94.3	92.5	93.2	90.2	<0.1	3.4	0.6
Idaho	23,854	99.6	83.9	83.5	84.0	83.4	1.8	9.8	1.6
Illinois†††,§§§§	137,699	100.0	92.1	91.9	91.9	91.8	NR	≥1.7	NA
Indiana§§§§,§§§§§	83,198	75.1	92.1	84.0	89.3	91.7	NR	2.4	0.5
Iowa†††,§§§§	40,111	100.0	≥90.6	≥90.6	≥90.6	≥90.6	5.4	2.4	0.2
Kansas§§§§,†††††,§§§§§,¶¶¶¶¶	36,526	29.5	91.1	90.0	92.2	90.4	NR	2.3	0.3
Kentucky§§§§,†††††,§§§§§	59,233	91.5	≥86.5	≥87.1	≥87.8	≥85.6	NR	1.3	0.3
Louisiana††††	66,518	100.0	93.7	96.2	97.6	91.4	NP	1.1	0
Maine	12,881	91.6	96.7	96.3	96.5	95.5	NR	1.8	−2.7
Maryland§§§§,†††††	53,866	98.4	93.9	88.6	94.8	92.7	NR	1.5	0.6
Massachusetts†††,§§§§,†††††	65,582	100.0	96.2	96.1	96.0	95.7	NP	1.0	−0.1
Michigan††††	114,251	100.0	93.6	94.1	94.8	93.6	0.7	4.5	0.8
Minnesota	69,403	98.7	89.0	89.0	89.3	88.7	NR	≥3.7	0.9
Mississippi†††,§§§§,*****	36,524	100.0	≥98.6	≥98.6	≥98.6	≥98.6	1.0	0.1	0
Missouri†††,§§§§	71,034	100.0	91.6	91.5	91.9	91.2	NR	≥3.0	0.5
Montana	NR	NA	NR	NR	NR	NR	NR	NR	NA
Nebraska§§§§,†††††	25,018	99.5	96.2	96.6	97.6	95.5	1.9	2.5	0.3
Nevada§§§§	36,855	99.2	92.7	91.5	92.2	92.1	3.1	4.8	0.4
New Hampshire†††,§§§§,§§§§§	12,157	100.0	≥88.7	≥88.7	≥88.7	≥88.7	5.2	3.4	0.6
New Jersey†††,§§§§,§§§§§	104,240	100.0	≥94.1	≥94.1	≥94.1	≥94.1	1.3	2.6	0.4
New Mexico†††,§§§§	20,736	100.0	94.3	94.0	94.3	93.6	0.4	1.4	0.5
New York (including New York City)§§§§,*****	195,377	99.3	98.0	97.3	97.4	97.4	2.0	0.1	0
New York City§§§§,*****	82,938	99.8	97.3	96.5	96.4	96.7	1.7	0.1	0
North Carolina§§§§,†††††,§§§§§	118,191	78.5	96.1	96.0	96.1	95.9	1.1	1.9	0.4
North Dakota	10,755	96.6	91.5	91.4	91.7	91.2	NR	5.3	1.1
Ohio	139,077	91.9	88.3	88.5	88.9	87.9	7.4	3.0	0.5
Oklahoma†††††	54,042	84.3	90.9	91.1	91.9	95.5	NR	3.5	1.1
Oregon†††,†††††	41,538	100.0	93.0	92.0	92.3	94.7	NR	7.0	1.6
Pennsylvania	139,558	94.9	95.0	95.4	95.1	94.8	NR	3.3	0.6
Rhode Island§§§§,†††††,§§§§§	11,002	96.9	97.3	97.0	97.1	97.0	NR	1.2	0.2
South Carolina§§§§,¶¶¶¶¶	58,276	27.2	92.7	91.0	91.9	92.4	3.4	3.4	1.0
South Dakota†††,§§§§	12,251	100.0	93.7	93.2	93.6	91.9	NR	3.5	0.1
Tennessee†††,§§§§,§§§§§	79,120	100.0	95.8	95.2	95.4	95.4	1.9	2.4	0.5
Texas (including Houston)†††††,§§§§§	389,037	99.3	94.0	93.7	94.0	93.5	1.8	2.9	0.6
Houston†††††,§§§§§	40,123	99.3	88.2	88.3	88.3	87.8	1.2	1.5	0.2
Utah††††	48,995	100.0	90.0	89.6	90.0	92.8	2.0	7.4	2.3
Vermont†††,§§§§	6,126	100.0	93.4	92.9	93.1	92.6	6.8	3.3	0.1
Virginia§§§§,¶¶¶¶¶	95,996	2.8	95.5	98.3	94.7	94.9	NR	1.8	0.3
Washington§§§§§	87,256	97.3	92.5	91.4	91.9	91.3	1.3	3.7	0.4
West Virginia§§§§,*****,§§§§§,†††††	18,070	85.5	96.5	96.5	96.6	98.0	3.8	0.1	NA
Wisconsin†††††	64,275	96.8	≥82.6	≥82.6	≥82.6	≥82.6	8.5	6.3	1.1
Wyoming†††,§§§§	7,382	100.0	92.9	92.5	93.8	93.6	2.1	3.9	0.9

See table footnotes on the next page.

TABLE. (*Continued*) Estimated* coverage† with measles, mumps, and rubella; diphtheria, tetanus, and acellular pertussis; poliovirus; and varicella vaccines; grace period or provisional enrollment§; and any exemption¶, among kindergartners, by immunization program — United States,†† 2021–22 school year**

Immunization program	Kindergarten population§§	Surveyed,¶¶ %	2 Doses MMR,*** %	5 Doses DTaP,††† %	4 Doses polio,§§§ %	2 Doses VAR,¶¶¶ %	Grace period or provisional enrollment, %	Any exemption, %	Percentage point change in any exemption, 2020–2021
Territories and freely associated states									
American Samoa††††	630	100.0	90.0	94.3	97.0	76.8	NR	0	NA
Federated States of Micronesia††††	1,884	100.0	85.4	78.1	82.5	Nreq	NR	NR	NA
Guam§§§§	2,236	96.8	91.5	89.8	90.9	Nreq	NR	0.2	NA
Marshall Islands††††	1,003	100.0	97.7	93.2	97.3	Nreq	NR	NR	NA
Northern Mariana Islands††††	914	100.0	94.4	85.0	90.8	93.5	NR	0	0
Palau	NR	NR	NR	NR	NR	NR	NR	NR	NA
Puerto Rico§§§§	27,591	8.0	85.2	92.6	91.2	86.0	NR	1.8	NA
U.S. Virgin Islands	NR	NR	NR	NR	NR	NR	NR	NR	NA

Abbreviations: DTaP = diphtheria, tetanus, and acellular pertussis vaccine; DTP = diphtheria and tetanus toxoids and pertussis vaccine; MMR = measles, mumps, and rubella vaccine; polio = poliovirus vaccine; NA = not available; NP = no grace period or provisional policy; NR = not reported to CDC; Nreq = not required; VAR = varicella vaccine.

* Estimates adjusted for nonresponse and weighted for sampling where appropriate.

† Estimates based on a completed vaccination series (i.e., not vaccine specific) use the "≥" symbol. Coverage might include history of disease or laboratory evidence of immunity. In Kentucky, public schools reported numbers of children up to date with specific vaccines, and most private schools reported numbers of children who received all doses of all vaccines required for school entry.

§ A grace period is a set number of days during which a student can be enrolled and attend school without proof of complete vaccination or exemption. Provisional enrollment allows a student without complete vaccination or exemption to attend school while completing a catch-up vaccination schedule. In states with one or both of these policies, the estimates represent the number of kindergartners who were within a grace period, were provisionally enrolled, or were in a combination of these categories.

¶ Some programs did not report the number of children with exemptions, but instead reported the number of exemptions for each vaccine, which could count some children more than once. Lower bounds of the percentage of children with any exemptions were estimated using the individual vaccines with the highest number of exemptions. Estimates based on vaccine-specific exemptions use the "≥" symbol.

** Exemptions, grace period or provisional enrollment, and vaccine coverage status might not be mutually exclusive. Some children enrolled under a grace period or provisional enrollment might be exempt from one or more vaccinations, and children with exemptions might be fully vaccinated with one or more required vaccines.

†† Includes five territories and three freely associated states.

§§ The kindergarten population is an approximation provided by each program.

¶¶ The number surveyed represents the number surveyed for coverage. Exemption estimates are based on 29,010 kindergartners for Kansas, 58,276 for South Carolina, and 92,265 for Virginia.

*** Most states require 2 doses of MMR; Alaska, New Jersey, and Oregon require 2 doses of measles, 1 dose of mumps, and 1 dose of rubella vaccines. Georgia, New York, New York City, North Carolina, and Virginia require 2 doses of measles and mumps vaccines and 1 dose of rubella vaccine. Iowa requires 2 doses of measles vaccine and 2 doses of rubella vaccine.

††† Pertussis vaccination coverage might include some DTP doses if administered in another country or by a vaccination provider who continued to use DTP after 2000. Most states require 5 doses of DTaP for school entry, or 4 doses if the fourth dose was received on or after the fourth birthday; Maryland and Wisconsin require 4 doses; Nebraska requires 3 doses. The reported coverage estimates represent the percentage of kindergartners with the state-required number of DTaP doses, except for Kentucky, which requires ≥5 but reports ≥4 doses of DTaP.

§§§ Most states require 4 doses of polio for school entry, or 3 doses if the fourth dose was received on or after the fourth birthday; Maryland and Nebraska require 3 doses. The reported coverage estimates represent the percentage of kindergartners with the state-required number of polio doses, except for Kentucky, which requires ≥4 but reports ≥3 doses of polio.

¶¶¶ Most states require 2 doses of VAR for school entry; Alabama, Arizona, New Jersey, Oklahoma, and Oregon require 1 dose. Reporting of VAR status for kindergartners with a history of varicella disease varied within and among states; some kindergartners were reported as vaccinated against varicella and others as medically exempt.

**** National coverage estimates and medians were calculated using data from 49 states (i.e., do not include Montana) and the District of Columbia. National grace period or provisional enrollment estimates and median were calculated using data from the 27 states that have either a grace period or provisional enrollment policy and reported relevant data to CDC. National exemption estimate and median were calculated from data from 49 states (i.e., did not include Montana) and the District of Columbia. Other jurisdictions excluded were Houston, New York City, American Samoa, Guam, Marshall Islands, Federated States of Micronesia, Northern Mariana Islands, Palau, Puerto Rico, and the U.S. Virgin Islands. Data reported from 3,536,546 kindergartners were assessed for coverage, 3,686,775 for exemptions, and 2,527,578 for grace period or provisional enrollment. Estimates represent rates for populations of coverage (3,835,130), exemptions (3,835,130), and grace period or provisional enrollment (2,604,872).

†††† The proportion surveyed is reported as 100% but might be <100% if based on incomplete information about the actual current enrollment.

§§§§ Philosophical exemptions were not allowed.

¶¶¶¶ Reported public and homeschool school data only.

***** Religious exemptions were not allowed.

††††† Counted some or all vaccine doses received regardless of Advisory Committee on Immunization Practices recommended age and time interval; vaccination coverage rates reported might be higher than those for valid doses.

§§§§§ Did not include certain types of schools, such as kindergartens in child care facilities, online schools, correctional facilities, or those located on military bases or tribal lands.

¶¶¶¶¶ Vaccination coverage data were collected from a sample of kindergartners; exemption data were collected from a census of kindergartners.

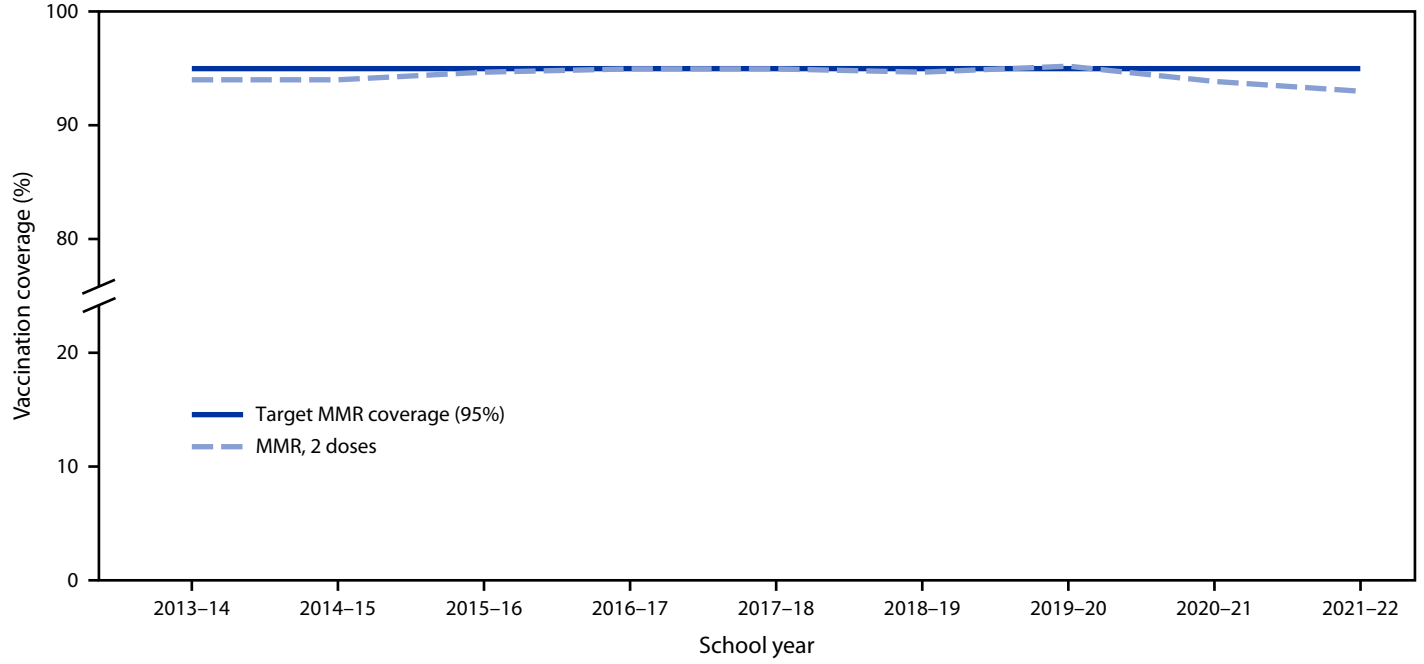
Discussion

During the 2021–22 school year, coverage with MMR, DTaP, polio, and varicella vaccines among kindergarten children was approximately 93% nationwide for each vaccine, lower than the 94% coverage reported during the 2020–21 school year, and the 95% coverage reported during the 2019–20 school year, when children were vaccinated before the pandemic (*2*,*3*). Coverage with all four vaccines declined in most states. National MMR coverage among kindergarten students remained below the Healthy People 2030 target of 95% (*4*) for the second consecutive year. These findings are consistent with those of continuing declines in routine childhood and adolescent vaccine administration through March 2021 (*5*). MMR coverage of 93.0% translates to approximately 250,000 kindergartners who are potentially not protected against measles; clusters of unvaccinated and undervaccinated children can lead to outbreaks of vaccine-preventable diseases.

The overall percentage of children with an exemption remained low during the 2021–22 school year at 2.6%, although the percentage of children with exemptions increased in 38 states and the District of Columbia. Nationwide, 4.4% of kindergarten students were not fully vaccinated with MMR and not exempt, and this percentage increased in most states compared with 2020–21. Nonexempt undervaccinated students often attend school while in a grace period or are provisionally enrolled; in many states, these policies were expanded either formally or informally during the 2020–21 school year, and this expansion continued to a lesser extent during the 2021–22 school year, even as most schools returned to in-person classes. States continued to report COVID-19–related impacts on vaccination coverage and assessment activities.

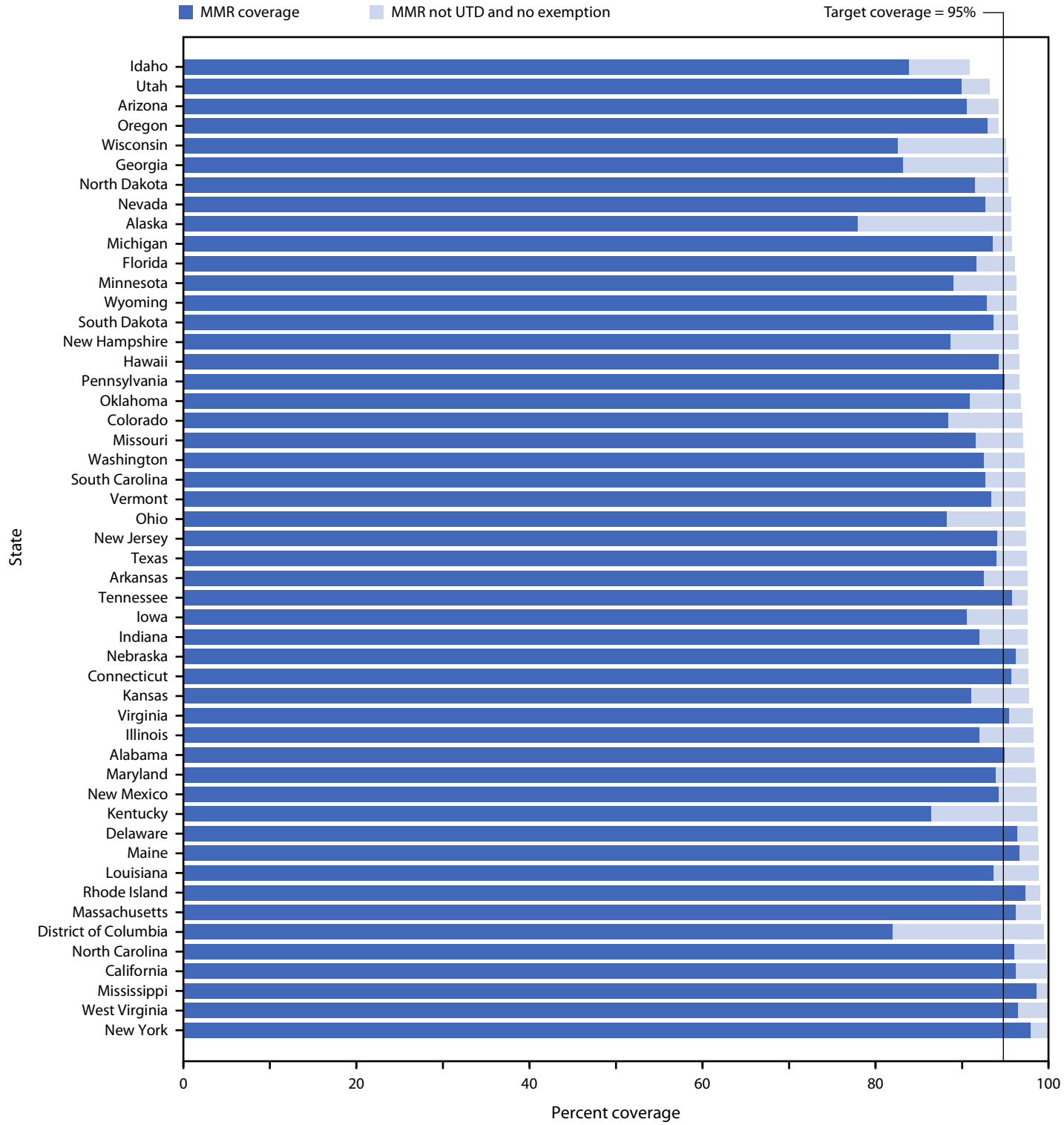
The findings in this report are subject to at least five limitations. First, comparisons among states are limited because of variation in states' requirements such as which vaccines are required, the number of doses required, the date required, and the type of documentation accepted; data collection methods; allowable exemptions; and definitions of grace period and provisional enrollment. Second, representativeness might be negatively affected by data collection methods that assess vaccination status at different times or miss some schools or students, such as those who are homeschooled. Third, vaccination coverage, exemption rates, or both, might be underestimated or overestimated because of inaccurate or absent documentation or missing schools. Fourth, national coverage estimates for the 2021–22 school year include only 49 of 50 states and the District of Columbia and use lower bound estimates for eight states; exemption estimates include 49 states and the District of Columbia and use lower bound estimates for five states, and grace period or provisional enrollment estimates include only 27 states. Finally, states continued to report that the COVID-19 pandemic response created various barriers that limited the amount and quality of student vaccination data collected and reported by local health departments.

FIGURE 1. Estimated national coverage with 2 doses of measles, mumps, and rubella vaccine among kindergartners — United States, 2013–14 to 2021–22 school years



Abbreviation: MMR = measles, mumps, and rubella vaccine.

FIGURE 2. Potentially achievable coverage*,† with measles, mumps, and rubella vaccine among kindergartners, by state — United States, 2021–22 school year



Abbreviations: MMR = measles, mumps, and rubella vaccine; UTD = up to date.

* States are ranked from lowest to highest potentially achievable coverage. Potentially achievable coverage is estimated as the sum of the percentage of students with UTD MMR and the percentage of students without UTD MMR and without a documented vaccine exemption.

† The exemptions used to calculate the potential increase in MMR coverage for Alaska, Arizona, Arkansas, Colorado, Delaware, District of Columbia, Idaho, Illinois, Maine, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, Nevada, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Texas, Utah, Vermont, Washington, Wisconsin, and Wyoming are the number of children with exemptions specifically for MMR. For all other states, numbers are based on an exemption to any vaccine.

Summary

What is already known about this topic?

During the 2020–21 school year, national coverage with state-required vaccines among kindergarten students declined from 95% to approximately 94%.

What is added by this report?

During the 2021–22 school year, coverage decreased again to approximately 93% for all state-required vaccines. The exemption rate remained low (2.6%). An additional 4.4% without an exemption were not up to date with measles, mumps and rubella vaccine. Despite widespread return to in-person learning, COVID-19–related disruptions continued to affect vaccination coverage and assessment for the 2021–22 school year, preventing a return to prepandemic coverage.

What are the implications for public health practice?

Increasing follow-up with undervaccinated students to reduce the impact of disruptions on vaccination coverage can help protect students from vaccine-preventable diseases.

Vaccination coverage among kindergarten students remains below prepandemic levels; pockets of undervaccinated children within larger areas of high vaccination coverage can lead to outbreaks (*6*–*8*). Immunization programs can use local-level data, such as that from school assessments or immunization information systems, to identify schools or communities with low vaccination coverage. Rigorously enforced school vaccination requirements, school-based vaccination clinics, reminder and recall systems, and follow-up with undervaccinated students by school nurses are effective strategies to improve vaccination coverage (*9*,*10*). As schools return to in-person learning, high vaccination coverage is critical to continue protecting children and communities from vaccine-preventable diseases.

Corresponding author: Ranee Seither, rseither@cdc.gov.

[1]Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC; [2]Certified Technical Experts, Inc., Montgomery, Alabama; [3]Association of Schools and Programs of Public Health, Washington, DC.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Omer SB, Salmon DA, Orenstein WA, deHart MP, Halsey N. Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases. N Engl J Med 2009;360:1981–8. PMID:19420367 https://doi.org/10.1056/NEJMsa0806477
2. CDC. SchoolVaxView. Vaccination coverage and exemptions among kindergartners. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://www.cdc.gov/vaccines/imz-managers/coverage/schoolvaxview/data-reports/index.html
3. Seither R, Laury J, Mugerwa-Kasujja A, Knighton CL, Black CL. Vaccination coverage with selected vaccines and exemption rates among children in kindergarten—United States, 2020–21 school year. MMWR Morb Mortal Wkly Rep 2022;71:561–8. PMID:35446828 https://doi.org/10.15585/mmwr.mm7116a1
4. US Department of Health and Human Services. Healthy people 2030: maintain the vaccination coverage level of 2 doses of the MMR vaccine for children in kindergarten—IID-04. Washington, DC: US Department of Health and Human Services; 2020. https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/maintain-vaccination-coverage-level-2-doses-mmr-vaccine-children-kindergarten-iid-04
5. Kujawski SA, Yao L, Wang HE, Carias C, Chen Y-T. Impact of the COVID-19 pandemic on pediatric and adolescent vaccinations and well child visits in the United States: a database analysis. Vaccine 2022;40:706–13. PMID:35012776 https://doi.org/10.1016/j.vaccine.2021.12.064
6. Bahta L, Bartkus J, Besser J, et al.; CDC. Poliovirus infections in four unvaccinated children—Minnesota, August–October 2005. MMWR Morb Mortal Wkly Rep 2005;54:1053–5. PMID:16237378
7. Lopez AS, LaClair B, Buttery V, et al. Varicella outbreak surveillance in schools in sentinel jurisdictions, 2012–2015. J Pediatric Infect Dis Soc 2019;8:122–7. PMID:29522133 https://doi.org/10.1093/jpids/piy010
8. Zucker JR, Rosen JB, Iwamoto M, et al. Consequences of undervaccination—measles outbreak, New York City, 2018–2019. N Engl J Med 2020;382:1009–17. PMID:32160662 https://doi.org/10.1056/NEJMoa1912514
9. Briss PA, Rodewald LE, Hinman AR, et al.; The Task Force on Community Preventive Services. Reviews of evidence regarding interventions to improve vaccination coverage in children, adolescents, and adults. Am J Prev Med 2000;18(Suppl):97–140. PMID:10806982 https://doi.org/10.1016/S0749-3797(99)00118-X
10. Guarinoni MG, Dignani L. Effectiveness of the school nurse role in increasing the vaccination coverage rate: a narrative review. Ann Ig 2021;33:55–66. PMID:33354696 https://doi.org/10.7416/ai.2021.2408

Vaccination Coverage by Age 24 Months Among Children Born During 2018–2019 — National Immunization Survey–Child, United States, 2019–2021

Holly A. Hill, MD, PhD[1]; Michael Chen, PhD[1]; Laurie D. Elam-Evans, PhD[1]; David Yankey, PhD[1]; James A. Singleton, PhD[1]

Millions of young children are vaccinated safely in the United States each year against a variety of potentially dangerous infectious diseases (*1*). The Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination against 14 diseases during the first 24 months of life* (*2*). This report describes vaccination coverage by age 24 months using data from the National Immunization Survey–Child (NIS-Child).† Compared with coverage among children born during 2016–2017, coverage among children born during 2018–2019 increased for a majority of recommended vaccines. Coverage was >90% for ≥3 doses of poliovirus vaccine (93.4%), ≥3 doses of hepatitis B vaccine (HepB) (92.7%), ≥1 dose of measles, mumps, and rubella vaccine (MMR) (91.6%), and ≥1 dose of varicella vaccine (VAR) (91.1%); coverage was lowest for ≥2 doses of hepatitis A vaccine (HepA) (47.3%). Vaccination coverage overall was similar or higher among children reaching age 24 months during March 2020 or later (during the COVID-19 pandemic) than among those reaching age 24 months before March 2020 (prepandemic); however, coverage with the combined 7-vaccine series§ among children living below the federal poverty level or in rural areas decreased by 4–5 percentage points during the pandemic (*3*). Among children born during 2018–2019, coverage disparities were observed by race and ethnicity, poverty status, health insurance status, and Metropolitan Statistical Area (MSA) residence. Coverage was typically higher among privately insured children than among children with other insurance or no insurance. Persistent disparities by health insurance status indicate the need to improve access to vaccines through the Vaccines for Children (VFC) program.¶ Providers should review children's histories and recommend needed vaccinations during every clinical encounter and address parental hesitancy to help reduce disparities and ensure that all children are protected from vaccine-preventable diseases.

NIS-Child is a random-digit–dialed survey of households that includes children aged 19–35 months. Parents or guardians complete a telephone survey,** and consent to contact the child's vaccination providers is requested. With parental or guardian consent, identified providers are mailed a questionnaire to obtain vaccination information, which is synthesized to create the child's comprehensive vaccination history. Children born during 2018–2019 were identified from data collected during 2019–2021, resulting in 29,598 children with adequate provider data†† for analysis. The 2021 household response rate§§ was 22.9%, and adequate provider data were obtained from 51.5% of households with completed interviews. Vaccination coverage by age 24 months was estimated using Kaplan-Meier techniques, except for the birth dose of

* Vaccination against COVID-19 was recommended for children aged 6 months–4 years in June 2022 (https://www.cdc.gov/vaccines/acip/recs/grade/covid-19-moderna-pfizer-children-vaccine-etr.html). Children in this report were either aged >4 years during June 2022 (some were eligible for COVID-19 vaccine at age ≥5 years, but vaccine history was not ascertained past age 35 months), or data on vaccine histories were collected before 2022.

† Estimates for U.S. Department of Health and Human Services regions, states, selected local areas, and the territories of Guam and Puerto Rico can be found online (https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/data-reports/index.html). Certain local areas that receive federal Section 317 immunization funds are sampled separately and included in the NIS-Child sample every year (Chicago, Illinois; New York, New York; Philadelphia County, Pennsylvania; Bexar County, Texas; and Houston, Texas). National estimates in this report exclude territories.

§ The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine; ≥3 doses of poliovirus vaccine; ≥1 dose of measles-containing vaccine; ≥3 or ≥4 doses (depending upon product type) of *Haemophilus influenzae* type b conjugate vaccine; ≥3 doses of hepatitis B vaccine; ≥1 dose of varicella vaccine; and ≥4 doses of pneumococcal conjugate vaccine.

¶ Eligible children include those aged ≤18 years who are Medicaid-eligible, uninsured, American Indian or Alaska Native, or insured by health plans that do not fully cover routine immunization (if vaccination is received at a Federally Qualified Health Center or a rural health clinic). https://www.cdc.gov/vaccines/programs/vfc/

** NIS-Child used a landline-only sampling frame during 1995–2010. During 2011–2017, the survey was conducted using a dual-frame design, with both mobile and landline sampling frames included. During 2018, NIS-Child returned to a single-frame design, with all interviews conducted by mobile telephone.

†† Children with at least one vaccination reported by a provider and those who had received no vaccinations were considered to have adequate provider data. "No vaccinations" indicates that the vaccination status is known because the parent or guardian indicated there were no vaccinations and the providers returned no immunization history forms or returned them indicating that no vaccinations had been administered.

§§ The Council of American Survey Research Organizations (CASRO) household response rate is calculated as the product of the resolution rate (percentage of the total telephone numbers called that were classified as nonworking, nonresidential, or residential), screening completion rate (percentage of known households that were successfully screened for the presence of age-eligible children), and the interview completion rate (percentage of households with one or more age-eligible children that completed the household survey). The CASRO household response rate is equivalent to the American Association for Public Opinion Research type 3 response rate (https://www-archive.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf). CASRO response rates and the proportions of children with household interviews that had adequate provider data for survey years 2015–2020 are available online. https://www.cdc.gov/vaccines/imz-managers/nis/downloads/NIS-PUF20-DUG.pdf

HepB[¶¶] and rotavirus vaccine.[***] Coverage with ≥2 doses of HepA was also estimated by age 35 months (the maximum age available).[†††] Significance of coverage differences was assessed using z-tests; p-values <0.05 were considered statistically significant. Analyses used weighted data and were performed using SAS (version 9.4; SAS Institute) and SUDAAN (version 11; RTI International). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§§§]

¶¶ The birth dose of HepB is measured as the proportion of children who received a dose of HepB by age 3 days.

*** Rotavirus is assessed at age 8 months to reflect the maximum age at administration recommended by ACIP.

††† Children waiting 12–18 months to receive the second dose of HepA might receive it during the beginning of the catch-up period, which starts at age 24 months.

§§§ 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.

TABLE 1. Estimated vaccination coverage by age 24 months,* among children born during 2016–2017 and during 2018–2019 for selected vaccines and doses — National Immunization Survey–Child, United States, 2017–2021

	% (95% CI)		
	Birth year[†]		Percentage point difference
Vaccine and dose	**2016–2017**	**2018–2019**	**(2016–2017 to 2018–2019)**
DTaP[§]			
≥3 doses	93.2 (92.6 to 93.7)	94.2 (93.6 to 94.8)	1.0 (0.2 to 1.9)[¶]
≥4 doses	80.6 (79.7 to 81.6)	81.9 (80.9 to 82.8)	1.3 (−0.1 to 2.6)
Poliovirus (≥3 doses)	92.0 (91.4 to 92.6)	93.4 (92.8 to 94.0)	1.4 (0.5 to 2.2)[¶]
MMR (≥1 dose)**	90.6 (89.9 to 91.3)	91.6 (90.9 to 92.3)	1.1 (0.1 to 2.0)[¶]
Hib[††]			
Primary series	92.4 (91.7 to 93.0)	93.6 (93.0 to 94.1)	1.2 (0.3 to 2.1)[¶]
Full series	79.6 (78.6 to 80.6)	80.0 (79.0 to 81.0)	0.4 (−1.0 to 1.8)
HepB			
Birth dose[§§]	76.4 (75.4 to 77.4)	79.8 (78.8 to 80.8)	3.4 (2.0 to 4.8)[¶]
≥3 doses	91.2 (90.6 to 91.9)	92.7 (92.0 to 93.3)	1.4 (0.5 to 2.3)[¶]
VAR (≥1 dose)**	90.1 (89.4 to 90.8)	91.1 (90.3 to 91.8)	1.0 (0 to 2.0)
PCV			
≥3 doses	91.7 (91.0 to 92.3)	93.3 (92.7 to 93.9)	1.7 (0.8 to 2.5)[¶]
≥4 doses	81.2 (80.2 to 82.1)	83.5 (82.6 to 84.4)	2.3 (1.0 to 3.7)[¶]
HepA			
≥1 dose	85.6 (84.8 to 86.4)	88.3 (87.5 to 89.1)	2.7 (1.5 to 3.8)[¶]
≥2 doses[¶¶]	45.2 (44.0 to 46.4)	47.3 (46.0 to 48.5)	2.1 (0.3 to 3.8)[¶]
≥2 doses (by age 35 mos)[¶¶]	76.8 (75.6 to 78.1)	79.6 (78.0 to 81.0)	2.7 (0.8 to 4.7)[¶]
Rotavirus (by age 8 mos)***	74.6 (73.5 to 75.6)	77.1 (76.1 to 78.2)	2.6 (1.1 to 4.1)[¶]
Influenza (≥2 doses)[†††]	57.5 (56.3 to 58.6)	63.9 (62.7 to 65.0)	6.4 (4.8 to 8.0)[¶]
Combined 7-vaccine series[§§§]	69.8 (68.6 to 70.9)	70.1 (68.9 to 71.2)	0.3 (−1.3 to 1.9)
No vaccinations[¶¶¶]	1.3 (1.1 to 1.5)	0.9 (0.7 to 1.1)	−0.4 (−0.7 to −0.1)[¶]

Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine; RV5 = pentavalent rotavirus vaccine; VAR = varicella vaccine.

* Includes vaccinations received by age 24 months (before the day the child turns age 24 months), except for the HepB birth dose, rotavirus vaccination, and ≥2 HepA doses by age 35 months. For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (age 35 months for ≥2 HepA doses).

† Data for the 2016 birth year are from survey years 2017, 2018, and 2019; data for the 2017 birth year are from survey years 2018, 2019, and 2020; data for the 2018 birth year are from survey years 2019, 2020, and 2021; data for the 2019 birth year are considered preliminary and are from survey years 2020 and 2021 (data from survey year 2022 are not yet available).

§ Includes children who might have received diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine. Healthy People 2030 target for ≥4 doses of DTaP is 90%. https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination

¶ Statistically significantly different from 0 at p<0.05.

** Includes children who might have received measles, mumps, rubella, and varicella combination vaccine. Healthy People 2030 target for ≥1 dose of MMR is 90.8%. https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination

†† Hib primary series: receipt of ≥2 or ≥3 doses, depending on product type received; full series: primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

§§ One dose HepB administered from birth through age 3 days.

¶¶ Before 2020, first dose of HepA was recommended at age 12–23 months, with second dose administered 6–18 months after the first, depending upon the product type received. During 2020, recommendation was revised to 2 doses between ages 12 and 23 months, ≥6 months apart. Because children in this analysis were vaccinated under both recommendations, coverage estimates for both <24 months and <35 months are provided.

*** Includes ≥2 doses of Rotarix monovalent rotavirus vaccine or ≥3 doses of RotaTeq RV5. If any dose in the series is either RV5 or unknown, the default is a 3-dose series. The maximum age for the final rotavirus dose is age 8 months, 0 days.

††† Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.

§§§ The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full Hib series (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

¶¶¶ Healthy People 2030 target for children who get zero recommended vaccines by age 2 years is 1.3%. https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination

National Vaccination Coverage

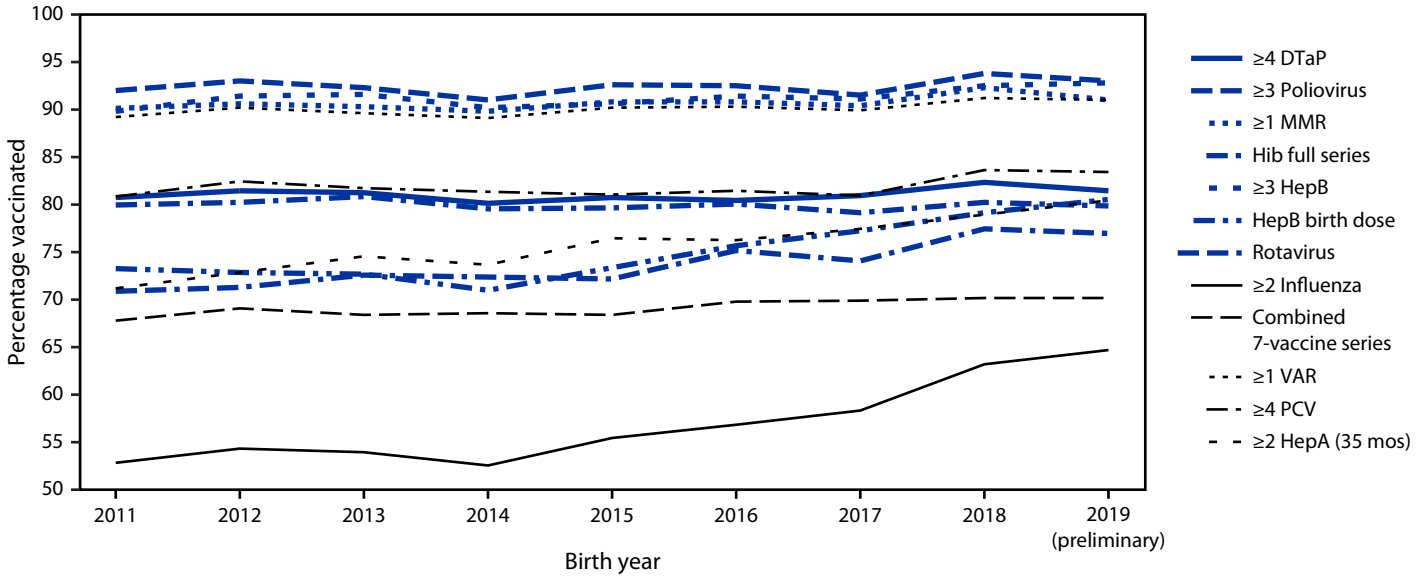
Among children born during 2018–2019, vaccination coverage by age 24 months increased compared with that among children born during 2016–2017 for a majority of vaccines (Table 1). Coverage was >90% for ≥3 doses of poliovirus vaccine (93.4%), ≥1 dose of MMR (91.6%), ≥3 doses of HepB (92.7), and ≥1 dose of VAR (91.1%). The only vaccines for which coverage was <70% were ≥2 doses of HepA (47.3%) and ≥2 doses of influenza vaccine (63.9%). The proportion of children who received no vaccinations by age 24 months decreased from 1.3% among those born during 2016–2017 to 0.9% among those born during 2018–2019. Coverage by birth year during 2011–2019 was stable for a majority of vaccines, with increases during recent years for the HepB birth dose, rotavirus vaccine, ≥2 influenza vaccine doses, and ≥2 HepA doses by age 35 months (Figure).

Vaccination by Selected Sociodemographic Characteristics and Geographic Locations

Among children born during 2018–2019, coverage among those who were uninsured and those insured by Medicaid or other insurance[¶¶¶] was lower than that among privately insured children for all vaccines except the HepB birth dose, which was lower among uninsured children only (Table 2). The proportion of children who were unvaccinated by age 24 months was eight times higher for uninsured compared with privately insured children. Compared with non-Hispanic White children, coverage with a majority of vaccines was lower among non-Hispanic Black or African American (Black) children, and coverage with ≥1 MMR dose, ≥1 VAR dose, rotavirus vaccine,

[¶¶¶] "Other insurance" includes the Children's Health Insurance Program, military insurance, coverage via the Indian Health Service, and any other type of health insurance not mentioned elsewhere.

FIGURE. Estimated vaccination coverage with selected individual vaccines[*,†,§,¶,,††] and a combined vaccine series[§§] by age 24 months,[¶¶] by birth year 2011–2019[***] — National Immunization Survey–Child, United States, 2012–2021**



Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine; VAR = varicella vaccine.

* Four or more DTaP includes children who might have received diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine.

† One or more MMR includes children who might have received measles, mumps, rubella, and varicella combination vaccine.

§ Hib full series: primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

¶ HepB birth dose = 1 dose HepB administered from birth through age 3 days.

** Rotavirus vaccination includes ≥2 doses of Rotarix monovalent rotavirus vaccine or ≥3 doses of RotaTeq pentavalent rotavirus vaccine. The maximum age for the final rotavirus dose is 8 months, 0 days.

†† Influenza vaccine doses must be administered ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.

§§ The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

¶¶ Includes vaccinations received before age 24 months, except for the HepB birth dose, rotavirus vaccination, and ≥2 HepA doses by age 35 months. For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (35 months for ≥2 HepA doses).

*** Children born in 2011 are included in survey years 2012, 2013, and 2014; children born in 2012 are included in survey years 2013, 2014, and 2015; children born in 2013 are included in survey years 2014, 2015, and 2016; children born in 2014 are included in survey years 2015, 2016, and 2017; children born in 2015 are included in survey years 2016, 2017, and 2018; children born in 2016 are included in survey years 2017, 2018, and 2019; children born in 2017 are included in survey years 2018, 2019 and 2020; children born in 2018 are included in survey years 2019 and 2020, and 2021; data for children born in 2019 are considered preliminary and are included in survey years 2020 and 2021 (data from survey year 2022 are not yet available).

≥2 influenza vaccine doses, and the 7-vaccine series was lower among Hispanic or Latino (Hispanic) children (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/123206). Coverage was lower among children living below the poverty level than among those living at or above the poverty level for all vaccines except the HepB birth dose (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/123207). Coverage with all vaccines except for the HepB birth dose was lower among children living in a non-MSA**** compared with those in an MSA principal city. Vaccination coverage varied widely by jurisdiction (Supplementary Table 3, https://stacks.cdc.gov/view/cdc/123208), especially coverage with ≥2 influenza vaccine doses, which ranged from 39.7% (Alabama) to 84.0% (Rhode Island).

**** MSA status was determined based on household reported city and county of residence and was grouped into three categories: MSA principal city, MSA nonprincipal city, and non-MSA. MSAs and principal cities were as defined by the U.S. Census Bureau (https://www.census.gov/programs-surveys/metro-micro.html). Non-MSA areas include urban populations not located within an MSA and completely rural areas.

TABLE 2. Estimated vaccination coverage by age 24 months* among children born during 2018–2019,† by selected vaccines and doses and health insurance status§ — National Immunization Survey–Child, United States, 2019–2021

Vaccine and dose	Health insurance status, % (95% CI)			
	Private only (Ref) (n = 16,629)	Any Medicaid (n = 10,200)	Other insurance (n = 2,168)	Uninsured (n = 601)
DTaP¶				
≥3 doses	96.9 (96.4–97.4)	92.3 (91.2–93.2)**	92.7 (90.3–94.7)**	85.5 (80.6–89.7)**
≥4 doses	88.6 (87.6–89.6)	77.1 (75.4–78.8)**	78.9 (75.3–82.3)**	57.0 (49.1–65.0)**
Poliovirus (≥3 doses)	**96.1 (95.5–96.6)**	**91.4 (90.3–92.5)****	**91.9 (89.4–94.1)****	**84.8 (79.7–89.1)****
MMR (≥1 dose)††	**95.1 (94.4–95.7)**	**89.2 (87.9–90.4)****	**90.0 (87.2–92.5)****	**79.7 (73.0–85.6)****
Hib§§				
Primary series	96.7 (96.1–97.1)	91.3 (90.2–92.4)**	92.4 (90.0–94.4)**	83.4 (77.9–88.2)**
Full series	86.2 (85.0–87.3)	75.6 (74.0–77.3)**	76.8 (73.2–80.3)**	57.8 (50.0–65.9)**
HepB				
Birth dose¶¶	80.6 (79.1–81.9)	79.8 (78.2–81.4)	77.4 (74.1–80.5)	69.9 (61.7–77.1)**
≥3 doses	94.6 (93.9–95.3)	91.4 (90.3–92.4)**	91.2 (88.7–93.3)**	84.6 (79.4–89.0)**
VAR (≥1 dose)††	**94.3 (93.6–95.0)**	**89.1 (87.7–90.3)****	**88.8 (85.9–91.4)****	**76.8 (69.9–83.1)****
PCV				
≥3 doses	96.2 (95.6–96.8)	91.3 (90.2–92.4)**	91.1 (88.6–93.3)**	83.9 (78.6–88.5)**
≥4 doses	90.0 (89.0–91.0)	78.8 (77.2–80.3)**	80.6 (77.3–83.7)**	62.3 (54.9–69.7)**
HepA				
≥1 dose	91.3 (90.4–92.2)	86.3 (84.9–87.7)**	87.0 (84.4–89.4)**	73.2 (66.1–79.8)**
≥2 doses***	49.6 (47.9–51.3)	46.3 (44.3–48.3)**	45.4 (41.2–49.7)	27.9 (21.5–35.8)**
≥2 doses (by age 35 mos)***	84.9 (83.0–86.7)	76.2 (73.6–78.7)**	79.1 (73.9–83.8)**	43.4 (34.9–52.9)**
Rotavirus (by age 8 mos)†††	**85.1 (83.9–86.2)**	**71.1 (69.3–72.8)****	**72.0 (67.8–75.8)****	**63.8 (56.4–70.7)****
Influenza (≥2 doses)§§§	**77.1 (75.7–78.4)**	**52.6 (50.6–54.5)****	**63.5 (59.4–67.6)****	**40.1 (33.0–48.0)****
Combined 7-vaccine series¶¶¶	**78.0 (76.6–79.4)**	**64.2 (62.3–66.1)****	**67.4 (63.4–71.2)****	**45.2 (37.8–53.3)****
No vaccinations	**0.7 (0.5–0.9)**	**0.9 (0.6–1.3)**	**1.0 (0.6–1.7)**	**6.0 (3.2–10.0)****

Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine; Ref = referent group; VAR = varicella vaccine.

* Includes vaccinations received by age 24 months (before the day the child turns 24 months), except for the HepB birth dose, rotavirus vaccination, and ≥2 HepA doses by 35 months. For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (35 months for ≥2 HepA doses).

† Data for the 2018 birth year are from survey years 2019, 2020, and 2021; data for the 2019 birth year are considered preliminary and are from survey years 2020 and 2021 (data from survey year 2022 are not yet available).

§ Children's health insurance status was reported by parent or guardian. "Other insurance" includes the Children's Health Insurance Program, military insurance, coverage via the Indian Health Service, and any other type of health insurance not mentioned elsewhere.

¶ Includes children who might have received diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine.

** Statistically significant ($p<0.05$) difference compared with Ref.

†† Includes children who might have received MMR and VAR combination vaccine.

§§ Hib primary series: receipt of ≥2 or ≥3 doses, depending on vaccine product type received; full series: primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on vaccine product type received.

¶¶ One dose HepB administered from birth through age 3 days.

*** Before 2020, first dose of HepA recommended at age 12–23 months, with second dose administered 6–18 months after the first, depending upon the vaccine product type received. During 2020, recommendation revised to 2 doses between ages 12 and 23 months, ≥6 months apart. Because children in this analysis were vaccinated under both recommendations, coverage estimates for both <24 months and <35 months are provided.

††† Includes ≥2 doses of Rotarix monovalent rotavirus vaccine, or ≥3 doses of RotaTeq pentavalent rotavirus vaccine. If any dose in the series is either RotaTeq or unknown, the default is a 3-dose series. The maximum age for the final rotavirus dose is 8 months, 0 days.

§§§ Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.

¶¶¶ The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

Summary

What is already known about this topic?

The Advisory Committee on Immunization Practices recommends routine vaccination against 14 diseases during the first 24 months of life.

What is added by this report?

Vaccination coverage among young children has remained high and stable for most vaccines, although disparities persist. The National Immunization Survey–Child identified no decline overall in routine vaccination coverage associated with the COVID-19 pandemic among children born during 2018–2019, although declines were observed among children living below the federal poverty level and in rural areas.

What are the implications for public health practice?

Additional efforts, such as providers reviewing children's immunization histories during every clinical encounter, recommending needed vaccinations, and addressing parental hesitancy, are warranted to reduce disparities so that all children can be protected from vaccine-preventable diseases.

Discussion

U.S. coverage with most recommended childhood vaccines has remained high and stable for many years. Increases in coverage by age 24 months were observed for most vaccines when comparing children born during 2018–2019 with those born during 2016–2017. Approximately 70% of children born in recent years (2016–2019) were up to date with the 7-vaccine series by age 24 months, with coverage >70% for all other vaccines except for ≥2 influenza vaccine doses and ≥2 doses of HepA. The proportion of children completely unvaccinated by age 24 months was 0.9% for children born during 2018–2019, meeting the Healthy People 2030[††††] objective of <1.3%.

This report did not identify any overall decline in vaccination coverage associated with the COVID-19 pandemic among all children. The youngest children were born in 2019. These children reached age 12 months in 2020 and 24 months in 2021; therefore, many of these children had vaccine doses recommended after the pandemic was declared in March 2020. In a more detailed analysis, coverage with the combined 7-vaccine series by age 24 months decreased 4–5 percentage points among children living below the federal poverty level or in rural areas (*3*). In addition, MMR coverage was 10 percentage points lower for children reaching age 13 months during April–May 2020 compared with those reaching age 13 months before and after this time frame, but coverage reached prepandemic levels by age 19 months (*3*). Similar decreases in coverage were observed in other data sources (*4*). The 2022 NIS-Child will include more children born shortly before or during the pandemic, providing a more complete assessment of trends in vaccination coverage during the pandemic.

Vaccination coverage declined for children living below the federal poverty level or in rural areas during the pandemic, and substantial variation in coverage by sociodemographic characteristics persists. As observed elsewhere (*4*), estimated coverage was highest among Asian children and lowest among Black children. Lower coverage was found among children living below the federal poverty level, without private health insurance, and in rural (non-MSA) areas.

If equity is to be achieved in the national childhood vaccination program, a number of obstacles must be overcome. Parents and other caregivers must have the willingness and the means to get children vaccinated. A recent report estimated that 6.5%–31.3% of nonvaccination among children could be attributed to parental hesitancy, depending upon the vaccine (*5*). CDC has developed a Vaccinate with Confidence strategy for identifying activities designed to bolster vaccine confidence and prevent outbreaks of vaccine-preventable diseases (*6*). Several additional evidence-based approaches to increasing vaccination coverage include strong health care provider recommendations, advocating for vaccines at every health care encounter, use of reminder and recall notices and standing orders, and the presence of state and local immunization information systems to provide consolidated immunization histories (*7*).

Logistical and financial barriers also must be addressed. The VFC program covers the cost of all recommended vaccines for eligible children; it is imperative that this program retain an adequate supply of participating vaccination providers and that families in need are aware of how to access it. Establishment of alternative vaccination settings such as pharmacies, emergency departments, hospitals, and outpatient subspecialty clinics might help address accessibility issues for underserved communities (*8*).

The findings in this report are subject to at least three limitations. First, the possibility of selection bias exists because of the low household interview response rate (ranging from 21%–26% during survey years 2017–2021) and the availability of adequate provider data for 49%–54% of those who completed interviews in survey years 2017–2021. Second, although the data were weighted to account for nonresponse and households without telephones, some bias could remain. Finally, coverage estimates could be incorrect if some vaccination providers did not return questionnaires or if administered vaccines were not documented accurately. Total survey error (*9*) for the 2021 survey year data was assessed and demonstrated that coverage was underestimated by 3.1 percentage points for ≥1 dose of MMR, 4.4 percentage points for the HepB birth dose, and 8.7 percentage points for the combined -vaccine

[††††] https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination

series. An analysis of change in bias of vaccination coverage estimates from 2020 to 2021 determined that a meaningful change was unlikely.[§§§§]

At the national level, coverage with most routine childhood vaccines is high; however, this high coverage is not distributed uniformly: coverage is lower among Black and Hispanic children, those of lower socioeconomic status, and those living in rural areas. Recent measles outbreaks[¶¶¶¶] and the diagnosis of a case of polio (*10*) serve as reminders that pockets of susceptibility can and do exist, even in a largely well-vaccinated society. Parents and providers must remain vigilant to ensure that all children are up to date with their routine vaccinations to protect them from vaccine-preventable diseases.

[§§§§] https://www.cdc.gov/vaccines/imz-managers/nis/downloads/NIS-PUF21-DUG.pdf

[¶¶¶¶] https://www.cdc.gov/measles/cases-outbreaks.html

Corresponding author: Holly A. Hill, hhill@cdc.gov, 404-639-8044.

[1]Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Wharton M. Vaccine safety: current systems and recent findings. Curr Opin Pediatr 2010;22:88–93. PMID:19952750 https://doi.org/10.1097/MOP.0b013e3283350425
2. Wodi AP, Ault K, Hunter P, McNally V, Szilagyi PG, Bernstein H. Advisory Committee on Immunization Practices recommended immunization schedule for children and adolescents aged 18 years or younger—United States, 2021. MMWR Morb Mortal Wkly Rep 2021;70:189–92. PMID:33571172 https://doi.org/10.15585/mmwr.mm7006a1
3. CDC. Childhood vaccination coverage before and during the COVID-19 pandemic among children born January 2017–May 2020, National Immunization Survey-Child (NIS-Child), 2018–2021. Atlanta, GA: US Department of Health and Human Services, CDC; 2022. https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/nis-child-pandemic-effects-2018-2021.html
4. DeSilva MB, Haapala J, Vazquez-Benitez G, et al. Association of the COVID-19 pandemic with routine childhood vaccination rates and proportion up to date with vaccinations across 8 US health systems in the Vaccine Safety Datalink. JAMA Pediatr 2022;176:68–77. PMID:34617975 https://doi.org/10.1001/jamapediatrics.2021.4251
5. Nguyen KH, Srivastav A, Vaish A, Singleton JA. Population attributable fraction of nonvaccination of child and adolescent vaccines attributed to parental vaccine hesitancy, 2018–2019. Am J Epidemiol 2022;191:1626–35. PMID:35292806 https://doi.org/10.1093/aje/kwac049
6. Mbaeyi S, Cohn A, Messonnier N. A call to action: strengthening vaccine confidence in the United States. Pediatrics 2020;145:e20200390. PMID:32461260 https://doi.org/10.1542/peds.2020-0390
7. Stokley S, Kempe A, Stockwell MS, Szilagyi PG. Improving pediatric vaccination coverage in the United States. Acad Pediatr 2021;21(4S):S1–2. PMID:33958085 https://doi.org/10.1016/j.acap.2021.03.004
8. Hofstetter AM, Schaffer S. Childhood and adolescent vaccination in alternative settings. Acad Pediatr 2021;21(4S):S50–6. PMID:33958093 https://doi.org/10.1016/j.acap.2021.02.001
9. Mulry MH, Spencer BD. Total error in PES estimates of population. J Am Stat Assoc 1991;86:839–55. PMID:12155391 https://doi.org/10.1080/01621459.1991.10475122
10. Link-Gelles R, Lutterloh E, Schnabel Ruppert P, et al.; 2022 U.S. Poliovirus Response Team. Public health response to a case of paralytic poliomyelitis in an unvaccinated person and detection of poliovirus in wastewater—New York, June–August 2022. MMWR Morb Mortal Wkly Rep 2022;71:1065–8. PMID:35980868 https://doi.org/10.15585/mmwr.mm7133e2

Safety Monitoring of Bivalent COVID-19 mRNA Vaccine Booster Doses Among Children Aged 5–11 Years — United States, October 12–January 1, 2023

Anne M. Hause, PhD[1]; Paige Marquez, MSPH[1]; Bicheng Zhang, MS[1]; John R. Su, MD, PhD[1]; Tanya R. Myers, PhD[1]; Julianne Gee, MPH[1]; Sarada S. Panchanathan, MD[2]; Deborah Thompson, MD[2]; Tom T. Shimabukuro, MD[1]; David K. Shay, MD[1]

On October 12, 2022, the Food and Drug Administration (FDA) issued Emergency Use Authorizations (EUAs) for bivalent (mRNA encoding the spike protein from the SARS-CoV-2 ancestral strain and BA.4/BA.5 Omicron variants) formulations of Pfizer-BioNTech and Moderna mRNA COVID-19 vaccines for use as a single booster dose ≥2 months after completion of primary series or monovalent booster vaccination for children aged 5–11 years (Pfizer-BioNTech) and 6–17 years (Moderna); on December 8, 2022, FDA amended the EUAs to include children aged ≥6 months (*1*,*2*). The Advisory Committee on Immunization Practices (ACIP) recommends that all persons aged ≥6 months receive an age-appropriate bivalent mRNA booster dose (*3*). The safety of bivalent mRNA booster doses among persons aged ≥12 years has previously been described (*4*). To characterize the safety of bivalent mRNA booster doses among children aged 5–11 years after receipt of bivalent Pfizer-BioNTech and Moderna booster doses, CDC reviewed adverse events and health impacts reported to v-safe,* a voluntary, smartphone-based U.S. safety surveillance system established by CDC to monitor adverse events after COVID-19 vaccination, and to the Vaccine Adverse Event Reporting System (VAERS), a U.S. passive vaccine safety surveillance system co-managed by CDC and FDA† (*5*). During October 12–January 1, 2023, a total of 861,251 children aged 5–11 years received a bivalent Pfizer-BioNTech booster, and 92,108 children aged 6–11 years received a bivalent Moderna booster.§ Among 3,259 children aged 5–11 years registered in v-safe who received a bivalent booster dose, local (68.7%) and systemic reactions (49.5%) were commonly reported in the week after vaccination. Approximately 99.8% of reports to VAERS for children aged 5–11 years after bivalent booster vaccination were nonserious. There were no reports of myocarditis or death after bivalent booster vaccination. Eighty-four percent of VAERS reports were related to vaccination errors, 90.5% of which did not list an adverse health event. Local and systemic reactions reported after receipt of a bivalent booster dose are consistent with those reported after a monovalent booster dose; serious adverse events are rare. Vaccine providers should provide this information when counseling parents or guardians about bivalent booster vaccination. Preliminary safety findings from the first 11 weeks of bivalent booster vaccination among children aged 5–11 years are reassuring. Compared with the low risk of serious health effects after mRNA COVID-19 vaccination, the health effects of SARS-CoV-2 infection include death and serious long-term sequalae (*6*). ACIP recommends that all persons aged ≥6 months receive an age-appropriate bivalent mRNA booster dose ≥2 months after completion of a COVID-19 primary series or receipt of a monovalent booster dose.¶

A parent or guardian with a v-safe account can register a child aged <15 years and complete health surveys on behalf of the child.** Health surveys sent daily during the week after vaccination ask questions about local injection site and systemic reactions and health impacts experienced; registrants can provide additional information about these reactions or health impacts via free text responses. CDC's v-safe call center personnel contact registrants who report receiving medical care to request further information; registrants are also encouraged to complete a VAERS report, if indicated.

VAERS accepts reports of postvaccination adverse events from health care providers, vaccine manufacturers, and members of the public.†† Providers in the CDC COVID-19 Vaccination Program are required to file VAERS reports for observed adverse events after vaccination and for vaccination errors. Signs, symptoms, and diagnoses reported to VAERS are assigned Medical Dictionary for Regulatory Activities preferred terms (MedDRA PTs) by VAERS personnel.§§ Death certificates and autopsy reports are requested for any reported death.

* https://vsafe.cdc.gov/en
† https://vaers.hhs.gov
§ https://covid.cdc.gov/covid-data-tracker/#vaccination-demographic (Accessed January 1, 2023).

¶ https://www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html (Accessed January 1, 2023).
** Text message reminders are sent to parents or guardians to complete online health surveys for their child on days 0–7 after vaccination; then weekly through 6 weeks after vaccination; and then 3, 6, and 12 months after vaccination. Previously registered persons can report receipt of a COVID-19 booster dose, and new registrants can enter information about all doses received; registrants can also indicate whether any other vaccines were administered during the same visit. Parents and guardians use the following definitions to describe the severity of a child's symptoms: mild (noticeable, but not problematic), moderate (limit normal daily activities), or severe (make daily activities difficult or impossible).
†† Under EUA, and as enrolled providers in the CDC COVID-19 Vaccination Program, health care providers are required to report certain adverse events after COVID-19 vaccination to VAERS, including death (https://vaers.hhs.gov/faq.html). VAERS forms ask for patient, vaccine, administration, and adverse event information. https://vaers.hhs.gov/docs/VAERS%202.0_Checklist.pdf
§§ Each VAERS report might be assigned more than one MedDRA PT. A MedDRA-coded event does not indicate a medically confirmed diagnosis. https://www.meddra.org/how-to-use/basics/hierarchy

A bivalent booster dose in v-safe was defined as administration of an age-appropriate mRNA COVID-19 vaccine dose on or after October 12, 2022, to a registrant who had completed at least a primary vaccination series (2 doses of Pfizer-BioNTech or Moderna vaccine). In this report, local and systemic reactions and health impacts reported during the week after vaccination were described for v-safe registrants aged 5–11 years who received a bivalent booster dose during October 12–January 1, 2023. VAERS adverse event reports were described by serious and nonserious classification, demographic characteristics, and MedDRA PTs. Reports of serious events to VAERS were reviewed by CDC physicians to form a consensus on clinical impression based on available data.[¶¶] Possible cases of myocarditis, a rare adverse event that has been associated with mRNA COVID-19 vaccines, were identified using selected MedDRA PTs (*6*). All analyses were conducted using SAS software (version 9.4; SAS Institute). These surveillance activities were reviewed by CDC and conducted consistent with applicable federal law and CDC policy.[***]

Review of v-safe Data

During October 12–January 1, 2023, a total of 3,259 v-safe registrants aged 5–11 years received an age-appropriate bivalent booster dose (Table 1); 2,647 (81.2%) received Pfizer-BioNTech, and 612 (18.8%) received Moderna bivalent booster doses. Approximately 20.6% (670) of registrants received at least one other vaccination at the same visit as bivalent booster vaccination; among these, 649 (96.9%) received an influenza vaccine.

On ≥1 day during the week after receipt of the bivalent booster dose, local injection site reactions were reported for 1,740 (65.7%) Pfizer-BioNTech recipients and 470 (76.8%) Moderna recipients (Table 2); systemic reactions were reported for 1,215 (45.9%) Pfizer-BioNTech recipients and 379 (61.9%) Moderna recipients. The most commonly reported adverse reactions after receipt of either vaccine were injection site pain (2,146; 65.9%), fatigue (1,076; 33.0%), and headache (745; 22.9%). Most reported reactions were mild in severity (noticeable, but not problematic). Reactions were most frequently reported the day after vaccination; reporting frequency decreased in the days that followed. At least 1 day during the week after bivalent booster vaccination, 469 (14.4%) children were reported to be unable to attend school, and 447 (13.7%) were unable to complete daily activities. Sixty-two (1.9%) parents or guardians reported seeking medical care for their child after bivalent booster vaccination, most commonly in an outpatient clinic (37; 1.1%); no children received hospital care. Of the 64 reports of medical care sought, 37 had additional information available; parents or guardians of 35 children reported that seeking care was unrelated to vaccination.

Review of VAERS Data

During October 12–January 1, 2023, VAERS received and processed 922 reports of adverse events among children aged 5–11 years (Table 3).[†††] The median recipient age was 9 years

[¶¶] VAERS reports are classified as serious (based on FDA C.F.R. Title 21) if any of the following are reported: hospitalization, prolongation of hospitalization, life-threatening illness, permanent disability, congenital anomaly or birth defect, or death. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr

[***] 45 C.F.R. part 46, 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.

[†††] Processed VAERS reports are those that have been coded using MedDRA, deduplicated, and undergone standard quality assurance and quality control review.

TABLE 1. Demographic and vaccination characteristics reported to v-safe for children aged 5–11 years* who received a bivalent Pfizer-BioNTech or Moderna COVID-19 vaccine booster dose† — United States, October 12–January 1, 2023

Characteristic	No. (%), by vaccine		
	Pfizer-BioNTech (n = 2,647)	Moderna (n = 612)	Total (N = 3,259)
Sex			
Female	1,296 (49.0)	300 (49.0)	**1,596 (49.0)**
Male	1,338 (50.6)	310 (50.7)	**1,648 (50.6)**
Unknown	13 (0.5)	2 (0.3)	**15 (0.5)**
Age range, yrs (median)	5–11 (8)	6–11 (8)	**5–11 (8)**
Ethnicity			
Hispanic or Latino	298 (11.3)	51 (8.3)	**349 (10.7)**
Non-Hispanic or Latino	2,293 (86.6)	549 (89.7)	**2,842 (87.2)**
Unknown	56 (2.1)	12 (2.0)	**68 (2.1)**
Race			
American Indian or Alaska Native	7 (0.3)	2 (0.3)	**9 (0.3)**
Asian	131 (5.0)	27 (4.4)	**158 (4.9)**
Black or African American	99 (3.7)	16 (2.6)	**115 (3.5)**
Native Hawaiian or other Pacific Islander	5 (0.2)	0 (—)	**5 (0.2)**
White	2,033 (76.8)	489 (79.9)	**2,522 (77.4)**
Multiracial	245 (9.3)	58 (9.5)	**303 (9.3)**
Other	71 (2.7)	8 (1.3)	**79 (2.4)**
Unknown	56 (2.1)	12 (2.0)	**68 (2.1)**
Total no. of COVID-19 vaccine doses received			
3	1,055 (39.9)	119 (19.4)	**1,174 (36.0)**
4	1,588 (60.0)	493 (80.6)	**2,081 (63.9)**
5	4 (0.1)	0 (—)	**4 (0.1)**
Vaccine co-administration§			
Yes	565 (21.3)	105 (17.2)	**670 (20.6)**
No	2,082 (78.7)	507 (82.8)	**2,589 (79.4)**

* On October 12, 2022, the Food and Drug Administration authorized bivalent (mRNA encoding the spike protein from the SARS-CoV-2 ancestral strain and BA.4/BA.5 Omicron variants formulations of Pfizer-BioNTech and Moderna mRNA COVID-19 vaccines for use as a single booster dose ≥2 months after completion of primary series or monovalent booster vaccination for children aged 5–11 years and 6–17 years, respectively. A bivalent booster dose in v-safe was defined as an age-appropriate mRNA vaccine dose administered on or after October 12, 2022, for registrants who had completed at least a primary series (2 doses of Pfizer-BioNTech or Moderna vaccine).

† Includes registrants who completed at least one survey during postvaccination days 0–7.

§ Other vaccines administered during the same visit.

(range = 5–11 years), and 459 (49.8%) reports were for females. Approximately 13.4% (124) of registrants received at least one other vaccination during that same visit; of those, 115 (92.7%) received an influenza vaccine. Among all 922 VAERS reports, 920 (99.8%) were classified as nonserious, 845 (99.8%) after Pfizer-BioNTech and 75 (100%) after Moderna bivalent booster vaccination.

The most common events reported (775; 84.2%) were vaccination errors (e.g., incorrect dose administered [303; 39.1%], incorrect product formulation administered [207; 26.7%], product preparation issue [177; 22.8%], and product administered to patient of an inappropriate age [126; 16.3%]).

TABLE 2. Adverse reactions and health impacts reported to v-safe for children aged 5–11 years* who received a bivalent Pfizer-BioNTech or Moderna COVID-19 vaccine booster dose, by vaccine — United States, October 12–January 1, 2023

Event†	No. (%) reporting reaction or health impact after vaccination§		
	Pfizer-BioNTech (n = 2,647)	Moderna (n = 612)	Total (N = 3,259)
Any injection site reaction	1,740 (65.7)	470 (76.8)	**2,210 (67.8)**
Pain	1,683 (63.6)	463 (75.7)	**2,146 (65.9)**
Swelling or hardness	229 (8.7)	64 (10.5)	**293 (9.0)**
Redness	211 (8.0)	64 (10.5)	**275 (8.4)**
Itching	123 (4.7)	21 (3.4)	**144 (4.4)**
Any systemic reaction	**1,215 (45.9)**	**379 (61.9)**	**1,594 (48.9)**
Fatigue	798 (30.2)	278 (45.4)	**1,076 (33.0)**
Headache	534 (20.2)	211 (34.5)	**745 (22.9)**
Fever	512 (19.3)	198 (32.4)	**710 (21.8)**
Myalgia	353 (13.3)	145 (23.7)	**498 (15.3)**
Chills	247 (9.3)	103 (16.8)	**350 (10.7)**
Nausea	208 (7.9)	89 (14.5)	**297 (9.1)**
Abdominal pain	182 (6.9)	56 (9.2)	**238 (7.3)**
Vomiting	115 (4.3)	39 (6.4)	**154 (4.7)**
Joint pain	106 (4.0)	41 (6.7)	**147 (4.5)**
Diarrhea	74 (2.8)	15 (2.5)	**89 (2.7)**
Rash	37 (1.4)	8 (1.3)	**45 (1.4)**
Any health impact	**506 (19.1)**	**196 (32.0)**	**702 (21.5)**
Unable to attend school	355 (13.4)	114 (18.6)	**469 (14.4)**
Unable to perform normal daily activities	298 (11.3)	149 (24.4)	**447 (13.7)**
Needed medical care	49 (1.9)	13 (2.1)	**62 (1.9)**
Outpatient clinic	30 (1.1)	7 (1.1)	**37 (1.1)**
Telehealth	10 (0.4)	4 (0.7)	**14 (0.4)**
Other	12 (0.5)	3 (0.5)	**15 (0.5)**
Emergency department visit	4 (0.1)	0 (—)	**4 (0.1)**
Hospitalization	0 (—)	0 (—)	**0 (—)**

* On October 12, 2022, the Food and Drug Administration authorized bivalent (mRNA encoding the spike protein from the SARS-CoV-2 ancestral strain and BA.4/BA.5 Omicron variants) formulations of Pfizer-BioNTech and Moderna mRNA COVID-19 vaccines for use as a single booster dose ≥2 months after completion of primary series or monovalent booster vaccination for children aged 5–11 years and 6–17 years, respectively. A bivalent booster dose in v-safe was defined as an age-appropriate mRNA vaccine dose administered on or after October 12, 2022, for registrants who had completed at least a primary series (2 doses of Pfizer-BioNTech or Moderna vaccine).

† Events reported are not mutually exclusive.

§ Percentage of registrants reported a reaction or health impact at least once during postvaccination days 0–7.

Reports assigned the MedDRA PTs "incorrect dose administered," "incorrect product formulation administered," or "product administered to patient of inappropriate age" often represented situations in which a child received an adult bivalent booster dosage or a bivalent booster dose instead of the appropriate monovalent primary series dose. Reports assigned the MedDRA PT "product preparation issue" often

TABLE 3. Events* reported to the Vaccine Adverse Event Reporting System for children aged 5–11 years† after receipt of a bivalent Pfizer-BioNTech or Moderna COVID-19 vaccine booster dose — United States, October 12–November 20, 2022

Adverse events	No. (%) reporting, by vaccine		
	Pfizer-BioNTech (n = 847)	Moderna (n = 75)	Total (N = 922)
Serious reports§			
Total serious reports	**2 (0.2)**	**0 (—)**	**2 (0.2)**
Nonserious reports			
Total nonserious reports	**845 (99.8)**	**75 (100)**	**920 (99.8)**
Reports of vaccination error¶	**726 (85.9)**	**49 (65.3)**	**775 (84.2)**
Error without adverse health event	661 (91.0)	40 (81.6)	**701 (90.5)**
Error with adverse health event**	65 (9.0)	9 (18.4)	**74 (9.5)**
Reports not specifying vaccination error††	**119 (14.1)**	**26 (34.7)**	**145 (15.8)**
Fever	13 (10.9)	8 (30.8)	**21 (14.5)**
Syncope	17 (14.3)	3 (11.5)	**20 (13.8)**
Vomiting	10 (8.4)	8 (30.8)	**18 (12.4)**
Nausea	12 (10.1)	5 (19.2)	**17 (11.7)**
Dizziness	12 (10.1)	2 (7.7)	**14 (9.7)**
Fall	11 (9.2)	1 (3.9)	**12 (8.3)**
Fatigue	6 (5.0)	5 (19.2)	**11 (7.6)**
Headache	5 (4.2)	6 (23.1)	**11 (7.6)**
Loss of consciousness	11 (9.2)	0 (—)	**11 (7.6)**
Cough	7 (5.9)	2 (7.7)	**9 (6.21)**
Urticaria	7 (5.9)	2 (7.7)	**9 (6.21)**

Abbreviations: MedDRA PT = Medical Dictionary for Regulatory Activities preferred term; VAERS = Vaccine Adverse Event Reporting System.

* Signs and symptoms in VAERS reports are assigned MedDRA PTs by VAERS staff members. Each VAERS report might be assigned more than one MedDRA PT, which can include normal diagnostic findings. A MedDRA PT does not indicate a medically confirmed diagnosis.

† On October 12, 2022, the Food and Drug Administration authorized bivalent (mRNA encoding the spike protein from the SARS-CoV-2 ancestral strain and BA.4/BA.5 Omicron variants) formulations of Pfizer-BioNTech and Moderna mRNA COVID-19 vaccines for use as a single booster dose ≥2 months after completion of primary series or monovalent booster vaccination for children aged 5–11 years and 6–17 years.

§ The most common MedDRA PTs among reports of vaccination error included incorrect dose administered (303; 39.1%), incorrect product formulation administered (207; 26.7%), product preparation issue (177; 22.8%), and product administered to patient of inappropriate age (126; 16.3%).

¶ The most common adverse health events MedDRA PTs for reports with nonserious vaccination errors included fever (24; 32.4%), pain in extremity (20; 27.0%), fatigue (14; 18.9%), headache (11; 14.9%), and pain (eight; 10.8%).

** Excluding reports of vaccination error. Includes the top 10 most frequently coded MedDRA PTs among nonserious reports.

†† VAERS reports are classified as serious if any of the following are reported: hospitalization, prolongation of hospitalization, life-threatening illness, permanent disability, congenital anomaly or birth defect, or death. Serious reports to VAERS were reviewed by CDC physicians to form a clinical impression. https://www.meddra.org/how-to-use/basics/hierarchy

Summary

What is already known about this topic?

After CDC's October 2022 recommendation for bivalent COVID-19 booster vaccination for children aged 5–11 years, children in this age group received approximately 953,359 bivalent booster doses during October 12, 2022–January 1, 2023.

What is added by this report?

Early safety findings from v-safe and the Vaccine Adverse Event Reporting System (VAERS) for bivalent booster vaccination in children aged 5–11 years are similar to those described for monovalent booster vaccination. Most VAERS reports represented vaccine errors rather than adverse events. Neither myocarditis nor death were reported after bivalent booster vaccination.

What are the implications for public health practice?

These preliminary safety findings should be provided when counseling parents or guardians about bivalent booster vaccination. All eligible persons should receive a bivalent booster dose.

represented situations in which vaccine was incorrectly reconstituted. Among 775 reports of vaccination errors related to bivalent booster vaccination, 74 (9.5%) reports indicated that an adverse health event had occurred.

After excluding vaccination error reports, 145 (15.8%) of the 920 nonserious reports remained. Commonly reported events included fever (21; 14.5%), syncope (20; 13.8%), vomiting (18; 12.4%), nausea (17; 11.7%), and dizziness (14; 9.7%). Two serious reports were for children who received Pfizer-BioNTech vaccine; one for a child who developed symptoms consistent with Miller Fisher syndrome, a rare, acquired neurologic condition considered to be a variant of Guillain-Barré syndrome[§§§]; verification based on medical record review is pending. The other one was for a child hospitalized with urticaria and arthritis. No reports of myocarditis or death after bivalent booster vaccination were received.

Discussion

This report provides findings from v-safe and VAERS data collected during the first 11 weeks of bivalent Pfizer-BioNTech and Moderna mRNA booster dose administration among children aged 5–11 years; during this period, approximately 953,359 booster doses were administered to children in this age group. The findings in this report are generally consistent with those from postauthorization vaccine safety surveillance of monovalent mRNA COVID-19 booster vaccination in this age group (*7*).

Reports to v-safe of systemic and injection site reactions after bivalent booster vaccination among children aged 5–11 years were similar in frequency to those reported after monovalent Pfizer-BioNTech booster vaccination (*7*). Consistent with previous descriptions of reactogenicity after mRNA COVID-19 vaccination (*8*), reactions and health impacts were reported more frequently for children who received Moderna than for those who received Pfizer-BioNTech bivalent booster vaccination. Most reports to v-safe of children who received medical care after bivalent booster vaccination indicated that care was not related to vaccination.

After administration of >950,000 doses of bivalent booster vaccine to children aged 5-11 years, only two serious VAERS reports have been received. Approximately 99.8% of reports to VAERS for children aged 5–11 years after bivalent booster vaccination were deemed nonserious; most (85.0%) reports were related to vaccination errors. Many vaccination errors represented children receiving an incorrect bivalent booster dose for their age or an incorrectly reconstituted dose. Most reports of vaccination error did not include an adverse health event; those with an event were consistent with expected reactions after an mRNA COVID-19 vaccination. Among events reported to VAERS, vaccination errors were reported with a similar frequency among children aged 5–11 years after monovalent (71%) or bivalent (84%) booster vaccination (*7*). Vaccination errors represented a smaller proportion of events (35%) reported among persons aged ≥12 years who received bivalent booster vaccination (*4*). CDC provides updated clinical guidance, educational materials, and training opportunities after each update to COVID-19 vaccine recommendations.[¶¶¶] Public health officials should continue to provide training materials for vaccine administrators to help reduce vaccination errors among children.

The findings in this report are subject to at least four limitations. First, v-safe is a voluntary program, and data might not be representative of the vaccinated population. Second, v-safe does not directly identify whether a vaccine is monovalent or bivalent; therefore, misclassification might occur among children who aged into this population without having completed a 3-dose primary series. Third, VAERS is a passive surveillance system and subject to reporting biases and underreporting, especially of nonserious events (*5*). Finally, conclusions drawn from these data are limited by the 11-week surveillance period; safety monitoring will continue during the bivalent booster vaccination program.

ACIP recommends that all persons aged ≥6 months receive an age-appropriate bivalent mRNA booster dose ≥2 months after completion of a COVID-19 primary series or receipt of a

[§§§] https://www.ninds.nih.gov/health-information/disorders/miller-fisher-syndrome#:~:text%20=%20Miller%20Fisher%20syndrome%20is%20a,preceded%20by%20a%20viral%20illness

[¶¶¶] https://www.cdc.gov/vaccines/covid-19/index.html

monovalent booster dose. Preliminary safety findings from the first 11 weeks of bivalent booster vaccination among children aged 5–11 years are reassuring. Compared with the low risk of serious health effects after mRNA COVID-19 vaccination, the health effects of SARS-CoV-2 infection include death and serious long-term sequalae (*6*). Immunization with bivalent vaccines provides significant additional protection against symptomatic SARS-CoV-2 infection (*9*). CDC and FDA will continue to monitor vaccine safety and will provide updates as needed to help guide COVID-19 vaccination recommendations.

Acknowledgments

Charles Licata, Isaac McCullum.

Corresponding author: Anne M. Hause, voe5@cdc.gov.

[1]CDC COVID-19 Emergency Response Team; [2]Food and Drug Administration, Silver Spring, Maryland.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

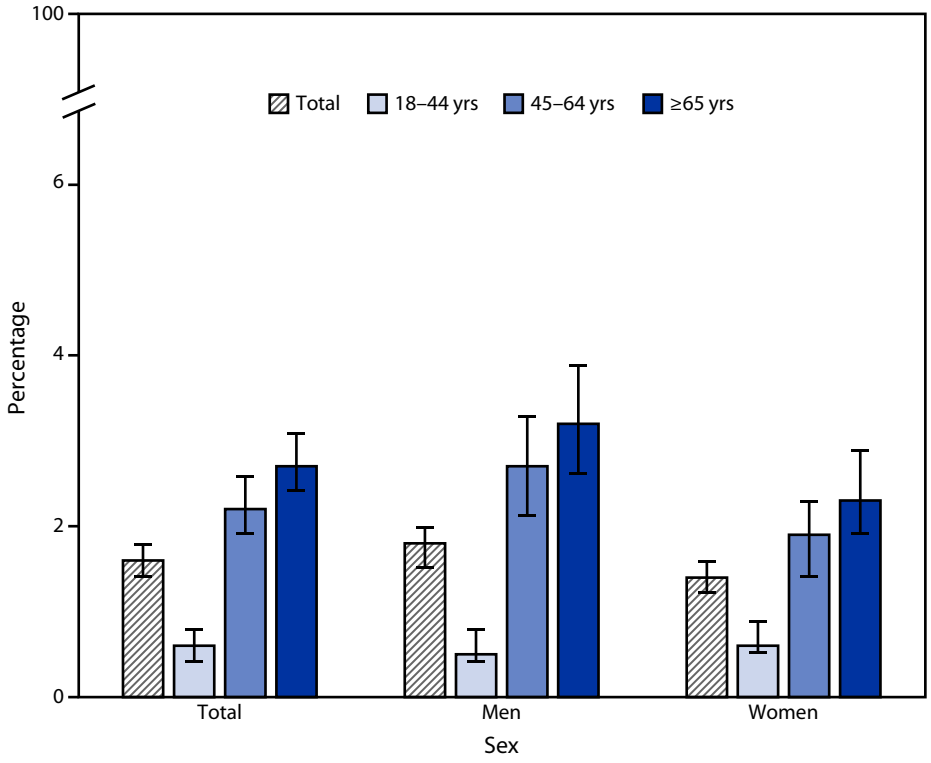
References

1. Food and Drug Administration. Pfizer-BioNTech COVID-19 vaccine letter of authorization (reissued). Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2022. https://www.fda.gov/media/150386/download
2. Food and Drug Administration. Moderna COVID-19 vaccine letter of authorization (reissued). Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2022. https://www.fda.gov/media/144636/download
3. Rosenblum HG, Wallace M, Godfrey M, et al. Interim recommendations from the Advisory Committee on Immunization Practices for the use of bivalent booster doses of COVID-19 vaccines—United States, October 2022. MMWR Morb Mortal Wkly Rep 2022;71:1436–41. PMID:36355612 https://doi.org/10.15585/mmwr.mm7145a2
4. Hause AM, Marquez P, Zhang B, et al. Safety monitoring of bivalent COVID-19 mRNA vaccine booster doses among persons aged ≥12 years—United States, August 31–October 23, 2022. MMWR Morb Mortal Wkly Rep 2022;71:1401–6. PMID:36327162 https://doi.org/10.15585/mmwr.mm7144a3
5. Shimabukuro TT, Nguyen M, Martin D, DeStefano F. Safety monitoring in the Vaccine Adverse Event Reporting System (VAERS). Vaccine 2015;33:4398–405. PMID:26209838 https://doi.org/10.1016/j.vaccine.2015.07.035
6. Block JP, Boehmer TK, Forrest CB, et al. Cardiac complications after SARS-CoV-2 infection and mRNA COVID-19 vaccination—PCORnet, United States, January 2021–January 2022. MMWR Morb Mortal Wkly Rep 2022;71:517–23. PMID:35389977 https://doi.org/10.15585/mmwr.mm7114e1
7. Hause AM, Baggs J, Marquez P, et al. Safety monitoring of Pfizer-BioNTech COVID-19 vaccine booster doses among children aged 5–11 years—United States, May 17–July 31, 2022. MMWR Morb Mortal Wkly Rep 2022;71:1047–51. PMID:35980875 https://doi.org/10.15585/mmwr.mm7133a3
8. Hause AM, Baggs J, Marquez P, et al. Safety monitoring of COVID-19 vaccine booster doses among adults—United States, September 22, 2021–February 6, 2022. MMWR Morb Mortal Wkly Rep 2022;71:249–54. PMID:35176008 https://doi.org/10.15585/mmwr.mm7107e1
9. Link-Gelles R, Ciesla AA, Fleming-Dutra KE, et al. Effectiveness of bivalent mRNA vaccines in preventing symptomatic SARS-CoV-2 infection—Increasing Community Access to Testing program, United States, September–November 2022. MMWR Morb Mortal Wkly Rep 2022;71:1526–30. PMID:36454688 https://doi.org/10.15585/mmwr.mm7148e1

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Adults Aged ≥18 Years Who Have Ever Had Hepatitis,† by Age Group and Sex — National Health Interview Survey,§ United States, 2021



* With 95% CIs indicated by error bars.
† Based on an affirmative response to the survey question, "Have you ever been told by a doctor or other health professional that you had hepatitis?" All types and causes of hepatitis could be reported by the respondent.
§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population.

In 2021, 1.6% of adults aged ≥18 years reported having ever had hepatitis. The prevalence of hepatitis was lowest among adults aged 18–44 years (0.6%) and highest among adults aged ≥65 years (2.7%). Prevalence increased with age for both men and women. The percentage of adults who ever had hepatitis was higher in men than women aged 45–64 years (2.7% versus 1.9%) and ≥65 years (3.2% versus 2.3%), but was similar in adults aged 18–44 years (0.5% versus 0.6%).

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

Reported by: Julie D. Weeks, PhD, jweeks@cdc.gov, 301-458-4562; Nazik Elgaddal, MS.

The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format. To receive an electronic copy each week, visit *MMWR* at *https://www.cdc.gov/mmwr/index.html*.

Readers who have difficulty accessing this PDF file may access the HTML file at https://www.cdc.gov/mmwr/index2023.html. Address all inquiries about the *MMWR* Series to Editor-in-Chief, *MMWR* Series, Mailstop V25-5, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30329-4027 or to mmwrq@cdc.gov.

ISSN: 0149-2195 (Print)