Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 73 / No. 15
April 18, 2024

Heat-Related Emergency Department Visits — United States, May–September 2023

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Abstract

Unprecedented heat waves can affect all persons, but some are more sensitive to the effects of heat, including children and adults with underlying health conditions, pregnant women, and outdoor workers. Many regions of the United States experienced record-breaking high temperatures in 2023, with populations exposed to extremely high temperatures for prolonged periods. CDC examined emergency department (ED) visits associated with heat-related illness (HRI) from the National Syndromic Surveillance Program and compared daily HRI ED visit rates during the warm-season months (May–September) of 2023 with those during 2018–2022. In the 2023 warm-season months, daily HRI ED visit rates peaked in several regions and remained elevated for a prolonged duration. More males than females sought care in EDs for HRI, especially males aged 18–64 years. CDC issued multiple public health alerts using the Epidemic Information Exchange system to bring attention to increases in ED utilization for HRI. Deaths and illnesses associated with heat exposure are a continuing public health concern as climate change results in longer, hotter, and more frequent episodes of extreme heat. Near real-time monitoring of weather conditions and adverse health outcomes can guide public health practitioners' timing of risk communication and implementation of prevention measures associated with extreme heat.

Introduction

The warm-season months (May–September) of 2023 were the hottest ever recorded in the United States,* and adverse health impacts, including deaths and illnesses attributable to high ambient temperatures, received considerable attention.† Hot weather conditions can affect all persons; however, for certain specific populations, exposure and health risks are compounded by adverse physiologic, behavioral, demographic, or socioeconomic factors that result in their being disproportionately affected by extreme heat (*1*). Populations at highest risk typically include older persons, children and adolescents, persons with preexisting health conditions, pregnant women, outdoor workers, persons with limited access to cooling resources, and persons living in low-income communities.§ Further, exceptionally hot conditions can increase the demand for medical services and strain health systems (e.g., a surge in persons seeking emergency department [ED] care) (*2*).

* https://www.nasa.gov/news-release/nasa-announces-summer-2023-hottest-on-record/

† https://www.whitehouse.gov/briefing-room/statements-releases/2023/07/27/fact-sheet-president-biden-to-announce-new-actions-to-protect-workers-and-communities-from-extreme-heat

§ https://www.cdc.gov/disasters/extremeheat/index.html

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Successful public health measures to reduce heat-related illness (HRI), including targeted communication and outreach campaigns for populations at risk, require coordination across various health care sectors and are often guided by near real-time assessments of heat exposure and its resulting adverse health impacts. To assess the health impact of exceedingly high temperatures observed during the warm-season months of 2023, CDC analyzed National Syndromic Surveillance Program (NSSP) data to compare daily HRI ED visit rates during May–September 2023 with those during May–September 2018–2022.

Methods

Data Sources

Data on HRI ED visits[¶] occurring during January 2018–December 2023 were extracted from NSSP's Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE).[**] The daily number of HRI and all-cause ED visits were tabulated for each of the 10 U.S. Department of Health and Human Services (HHS) regions.[††]

NSSP data were analyzed to compare the 2023 heat season with the 2018–2022 seasons. To account for temporal changes among facilities sharing data with NSSP, comparisons between 2023 and previous years were restricted to those EDs with consistent reporting during the study period.[§§]

Descriptive and Statistical Analyses

After applying data quality filters to reduce artifactual changes in reporting patterns during 2018–2023, a maximum of 826 (range = 3–826; median = 36) ED facilities that participate in NSSP reported one or more visits associated with HRI. The HHS region–specific daily HRI ED visit rate (the number of ED visits for HRI per 100,000 all-cause ED visits) observed during the warm-season months of 2023 was compared with the 95th percentile value of the daily HRI ED visit rate distribution. The 95th percentile for each region was computed based on HRI ED data recorded for the 2018–2022 warm-season months.

Differences in HRI ED visit rates were evaluated by age group (0–17, 18–25, 26–54, 55–64, 65–74, and ≥75 years),

[¶] HRI ED visits were identified using administrative discharge diagnosis codes and free text search of the patient's reason for visit (i.e., their chief complaint). https://knowledgerepository.syndromicsurveillance.org/heat-related-illness-v2

[**] https://publichealth.jmir.org/2021/6/e26303/authors

[††] The dataset does not include data from American Samoa, Federated States of Micronesia, Marshall Islands, Northern Mariana Islands, Palau, Puerto Rico, or the U.S. Virgin Islands. https://www.hhs.gov/about/agencies/iea/regional-offices/index.html

[§§] To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation for ED visits ≤40 and average weekly informative discharge diagnosis ≥70% complete with discharge diagnosis code formatting during January 2018–December 2023. After applying this data quality filter, a maximum of 823 ED (range = 3–823; median = 111) facilities that participate in NSSP returned one or more visits associated with HRI. https://www.cdc.gov/nssp/index.html

The *MMWR* series of publications is published by the Office of Science, 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 2024;73:[inclusive page numbers].

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sex, HHS region, and occurrence of the HRI ED visits during the hotter warm-season months (i.e., July and August). Rate ratios (RRs) and associated 95% CIs were estimated using a multivariate Poisson regression model. The daily number of HRI visits was regressed against predictors such as age group, sex, HHS region, and an indicator to denote the occurrence of HRI ED visits during the hotter warm-season months of July and August. The model also included the logarithm of all-cause ED visits to account as an offset term. For each predictor, the category with the lowest warm-season HRI ED visit rate was identified as the referent population. Regressions were executed for 2023 and 2018–2022 with the same model specifications and parameters. Analysis and visualization were conducted using R software (version 4.1.2; R Foundation) and SAS software (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[¶¶]

Results

Characteristics of HRI ED Visits

During January 1–December 31, 2023, a total of 119,605 HRI ED visits were recorded in the ESSENCE system[***]; 92% of these visits occurred during May–September. Across the study period, July and August accounted for a higher average HRI ED visit rate (303 per 100,000 ED visits) compared with other warm-season months (May, June, and September) (97) (Table 1). Further, the risk observed during July–August 2023 was more than three times that during May, June, and September (mean RR = 3.07), consistent with record-breaking temperatures observed across several HHS regions in 2023.[†††] In comparison, the risk observed in July–August 2018–2022 was approximately twice as high as that of May, June, and September of the same period.

Demographic Characteristics of Persons with HRI ED Visits

In 2023, among the demographic groups considered, higher rates of HRI ED visits were observed among males (271 per 100,000 ED visits) than among females (104) and among adults aged 18–64 years (range = 207–222) than adults aged ≥65 years (range = 120–173). In addition, the risk for HRI ED visits among adults aged 18–25 and 26–54 years was approximately 2.5 times the risk in the referent population (persons aged <18 years).

Regional Differences in HRI ED Visits

HHS regional differences in warm-season HRI ED visit rates were observed in 2023. The lowest average warm-season HRI ED visit rate (51 per 100,000 ED visits) was reported by HHS Region 2 (New Jersey and New York), whereas the highest rate was reported by Region 6 (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas) (483). Compared with Region 2 (the referent region), the HRI ED visit risks for regions 4, 6, 7, and 9 in 2023 were 1.5–2.5 times those during 2018–2022.

Daily HRI ED visit rates during the warm-season months in 2023 for several regions exceeded the 95th percentile of the daily HRI ED visit rate distribution for the warm-season months during 2018–2022 for multiple periods of ≥3 consecutive days in some regions (Supplementary Figure, https://stacks.cdc.gov/view/cdc/153146). For instance, in regions 6 and 9, HRI ED rates in July 2023 exceeded the 2018–2022 95th percentile for 16 and 18 consecutive days, respectively. In the warm-season months of 2023, every HHS region experienced ≥1 day above the 95th percentile (Table 2). In regions 4, 6, 7, and 9, the number of days with HRI ED visit rates exceeding the 95th percentile was higher than that in any previous year in the study period. In Region 6 alone, more than one third (37%; 56) of the days during the warm season of 2023 had daily HRI ED visit rates exceeding the 95th percentile. Regions 6 and 7 experienced days with the highest rate of HRI ED visits ever recorded in the ESSENCE system for their respective region since 2018.

Discussion

In recent years, health emergencies caused by heat exposure have become more frequent and widespread in the United States (*1*). The severity, frequency, and duration of heat waves in 2023 in some HHS regions resulted in record-high rates of HRI ED visits during the year, which prompted CDC to issue Epidemic Information Exchange (Epi-X) public health alerts.[§§§]

The finding of increased risk for HRI ED visit rates among certain demographic groups in 2023, particularly among males and adults aged 18–64 years, is similar to findings reported in other studies (*3*). Although the lowest HRI ED visit rates occurred among persons aged <18 years, previous studies of children and adolescents in different age groups suggest that children might also be subject to the effects of heat exposure at rates similar to those among adults in some areas of the United States (*4*). Persons who work outdoors might regularly endure

[¶¶] 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.

[***] All facilities reporting HRI data to NSSP were considered to obtain the total HRI ED visits reported during January 1–December 31, 2023, across all HHS regions. During this period, HRI data were reported by a maximum of 1,238 EDs (range = 12–1,238; median = 152) that participated in NSSP and returned one or more visits associated with HRI.

[†††] https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202313

[§§§] On June 30, 2023, and August 23, 2023, CDC issued public health alerts using the Epi-X system upon noticing high levels of heat-related ED visits.

TABLE 1. Comparison* of mean rate and rate ratios for heat-related illness emergency department visits† for warm-season months (May–September), by age group, sex, U.S. Department of Health and Human Services region,§ and peak heat season — United States, 2023 and 2018–2022

Characteristic	Year					
	2023			2018–2022		
	Mean HRI ED visit rate (95% CI)	Mean RR (95% CI)	p-value	Mean HRI ED visit rate (95% CI)	Mean RR (95% CI)	p-value
Total	**180 (155–208)**	**NA**	**NA**	**151 (128–177)**	**NA**	**NA**
Age group, yrs						
<18 (Ref)	95 (77–116)	NA	NA	85 (68–105)	NA	NA
18–25	211 (183–241)	2.52 (2.16–2.94)	<0.001	173 (148–201)	2.32 (2.00–2.69)	<0.001
26–54	222 (194–253)	2.54 (2.23–2.88)	<0.001	180 (155–208)	2.27 (2.01–2.57)	<0.001
55–64	207 (180–237)	2.29 (1.97–2.65)	<0.001	166 (142–193)	2.01 (1.74–2.33)	<0.001
65–74	173 (148–201)	1.95 (1.67–2.28)	<0.001	150 (127–176)	1.85 (1.58–2.16)	<0.001
≥75	120 (99–143)	1.47 (1.25–1.73)	<0.001	109 (90–131)	1.46 (1.24–1.72)	<0.001
Sex						
Female (Ref)	104 (85–126)	NA	NA	86 (69–106)	NA	NA
Male	271 (240–305)	2.73 (2.54–2.94)	<0.001	229 (200–261)	2.77 (2.57–2.98)	<0.001
HHS region						
1	69 (54–87)	1.36 (1.03–1.81)	0.029	92 (74–113)	1.39 (1.11–1.74)	0.004
2¶ (Ref)	51 (38–67)	NA	NA	66 (51–84)	NA	NA
3	121 (100–145)	2.43 (1.93–3.05)	<0.001	144 (121–170)	2.22 (1.84–2.68)	<0.001
4	226 (197–257)	4.58 (3.74–5.59)	<0.001	183 (157–212)	2.85 (2.42–3.37)	<0.001
5	102 (83–124)	2.03 (1.63–2.53)	<0.001	109 (90–131)	1.67 (1.40–2.01)	<0.001
6	483 (441–528)	9.89 (8.05–12.15)	<0.001	254 (224–287)	4.00 (3.33–4.80)	<0.001
7	327 (293–364)	6.60 (5.02–8.68)	<0.001	248 (218–281)	3.88 (2.99–5.04)	<0.001
8	127 (106–151)	2.47 (1.81–3.37)	<0.001	120 (99–143)	1.80 (1.36–2.38)	<0.001
9	298 (265–334)	5.92 (4.77–7.35)	<0.001	247 (217–280)	3.82 (3.16–4.60)	<0.001
10	128 (107–152)	2.53 (1.96–3.26)	<0.001	131 (110–155)	1.99 (1.59–2.48)	<0.001
Peak heat season						
Jul and Aug	303 (270–339)	3.07 (2.85–3.30)	<0.001	208 (181–238)	1.84 (1.72–1.97)	<0.001
Other warm-season months (May, Jun, and Sep) (Ref)	97 (79–118)	NA	NA	112 (92–135)	NA	NA

Abbreviations: ED = emergency department; HHS = U.S. Department of Health and Human Services; HRI = heat-related illness; NA = not applicable; Ref = referent group; RR = rate ratio.

* To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation for ED visits ≤40 and average weekly informative discharge diagnosis ≥70% complete with discharge diagnosis code formatting during January 2018–December 2023. After applying this data quality filter, a maximum of 823 ED (range = 3–823; median = 111) facilities that participate in the National Syndromic Surveillance Program returned one or more visits associated with HRI. https://www.cdc.gov/nssp/index.html

† HRI ED visits per 100,000 ED visits.

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

¶ Region 2 (Ref) includes New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands. Puerto Rico and the U.S. Virgin Islands currently do not report data to the National Syndromic Surveillance Program.

extreme heat; this group warrants particular attention because of the high prevalence of HRI ED visits observed in working-aged adults. Frontline essential workers tending to emergencies, such as firefighters, might be at particularly high risk for exposure to heat stress (*5*). Regional differences in rates of HRI ED visits might reflect differential acclimatization, behavioral responses, and adaptation strategies (*1*,*6*). Understanding the causes of these differences can help guide the development and implementation of public health interventions, such as heat action plans and issuance of heat alerts calibrated based on local epidemiologic data (e.g., HeatRisk).¶¶¶

Effective implementation of heat mitigation strategies is associated with social determinants of health. For example, even in areas with high rates of air conditioning, such as the South and southeastern United States, persons exposed to extreme heat might have limited or no access to cooling spaces (*1*). Factors that affect air conditioning use and access to cooling spaces include energy costs**** and the occurrence of outages due to power grid failure (*1*,*7*,*8*). HHS programs that provide financial assistance for residential energy†††† and monitor the safety of persons reliant on electricity-dependent durable medical equipment in case of power outages during extreme heat§§§§

¶¶¶ HeatRisk is a health-based heat forecast developed by the National Oceanic and Atmospheric Administration's National Weather Service and CDC. It integrates health and temperature data to deliver a 7-day outlook for hot weather. HeatRisk uses a 5-level scale to indicate how risky the heat level is in a specific area. www.cdc.gov/HeatRisk

**** https://neada.org/wp-content/uploads/2023/07/summercoolingestPR.pdf

†††† https://www.acf.hhs.gov/ocs/programs/liheap

§§§§ https://empowerprogram.hhs.gov/

TABLE 2. Number of days that the heat-related illness emergency department visit rate exceeded the 95th percentile,* by U.S. Department of Health and Human Services region, month, and year — United States, 2018–2023†

HHS region§/ Month	No. of days, by year					
	2018	2019	2020	2021	2022	2023
Region 1						
May	0	0	0	0	0	0
Jun	1	0	1	7	1	0
Jul	5	4	4	0	5	3
Aug	5	0	0	3	2	0
Sep	0	0	0	0	0	0
Region 2¶						
May	0	0	0	0	2	0
Jun	1	0	0	5	1	0
Jul	4	4	5	2	5	4
Aug	2	0	0	3	3	0
Sep	1	0	0	0	0	0
Region 3						
May	0	0	0	0	2	0
Jun	2	1	0	5	1	0
Jul	4	6	5	1	3	4
Aug	2	1	0	2	2	0
Sep	1	0	0	0	0	1
Region 4						
May	0	2	0	0	0	0
Jun	2	0	0	0	8	3
Jul	2	10	6	2	5	18
Aug	0	1	0	0	0	14
Sep	0	0	0	0	0	0
Region 5						
May	2	0	1	0	2	0
Jun	5	2	0	2	5	0
Jul	3	8	6	0	0	2
Aug	0	0	0	1	1	3
Sep	0	0	0	0	0	0
Region 6						
May	0	0	0	0	0	0
Jun	0	0	0	1	10	13
Jul	4	3	3	0	13	17
Aug	0	2	2	0	0	23
Sep	0	0	0	0	0	3
Region 7						
May	0	0	0	0	0	0
Jun	6	2	1	4	7	2
Jul	4	5	0	4	3	5
Aug	0	1	0	0	1	8
Sep	0	0	0	0	0	0
Region 8						
May	0	0	0	0	0	0
Jun	2	0	0	9	2	0
Jul	3	2	1	7	7	11
Aug	1	0	2	0	0	0
Sep	0	0	0	0	2	0
Region 9						
May	0	0	0	0	0	0
Jun	0	1	0	6	2	0
Jul	3	2	3	6	5	21
Aug	0	0	6	0	0	0
Sep	0	0	2	0	2	0
Region 10						
May	0	0	0	0	0	1
Jun	0	1	0	8	3	0
Jul	6	0	1	4	8	3
Aug	3	0	0	2	2	5
Sep	0	0	0	0	0	0

Abbreviations: ED = emergency department; HHS = U.S. Department of Health and Human Services.

* 95th percentile based on region-specific heat-related illness ED visit rate during warm-season months (May–September) during 2018–2022.

† To reduce artifactual impact from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation for ED visits ≤40 and average weekly informative discharge diagnosis ≥70% complete with discharge diagnosis code formatting during January 2018–December 2023. After applying this data quality filter, a maximum of 823 ED (range = 3–823; median = 111) facilities that participate in the National Syndromic Surveillance Program returned one or more visits associated with heat-related illness. https://www.cdc.gov/nssp/index.html

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

¶ Region 2 includes New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands. Puerto Rico and the U.S. Virgin Islands currently do not report data to the National Syndromic Surveillance Program.

can protect populations affected by heat stress. The intersection of communities with a high proportion of groups at risk, especially those with limited access to health care, with areas that experience persistent high ambient temperatures (e.g., heat islands or lack of green spaces) could be more susceptible to the effects of heat exposure (*1*). Public health initiatives can be designed to help communities prepare for extreme heat conditions and complement the efforts of weather and emergency management agencies, reducing illnesses and deaths. Tools used for syndromic surveillance, including ESSENCE, local systems, and visualization dashboards, help guide and strengthen public health preparedness and response. An example is CDC's Heat and Health Tracker (https://ephtracking.cdc.gov/Applications/heatTracker/), which provides local heat and health information for communities.

Limitations

The findings in this report are subject to at least five limitations. First, NSSP data are not nationally representative, and participation can vary by HHS region. Second, although the prevalence of HRI among U.S. military veterans has been increasing (*9*), this analysis does not include facilities operated by U.S. Department of Veterans Affairs. In addition, the HRI ED visit rate reported by ESSENCE might not be representative of the rate in the general population because ESSENCE is not a population-based system but rather reflects the number of HRI ED visits among all-cause ED visits. Third, HRI information reported at the HHS regional level can obscure subregional variation. Fourth, estimation of HRI ED visit rates

Summary

What is already known about this topic?

Unprecedented heat waves can affect all persons, but some are more sensitive to the effects of heat, including children and adults with underlying health conditions, pregnant women, and outdoor workers.

What is added by this report?

During the 2023 warm-season months (May–September), rates of emergency department visits for heat-related illness substantially increased across several U.S. regions compared with previous years, especially among males and adults aged 18–64 years.

What are the implications for public health practice?

Heat-related illness will continue to be a significant public health concern as climate change results in longer, hotter, and more frequent episodes of extreme heat. By monitoring heat-related health impacts, public health agencies can detect trends in health care utilization rates, identify subpopulations at increased risk, and guide public health actions tailored to specific heat exposure levels.

might have been affected during the COVID-19 pandemic because overall ED utilization patterns changed for specific subpopulations (*10*). Finally, HRI data from the ESSENCE system are based on ED visits only and do not identify cases of HRI among persons who sought treatment elsewhere, likely resulting in an underestimation of HRI prevalence.

Implications for Public Health Practice

The record-breaking temperatures of the 2023 warm-weather season had a substantial public health impact, and this trend might increase in the coming years because of climate change (*1*). Public health agencies rely on tools and surveillance systems to assess the adverse health effects of heat exposure. Timely mechanisms for tracking and reporting health effects, along with the ability to detect anomalous trends, especially during extreme heat emergencies, can facilitate the implementation of public health strategies to protect affected populations.

Acknowledgments

Shubhayu Saha, Paul Schramm, Division of Environmental Health Science and Practice, National Center for Environmental Health, CDC; Sue Swensen, Office of Public Health Data, Surveillance, and Technology, CDC.

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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.

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Durability of Original Monovalent mRNA Vaccine Effectiveness Against COVID-19 Omicron–Associated Hospitalization in Children and Adolescents — United States, 2021–2023

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Abstract

Pediatric COVID-19 vaccination is effective in preventing COVID-19–related hospitalization, but duration of protection of the original monovalent vaccine during SARS-CoV-2 Omicron predominance merits evaluation, particularly given low coverage with updated COVID-19 vaccines. During December 19, 2021–October 29, 2023, the Overcoming COVID-19 Network evaluated vaccine effectiveness (VE) of ≥2 original monovalent COVID-19 mRNA vaccine doses against COVID-19–related hospitalization and critical illness among U.S. children and adolescents aged 5–18 years, using a case-control design. Too few children and adolescents received bivalent or updated monovalent vaccines to separately evaluate their effectiveness. Most case-patients (persons with a positive SARS-CoV-2 test result) were unvaccinated, despite the high frequency of reported underlying conditions associated with severe COVID-19. VE of the original monovalent vaccine against COVID-19–related hospitalizations was 52% (95% CI = 33%–66%) when the most recent dose was administered <120 days before hospitalization and 19% (95% CI = 2%–32%) if the interval was 120–364 days. VE of the original monovalent vaccine against COVID-19–related hospitalization was 31% (95% CI = 18%–43%) if the last dose was received any time within the previous year. VE against critical COVID-19–related illness, defined as receipt of noninvasive or invasive mechanical ventilation, vasoactive infusions, extracorporeal membrane oxygenation, and illness resulting in death, was 57% (95% CI = 21%–76%) when the most recent dose was received <120 days before hospitalization, 25% (95% CI = –9% to 49%) if it was received 120–364 days before hospitalization, and 38% (95% CI = 15%–55%) if the last dose was received any time within the previous year. VE was similar after excluding children and adolescents with documented immunocompromising conditions. Because of the low frequency of children who received updated COVID-19 vaccines and waning effectiveness of original monovalent doses, these data support CDC recommendations that all children and adolescents receive updated COVID-19 vaccines to protect against severe COVID-19.

Introduction

mRNA COVID-19 vaccines have been recommended for U.S. children and adolescents aged ≥5 years since November 2021[†] (*1*). Two doses of Pfizer-BioNTech (BNT162b2) vaccine protected against COVID-19–related hospitalizations before and after emergence of the SARS-CoV-2 Delta variant (*2*,*3*). Throughout Omicron variant predominance (beginning in December 2021), estimated pediatric COVID-19 vaccine effectiveness (VE) of the original monovalent vaccine was lower (*2*,*4*). This analysis evaluated durability of effectiveness of original monovalent vaccines, which were only available before September 2022, against COVID-19–related hospitalization among children and adolescents aged 5–18 years during December 19, 2021–October 29, 2023, when the SARS-CoV-2 Omicron variant predominated.

Methods

Study Participants

VE of ≥2 original monovalent COVID-19 vaccine doses[§] against COVID-19–related hospitalizations (December 19,

[*] These senior authors contributed equally to this report.

[†] A comprehensive listing of COVID-19 vaccination recommendations from the Advisory Committee on Immunization Practices is available. https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/covid-19.html

[§] The original monovalent vaccine was administered for all COVID-19 vaccinations until the bivalent formulation was authorized (on September 1, 2022, for third or higher doses for those aged >12 years; October 12, 2022, for third or higher doses for children aged 5–11 years; and April 22, 2023, for first or second doses for all eligible ages).

2021–October 29, 2023[¶]) across 34 Overcoming COVID-19 Network sites[**] was evaluated using a case-control design according to previously described methods (*2*,*3*). Case-patients were children and adolescents aged 5–18 years who were hospitalized for acute COVID-19 and received a positive SARS-CoV-2 test result.[††] Control patients hospitalized for COVID-19–like illness were matched to case-patients by site, age group, and admission date, but received a negative SARS-CoV-2 test result.[§§] Critical COVID-19–related illness was defined as receipt of noninvasive or invasive mechanical ventilation, vasoactive infusions, extracorporeal membrane oxygenation, and illness resulting in death. Children and adolescents were a priori excluded from the analysis if they 1) received their most recent dose ≥365 days before hospitalization, 2) had an incomplete COVID-19 mRNA primary vaccination series, 3) had a COVID-19 hospitalization within the preceding 60 days, 4) had an unverifiable vaccination status, or 5) received a positive influenza test result.[¶¶] Given subsequent findings of low (3%) bivalent vaccination coverage and no reported receipt of updated (2023–2024 formula) monovalent doses, children who received updated formulations were post hoc excluded from VE analyses.

Statistical Analysis and Vaccine Effectiveness Estimation

Bivariate associations between sociodemographic factors and both case or control status and vaccination status among case- and control patients were assessed using chi-square tests for binomial or categorical variables or Wilcoxon rank-sum tests for continuous variables. VE was estimated among all hospitalized patients and among patients without documented immunocompromising conditions[***] and calculated as (1 – adjusted odds ratio) × 100% by time between last vaccine dose and hospitalization and by age,[†††] using multivariable logistic regression,[§§§] including hospital site as a repeated effect using generalized estimating equations, and adjusting for the presence of one or more underlying medical condition, age (in years), month and year of hospitalization, U.S. Census Bureau region of hospital, social vulnerability index (SVI; i.e., continuous ranging from 0–1, with higher scores indicating increased vulnerability), and race and ethnicity. SAS software (version 9.4; SAS Institute) was used to conduct all analyses. This activity was reviewed by CDC, deemed not research, and conducted consistent with applicable federal law and CDC policy.[¶¶¶]

[¶] To use all available data, this investigation included children and adolescents admitted through October 29, 2023, which included September 11, 2023–October 29, 2023, when children and adolescents were eligible to receive updated monovalent vaccines specific for the Omicron XBB lineage. However, no child or adolescent in this investigation had received an updated monovalent dose before the October 29, 2023, cutoff date.

[**] Children and adolescents were enrolled from 34 hospitals in 26 states across all four U.S. Census Bureau regions. *Northeast*: Boston Children's Hospital (Massachusetts), Children's Hospital of Philadelphia (Pennsylvania), Cooperman Barnabas Medical Center (New Jersey), and Columbia University Irving Medical Center/New York-Presbyterian (New York); *Midwest*: Akron Children's Hospital (Ohio), Children's Hospital of Michigan (Michigan), Children's Mercy Kansas City (Missouri), Children's Nebraska (Nebraska), Cincinnati Children's Hospital Center (Ohio), C.S. Mott Children's Hospital (Michigan), Lurie Children's Hospital (Illinois), Mayo Clinic (Minnesota), Minnesota Masonic (Minnesota), Nationwide Children's Hospital (Ohio), and Riley Children's (Indiana); *South*: Arkansas Children's Hospital (Arkansas), Children's of Alabama (Alabama), Children's Healthcare of Atlanta, Emory University (Georgia), Children's Hospital of New Orleans (Louisiana), Children's Medical Center of Dallas (Texas), Holtz Children's Hospital (Florida), Medical University of South Carolina Children's Health (South Carolina), Monroe Carell Jr. Children's Hospital at Vanderbilt (Tennessee), Texas Children's Hospital (Texas),University of Mississippi Medical Center (Mississippi), and University of North Carolina at Chapel Hill Children's Hospital (North Carolina); *West*: Children's Hospital Colorado (Colorado), Children's Hospital Los Angeles (California), Oregon Health & Science University Doernbecher Children's Hospital (Oregon), Primary Children's Hospital (Utah), Seattle Children's (Washington), University of California, San Francisco Benioff Children's Hospital Oakland (California), University of California San Diego-Rady Children's Hospital (California), and University of California, San Francisco Benioff Children's Hospital (California).

[††] Case-patients received a positive result for a SARS-CoV-2 nucleic acid amplification test (NAAT) or antigen test result 10 days before or within 72 hours after admission, with COVID-19 as the primary reason for hospitalization (directly or as an exacerbation of an underlying disease).

[§§] Control patients matched to cases (1:1) by site, age group, and date of admission (within 3 weeks). COVID-19–like illness among control patients was defined as one or more of the following <14 days of hospitalization: fever, cough, shortness of breath, loss of taste or smell, new or elevated respiratory support, new pulmonary findings on chest imaging, and gastrointestinal symptoms. Control patients received negative test results for SARS-CoV-2 by NAAT during or ≤7 days before hospital admission, with no positive NAAT/antigen test result <3 days after hospitalization.

[¶¶] Patients who had an incomplete COVID-19 mRNA vaccination series included those who received only 1 dose of an mRNA primary series or whose last dose was too recent (second dose was completed within 14 days of hospitalization or third or higher dose was received within 7 days of hospitalization). Those excluded because of unverifiable vaccination status include those whose vaccination status could not be verified through source documentation (such as state immunization information systems, electronic medical records, or pediatrician records) or plausible self-report, whereby a parent or caregiver provided the date and location of dose.

[***] Immunocompromising conditions included active or previous oncologic disorder or nononcologic immunosuppressive disorder (including solid organ transplant, HIV or AIDS, primary immunodeficiency, bone marrow transplant for nononcologic disease, and other disorder requiring treatment that suppresses immune system).

[†††] Analyses included time since last dose as a multilevel categorical predictor and used the following cutoffs: 14–119 days for second dose or 7–119 days for a third or higher dose, and 120–364 days for all second or higher doses. The interval between receipt of the last dose and hospitalization was calculated as the number of inclusive days between those events. Models examining VE by age were stratified by age group (ages 5–11 years and 12–18 years).

[§§§] Multivariable models controlled for the presence of at least one underlying medical condition, continuous age in years, month and year of hospital admission, U.S. Census Bureau region, continuous SVI ranging between 0 and 1, and race and ethnicity, categorized as non-Hispanic White, non-Hispanic Black or African American, Hispanic or Latino, and other races, multiple races, or unknown.

[¶¶¶] 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.

Results

Characteristics of Enrolled Population

During December 19, 2021–October 29, 2023, a total of 3,348 patients were enrolled, including 1,551 (46%) case-patients and 1,797 (54%) control patients.**** Only 3% of case-patients and of control patients had received bivalent COVID-19 vaccine, and none reported receipt of an updated monovalent dose; therefore, VE for these specific formulations could not be estimated. Case- and control patients were similar in age, sex, hospital U.S. Census Bureau region,†††† presence of any underlying respiratory condition (e.g., asthma or chronic lung disease), and clinical support received (Table 1). The presence of at least one underlying health condition was more common among case-patients (82%) than among control patients (73%) (p-value <0.001). Critical illness occurred in 294 (19%) case-patients and 322 (18%) control patients (p = 0.43). Patients living in lower SVI areas were more frequently vaccinated (Table 2).

Vaccine Effectiveness

VE of original monovalent mRNA COVID-19 vaccines against COVID-19–related hospitalization was 52% (95% CI = 33–66) when the most recent vaccine dose was received 7–119 days before hospitalization, 19% (95% CI = 2–32) when it was received 120–364 days before hospitalization, and 31% (95% CI = 18–43) if the last dose was received any time within the previous year. VE against critical COVID-19–related illness was 57% (95% CI = 21–76) when the last dose was 7–119 days before hospitalization, not significant when it was received 120–364 days before hospitalization, and 38% (95% CI = 15–55) when the most recent dose was received at any point within the previous year. During the peak of pediatric COVID-19 hospitalizations (December 19, 2021–March 19, 2022), VE was 55% (95% CI = 38–67) against COVID-19–related hospitalizations when the last dose was received a median of 129 days before hospitalization (IQR = 47–198 days) and 79% (95% CI = 59–89) against critical COVID-19–related illness when the last dose was received a median of 132 days before hospitalization (IQR = 46–215) (Supplementary Table, https://stacks.cdc.gov/view/cdc/152988). Estimates were similar after excluding children and adolescents with documented immunocompromising conditions (Table 3).

**** Initial inclusion criteria were met by 1,815 potential case-patients and 2,087 potential control patients. Among potential enrollees, 264 case-patients and 290 control patients were excluded, based on receipt of last vaccine dose ≥365 days before hospitalization (155 case-patients and 143 control patients), COVID-19 hospitalization within 60 days (13 case-patients and one control patient), incomplete vaccination or dose too recent (91 case-patients and 136 control patients), and unverifiable vaccination status through source documentation or plausible self-report (five case-patients and 10 control patients).

†††† https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

TABLE 1. Characteristics of children and adolescents aged 5–18 years hospitalized with a COVID-19–like illness and a positive SARS-CoV-2 test result (case-patients) or a negative SARS-CoV-2 test result (control patients) — Overcoming COVID-19 Network, 34 pediatric hospitals, 26 states, December 19, 2021–October 29, 2023

Characteristic (no. with known information)	No. (%) Case-patients (n = 1,551)	No. (%) Control patients (n = 1,797)	p-value*
Age group, yrs			
5–11	853 (55)	1,042 (58)	0.08
12–18	698 (45)	755 (42)	
Median age, yrs, IQR	11.3 (7.7–15.1)	10.5 (7.3–14.7)	0.01
Female sex	712 (46)	857 (48)	0.59
Race and ethnicity			
Asian, non-Hispanic	71 (5)	41 (2)	<0.001
Black or African American, non-Hispanic	403 (26)	438 (24)	
White, non-Hispanic	571 (37)	675 (38)	
Hispanic or Latino, any race	406 (26)	485 (27)	
Multiple or other races, non-Hispanic	47 (3)	65 (4)	
Unknown	53 (3)	93 (5)	
Median social vulnerability index, IQR (3,345)†	0.58 (0.37–0.78)	0.57 (0.33–0.77)	0.10
U.S. Census Bureau region§			
Northeast	253 (16)	272 (15)	0.35
Midwest	364 (23)	466 (26)	
South	565 (36)	628 (35)	
West	369 (24)	431 (24)	
Circulating Omicron subvariant during hospitalization¶			
Omicron BA.1/BA.1.1	638 (41)	776 (43)	0.23
Omicron BA.2/BA.4/BA.5/XBB.1.5/XBB.1.6	913 (59)	1021 (57)	
Underlying health conditions			
None	275 (18)	489 (27)	<0.001
One or more	1,276 (82)	1,308 (73)	
Respiratory, including asthma	619 (40)	744 (41)	0.38
Cardiac	235 (15)	172 (10)	<0.001
Neurologic or neuromuscular	524 (34)	352 (20)	<0.001
Immunocompromising conditions**	273 (18)	165 (9)	<0.001
Endocrine, including diabetes	195 (13)	181 (10)	0.02
Multiple	526 (34)	382 (21)	<0.001
COVID-19 vaccination status			
Unvaccinated	1,137 (73)	1,210 (67)	<0.001
Original monovalent dose, 7–119 days before hospitalization††	94 (6)	207 (12)	
Original monovalent dose, 120–364 days before hospitalization	277 (18)	322 (18)	
Bivalent dose§§	43 (3)	58 (3)	
Clinical course			
ICU admission (3,347)	404 (26)	500 (28)	0.25
Critical illness (3,343)¶¶	294 (19)	322 (18)	0.43
Invasive mechanical ventilation	107 (7)	129 (7)	0.75
Noninvasive mechanical ventilation (BiPAP or CPAP) (3,347)	222 (14)	228 (13)	0.17
Vasoactive infusion	83 (5)	86 (5)	0.46
Extracorporeal membrane oxygenation	9 (1)	10 (1)	0.93
Died (3,343)	10 (1)	9 (1)	0.58
Median hospital days (IQR) (3,340)	4 (2–7)	4 (3–7)	0.79

See table footnotes on the next page.

TABLE 1. (*Continued*) Characteristics of children and adolescents aged 5–18 years hospitalized with a COVID-19–like illness and a positive SARS-CoV-2 test result (case-patients) or a negative SARS-CoV-2 test result (control patients) — Overcoming COVID-19 Network, 34 pediatric hospitals, 26 states, December 19, 2021–October 29, 2023

Abbreviations: BiPAP = bilevel positive airway pressure; CPAP = continuous positive airway pressure; ICU = intensive care unit.

* Binomial or categorical variables were compared using chi-square tests of independence, and continuous variables were compared using Wilcoxon rank-sum tests.

† The social vulnerability index is a scale (range = 0–1), reflecting a composite score of socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. A lower score indicates lower social vulnerability, whereas a higher score indicates higher social vulnerability, which might predispose a population to worse health outcomes. https://www.atsdr.cdc.gov/placeandhealth/svi

§ https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

¶ Periods of Omicron subvariant circulation were defined as follows: BA.1: December 19, 2021–March 19, 2022 and BA.2/BA.4/BA.5/XBB.1.5/XBB.1.6: March 20–October 29, 2022.

** Immunocompromising conditions included active or previous oncologic disorder or nononcologic immunosuppressive disorder (including solid organ transplant, HIV or AIDS, primary immunodeficiency, bone marrow transplant for nononcologic disease, and other disorder requiring treatment that suppresses the immune system).

†† All monovalent doses were original monovalent doses directed against wild type SARS-CoV-2. No child or adolescent had received an updated (2023–2024 formula) monovalent dose, authorized on September 11, 2023, before their hospitalization.

§§ Children and adolescents who received a bivalent dose were excluded from the primary vaccine effectiveness analysis because bivalent vaccination coverage was insufficient to calculate vaccine effectiveness for this formulation.

¶¶ Critical illness was defined as illness resulting in noninvasive ventilation, invasive mechanical ventilation, receipt of vasoactive infusions, extracorporeal membrane oxygenation, or death.

Summary

What is already known about this topic?

COVID-19 vaccination was shown to be effective against pediatric COVID-19 hospitalization before the emergence of the Omicron variant.

What is added by this report?

During December 19, 2021–October 29, 2023, receipt of ≥2 doses of an original monovalent mRNA COVID-19 vaccine was 52% effective against pediatric COVID-19 hospitalization and 57% effective against critical illness related to COVID-19, when the last dose was received within the 4 months preceding hospitalization, but protection decreased over time.

What are the implications for public health practice?

These findings support existing recommendations that children and adolescents aged 5–18 years remain up to date with COVID-19 vaccination given low vaccination coverage and waning effectiveness over time against COVID-19–related hospitalizations.

Discussion

During the period of SARS-CoV-2 Omicron predominance, receipt of ≥2 original monovalent COVID-19 vaccine doses was associated with fewer COVID-19–related hospitalizations in children and adolescents aged 5–18 years; however, protection from original vaccines was not sustained over time, necessitating increased coverage with updated vaccines. Most children and adolescents in this analysis who were hospitalized with COVID-19 were unvaccinated, and few had received updated vaccine doses despite a high prevalence of underlying comorbidities associated with more severe disease. Vaccination frequency declined with increasing social vulnerability, highlighting disparities in vaccination coverage comparable with published estimates from at least one other U.S. public health surveillance network (*5*). This finding might be driven by factors including vaccine hesitancy or barriers to accessing vaccines among more vulnerable populations (*5*).

VE of original monovalent doses against COVID-19–related pediatric hospitalizations was lower than previous VE estimates reported by the Overcoming COVID-19 Network before Omicron emergence (*2*). However, VE estimates from this report among children and adolescents hospitalized during December 19, 2021–March 19, 2022, were similar to previously published VE estimates from this network among children and adolescents hospitalized within the same date range (*2*). In a separate U.S. study of children and adolescents aged 5–15 years, VE against symptomatic SARS-CoV-2 infections was reported to wane in the months after a second dose, with improved VE observed after receipt of a booster dose (*4*). Effectiveness of bivalent vaccine formulations against pediatric hospitalizations was not estimable in this investigation; however, two recent studies report that receipt of a bivalent vaccine was associated with higher VE against symptomatic pediatric infections (*6*) and COVID-19–related hospitalizations in immunocompetent adults (*7*).

Limitations

The findings in this report are subject to at least four limitations. First, SARS-CoV-2 infection-induced immunity was not assessed (*8*); increased seroprevalence after Omicron BA.1 emergence (*9*) might have influenced observed VE. Second, limited viral sequencing data prevented consideration of subvariant-attributed immune evasion (*10*). Third, limited coverage with bivalent vaccines and currently recommended updated monovalent vaccines precluded the estimation of VE of these formulations. Finally, previously healthy children and adolescents accounted for <20% of case-patients, limiting generalizability.

Implications for Public Health Practice

Among approximately 1,500 children and adolescents aged 5–18 years with a COVID-19–related hospitalization, including nearly 300 with critical illness, original monovalent COVID-19 vaccines were associated with fewer hospitalizations, particularly within the first 4 months after vaccination.

TABLE 2. Characteristics of COVID-19 case-patients and control patients with COVID-19–like illness, by vaccination status (N = 3,247) — Overcoming COVID-19 Network, 34 pediatric hospitals, 26 states, December 19, 2021–October 29, 2023

Characteristic (no. with known information if less than total N)	COVID-19 vaccination status, no. (%)					
	Case-patients (n = 1,508)*			Control patients (n = 1,739)†		
	Unvaccinated (n = 1,137)	Original monovalent dose, 7–364 d§ (n = 371)	p-value¶	Unvaccinated (n = 1,210)	Original monovalent dose, 7–364 d§ (n = 529)	p-value¶
Median age, yrs (IQR)	10.1 (7.2–14.0)	14.4 (11.0–16.6)	<0.001	9.3 (6.9–13.7)	13.3 (9.0–15.9)	<0.001
Age group, yrs						
5–11	718 (86)	114 (14)	<0.001	806 (80)	207 (20)	<0.001
12–18	419 (62)	257 (38)		404 (56)	322 (44)	
Sex (3,246)**						
Female	508 (74)	183 (26)	0.26	569 (68)	263 (32)	0.30
Male	628 (77)	188 (23)		641 (71)	266 (29)	
Race and ethnicity						
Asian, non-Hispanic	41 (59)	28 (41)	0.008	16 (40)	24 (60)	<0.001
Black or African American, non-Hispanic	312 (79)	83 (21)		327 (77)	97 (23)	
White, non-Hispanic	409 (73)	149 (27)		447 (69)	206 (32)	
Hispanic or Latino, any race	301 (77)	89 (23)		310 (66)	163 (34)	
Multiple or other races, non-Hispanic	37 (82)	8 (18)		50 (81)	12 (19)	
Unknown	37 (73)	14 (27)		60 (69)	27 (31)	
Median SVI (IQR) (3,244)††	0.60 (0.38–0.79)	0.55 (0.32–0.76)	0.01	0.59 (0.38–0.78)	0.52 (0.26–0.76)	<0.001
U.S. Census Bureau region§§						
Northeast	154 (63)	91 (37)	<0.001	143 (55)	118 (45)	<0.001
Midwest	289 (82)	65 (18)		330 (73)	121 (27)	
South	457 (82)	99 (18)		476 (78)	135 (22)	
West	237 (67)	116 (33)		261 (63)	155 (37)	
Underlying health conditions¶¶						
None	214 (78)	59 (22)	0.20	342 (71)	138 (29)	0.35
One or more underlying condition	923 (75)	312 (25)		868 (69)	391 (31)	
Respiratory, including asthma	445 (75)	147 (25)	0.87	505 (71)	207 (29)	0.31
Cardiac	156 (69)	71 (31)	0.01	103 (62)	63 (38)	0.03
Neurologic or neuromuscular	379 (75)	127 (25)	0.75	207 (63)	122 (37)	0.004
Immunocompromising conditions***	188 (71)	76 (29)	0.08	99 (62)	61 (38)	0.03
Endocrine, including diabetes	131 (71)	54 (29)	0.12	115 (66)	59 (34)	0.29
Obesity	140 (75)	47 (25)	0.86	114 (67)	56 (33)	0.45
Multiple	355 (71)	145 (29)	0.005	231 (64)	130 (36)	0.01

Abbreviations: d = days before hospitalization; SVI = social vulnerability index.

* This analysis excludes 43 of 1,551 case-patients who received a bivalent vaccine dose.

† This analysis excludes 58 of 1,797 control patients who received a bivalent vaccine dose.

§ All monovalent doses received before hospitalization were original monovalent vaccine doses directed against the original SARS-CoV-2 strain. No child or adolescent had received an updated (2023–2024 formula) monovalent vaccine dose, authorized on September 11, 2022, before hospitalization.

¶ Binomial or categorical variables were compared using chi-square tests of independence and continuous variables were compared using Wilcoxon rank-sum tests.

** One unvaccinated case-patient had sex noted as "other" and was excluded from this comparison.

†† SVI is a scale (range = 0–1), reflecting a composite score of socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. A lower score indicates lower social vulnerability, whereas a higher score indicates higher social vulnerability, which might predispose a population to worse health outcomes. https://www.atsdr.cdc.gov/placeandhealth/svi

§§ https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

¶¶ Underlying medical conditions were coded as not present if they were either specifically marked as absent or if they were not noted in the child's medical record. The reference group for each comparison is defined by those who did not have the listed underlying health condition.

*** Immunocompromising conditions included active or previous oncologic disorder or nononcologic immunosuppressive disorder (including solid organ transplant, HIV or AIDS, primary immunodeficiency, bone marrow transplant for nononcologic disease, and other disorder requiring treatment that suppresses the immune system).

TABLE 3. Durability of effectiveness of original monovalent mRNA COVID-19 vaccination against hospitalization and critical illness for COVID-19 among pediatric patients aged 5–18 years, by age, vaccination timing, and patients without documented immunocompromising conditions — Overcoming COVID-19 Network, 34 pediatric hospitals, 26 states, December 19, 2021–October 29, 2023

Subgroup*	No. vaccinated/Total no. (%)		Interval from last vaccine dose to hospitalization, days, median (IQR)	VE against COVID-19 hospitalization, % (95% CI)†
	Case-patients	Control patients		
Hospitalizations among all patients				
Any original monovalent dose	371/1,508 (25)	529/1,739 (30)	169 (86 to 237)	31 (18 to 43)
7–119 days since last dose	94/1,231 (8)	207/1,417 (15)	53 (32 to 86)	52 (33 to 66)
120–364 days since last dose	277/1,414 (20)	322/1,532 (21)	212 (169 to 275)	19 (2 to 32)
Any dose, ages 5–11 yrs	114/832 (14)	207/1,013 (20)	120 (46 to 224)	40 (22 to 53)
Any dose, ages 12–18 yrs	257/676 (38)	322/726 (44)	181 (121 to 245)	28 (6 to 44)
Hospitalizations among patients without documented immunocompromising conditions§,¶				
Any original monovalent dose	295/1,244 (24)	468/1,579 (30)	173 (88 to 243)	34 (22 to 44)
7–119 days since last dose	62/1,011 (6)	183/1,294 (14)	53 (33 to 84)	61 (40 to 75)
120–364 days since last dose	233/1,182 (20)	285/1,396 (20)	213 (171 to 278)	17 (0 to 31)
Ages 5–11 yrs	84/684 (12)	191/933 (20)	120 (46 to 222)	48 (29 to 61)
Ages 12–18 yrs	211/560 (38)	277/646 (43)	187 (129 to 252)	23 (2 to 40)**
Critical illness†† among all patients				
Any original monovalent dose	65/278 (23)	91/307 (30)	175 (79 to 253)	38 (15 to 55)
7–119 days since last dose	16/229 (7)	35/251 (14)	51 (36 to 74)	57 (21 to 76)§§
120–364 days since last dose	49/262 (19)	56/272 (21)	218 (172 to 287)	25 (–9 to 49)§§
Critical illness†† among patients without documented immunocompromising conditions¶				
Any original monovalent dose	59/253 (23)	85/288 (30)	171 (73 to 247)	36 (17 to 50)
7–119 days since last dose	13/207 (6)	34/237 (14)	51 (36 to 71)	63 (35 to 79)**
120–364 days since last dose	46/240 (19)	51/254 (20)	218 (170 to 287)	16 (–20 to 41)**,§§

Abbreviation: VE = vaccine effectiveness.

* All analyses excluded patients who received a bivalent vaccine dose (43 case-patients and 58 control patients). Models examining VE by time since last dose incorporated a three-level categorical predictor variable (unvaccinated, last monovalent dose 7–119 days before hospitalization, and last original monovalent dose 120 –364 days before hospitalization) to obtain VE estimates for each interval range. Models examining VE by age were stratified by age group (5–11 years and 12–18 years). All children who had received any original monovalent dose received their last dose within the previous year before hospitalization (<365 days).

† All models controlled for underlying medical condition, continuous age (in years), month and year of hospital admission, U.S. Census Bureau region, continuous social vulnerability index (range = 0–1), and race and ethnicity (categorized as non-Hispanic White, non-Hispanic Black or African-American, Hispanic or Latino, and other, multiple races, or unknown. Hospital site of enrollment was incorporated as a repeated effect.

§ This analysis excludes an additional 264 case-patients and 160 control patients who had documented immunocompromising conditions, yielding 1,244 case-patients and 1,579 control patients without any documented immunocompromising condition.

¶ Immunocompromising conditions included active or previous oncologic disorder or immunosuppressive disorder (defined as solid organ transplant, HIV or AIDS, primary immunodeficiency, bone marrow transplant for nononcologic disease, or other disorder requiring treatment that suppresses the immune system).

** Where models did not converge, subvariant period (BA.1: December 19, 2021–March 19, 2022 and BA.2/BA.4/BA.5/XBB.1.5/XBB.1.6: March 20, 2022–October 29, 2023) was substituted as a covariate in place of month and year of hospital admission.

†† Critical illness was defined as illness resulting in noninvasive ventilation, invasive mechanical ventilation, receipt of vasoactive infusions, extracorporeal membrane oxygenation, or death. Both case-patients and control patients were required to have met this definition to be included in this subanalysis.

§§ Some estimates are imprecise (where 95% CIs were wider than 50%), which might be due to a relatively small number of persons in each level of vaccination or case status. This imprecision indicates that the actual VE could be substantially different from the point estimate shown, and estimates should therefore be interpreted with caution. Additional data accrual could allow more precise interpretation.

To address low coverage of updated vaccines and waning effectiveness of the original monovalent vaccine, children and adolescents should remain up to date with COVID-19 vaccination, including the current CDC recommendation for all persons aged ≥6 months to receive vaccination with updated (2023–2024) COVID-19 vaccines (*1*).

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Danielle M. Zerr reports institutional support from Merck and consulting fees from AlloVir. Melissa S. Stockwell reports institutional support from the National Institutes of Health (NIH). Mary Allen Staat reports institutional support from NIH, Pfizer, Cepheid, and Merck and receipt of royalties from UpToDate for chapters on adoption and immunization. Jennifer E. Schuster reports institutional support from NIH, the Food and Drug Administration, and the State of Missouri, receipt of an honorarium from the Missouri chapter of the American Academy of Pediatrics (AAP) and participation on the advisory board of the Association of American Medical Colleges and the Association for Professionals in Infection Control and Epidemiology. Adrienne G. Randolph reports institutional support from NIH, royalties for UpToDate for work as a section editor, consulting fees from Inotrem, Inc. and ThermoFisher, Inc., receipt of honoraria from St. Jude Children's Research Center and Volition, Inc., travel support from the International Sepsis Forum, participation on a data safety monitoring board for NIH and the Randomized Embedded Multifactorial Adaptive Platform for Community-acquired Pneumonia, serving as chair (2023–2024) of the International Sepsis Forum, and receipt of equipment from Illumina, Inc. (for institutional use). Pia S. Pannaraj reports institutional support from the National Institute on Allergy and Infectious Diseases, the National Institute of Child Health and Human Development, and AstraZeneca, receipt of honoraria from IDweek and Infectious Diseases in Children Symposium, payment for expert testimony from BBV Law Firm and Helsell Fetterman Law Firm, waiver of registration fee for IDweek meeting, uncompensated participation on three data safety monitoring boards 1) Phase II, Double-Blind, Multicenter, Randomized, Placebo-Controlled Trial to Assess the Safety, Reactogenicity and Immunogenicity of One or Two Doses of Multimeric-001 (M-001) Followed by One or Two Doses of an Influenza A/H7N9 Vaccine, 2) Therapeutic Fecal Transplant on the Gut Microbiome in Children with Ulcerative Colitis, and 3) Safety of Fecal Transplant in maintenance of pediatric Crohn's disease), and uncompensated services as president of the California Immunization Coalition and the AAP Committee on Infectious Diseases. Kanokporn Mongkolrattanothai reports institutional support from Gilead. Samina S. Bhumbra reports travel support from CDC to present a plenary lecture at the Conference on Emerging Infectious Diseases. Kathleen Chiotos reports institutional support from the Agency for Healthcare Research and Quality and travel support from IDWeek (2022), Society for Healthcare Epidemiology of America (2022), and Pediatric Academic Societies (2022). Bria M. Coates reports institutional support from the National Heart, Lung, and Blood Institute and the American Lung Association, payment for expert testimony from Triplett Woolf Garretson, and participation on a Sobi Data Safety Monitoring Board. Thomas J. Connors reports grant support from NIH. Melissa L. Cullimore reports institutional support from NIH. Heidi R. Flori reports receipt of consulting fees from Lucira Health for advisory role for rapid diagnostic devices for COVID-19. Shira J. Gertz reports ownership of Pfizer stock. Ivan Gonzalez reports receipt of honoraria from the Florida Chapter of AAP for educational infection control initiatives and travel support from the Florida Chapter of AAP for regional conference attendance. Judith A. Guzman-Cottrill reports receipt of a consulting contract from the Oregon Health Authority. Natasha B. Halasa reports receipt of investigator-initiated grants from Sanofi, Quidel, and Merck. Charlotte V. Hobbs reports receipt of consulting fees from Dynamed.com and royalties as a content reviewer for UpToDate.com. Janet R. Hume reports institutional support from NIH and uncompensated participation on a data safety monitoring board for a study at the University of Minnesota (Magnesium sulfate as adjuvant analgesia and its effect on opiate use by postoperative transplant patients in the pediatric intensive care unit). Satoshi Kamidani reports institutional support from NIH, Pfizer, Moderna, Meissa, and Bavarian Nordic and receipt of honoraria from AAP. Michele Kong reports institutional support from NIH and uncompensated service on the Board of Directors for Jefferson County Department of Health, Callahan Eye Hospital, University of Alabama at Birmingham, and KultureCity. Regina M. Simeone reports payments received by her spouse from a previously managed Pfizer investment, which was sold in April 2023. No other potential conflicts of interest were disclosed.

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COVID-19 Vaccination Coverage, and Rates of SARS-CoV-2 Infection and COVID-19–Associated Hospitalization Among Residents in Nursing Homes — National Healthcare Safety Network, United States, October 2023–February 2024

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Abstract

Nursing home residents are at increased risk for developing severe COVID-19. Nursing homes report weekly facility-level data on SARS-CoV-2 infections, COVID-19–associated hospitalizations, and COVID-19 vaccination coverage among residents to CDC's National Healthcare Safety Network. This analysis describes rates of incident SARS-CoV-2 infection, rates of incident COVID-19–associated hospitalization, and COVID-19 vaccination coverage during October 16, 2023–February 11, 2024. Weekly rates of SARS-CoV-2 infection ranged from 61.4 to 133.8 per 10,000 nursing home residents. The weekly percentage of facilities reporting one or more incident SARS-CoV-2 infections ranged from 14.9% to 26.1%. Weekly rates of COVID-19–associated hospitalization ranged from 3.8 to 7.1 per 10,000 residents, and the weekly percentage of facilities reporting one or more COVID-19–associated hospitalizations ranged from 2.6% to 4.7%. By February 11, 2024, 40.5% of nursing home residents had received a dose of the updated 2023–2024 COVID-19 vaccine that was first recommended in September 2023. Although the peak rate of SARS-CoV-2 infection among nursing home residents was lower during the 2023–24 respiratory virus season than during the three previous respiratory virus seasons, nursing home residents continued to be disproportionately affected by SARS-CoV-2 infection and related severe outcomes. Vaccination coverage remains suboptimal in this population. Ongoing surveillance for SARS-CoV-2 infections and COVID-19–associated hospitalizations in this population is necessary to develop and evaluate evidence-based interventions for protecting nursing home residents.

Introduction

Nursing home residents are at increased risk for contracting SARS-CoV-2 and developing severe disease compared with community-dwelling older adults (*1*). Staying up to date with recommended COVID-19 vaccination protects nursing home residents against SARS-CoV-2 infection and associated severe outcomes (*2*,*3*). The Centers for Medicare & Medicaid Services (CMS) has required nursing homes to report SARS-CoV-2 infections among nursing home residents to CDC's National Healthcare Safety Network (NHSN) since May 2020* and COVID-19 vaccination coverage among residents to NHSN since May 2021.† In May 2023, in the context of decreased incidence of SARS-CoV-2 infection and severe COVID-19 disease in the U.S. population, the Public Health Emergency for COVID-19 expired.§ To better understand the evolving epidemiology of COVID-19 in nursing home residents, in accordance with mandates from CMS,¶ nursing homes began reporting COVID-19–associated hospitalizations among residents to NHSN in June 2023.** In September 2023, CDC's Advisory Committee on Immunization Practices (ACIP) recommended vaccination with an updated 2023–2024 COVID-19 vaccine for all persons aged ≥6 months (*4*). This analysis used NHSN data to describe rates of incident SARS-CoV-2 infection, rates of incident COVID-19–associated hospitalization, and COVID-19 vaccination coverage among nursing home residents during October 16, 2023–February 11, 2024.

Methods

Data Collection

CMS-certified nursing homes report weekly, facility-level data on incident resident SARS-CoV-2 infections, incident resident COVID-19–associated hospitalizations, and resident up-to-date COVID-19 vaccination coverage to NHSN. NHSN defined a case of SARS-CoV-2 infection as a newly positive, laboratory-confirmed SARS-CoV-2 viral test result in a nursing home resident, a COVID-19–associated hospitalization as a hospital admission within 10 days after a laboratory-confirmed SARS-CoV-2 infection,†† and up-to-date

* https://www.cms.gov/files/document/qso-20-29-nh.pdf
† https://www.cms.gov/files/document/qso-21-19-nh.pdf
§ https://www.hhs.gov/about/news/2023/02/09/fact-sheet-covid-19-public-health-emergency-transition-roadmap.html
¶ https://www.federalregister.gov/documents/2021/11/09/2021-23993/medicare-and-medicaid-programs-cy-2022-home-health-prospective-payment-system-rate-update-home#p-amd-22
** https://www.cdc.gov/nhsn/pdfs/covid19/archive/ltcf/57.144-form-v14.pdf
†† https://www.cdc.gov/nhsn/pdfs/covid19/ltcf/57.144-toi-508.pdf

COVID-19 vaccination as documentation of receipt of an updated 2023–2024 COVID-19 vaccine dose.[§§]

Data Analysis

Data reported for October 16, 2023–February 11, 2024, were included in the analysis. Facilities missing SARS-CoV-2 infection, COVID-19–associated hospitalization, or vaccination data for a given week were excluded from the analysis for that week. To assess weekly rates of SARS-CoV-2 infection and COVID-19–associated hospitalization, weekly incident counts of SARS-CoV-2 infections and COVID-19–associated hospitalizations and weekly resident counts were used to generate rates of SARS-CoV-2 infection (cases per 10,000 residents) and COVID-19–associated hospitalization (hospitalizations per 10,000 residents), with 95% CIs[¶¶] for each week. Cumulative weekly SARS-CoV-2 infection and COVID-19–associated hospitalization rates (events per 10,000 residents), overall and stratified by U.S. region,[***] were calculated by dividing the cumulative incident SARS-CoV-2 infection and COVID-19–associated hospitalization counts across the study period by the total resident-weeks and multiplying by 10,000. Weekly COVID-19 vaccination coverage estimates (percentage of residents up to date with COVID-19 vaccination) and 95% CIs[†††] were also calculated. Residents reported to have a medical contraindication to COVID-19 vaccination were subtracted from the denominator for vaccination coverage calculations. Analyses were performed using SAS software (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed not research, and conducted consistent with applicable federal law and CDC policy.[§§§]

[§§] NHSN defines up-to-date COVID-19 vaccination for surveillance purposes at the start of each quarter; https://www.cdc.gov/nhsn/pdfs/hps/covidvax/UpToDateGuidance-508.pdf (Accessed April 12, 2024).

[¶¶] 95% CIs for rates of SARS-CoV-2 infection and COVID-19–associated hospitalization were calculated using mid-p exact tests for incidence density rate.

[***] *Northeast*: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; *Midwest*: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *Mountain*: Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming; *Pacific*: Alaska, California, Hawaii, Oregon, and Washington.

[†††] 95% CIs for vaccination coverage were calculated using Poisson regression models.

[§§§] 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.

Results

SARS-CoV-2 Infection

Weekly rates of incident SARS-CoV-2 infection ranged from 61.4 per 10,000 nursing home residents during the week ending February 11, 2024, to 133.8 during the week ending December 3, 2023 (Figure) (Supplementary Table, https://stacks.cdc.gov/view/cdc/153239). The weekly percentage of facilities reporting one or more cases of SARS-CoV-2 infection ranged from 14.9% (week ending October 22, 2023) to 26.1% (week ending January 7, 2024) (Table 1). The weekly percentage of facilities reporting two or more cases of SARS-CoV-2 infection ranged from 8.6% (week ending February 11, 2024) to 16.6% (week ending January 7, 2024). The cumulative weekly SARS-CoV-2 infection rate was 109.3 per 10,000 residents and was highest in the Midwest region (130.1) and lowest in the South (93.1) (Table 2).

COVID-19–Associated Hospitalization

Weekly COVID-19–associated hospitalization rates ranged from 3.8 per 10,000 residents (week ending February 11, 2024) to 7.1 (week ending January 7, 2024) (Figure) (Supplementary Table, https://stacks.cdc.gov/view/cdc/153239). The weekly percentage of facilities reporting one or more COVID-19–associated hospitalizations ranged from 2.6% (week ending February 11, 2024) to 4.7% (week ending January 7, 2024) (Table 1). The cumulative weekly COVID-19–associated hospitalization rate was 5.8 per 10,000 residents and was highest in the Midwest (6.7) and lowest in the South (5.0) (Table 2).

Up-to-Date COVID-19 Vaccination Coverage

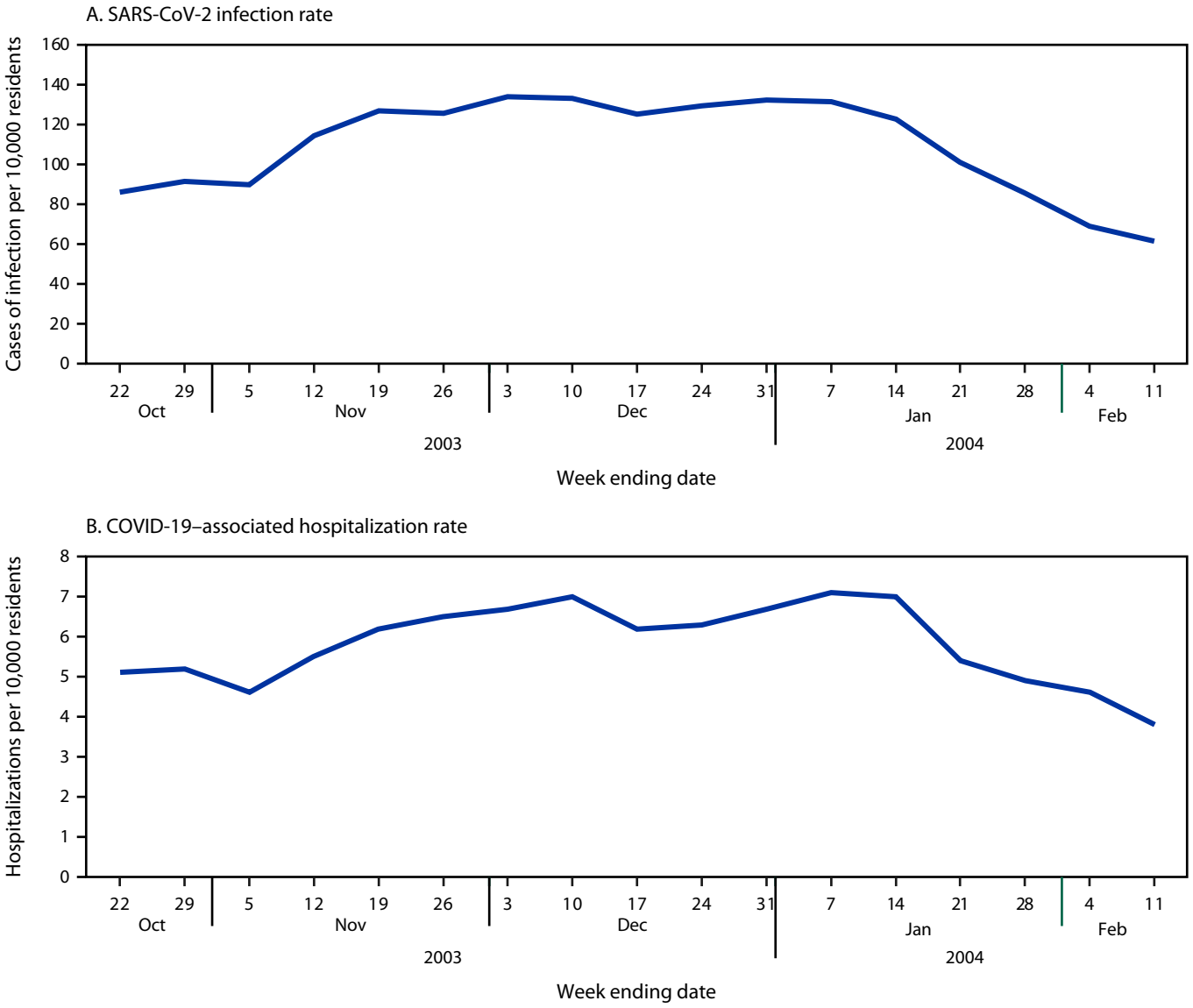
Up-to-date COVID-19 vaccination coverage increased from 16.7% to 40.5% over the study period (Table 1). Vaccination coverage as of February 11, 2024, was highest in the Northeast (47.3%) and lowest in the South (32.4%) (Table 2).

Discussion

During the 2023–24 respiratory virus season, the peak SARS-CoV-2 infection rate (133.8 per 100,000 residents) was lower than the peaks of 306, 435, and 176 during the 2020–21, 2021–22, and 2022–23 respiratory virus seasons, respectively[¶¶¶]; however, SARS-CoV-2 infection continued to cause substantial morbidity among nursing home residents during the 2023–24 respiratory virus season. COVID-19–associated

[¶¶¶] https://www.cdc.gov/nhsn/covid19/ltc-report-overview.html#anchor_1594393304 (Accessed April 12, 2024).

FIGURE. Weekly rates of SARS-CoV-2 infection (A)* and COVID-19–associated hospitalization (B)† among nursing home residents — National Healthcare Safety Network, United States, October 16, 2023–February 11, 2024



* Weekly incident SARS-CoV-2 infections (receipt of a newly positive, laboratory-confirmed SARS-CoV-2 viral test result by a nursing home resident) per 10,000 nursing home residents.

† Weekly COVID-19–associated hospitalizations (a hospital admission within 10 days after a laboratory-confirmed SARS-CoV-2 infection) per 10,000 nursing home residents.

hospitalizations among nursing home residents peaked at 7.1 per 10,000 residents, more than eight times the peak weekly rate of 0.87 per 10,000 among all U.S. adults aged ≥70 years.**** Although data reported to NHSN by nursing homes cannot be directly compared with those submitted by hospitals because of differences in methodology and populations, this stark difference underscores the high risk for COVID-19–associated hospitalization among nursing home residents.

Despite the lower rates of SARS-CoV-2 infection among nursing home residents during 2023–24 compared with previous seasons, during each week of the current study period, 14.9%–26.1% of nursing homes reported one or more incident cases of SARS-CoV-2 infection and 8.6%–16.6% reported two or more incident cases. Although, as of March 2024, CDC no longer recommends that members of the public isolate for 5 days after onset of COVID-19 symptoms,†††† this guidance does not apply to residents of long-term care

**** https://covid.cdc.gov/covid-data-tracker/#new-hospital-admissions (Accessed April 12, 2024).

†††† https://www.cdc.gov/media/releases/2024/p0301-respiratory-virus.html

TABLE 1. Weekly percentage of nursing homes reporting incident SARS-CoV-2 infections* and COVID-19–associated hospitalizations† and up-to-date COVID-19 vaccination coverage§ among nursing home residents — National Healthcare Safety Network, United States, October 16, 2023–February 11, 2024

Year/Week ending	No. of nursing homes¶	Total no. of residents	No. of nursing homes with ≥1, ≥2, and ≥5 incident SARS-CoV-2 infections (%)			No. of nursing homes with ≥1 and ≥2 incident COVID-19–associated hospitalizations (%)		% of residents up to date with COVID-19 vaccination (95% CI)**
			≥1 infection	≥2 infections	≥5 infections	≥1 hospitalization	≥2 hospitalizations	
2023								
Oct 22	14,637	**1,240,410**	2,188 (14.9)	1,416 (9.7)	745 (5.1)	464 (3.2)	108 (0.7)	16.7 (16.6–16.8)
Oct 29	14,513	**1,232,303**	2,269 (15.6)	1,486 (10.2)	776 (5.3)	485 (3.3)	101 (0.7)	18.5 (18.4–18.6)
Nov 5	14,634	**1,241,181**	2,256 (15.4)	1,506 (10.3)	781 (5.3)	449 (3.1)	96 (0.7)	20.8 (20.7–20.8)
Nov 12	14,619	**1,238,956**	2,561 (17.5)	1,784 (12.2)	987 (6.8)	535 (3.7)	103 (0.7)	23.8 (23.7–23.9)
Nov 19	14,630	**1,240,817**	2,859 (19.5)	1,973 (13.5)	1,075 (7.3)	606 (4.1)	118 (0.8)	26.9 (26.8–27.0)
Nov 26	14,549	**1,226,819**	2,950 (20.3)	2,012 (13.8)	1,065 (7.3)	616 (4.2)	129 (0.9)	28.9 (28.8–29.0)
Dec 3	14,610	**1,233,899**	3,225 (22.1)	2,167 (14.8)	1,097 (7.5)	646 (4.4)	131 (0.9)	31.2 (31.1–31.3)
Dec 10	14,629	**1,240,383**	3,322 (22.7)	2,225 (15.2)	1,174 (8.0)	654 (4.5)	149 (1.0)	33.3 (33.2–33.4)
Dec 17	14,630	**1,242,276**	3,399 (23.2)	2,189 (15.0)	1,078 (7.4)	610 (4.2)	119 (0.8)	35.0 (34.9–35.1)
Dec 24	14,634	**1,241,841**	3,507 (24.0)	2,284 (15.6)	1,119 (7.6)	626 (4.3)	119 (0.8)	36.4 (36.3–36.5)
Dec 31	14,408	**1,211,400**	3,634 (25.2)	2,358 (16.4)	1,080 (7.5)	642 (4.5)	124 (0.9)	37.5 (37.4–37.6)
2024								
Jan 7	14,625	**1,234,100**	3,818 (26.1)	2,427 (16.6)	1,076 (7.4)	684 (4.7)	132 (0.9)	37.4 (37.3–37.5)
Jan 14	14,636	**1,244,597**	3,542 (24.2)	2,257 (15.4)	1,017 (6.9)	666 (4.6)	121 (0.8)	37.9 (37.8–38.0)
Jan 21	14,602	**1,247,724**	3,082 (21.1)	1,901 (13.0)	841 (5.8)	555 (3.8)	95 (0.7)	38.5 (38.4–38.6)
Jan 28	14,461	**1,241,081**	2,724 (18.8)	1,604 (11.1)	691 (4.8)	475 (3.3)	89 (0.6)	39.1 (39.0–39.2)
Feb 4	14,529	**1,248,487**	2,432 (16.7)	1,436 (9.9)	539 (3.7)	433 (3.0)	77 (0.5)	40.0 (39.8–40.1)
Feb 11	14,411	**1,240,058**	2,184 (15.2)	1,235 (8.6)	494 (3.4)	380 (2.6)	63 (0.4)	40.5 (40.4–40.6)

* Weekly incident SARS-CoV-2 infections (receipt of a newly positive, laboratory-confirmed SARS-CoV-2 viral test result by a nursing home resident) per 10,000 nursing home residents.
† Weekly COVID-19–associated hospitalizations (a hospital admission within 10 days after a laboratory-confirmed SARS-CoV-2 infection) per 10,000 nursing home residents.
§ Up-to-date COVID-19 vaccination was defined as receipt of a 2023–2024 updated COVID-19 vaccine.
¶ Nursing homes missing SARS-CoV-2 infection, COVID-19–associated hospitalization, or COVID-19 vaccination data for a given week were excluded from the analysis for that week.
** 95% CIs for vaccination coverage were calculated using Poisson regression models.

facilities. According to thresholds set by the Council of State and Territorial Epidemiologists and the Council for Outbreak Response: Healthcare Associated Infections and Antimicrobial-Resistant Pathogens, one or more cases of SARS-CoV-2 infection in a nursing home should trigger the facility to conduct additional investigation including, depending on the characteristics of the outbreak and the facility, collecting additional data, conducting additional laboratory testing, implementing infection control practices, and collaborating with relevant public health jurisdictions. A nursing home with two or more cases within 7 days should report the cases to public health, and two or more cases with possible common exposure constitutes an outbreak (*5*). Thus, each week during the 2023–24 respiratory virus season, a proportion of nursing homes underwent case investigations, and some likely experienced SARS-CoV-2 outbreaks.

In September 2023, ACIP recommended the updated 2023–2024 COVID-19 vaccine for persons aged ≥6 months (*4*). During the 2023–24 respiratory virus season, coverage with the updated 2023–2024 COVID-19 vaccine among residents of nursing homes reporting to NHSN reached 41.5% overall and remained <50% in every U.S. region. This finding indicates that an important prevention tool is being underutilized in this population. In February 2024, CDC and ACIP recommended that all adults aged ≥65 years receive 1 additional dose of an updated 2023–2024 COVID-19 vaccine at least 4 months after the previous updated dose; additional doses are also available for persons who are moderately or severely immunocompromised.[§§§§] Surveillance of COVID-19 vaccination coverage among nursing home residents is critical to supporting tailored outreach activities to increase vaccination coverage.

NHSN is the only national surveillance system continuously monitoring COVID-19 incidence, COVID-19–associated hospitalization, and COVID-19 vaccination coverage among nursing home residents. COVID-19 surveillance data from NHSN is provided to state and local health departments; these data have also been used to support infection prevention and control policy and evaluate vaccine effectiveness (*2*).

Limitations

The findings in this report are subject to at least four limitations. First, data are reported by nursing homes; therefore, misclassification of SARS-CoV-2 infection, COVID-19–associated hospitalization, and COVID-19 vaccination status of residents is possible. Second, this analysis was conducted using aggregate, facility-level data reported to NHSN; therefore,

§§§§ https://www.cdc.gov/vaccines/acip/recommendations.html (Accessed April 12, 2024).

TABLE 2. Cumulative weekly rates of incident SARS-CoV-2 infection,* COVID-19–associated hospitalization† and percentage up to date with COVID-19 vaccination§ by facility among nursing home residents, by U.S. region¶ — National Healthcare Safety Network, United States, October 16, 2023–February 11, 2024

Region	No. of facilities	Resident-weeks	No. of SARS-CoV-2 infections	Cumulative weekly rate of SARS-CoV-2 infection (95% CI)*,**	No. of COVID-19–associated hospitalizations	Cumulative weekly COVID-19–associated hospitalization rate†,** (95% CI)	% of residents up to date with COVID-19 vaccination (95% CI)††
Overall	**14,811**	**21,046,590**	**230,105**	**109.3 (108.9–109.8)**	**12,211**	**5.8 (5.7–5.9)**	**40.5 (40.4–40.6)**
Northeast	2,432	4,772,100	54,229	113.6 (112.7–114.6)	2,812	5.9 (5.7–6.1)	47.3 (47.1–47.6)
South	5,508	7,956,877	74,094	93.1 (92.5–93.8)	4,002	5.0 (4.9–5.2)	32.4 (32.2–32.5)
Midwest	4,774	5,619,718	73,134	130.1 (129.2–131.1)	3,782	6.7 (6.5–6.9)	44.7 (44.5–45.0)
Mountain	547	599,880	6,799	113.3 (110.7–116.1)	328	5.5 (4.9–6.1)	41.9 (41.2–42.5)
Pacific	1,550	2,098,015	21,849	104.1 (102.8–105.5)	1,287	6.1 (5.8–6.5)	44.1 (43.7–44.5)

* Weekly incident SARS-CoV-2 infections (receipt of a newly positive, laboratory-confirmed SARS-CoV-2 viral test result by a nursing home resident) per 10,000 nursing home residents.
† Weekly COVID-19–associated hospitalizations (a hospital admission within 10 days after a laboratory-confirmed SARS-CoV-2 infection) per 10,000 nursing home residents.
§ Up-to-date COVID-19 vaccination was defined as receipt of a 2023–2024 updated COVID-19 vaccine.
¶ *Northeast*: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; *Midwest*: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *Mountain*: Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming; *Pacific:* Alaska, California, Hawaii, Oregon, and Washington.
** 95% CIs for rates of SARS-CoV-2 infection and COVID-19–associated hospitalization were calculated using mid-p exact tests for incidence density rate.
†† 95% CIs for vaccination coverage were calculated using Poisson regression models.

crude rates included in this analysis could not account for potential person-level confounding factors, including time since vaccination, previous infection, age, or comorbidities. Third, this analysis did not account for regional or facility-level differences in SARS-CoV-2 testing. Finally, COVID-19–associated hospitalization was defined by NHSN as a hospital admission within 10 days after a laboratory-confirmed SARS-CoV-2 infection. Thus, it is possible that some hospitalizations were classified as COVID-19–associated but were the result of other medical conditions. However, NHSN's method for defining COVID-19–associated hospitalizations is consistent with that of other surveillance systems.[¶¶¶¶]

Implications for Public Health Practice

COVID-19 continues to cause substantial morbidity among nursing home residents. Nursing homes should continue to implement recommended infection prevention and control practices,[*****] including encouraging residents, caregivers, and nursing home staff members to remain up to date with all recommended COVID-19 vaccine doses to limit the introduction and spread of SARS-CoV-2 infection within nursing homes (*4*). Ongoing surveillance for SARS-CoV-2 infections and COVID-19–associated hospitalizations among nursing home residents is necessary to develop and evaluate evidence-based interventions for protecting nursing home residents.

¶¶¶¶ https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html
***** https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html

Summary

What is already known about this topic?

Nursing home residents are at increased risk for severe COVID-19.

What is added by this report?

Each week during October 16, 2023–February 11, 2024, 14.9%–26.1% of nursing homes reported one or more SARS-CoV-2 infections. Weekly rates of COVID-19–associated hospitalization ranged from 3.8 to 7.1 per 10,000 nursing home residents. By February 11, 2024, only 40.5% of residents had received an updated 2023–2024 COVID-19 vaccine.

What are the implications for public health practice?

During the 2023–24 respiratory virus season, nursing home residents continued to have high rates of COVID-19–associated hospitalization, and up-to-date COVID-19 vaccination coverage remained low. Ongoing surveillance for SARS-CoV-2 infections and COVID-19–associated hospitalizations in this population is necessary to develop and evaluate evidence-based interventions for protecting nursing home residents.

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Jacques W. Clerville reports ownership of 16 Moderna stock shares. No other potential conflicts of interest were disclosed.

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Use of the Pfizer Pentavalent Meningococcal Vaccine Among Persons Aged ≥10 Years: Recommendations of the Advisory Committee on Immunization Practices — United States, 2023

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Abstract

Meningococcal disease is a life-threatening invasive infection caused by *Neisseria meningitidis*. Two quadrivalent (serogroups A, C, W, and Y) meningococcal conjugate vaccines (MenACWY) (MenACWY-CRM [Menveo, GSK] and MenACWY-TT [MenQuadfi, Sanofi Pasteur]) and two serogroup B meningococcal vaccines (MenB) (MenB-4C [Bexsero, GSK] and MenB-FHbp [Trumenba, Pfizer Inc.]), are licensed and available in the United States and have been recommended by CDC's Advisory Committee on Immunization Practices (ACIP). On October 20, 2023, the Food and Drug Administration approved the use of a pentavalent meningococcal vaccine (MenACWY-TT/MenB-FHbp [Penbraya, Pfizer Inc.]) for prevention of invasive disease caused by *N. meningitidis* serogroups A, B, C, W, and Y among persons aged 10–25 years. On October 25, 2023, ACIP recommended that MenACWY-TT/MenB-FHbp may be used when both MenACWY and MenB are indicated at the same visit for the following groups: 1) healthy persons aged 16–23 years (routine schedule) when shared clinical decision-making favors administration of MenB vaccine, and 2) persons aged ≥10 years who are at increased risk for meningococcal disease (e.g., because of persistent complement deficiencies, complement inhibitor use, or functional or anatomic asplenia). Different manufacturers' serogroup B–containing vaccines are not interchangeable; therefore, when MenACWY-TT/MenB-FHbp is used, subsequent doses of MenB should be from the same manufacturer (Pfizer Inc.). This report summarizes evidence considered for these recommendations and provides clinical guidance for the use of MenACWY-TT/MenB-FHbp.

Introduction

Meningococcal disease is a life-threatening invasive infection caused by *Neisseria meningitidis*. CDC's Advisory Committee on Immunization Practices (ACIP) recommends routine administration of a single dose of quadrivalent (serogroups A, C, W, and Y) meningococcal conjugate vaccine (MenACWY) to persons at age 11 or 12 years, with a booster dose at age 16 years. ACIP recommends a 2-dose serogroup B meningococcal vaccine (MenB) series for persons aged 16–23 years, based on shared clinical decision-making, to provide short-term protection against meningococcal disease caused by most serogroup B strains (*1*). ACIP also recommends routine vaccination with MenACWY (for persons aged ≥2 months) and MenB (for persons aged ≥10 years) who are at increased risk for meningococcal disease caused by the serogroups covered by each vaccine (Box) (*1*).

In October 2023, a pentavalent meningococcal vaccine (MenACWY-TT/MenB-FHbp [Penbraya, Pfizer Inc.]) was licensed for use in persons aged 10–25 years (*2*). MenACWY-TT/MenB-FHbp contains the same components as those in two existing meningococcal vaccines: 1) *N. meningitidis* polysaccharide groups A, C, W, and Y conjugated to tetanus toxoid carrier protein (MenACWY-TT* [Nimenrix, Pfizer Inc.], a non–U.S.-licensed vaccine), and 2) two recombinant lipidated factor H–binding protein (FHbp) variants from *N. meningitidis* serogroup B (MenB-FHbp [Trumenba, Pfizer Inc.]). This report summarizes evidence considered for these recommendations and provides clinical guidance for the use of MenACWY-TT/MenB-FHbp.

Methods

During June 2022–October 2023, the ACIP Meningococcal Vaccines Work Group held monthly conference calls to review meningococcal disease epidemiology and evidence regarding use of MenACWY-TT/MenB-FHbp in persons currently recommended to receive MenACWY and MenB (policy question 1), MenACWY only (policy question 2), or MenB only (policy question 3). To guide deliberations, ACIP used the Evidence to Recommendations framework and considered the importance of meningococcal disease as a public health problem, benefits, and harms of MenACWY-TT/MenB-FHbp, values of the target population, acceptability, resource use, equity, and feasibility.† ACIP evaluated the available evidence on the following prespecified benefits and harms (each with ranked importance), using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach (*3*): disease caused by serogroups A, B, C, W, and Y (critical); short-term immunity (critical); persistent immunity (important); serious

* Nimenrix and MenQuadfi (both abbreviated MenACWY-TT) are different vaccines containing different amounts of tetanus toxoid conjugate.

† https://www.cdc.gov/vaccines/acip/recs/grade/mening-MenACWY-TT-MenB-FHbp-etr.html

BOX. Existing Meningococcal Vaccination Recommendations* — Advisory Committee on Immunization Practices, United States, 2024

ACIP recommends MenACWY vaccination for the following groups:

- Routine vaccination for persons aged 11 or 12 years, with a booster dose at age 16 years
- Routine and booster vaccination of persons aged ≥2 months at increased risk for meningococcal disease (dosing schedule varies by age and indication, and interval for booster doses varies by age at time of previous vaccination):
  - Persons with certain medical conditions including anatomic or functional asplenia, complement component deficiencies (e.g., C3, C5–C9, properdin, factor H, or factor D), complement inhibitor (e.g., eculizumab [Soliris] or ravulizumab [Ultomiris]) use, or HIV infection
  - Microbiologists with routine exposure to *Neisseria meningitidis* isolates
  - Persons at increased risk during an outbreak (e.g., in community or organizational settings, and among men who have sex with men)
  - Persons who travel to or live in countries where meningococcal disease is hyperendemic or epidemic
  - Unvaccinated or undervaccinated first-year college students living in residence halls
  - Military recruits

ACIP recommends MenB vaccination for the following groups:

- Routine and booster vaccination of persons aged ≥10 years at increased risk for meningococcal disease (dosing schedule varies by vaccine brand; boosters should be administered at 1 year after primary series completion, then every 2–3 years thereafter for those who remain at increased risk):
  - Persons with certain medical conditions, such as anatomic or functional asplenia, complement component deficiencies, or complement inhibitor use
  - Microbiologists with routine exposure to *N. meningitidis* isolates
  - Persons at increased risk during an outbreak (e.g., in community or organizational settings, and among men who have sex with men)
- Vaccination of adolescents and young adults aged 16–23 years with a 2-dose MenB series on the basis of shared clinical decision-making. The preferred age for MenB vaccination is 16–18 years

Abbreviations: ACIP = Advisory Committee on Immunization Practices; MenACWY = quadrivalent (serogroups A, C, W, and Y) meningococcal vaccine; MenB = serogroup B meningococcal vaccine.
* https://pubmed.ncbi.nlm.nih.gov/33417592/

adverse events (critical); nonserious adverse events (important); and interference with other recommended vaccines administered concurrently (important).[§]

Summary of Evidence for Use of MenACWY-TT/MenB-FHbp in Persons Aged ≥10 Years

Safety and Immunogenicity

The body of evidence comprised data from three randomized, quadruple-blinded multisite[¶] clinical trials that assessed immunogenicity and safety[**] among healthy participants aged 10–25 years. Participants were randomized to 1) the pentavalent group (2 doses of MenACWY-TT/MenB-FHbp, administered 6 or 12 months apart[††]) or 2) the control group (MenACWY-CRM [Menveo, GSK, 1 dose] + MenB-FHbp [2 doses administered 6 months apart]) (*4*). The trials included ACWY-naive and ACWY-primed participants; all study participants were MenB-naive. The GRADE assessment focused on the 6-month pentavalent dosing interval for immunity outcomes; data on both 6- and 12-month pentavalent dosing intervals were assessed for safety outcomes.

Short-Term Immunity

Among both MenACWY-naive and MenACWY-primed participants, seroresponse[§§] for serogroups A, C, W, and Y 1 month after the first trial dose of ACWY-containing vaccine

[§] https://www.cdc.gov/vaccines/acip/recs/grade/mening-MenACWY-TT-MenB-FHbp.html

[¶] The clinical trials were conducted in Czechia, Denmark, Finland, Hungary, Poland, and the United States.

[**] No data were available to assess the outcomes of disease caused by serogroups A, B, C, W, and Y, or interference with vaccines administered concurrently.

[††] Two trials evaluated 2 doses of MenACWY-TT/MenB-FHbp administered 6 months apart. One trial evaluated 2 doses of MenACWY-TT/MenB-FHbp administered 12 or 36 months apart; results were not available for the 36-month interval before the October 2023 ACIP vote.

[§§] Seroresponse was based on serum bactericidal antibody assays using human complement (hSBA). For participants with a baseline hSBA titer <1:4, seroresponse was defined as a titer ≥1:16. For those with a baseline hSBA titer ≥1:4 and <1:8 (<1:16 for FHbp type A22), seroresponse was defined as a titer ≥1:32 (≥1:64 for A22). For those with a baseline hSBA titer ≥1:8 (≥1:16 for A22), seroresponse was defined as a titer ≥4 times the baseline titer.

was achieved as often or more often in the pentavalent group than in the control group. On the basis of a composite measure, seroresponse for serogroup B 1 month after the second dose of serogroup B–containing vaccine was achieved more often in the pentavalent group than in the control group. The overall level of certainty for the critical outcome short-term immunity for all serogroups was moderate for healthy persons and low for persons at increased risk because of underlying medical conditions.

Persistent Immunity

Among ACWY-naive and ACWY-primed participants, seroprotection[¶¶] for meningococcal serogroups A, C, W, and Y occurred as often or more often in the pentavalent group (48 months after receipt of 2 doses MenACWY-TT/MenB-FHbp) compared with the control group (54 months after 1 dose MenACWY-CRM). Little or no difference was observed in the frequency of serogroup B strain–specific seroprotection[***] 48 months after receipt of 2 doses of pentavalent vaccine when compared with those seen 48 months after receipt of 2 doses of MenB-FHbp + 1 dose MenACWY-CRM. The overall level of certainty for this important outcome was low for serogroups A, C, W, and Y for healthy persons, moderate for serogroup B for healthy persons, and low for all serogroups for those at increased risk because of underlying medical conditions.

Adverse Events

The proportion of participants who experienced serious adverse events[†††] was similar in the pentavalent group (0.6%) and the control group (0.5%; p = 0.7). No serious adverse events were deemed related to the vaccine by the study investigators. The pentavalent group had significantly fewer nonserious adverse events[§§§] (24.6%) than did the control group (32.5%; p<0.001). The most common solicited adverse events within 7 days after receipt of either trial dose of MenACWY-TT/MenB-FHbp were injection site pain (84.4%–89.3%; mostly mild or moderate), fatigue (47.6%–52.1%; mostly mild or moderate), and headache (39.8%–46.8%; mostly mild or moderate) (*5*). For both serious and nonserious adverse events, the level of certainty was low for healthy persons and very low for those at increased risk because of underlying medical conditions.

Coadministration with Other Vaccines

No data exist on coadministration of MenACWY-TT/MenB-FHbp with other vaccines. Review of the interactions sections of the package inserts for the component vaccines Nimenrix (MenACWY-TT) and Trumenba (MenB-FHbp) did not identify any concerns for coadministration with other vaccines (*6*,*7*).

Resource Use

Findings from two economic models (CDC model and Pfizer Inc. model) that assessed the health benefits and cost-effectiveness of MenACWY-TT/MenB-FHbp for each policy question within the routine schedule were considered by ACIP (*8*). According to the CDC model, strategies likely to be societally cost-saving would use the pentavalent vaccine to 1) replace a single dose of MenACWY and MenB when both are indicated, or 2) replace MenACWY and MenB when both are indicated, followed by completion of the 2-dose MenB series with a second dose of pentavalent vaccine. The CDC model also illustrated that when immunization against serogroup B meningococcal disease is not indicated, replacing both doses of MenACWY with the pentavalent vaccine would be incrementally less cost-effective. Despite differences in input values and assumptions, similar conclusions were reported by the Pfizer Inc. model.

Recommendations for Use of MenACWY-TT/MenB-FHbp

ACIP recommended that MenACWY-TT/MenB-FHbp may be used when both MenACWY and MenB are indicated at the same visit for 1) healthy persons aged 16–23 years (routine schedule) when shared clinical decision-making favors administration of MenB vaccine and 2) persons aged ≥10 years who are at increased risk for meningococcal disease (e.g., because of persistent complement deficiencies, complement inhibitor use, or functional or anatomic asplenia) (Table) (Figure). Indications for MenACWY and MenB vaccination have not changed since they were previously published (*1*).

Clinical Guidance

Shared Clinical Decision-Making for MenB

For healthy persons, use of MenACWY-TT/MenB-FHbp should not supersede discussion of whether to administer MenB using shared clinical decision-making (Table). Clinicians should

[¶¶] Seroprotection was based on serum bactericidal antibody assays using hSBA and defined as achieving an hSBA titer ≥1:8 for serogroups A, C, W, and Y.
[***] Seroprotection was based on serum bactericidal antibody assays using hSBA and defined as an hSBA titer ≥1:8 for serogroup B (≥1:16 for strain A22).
[†††] https://www.fda.gov/safety/reporting-serious-problems-fda/what-serious-adverse-event
[§§§] For GRADE, nonserious adverse events included all adverse events during the vaccination phase except for serious adverse events. As defined by Pfizer Inc., all adverse events included serious adverse events, nonserious adverse events, medically attended events (nonserious adverse events that resulted in evaluation at a medical facility), and newly diagnosed chronic medical conditions (a disease or medical condition, not previously identified, that is expected to be persistent or is otherwise long-lasting in its effects). The vaccination phase was defined as the time from receipt of the first study vaccination through 1 month receipt after the second study vaccination.

TABLE. Recommended timing of meningococcal vaccine doses[*,†] within the routine schedule[§] based on the outcome of shared clinical decision-making regarding meningococcal B vaccine — United States, 2023

	Recommendation based on shared clinical decision-making for MenB		
Recipient age group, yrs	**MenB not favored**	**MenB favored at age 16 yrs**	**MenB favored at age >16 yrs**
11–12	MenACWY dose #1	MenACWY dose #1	MenACWY dose #1
16	MenACWY dose #2	MenACWY dose #2 + MenB-4C[¶] or MenACWY dose #2 + MenB-FHbp[**] or MenACWY-TT/MenB-FHbp followed by MenB-FHbp 6 mos later	MenACWY dose #2
17–23	NA	NA	MenB-4C[¶] or MenB-FHbp[**]

Abbreviations: MenACWY = quadrivalent (serogroups A, C, W, and Y) meningococcal conjugate vaccine; MenACWY-TT/MenB-FHbp = Penbraya (Pfizer Inc.) pentavalent (serogroups A, B, C, W, and Y) meningococcal vaccine; MenB-FHbp = Trumenba (Pfizer Inc.) serogroup B meningococcal vaccine; MenB-4C = Bexsero (GSK) serogroup B meningococcal vaccine; NA = not applicable.

[*] Assumes that a person has not previously been vaccinated with MenACWY or MenB.

[†] MenACWY vaccines are interchangeable; the same vaccine product is recommended, but not required, for all doses. Different manufacturers' MenB vaccines are not interchangeable. https://pubmed.ncbi.nlm.nih.gov/33417592/

[§] To determine catch-up vaccination recommendations for MenACWY and MenB, clinicians should see previously published recommendations. https://pubmed.ncbi.nlm.nih.gov/33417592/

[¶] Two-dose series with doses administered ≥1 month apart.

[**] Two-dose series with doses administered 6 months apart.

refer to previously published considerations for shared clinical decision-making and timing of MenB administration (*1*).

Interchangeability of Vaccine Products

MenACWY products are interchangeable; the same vaccine product is recommended, but not required, for all doses (*1*). Different manufacturers' MenB products are not interchangeable; administration of a B-component vaccine (monovalent or pentavalent) requires that all subsequent B-component vaccine doses, including booster doses, be from the same manufacturer. If one MenB dose was received but the vaccine manufacturer is not known, the series must be restarted with any licensed product to ensure completion of the MenB series using products from a single manufacturer.

If MenACWY-TT/MenB-FHbp is inadvertently administered in lieu of MenACWY or MenB when only one (i.e., MenACWY or MenB) was indicated, the dose can be considered valid if it would otherwise have been a valid dose of MenACWY or MenB (i.e., on the basis of indication, patient age, and dosing interval).

Dosing Intervals

The licensed dosing interval for MenACWY-TT/MenB-FHbp is 6 months. Data are not available regarding safety or immunogenicity of MenACWY-TT/MenB-FHbp with dosing intervals exceeding 12 months. Healthy adolescents and young adults aged 16–23 years who receive 1 dose of MenACWY-TT/MenB-FHbp on the basis of shared clinical decision-making should complete the MenB series with a dose of MenB-FHbp 6 months after the pentavalent vaccine dose was administered (Table).

Persons at increased risk for meningococcal disease who receive a dose of MenACWY-TT/MenB-FHbp and are recommended to receive additional doses of MenACWY and MenB <6 months after a dose of pentavalent meningococcal vaccine should receive separate MenACWY and MenB-FHbp vaccines rather than MenACWY-TT/MenB-FHbp (Figure). MenACWY-TT/MenB-FHbp may be used for booster doses in persons who remain at increased risk if a booster dose of both MenACWY and MenB are indicated at the same visit. MenACWY-TT/MenB-FHbp doses deviating from the licensed 6-month interval can be considered valid for MenACWY or MenB if the timing would otherwise have been valid for that component.

Contraindications and Precautions

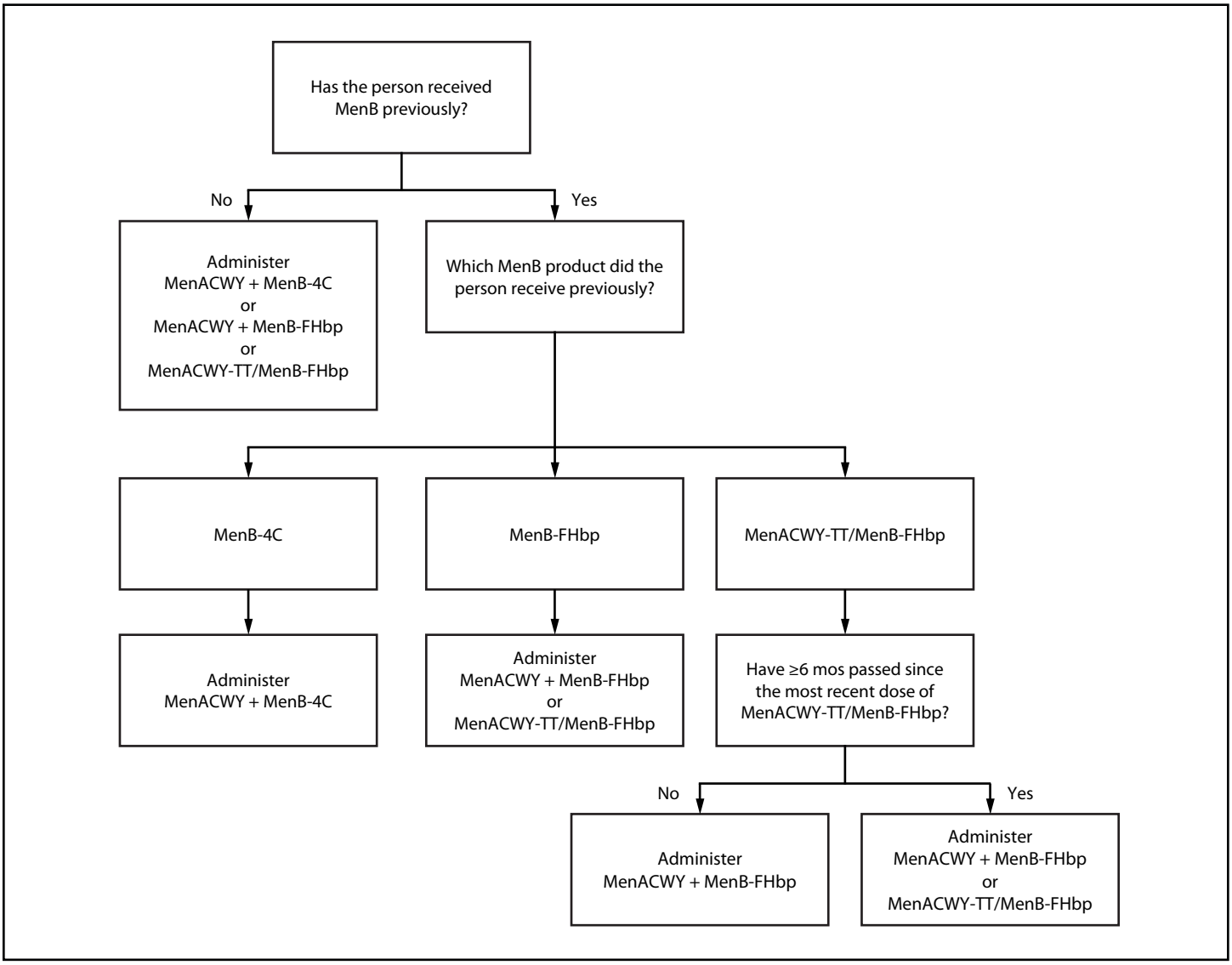
Severe allergy. MenACWY-TT/MenB-FHbp is contraindicated for persons with a history of severe allergic reaction, such as anaphylaxis, to any component of the vaccine or to a tetanus toxoid–containing vaccine.

Pregnancy and breastfeeding. No data exist on use of MenACWY-TT/MenB-FHbp during pregnancy or while breastfeeding. Because limited data are available for MenB vaccination during pregnancy, vaccination with MenB should be deferred unless the pregnant person is at increased risk for acquiring meningococcal disease, and, after consultation with their health care provider, the benefits of vaccination are considered to outweigh the potential risks. When MenACWY is indicated, persons who are pregnant or breastfeeding should receive MenACWY-CRM or MenACWY-TT (MenQuadfi, Sanofi Pasteur).

Reporting of Vaccine Adverse Events

Adverse events that occur in a patient after meningococcal vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS), even if it is uncertain whether the vaccine caused the event. Instructions for reporting to VAERS are available online at https://vaers.hhs.gov/reportevent.html or by telephone (800-822-7967).

FIGURE. Recommended meningococcal vaccines for persons at increased risk for meningococcal disease due to serogroups A, B, C, W, or Y and who are due for both meningococcal A, C, W, and Y vaccine* and meningococcal B vaccine†,§,¶, — United States, 2023**



Abbreviations: MenACWY = quadrivalent (serogroups A, C, W, and Y) meningococcal conjugate vaccine; MenACWY-TT/MenB-FHbp = Penbraya (Pfizer Inc.) pentavalent (serogroups A, B, C, W, and Y) meningococcal vaccine; MenB-FHbp = Trumenba (Pfizer Inc.) serogroup B meningococcal vaccine; MenB-4C = Bexsero (GSK) serogroup B meningococcal vaccine.

* MenACWY products are interchangeable; the same vaccine product is recommended, but not required, for all doses.

† Different manufacturers' MenB vaccines are not interchangeable.

§ To determine whether MenACWY and MenB are indicated based on a person's risk factors and timing of any previous meningococcal vaccines, clinicians should see previously published recommendations. https://pubmed.ncbi.nlm.nih.gov/33417592/

¶ If MenB was received previously but the vaccine manufacturer is not known, the series must be restarted with any licensed product to ensure completion of the series using products from a single manufacturer. For additional guidance, clinicians should see previously published recommendations. https://pubmed.ncbi.nlm.nih.gov/33417592/

** If MenB-FHbp was received previously, MenACWY-TT/MenB-FHbp may be used provided the person has not received MenACWY-TT/MenB-FHbp previously or ≥6 months have passed since the previous dose of MenACWY-TT/MenB-FHbp.

Summary

What is already known about this topic?

Meningococcal disease is a life-threatening invasive infection caused by *Neisseria meningitidis*. The pentavalent meningococcal vaccine (MenACWY-TT/MenB-FHbp [Penbraya, Pfizer Inc.]) protects against *N. meningitidis* serogroups A, B, C, W, and Y and is licensed for use among persons aged 10–25 years.

What is added by this report?

On October 25, 2023, the Advisory Committee on Immunization Practices recommended that MenACWY-TT/MenB-FHbp may be administered to persons aged ≥10 years when both a quadrivalent meningococcal conjugate vaccine (MenACWY) and meningococcal B vaccine (MenB) are indicated at the same visit.

What are the implications for public health practice?

MenACWY-TT/MenB-FHbp is the first pentavalent meningococcal vaccine approved for protection against serogroups A, B, C, W, and Y. Different manufacturers' MenB vaccines are not interchangeable; when MenACWY-TT/MenB-FHbp is administered, subsequent doses of MenB should be from the same manufacturer (Pfizer Inc.).

Acknowledgments

Alison Albert, Isha Berry, Gabrielle Cooper, LeAnne Fox, Susan Hariri, Angela Jiles, Shelby Miller, Noele Nelson, Amy Rubis, Jeremiah Williams, Division of Bacterial Diseases, National Center for Immunization and Respiratory Diseases, CDC; Jonathan Duffy, Tanya Myers, Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, CDC; Andrew Leidner, Elisabeth Velazquez, JoEllen Wolicki, Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC; Jessica MacNeil, Melinda Wharton, Office of the Director, National Center for Immunization and Respiratory Diseases, CDC. Rosters of current and past members of the Advisory Committee on Immunization Practices are available at https://www.cdc.gov/vaccines/acip/members/index.html.

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Jamie Loehr reports receipt of payment for presentations on general ACIP recommendations at the National Family Medicine Conference and the Virginia State Vaccine Group Conference. Katherine A. Poehling reports receipt of grant support from North Carolina Baptist Foundation, Optum Social Responsibility, Atrium Health, Wake Forest Baptist Clinical and Translational Science Institute, and the Kate B. Reynolds Foundation. No other potential conflicts of interest were disclosed.

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Vital Signs: Mammography Use and Association with Social Determinants of Health and Health-Related Social Needs Among Women — United States, 2022

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On April 9, 2024, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Abstract

Introduction: Approximately 40,000 U.S. women die from breast cancer each year. Mammography is recommended to screen for breast cancer and reduce breast cancer mortality. Adverse social determinants of heath (SDOH) and health-related social needs (HRSNs) (e.g., lack of transportation and social isolation) can be barriers to getting mammograms.

Methods: Data from the 2022 Behavioral Risk Factor Surveillance System were analyzed to estimate the prevalence of mammography use within the previous 2 years among women aged 40–74 years by jurisdiction, age group, and sociodemographic factors. The association between mammography use and measures of SDOH and HRSNs was assessed for jurisdictions that administered the Social Determinants and Health Equity module.

Results: Among women aged 50–74 years, state-level mammography use ranged from 64.0% to 85.5%. Having health insurance and a personal health care provider were associated with having had a mammogram within the previous 2 years. Among women aged 50–74 years, mammography prevalence was 83.2% for those with no adverse SDOH and HRSNs and 65.7% for those with three or more adverse SDOH and HRSNs. Life dissatisfaction, feeling socially isolated, experiencing lost or reduced hours of employment, receiving food stamps, lacking reliable transportation, and reporting cost as a barrier for access to care were all strongly associated with not having had a mammogram within the previous 2 years.

Conclusions and Implications for Public Health Practice: Identifying specific adverse SDOH and HRSNs that women experience and coordinating activities among health care providers, social services, community organizations, and public health programs to provide services that help address these needs might increase mammography use and ultimately decrease breast cancer deaths.

Introduction

Each year, breast cancer causes approximately 40,000 deaths among women in the United States (*1*). Although breast cancer death rates (breast cancer deaths per 100,000 women) have been decreasing, this reduction has not been equitable among all populations (*2*). Women who are non-Hispanic Black or African American (Black) and those who have low incomes are more likely to die from breast cancer (*3*,*4*). The U.S. Preventive Services Task Force (USPSTF) currently recommends that women aged 50–74 years have a screening mammogram every 2 years and that women aged 40–49 years should make an informed decision with their health care provider about screening (*5*). These recommendations might change in the near future because the USPSTF recently released a draft recommendation that women aged 40–74 years should have a screening mammogram every 2 years.* Mammograms can detect breast cancers at early stages when they are easier to treat (*6*). During the past decade, several studies have documented that some women were not up to date with receiving a mammogram per recommendations (*7*–*9*).

The U.S. Department of Health and Human Services defines social determinants of health (SDOH) as "conditions where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks" (*10*). Health-related social needs (HRSNs) are individual-level, adverse social conditions that can negatively affect a person's health or health care (*11*). Examples include food insecurity, housing instability, and lack of access to transportation.

Mammography use varies across the United States and is lowest among women without health insurance, those who have low incomes, and those who do not have a usual source of health care (*7*–*9*). These populations typically experience adverse SDOH and HRSNs that serve as barriers to receipt

*https://uspreventiveservicestaskforce.org/uspstf/index.php/draft-recommendation/breast-cancer-screening-adults

of health care (*12,13*). Understanding the impact of certain SDOH and HRSNs on mammography use could help improve cancer control efforts to reduce breast cancer deaths. This study assessed the association between mammography use and a comprehensive list of specific SDOH and HRSNs.

Methods

Behavioral Risk Factor Surveillance System

The Behavioral Risk Factor Surveillance System (BRFSS) is an annual, state- and population-based, combined landline and cell phone survey of the civilian, noninstitutionalized adult population aged ≥18 years. BRFSS collects information on health risk behaviors, preventive health practices, health care access, chronic diseases and conditions, and health outcomes across the United States. The median response rate for the 2022 BRFSS across jurisdictions was 45.1% (*14*). SAS-callable SUDAAN (version 9.4; RTI International) was used to analyze all data. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[†]

Mammography Use Data

Female BRFSS respondents aged ≥40 years in all states and the District of Columbia (DC) were asked if they had ever had a mammogram, and if so, when they had their last mammogram. Respondents who declined to answer, had a missing answer, or answered, "don't know/not sure" to the mammography questions and those who reported a personal history of breast cancer were excluded from the analysis. Mammography use was analyzed by age group, other demographic characteristics, jurisdiction, and the United States overall. Nonoverlapping 95% CIs were used as a proxy for statistical significance. Data were weighted to the age, sex, and racial and ethnic distribution of each jurisdiction's adult population using intercensal estimates (*15*).

Social Determinants of Health and Health-Related Social Needs Data

Thirty-nine states[§] and DC collected data through the new BRFSS Social Determinants and Health Equity module. The adverse SDOH measures were lost or reduced hours of employment ("In the past 12 months have you lost employment or had hours reduced?"), food insecurity ("During the past 12 months how often did the food that you bought not last, and you didn't have money to get more?"), housing insecurity ("During the last 12 months, was there a time when you were not able to pay your mortgage, rent or utility bills?"), experiencing threat to shut off utility services ("During the last 12 months was there a time when an electric, gas, oil, or water company threatened to shut off services?"), and lack of reliable transportation ("During the past 12 months has a lack of reliable transportation kept you from medical appointments, meetings, work, or from getting things needed for daily living?").

The HRSN measures were life dissatisfaction ("In general, how satisfied are you with your life?"), lack of social and emotional support ("How often do you get the social and emotional support that you need?"), feeling socially isolated ("How often do you feel socially isolated from others?"), receiving food stamps/Supplemental Nutrition Assistance Program (SNAP) ("During the past 12 months, have you received food stamps, also called SNAP, through the Supplemental Nutrition Assistance Program on an EBT [electronic benefit transfer] card?"), and mental distress ("Stress means a situation in which a person feels tense, restless, nervous or anxious or is unable to sleep at night because their mind is troubled all the time. Within the last 30 days, how often have you felt this kind of stress?").

An additional measure, cost as a barrier for access to care ("Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?") was collected as part of the BRFSS core dataset. The prevalence of mammography use among women who reported experiencing these SDOH and HRSNs was analyzed by age group (40–49 years and 50–74 years, respectively) and the variation in having a mammogram with the number of adverse SDOH and HRSNs experienced by state. Because of the low frequency of reporting three or more SDOH and HRSNs, those were grouped together. For each age group, logistic regression models were used to determine which SDOH and HRSNs were significantly related to not having had a mammogram ($p<0.05$). Each model combined all 39 states and DC and controlled for the other SDOH and HRSNs.

Results

Study Population

Among 142,471 female respondents aged 40–74 years, 11,283 (7.9%) declined to answer, had a missing answer, or answered, "don't know/not sure" to at least one of the mammography questions and were excluded from the analysis. An

[†] 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.

[§] The BRFSS Social Determinants and Health Equity module was administered in Alabama, Alaska, Arizona, California, Connecticut, Delaware, District of Columbia, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming.

additional 1,737 (1.3%) respondents who reported a personal history of breast cancer, and 11,985 (9.3%) who declined to answer, had a missing answer, or answered "don't know/not sure" to the question on history of breast cancer were also excluded. The final sample included 117,466 women, representing 82.4% of female respondents aged 40–74 years.

Mammography Use by Demographic Characteristics

In 2022, the U.S. prevalence of mammography use during the previous 2 years was 59.1% among women aged 40–49 years and 76.5% among those aged 50–74 years (Table 1). Mammography use varied across states, ranging from 44.5% (New Mexico) to 77.8% (South Dakota) among women aged 40–49 years and from 64.0% (Wyoming) to 85.5% (Rhode Island) among those aged 50–74 years. Mammography use among women aged 40–49 years was significantly lower than that among those aged 50–74 years in all states and DC except three (Mississippi, Pennsylvania, and South Dakota). In both age groups, Black women reported the highest prevalence of mammography use within the previous 2 years (65.2% and 82.9% among women aged 40–49 years and 50–74 years, respectively) (Table 2), and mammography use during the previous 2 years increased with increasing income and higher educational attainment. Among women aged 40–49 years and 50–74 years, mammography use was lower among those without health insurance (32.7% and 37.4%, respectively) and those who did not have a personal health care provider (32.7% and 42.2%, respectively) than among women who reported having health insurance (58.7% and 73.9%, respectively) and a personal provider (63.4% and 79.1%, respectively).

Association of Mammography Use with Social Determinants of Health and Health-Related Social Needs

Among women aged 50–74 years, median past–2-year mammography use prevalence decreased with increasing number of reported adverse SDOH and HRSNs (Figure) (Supplementary Table, https://stacks.cdc.gov/view/cdc/150461). Among women reporting no adverse SDOH or HRSNs, the median jurisdiction mammography use prevalence was 83.2% (range = 69.6%–91.0%); among those reporting one, two, or 3–11 adverse SDOH or HRSNs, the median state mammography use prevalences were 77.1% (range = 57.9%–89.5%), 73.3% (range = 63.6%–83.5%), and 65.7% (range = 44.8%–83.8%), respectively. The prevalence of reporting more than one adverse SDOH or HRSN among women aged 40–49 years was too low to produce stable estimates.

In the logistic regression model, among women aged 40–49 years, feeling socially isolated, experiencing lost or reduced employment hours, and reporting cost as a barrier to health care access were significantly associated with not having had a mammogram during the previous 2 years (Table 3). Among women aged 50–74 years, reporting life dissatisfaction, feeling socially isolated, experiencing lost or reduced employment hours, receiving food stamps, lacking reliable

TABLE 1. Percentage of women aged 40–74 years who reported having had a mammogram within the previous 2 years, by age group and jurisdiction — Behavioral Risk Factor Surveillance System, United States, 2022

Jurisdiction	Age group, yrs % (95% CI)	
	40–49	50–74
Total	**59.1 (57.9–60.4)**	**76.5 (75.9–77.1)**
Alabama	62.7 (54.2–70.5)	77.9 (74.4–81.0)
Alaska	53.2 (46.4–59.8)	67.7 (63.5–71.5)
Arizona	54.0 (47.4–60.5)	74.3 (71.3–77.1)
Arkansas	60.0 (53.4–66.3)	74.7 (71.6–77.5)
California	53.4 (47.6–59.2)	76.2 (72.9–79.2)
Colorado	55.2 (50.5–59.8)	70.6 (67.4–73.6)
Connecticut	71.3 (66.0–76.0)	81.9 (79.2–84.2)
Delaware	60.5 (51.4–68.9)	80.2 (76.9–83.1)
District of Columbia	58.5 (50.7–65.9)	77.0 (71.9–81.4)
Florida	60.1 (52.4–67.4)	79.0 (75.7–81.9)
Georgia	62.1 (56.0–67.9)	76.2 (73.2–78.9)
Hawaii	65.3 (59.8–70.3)	78.2 (75.2–81.0)
Idaho	48.7 (43.0–45.4)	67.6 (64.6–70.5)
Illinois	57.3 (50.7–63.7)	72.0 (67.5–76.1)
Indiana	58.0 (53.6–62.2)	77.6 (75.5–79.6)
Iowa	58.0 (52.7–63.1)	79.6 (76.9–82.0)
Kansas	56.3 (51.4–61.2)	73.4 (70.9–75.9)
Kentucky	58.8 (50.5–66.7)	71.9 (67.2–76.1)
Louisiana	68.6 (62.1–74.5)	81.1 (78.3–83.7)
Maine	59.3 (54.0–64.5)	81.5 (79.4–83.4)
Maryland	66.4 (62.0–70.5)	82.9 (81.0–84.6)
Massachusetts	63.5 (58.9–67.8)	84.4 (82.1–86.6)
Michigan	65.9 (60.8–70.6)	77.3 (75.1–79.4)
Minnesota	61.2 (57.5–64.8)	79.5 (77.5–81.4)
Mississippi*	65.8 (58.9–72.2)	72.7 (68.3–76.6)
Missouri	64.3 (58.3–70.0)	74.8 (71.7–77.7)
Montana	53.4 (47.7–59.1)	73.2 (70.1–76.1)
Nebraska	55.5 (49.6–61.2)	77.1 (74.4–79.7)
Nevada	48.7 (38.0–59.6)	69.9 (64.4–74.8)
New Hampshire	65.9 (57.9–73.1)	80.3 (77.7–82.6)
New Jersey	65.3 (59.5–70.8)	75.8 (72.5–78.8)
New Mexico	44.5 (37.4–51.8)	68.1 (64.2–71.8)
New York	66.3 (62.2–70.2)	78.4 (76.0–80.6)
North Carolina	61.7 (54.8–68.2)	80.4 (76.6–83.7)
North Dakota	62.5 (54.5–69.9)	80.8 (77.6–83.7)
Ohio	57.5 (53.2–61.8)	75.5 (73.3–77.6)
Oklahoma	53.1 (47.5–58.7)	68.2 (64.8–71.4)
Oregon	53.8 (48.3–59.1)	77.9 (74.8–80.8)
Pennsylvania*	67.2 (59.1–74.3)	74.5 (69.0–79.4)
Rhode Island	68.5 (61.6–74.7)	85.5 (83.0–87.6)
South Carolina	60.4 (54.9–65.7)	79.3 (77.1–81.3)
South Dakota*	77.8 (67.7–85.4)	71.9 (63.6–78.9)
Tennessee	61.0 (54.0–67.5)	75.5 (71.7–78.9)
Texas	53.6 (47.6–59.4)	73.9 (70.7–76.8)
Utah	53.0 (48.7–57.2)	74.5 (71.7–77.0)
Vermont	48.5 (43.5–53.5)	74.5 (71.8–77.0)
Virginia	63.8 (58.9–68.4)	77.5 (74.9–79.8)
Washington	50.0 (47.1–53.0)	74.2 (72.6–75.8)
West Virginia	60.5 (54.3–66.4)	77.0 (74.1–79.8)
Wisconsin	58.0 (53.2–62.7)	82.4 (80.4–84.2)
Wyoming	48.7 (41.3–56.0)	64.0 (60.3–67.5)

* Overlapping 95% CI between the two age groups.

transportation, and reporting cost as a barrier to health care access were all associated with not having had a mammogram within the previous 2 years. Among women in both age groups, cost as a barrier to health care access was the measure most strongly associated with not having had a mammogram within the previous 2 years.

Discussion

In 2022, more than three quarters (76.5%) of women aged 50–74 and more than one half (59.1%) of those aged 40–49 reported having had a mammogram within the previous 2 years. Mammography use varied by state and sociodemographic characteristics. Characteristics related to access to health care (i.e., low income, lack of health insurance, and lack of a personal health care provider) were associated with lower prevalences of mammography use. This finding is consistent with those from previous studies, which have shown associations between lower mammography use and lower educational attainment and income, not having a usual source of health care, and being uninsured (*8*,*9*). Persons who do not have routine health care providers and do not have health insurance might face barriers to receiving health care (*12*).

TABLE 2. Percentage of women aged 40–74 years who reported having had a mammogram within the previous 2 years, by age group and sociodemographic characteristics — Behavioral Risk Factor Surveillance System, United States, 2022

Characteristic	Age group, yrs % (95% CI)	
	40–49	50–74
Race and ethnicity*		
American Indian or Alaska Native	54.2 (44.7–63.4)	61.5 (54.8–67.7)
Asian, Native Hawaiian, or other Pacific Islander	54.3 (47.7–60.8)	76.8 (71.8–81.2)
Black or African American	65.2 (62.2–68.2)	82.9 (81.4–84.3)
White	60.4 (59.0–61.7)	76.6 (75.9–77.2)
Hispanic or Latino	54.5 (50.9–58.1)	74.3 (71.6–76.8)
Other race or multiracial	58.5 (51.1–65.4)	66.9 (61.0–72.4)
Education level		
Did not complete high school	44.6 (39.5–49.9)	64.9 (61.8–67.9)
Graduated from high school	56.0 (53.0–59.0)	73.5 (72.2–74.8)
Attended college or technical school	56.3 (54.0–58.6)	77.1 (76.1–78.2)
Graduated from college or technical school	67.1 (65.6–68.7)	81.6 (80.8–82.5)
Annual household income, $		
<15,000	45.7 (40.6–50.9)	63.1 (59.9–66.2)
15,000 to <35,000	50.7 (47.5–53.9)	69.2 (67.4–71.0)
35,000 to <50,000	55.3 (51.2–59.3)	74.7 (72.8–76.5)
50,000 to <75,000	56.6 (52.9–60.2)	78.0 (76.3–79.5)
≥75,000	65.6 (63.7–67.4)	82.6 (81.6–83.6)
U.S. Census Bureau region†		
Northeast	65.9 (63.3–68.5)	78.3 (76.7–79.8)
Midwest	59.8 (57.9–61.7)	76.3 (75.3–77.4)
South	59.8 (57.6–61.9)	76.9 (75.9–77.9)
West	52.9 (49.9–55.9)	74.5 (72.9–76.0)
Metropolitan statistical area		
Metro	59.6 (58.2–60.9)	77.2 (76.5–77.9)
Nonmetro	56.4 (53.7–59.1)	73.1 (71.8–74.4)
Has health insurance		
Yes	58.7 (49.9–66.9)	73.9 (69.8–77.7)
No	32.7 (28.3–37.4)	37.4 (33.6–41.3)
Has a personal health care provider		
Yes	63.4 (62.0–64.7)	79.1 (78.5–79.7)
No	32.7 (29.5–36.1)	42.2 (39.0–45.6)

* Persons of Hispanic or Latino (Hispanic) origin might be of any race but are categorized as Hispanic; all racial groups are non-Hispanic.
† https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

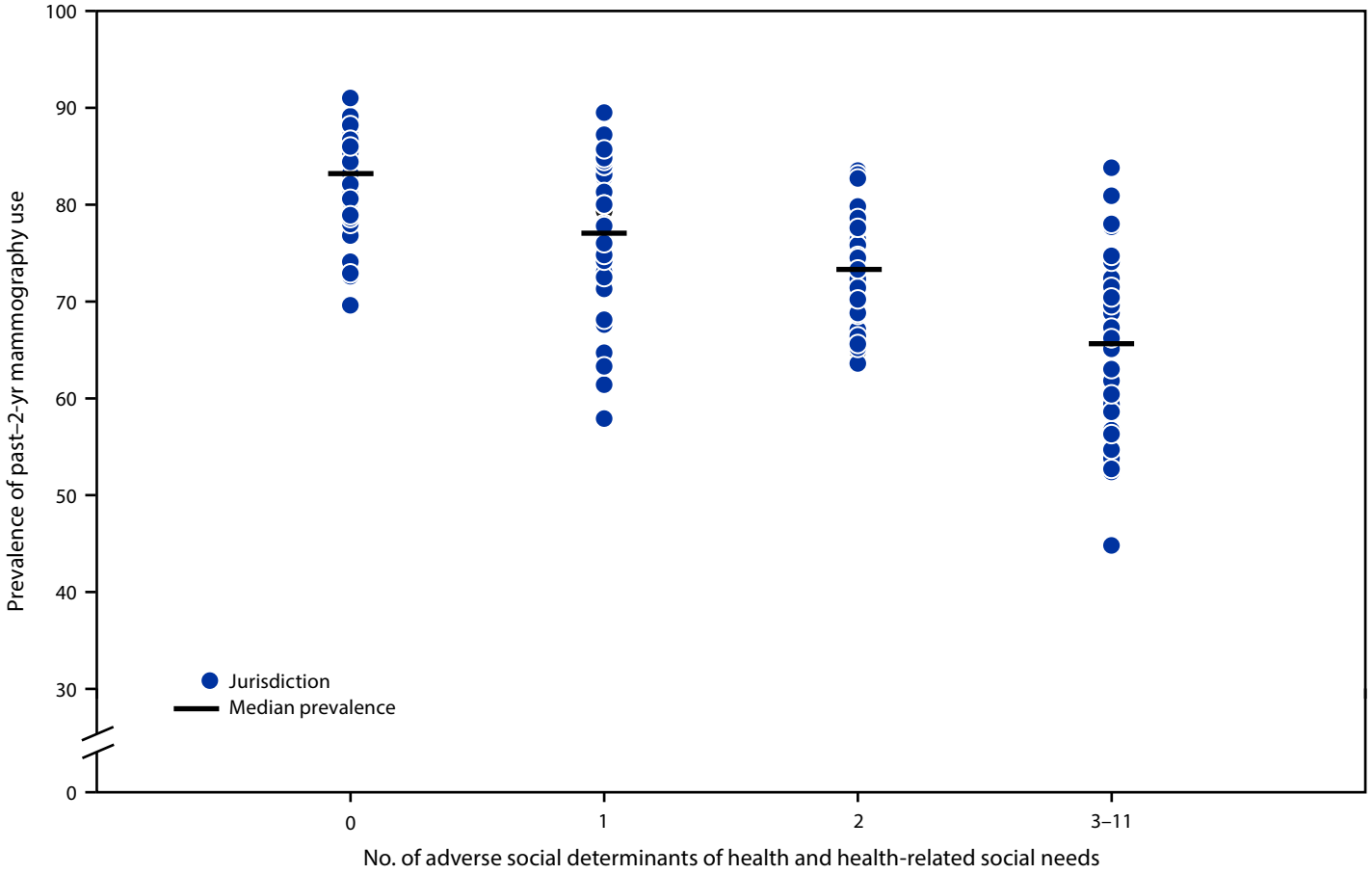
This analysis incorporated data from a new BRFSS module to explore the relationship between SDOH and HRSNs and mammography use. Individual SDOH and HRSNs, including feeling socially isolated, life dissatisfaction, lost or reduced employment hours, lack of reliable transportation, and cost as a barrier to accessing health care, were associated with not having had a mammogram within the previous 2 years. Cost as a barrier to accessing health care was most strongly associated, which might represent a wide range of factors beyond the cost of health care, including costs for transportation, child care, and taking time off work. Further, mammography use decreased as women experienced an increasing number of adverse SDOH and HRSNs. The impact of these SDOH and HRSNs might have been exacerbated during the COVID-19 pandemic when persons often remained at home, which potentially increased social isolation and job loss (*16*).

Studies have indicated that evidence-based interventions, including programs that provide healthy food options and equitable access to transportation, increase health care adherence and improve health outcomes (*17*). Addressing adverse SDOH and HRSNs might require multicomponent approaches. The White House released an SDOH playbook (*18*) that provides a list of specific measures to improve the social circumstances that adversely affect health. This playbook specifically calls for better understanding and sharing of information on SDOH and HRSNs to guide and improve policy decisions and quality improvement activities, funding of community organizations that focus on specific needs of persons, and coordination of health care with public health and social services. As part of an effort to address some cost concerns, mammograms are available at no cost or low cost through insurance mandates under the Affordable Care Act,¶ Medicare,** and CDC's National Breast and Cervical Cancer Early Detection Program.††

In 2024, the Centers for Medicare & Medicaid Services (CMS) implemented a new billing code that allows health care providers to be reimbursed for administering an assessment to identify SDOH and HRSNs.§§ CMS also encourages providers

¶ https://www.healthcare.gov/preventive-care-women/
** https://www.cms.gov/medicare/coverage/preventive-services-coverage
†† https://www.cdc.gov/cancer/nbccedp/
§§ https://www.cms.gov/newsroom/fact-sheets/calendar-year-cy-2024-medicare-physician-fee-schedule-final-rule

FIGURE. Percentage of women aged 50–74 years who reported having had a mammogram within the previous 2 years, by jurisdiction* and number of reported adverse social determinants of health and health-related social needs — Behavioral Risk Factor Surveillance System, United States, 2022



* Data available for 39 states (Alabama, Alaska, Arizona, California, Connecticut, Delaware, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming) and the District of Columbia.

to document *International Classification of Diseases, Tenth Revision* codes to capture information on patients' SDOH and HRSNs in medical records (*19*). Reimbursement, as recognition that these SDOH and HRSNs directly influence health outcomes, could provide incentives to health care providers to perform this assessment during medical visits and link patients to needed social services that address SDOH and HRSNs.

Limitations

The findings in this report are subject to at least five limitations. First, BRFSS data are based on self-report and are not confirmed by medical record review; this might result in under- or overestimating mammography use. Second, the mammography use question does not distinguish between screening and diagnostic testing, which might lead to overestimating up-to-date mammography use per screening recommendations. Third, this analysis might have included women at high risk for developing breast cancer, for whom USPSTF recommendations do not apply because they require more frequent screening. Fourth, the SDOH and HRSNs assessed in this analysis are not specifically related to mammography use and are not available for all states, which might limit generalizability. Finally, because the BRFSS response rate was 45%, the findings might not be representative of the total adult population.

Implications for Public Health Practice

In addition to implementing evidence-based interventions to increase mammography use (e.g., client reminders, videos, brochures, flyer, postcards, newsletters, and reducing structural barriers) (*20*), addressing social needs might result in increased mammography use and reduced breast cancer deaths. Health care facilities, providers, and public health programs could consider developing policies and effective practices to conduct

TABLE 3. Association of adverse social determinants of health and health-related social needs with report of not having had a mammogram* within the previous 2 years among women aged 40–74 years, by age group — Behavioral Risk Factor Surveillance System, United States,† 2022

	Age group, yrs			
	40–49		50–74	
Adverse SDOH and health-related social needs	OR (95% CI)	p-value	OR (95% CI)	p-value
Life dissatisfaction	1.31 (0.94–1.83)	0.11	1.47 (1.20–1.81)	<0.001§
Lack of social and emotional support	0.94 (0.77–1.15)	0.52	1.09 (0.96–1.24)	0.18
Feeling socially isolated	1.30 (1.11–1.53)	0.001§	1.19 (1.07–1.32)	0.002§
Lost or reduced hours for employment	1.35 (1.06–1.71)	0.02§	1.20 (1.01–1.43)	0.04§
Receiving food stamps (SNAP)	1.17 (0.97–1.42)	0.10	1.29 (1.10–1.52)	0.002§
Food insecurity	0.84 (0.67–1.05)	0.12	1.19 (0.99–1.42)	0.06
Housing insecurity	0.99 (0.79–1.25)	0.94	1.02 (0.82–1.26)	0.88
Experiencing threat to shut off utility services	1.23 (0.98–1.56)	0.08	1.24 (0.97–1.58)	0.09
Lack of reliable transportation	1.14 (0.87–1.51)	0.34	1.29 (1.06–1.56)	0.01§
Mentally distressed	1.05 (0.88–1.26)	0.59	1.00 (0.86–1.15)	0.96
Cost is barrier to health care access	1.96 (1.55–2.48)	0§	2.11 (1.80–2.47)	0§

Abbreviations: OR = odds ratio; SDOH = social determinants of health; SNAP = Supplemental Nutrition Assistance Program.
* Each logistic regression model controls for the other SDOH and health-related social needs.
† Data available for 39 states (Alabama, Alaska, Arizona, California, Connecticut, Delaware, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming) and the District of Columbia.
§ Significantly associated with not having had a mammogram within the previous 2 years (p<0.05).

Summary

What is already known about this topic?

Approximately 40,000 U.S. women die from breast cancer each year. Mammography is recommended to screen for breast cancer and reduce breast cancer mortality. Adverse social determinants of health (SDOH) and health-related social needs (HRSNs) can be barriers to receiving mammograms.

What is added by this report?

Mammography use decreased with increasing adverse SDOH and HRSNs experienced. Social isolation, life dissatisfaction, and cost as a barrier to health care access were strongly associated with decreased mammography use.

What are the implications for public health practice?

Identifying specific adverse SDOH and HRSNs that women experience, and coordinating activities among health care providers, social services, community organizations, and public health programs to provide relevant services might increase mammography use and ultimately decrease breast cancer deaths.

risk assessments for adverse SDOH and HRSNs and address SDOH and HRSNs such as cost to access health care, social isolation, lack of reliable transportation, and food insecurity. Addressing SDOH and HRSNs and their drivers might increase the prevalence of receipt of mammography and other preventive health services.

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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.

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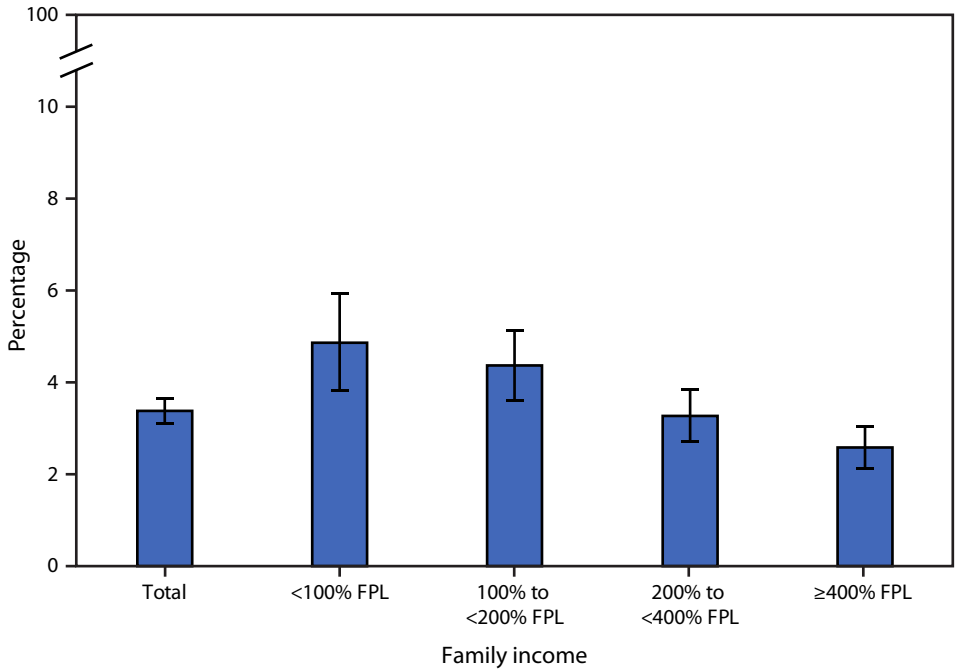
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Children and Adolescents Aged 3–17 Years Who Ever Received a Diagnosis of Autism Spectrum Disorder,† by Family Income,§ 2020–2022



Abbreviation: FPL = federal poverty level.
* Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population, with 95% CIs indicated by error bars.
† Based on a "yes" response to the question, "Has a doctor or other health professional ever told you that [sample child] had autism, Asperger's disorder, pervasive developmental disorder, or autism spectrum disorder?"
§ As a percentage of FPL, which is based on family income and family size, using the U.S. Census Bureau's poverty thresholds. Family income was imputed when missing.

During 2020–2022, 3.4% of children and adolescents aged 3–17 years had received a diagnosis of autism spectrum disorder. The prevalence of autism spectrum disorder among children and adolescents decreased as family income increased.

Supplementary Table: https://stacks.cdc.gov/view/cdc/152917

Source: National Center for Health Statistics, National Health Interview Survey, 2020–2022. https://www.cdc.gov/nchs/nhis.htm

Reported by: Julie D. Weeks, PhD, jweeks@cdc.gov; Nazik Elgaddal, MS; Natalie Young, PhD.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/ncbddd/autism/index.html

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ISSN: 0149-2195 (Print)