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Universal Hepatitis B Vaccination in Adults Aged 19–59 Years: Updated Recommendations of the Advisory Committee on Immunization Practices — United States, 2022

Mark K. Weng, MD[1]; Mona Doshani, MD[1]; Mohammed A. Khan, PhD[1]; Sharon Frey, MD[2]; Kevin Ault, MD[3]; Kelly L. Moore, MD[4]; Eric W. Hall, PhD[5]; Rebecca L. Morgan, PhD[6]; Doug Campos-Outcalt, MD[7]; Carolyn Wester, MD[1]; Noele P. Nelson, MD, PhD[1]

Hepatitis B (HepB) vaccines have demonstrated safety, immunogenicity, and efficacy during the past 4 decades (*1*,*2*). However, vaccination coverage among adults has been suboptimal, limiting further reduction in hepatitis B virus (HBV) infections in the United States. This Advisory Committee on Immunization Practices (ACIP) recommendation expands the indicated age range for universal HepB vaccination to now include adults aged 19–59 years. Removing the risk factor assessment previously recommended to determine vaccine eligibility in this adult age group (*2*) could increase vaccination coverage and decrease hepatitis B cases.

Background

Hepatitis B is a vaccine-preventable, communicable disease of the liver caused by HBV. HBV is transmitted through percutaneous (i.e., puncture through the skin) or mucosal (i.e., direct contact with mucous membranes) exposure to infectious blood or body fluids. Since HepB vaccine was introduced in 1982, the number of reported hepatitis B cases has declined substantially. However, despite reductions in hepatitis B incidence during the past 4 decades, which were achieved through incremental expansion of groups for whom HepB vaccination is recommended, progress in recent years on further reducing acute hepatitis B cases has stalled (*3*). Incident hepatitis B declined from 26,654 reported cases (172,700 estimated actual cases) in 1985 to a low of 2,791 reported cases (18,100 estimated actual cases) in 2014 (*3*,*4*). In 2019, a total of 3,192 cases of acute hepatitis B were reported to CDC, corresponding to 20,700 estimated acute infections (95% CI = 11,800–50,800). The most commonly reported risk behaviors and exposures were injection drug use (35%), multiple sex partners (23%), and surgery (10%), followed by other sexual and bloodborne risk behaviors; risk behavior and exposure information were missing for 37.1% of cases. There are an estimated 880,000 (95% CI = 580,000–1,170,000) prevalent chronic HBV infections in the United States based on 2013–2018 National Health and Nutrition Examination Survey data, with a modeled estimate of 1.89 million (range = 1.49–2.40 million) that accounts for potential underrepresentation of the non-U.S.–born population (*5*,*6*). In 2018, the reported HepB vaccination coverage (≥3 doses) was 30.0% among adults aged ≥19 years, only a small increase over the past 4 decades (*7*).

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Methods

During September 2019–October 2021, the ACIP* Hepatitis Work Group† (Work Group) held monthly conference calls to review and discuss scientific evidence relevant to the use of HepB vaccines in a universal adult vaccination recommendation. The Work Group identified the following outcomes of interest for evaluation: incidence of hepatitis B, morbidity related to hepatitis B, mortality related to hepatitis B, and vaccine-related serious adverse events. Data on universal HepB vaccination outcomes and safety were summarized based on findings from a systematic review of the literature completed on September 10, 2020, and updated September 20, 2021. The Work Group assessed the certainty of evidence at the outcome level related to the U.S.-licensed HepB vaccines for all adults previously unvaccinated against HBV infection, using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach. Detailed descriptions of methods and results are available in the GRADE evidence profile (https://www.cdc.gov/vaccines/acip/recs/grade/hepb-adults.html). After the GRADE assessment, decisions were made using the Evidence to Recommendation (EtR) Framework (https://www.cdc.gov/vaccines/acip/recs/grade/hepb-adults-etr.html).

During July 2021–February 2022, the Work Group participated in three conference calls to review the evidence for the seroprotection and safety of PreHevbrio, a three-antigen 3-dose HepB vaccine newly approved by the Food and Drug Administration (FDA) in 2021. Description of the methods and results are available for the GRADE evidence (https://www.cdc.gov/vaccines/acip/recs/grade/prehevbrio-hepb.html) and EtR Framework (https://www.cdc.gov/vaccines/acip/recs/grade/prehevbrio-hepb-etr.html).

Summary of Key Findings

The scientific literature was searched through a systematic review using PubMed, Medline, Embase, CINAHL, and Cochrane Library databases from January 1, 2006, through September 10, 2020. Search terms included "hepatitis b vaccines," "adult," "routine," and "universal." To qualify as a candidate for inclusion in the review, a study had to discuss

* Recommendations for routine use of vaccines in children, adolescents, and adults are developed by the ACIP. ACIP is chartered as a federal advisory committee to provide expert external advice and guidance to the CDC Director on use of vaccines and related agents for the control of vaccine-preventable diseases in the civilian U.S. population. Recommendations for routine use of vaccines in children and adolescents are harmonized to the greatest extent possible with recommendations made by the American Academy of Pediatrics, the American Academy of Family Physicians (AAFP), and the American College of Obstetricians and Gynecologists (ACOG). Recommendations for routine use of vaccines in adults are harmonized with the recommendations of AAFP, ACOG, and the American College of Physicians. ACIP recommendations approved by the CDC Director become agency guidelines on the date published in the *Morbidity and Mortality Weekly Report*. https://www.cdc.gov/vaccines/acip

† The ACIP Hepatitis Vaccines Work Group comprises professionals from academic medicine (family medicine, internal medicine, pediatrics, obstetrics, infectious disease, occupational health, and preventive medicine specialists), federal and state public health entities, and medical societies.

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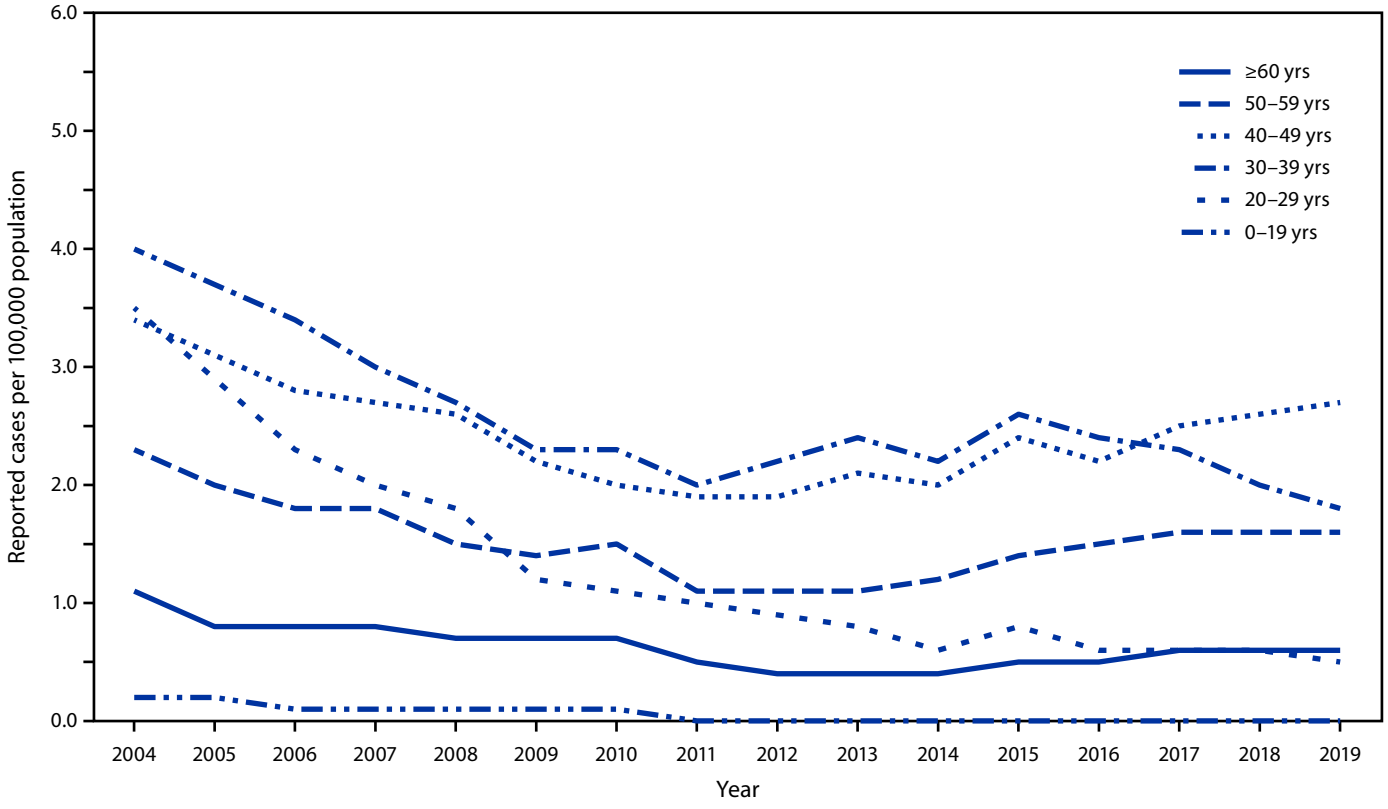
adult HepB vaccination. Studies were excluded if they did not address the adult population, were non-English language, discussed HepB vaccines not licensed in the United States, or if data could not be abstracted. The search identified 3,226 studies, 263 of which were deemed eligible and informed this review. Rates of reported acute hepatitis B have not notably decreased for over 1 decade, with 20,700 estimated infections in 2019 (*3*,*4*). None of the identified studies reported hepatitis B incidence, morbidity, and mortality when comparing universal and risk-based adult HepB vaccination. The safety of single-antigen 3-dose HepB vaccines has been established (*1*,*2*). PreHevbrio was approved by FDA in 2021 and recommended by ACIP in 2022. Little or no difference in seroprotection or occurrence of serious adverse events or mild adverse events (GRADE evidence type 3; low certainty evidence) was found for PreHevbrio in comparison with a 3-dose, single-antigen vaccine (Engerix-B), and serious adverse events were rare for both vaccines. The 2-dose HepB vaccine (Heplisav-B) was approved by FDA in 2017 and recommended by ACIP in 2018. No difference in occurrence of serious adverse events (GRADE evidence type 1; high certainty evidence) was found for Heplisav-B compared with a 3-dose vaccine (Engerix-B), and serious adverse events were rare for both vaccines (*8*,*9*).

Rationale for Recommendations

Approximately one half of acute hepatitis B cases reported in 2019 occurred among persons aged 30–49 years (Figure). The number of cases of acute hepatitis B has increased among adults aged ≥40 years, particularly among those aged 40–49 years, for whom the rate of reported cases increased from 1.9 per 100,000 population in 2011 to 2.7 per 100,000 population in 2019 (Figure). The rate among adults aged 50–59 years increased 45.5% during the same period (from 1.1 to 1.6 per 100,000 population) and accounted for 22.2% of reported cases in 2019. Acute HBV infections among adults leads to chronic hepatitis B disease in an estimated 2%–6% of cases.

HepB vaccination coverage among adults aged ≥19 years is low. In 2018, self-reported HepB vaccination coverage (≥3 doses) among adults aged ≥19 years was 30.0% (*7*). HepB vaccination coverage (≥3 doses) was 40.3% for adults aged 19–49 years and 19.1% for adults aged ≥50 years. During 2013–2018, 21.4% (95% CI = 20.2%–22.6%) of adults aged ≥25 years had vaccine-induced immunity to hepatitis B (*5*).

FIGURE. Rates of reported acute hepatitis B virus infection, by age group — United States, 2004–2019



Source: https://www.cdc.gov/hepatitis/statistics/2019surveillance/Figure2.4.htm

HepB vaccination coverage among adults with risk factors has been suboptimal. In 2018, self-reported coverage (≥3 doses) was 33.0% among adults with chronic liver disease, 38.9% among travelers to countries where HBV infections have been endemic since 1995, 33.0% among adults with diabetes aged 19–59 years, and 67.2% among health care personnel (*7*). In a national survey of 433 family medicine physicians and 420 internal medicine physicians to assess their barriers to adult HepB vaccination, 68% of physicians cited patients' nondisclosure of risk factors as a barrier, and 44% felt there was inadequate time to routinely assess patients for risk factors (*10*).

A universal recommendation for HepB vaccination could increase the number of persons who receive vaccination before the onset of chronic liver disease and other comorbidities (e.g., obesity or diabetes) that might make vaccination less effective. For example, patients with chronic liver disease are known to have decreased immune response to HepB vaccination (*11*).

Among the 3,192 case reports of acute hepatitis B received by CDC for 2019, risk behavior and exposure data were missing for 1,183 (37.1%). Risk factors assessed under prior recommendations for HepB vaccination include potential criminal or stigmatizing behavior (e.g., injection-drug use, incarceration, or multiple sex partners), limiting the effectiveness of provider risk assessment (*3*,*12*,*13*). A universal vaccination recommendation eliminates the need for risk assessment before vaccination.

Racial and ethnic disparities exist among those who become infected with HBV. In 2005, acute hepatitis B incidence among non-Hispanic Black Americans was approximately twice that among several other racial and ethnic populations (*3*). In 2019, the rate of HBV infection among non-Hispanic Black adults was triple that of Asian or Pacific Islander adults and approximately twice that of Hispanic adults (*3*). Rates of hepatitis B among children and adolescents of all races and ethnicities converged to a lower rate after a universal vaccination strategy was implemented for this age group (*3*).

Resource Use

An economic model was used to estimate the health improvements that are expected to result from universal adult HepB vaccination (*14*). One measure of cost-effectiveness, the incremental cost-effectiveness ratio (ICER), was calculated at $153,000 per quality-adjusted life-year (QALY) gained for all adults aged ≥19 years. A sub-analysis performed for adults aged 19–59 years yielded an ICER of $117,000 per QALY gained.[§] Increased vaccination coverage resulting from the modeled vaccination intervention strategies resulted in better health outcomes; the average QALYs gained, life-years gained, number of acute HBV infections averted, and number of hepatitis B-related deaths averted all increased as vaccination coverage in the intervention strategy increased (*14*). Among the cohort aged ≥60 years, hepatitis B incidence is markedly lower (0.6 cases per 100,000 population in 2019); thus, the number of preventable HBV infections in that age group is lower than for those aged 19–59 years.

Recommendations

HepB vaccination is recommended for adults aged 19–59 years and adults aged ≥60 years with risk factors for hepatitis B. Adults aged ≥60 years without known risk factors for hepatitis B may also receive HepB vaccines (Box). Infants and all other persons aged <19 years are already recommended to receive HepB vaccines (*2*).

Clinical Guidance

ACIP recommends that adults aged 19–59 years and adults aged ≥60 years with risk factors for hepatitis B should receive HepB vaccines, and that adults aged ≥60 years without known risk factors for hepatitis B may receive HepB vaccines. In previous HepB vaccine recommendations, providers were advised to administer HepB vaccine to all patients who requested it. The new language for adults aged ≥60 years without known risk factors is intended to prompt all providers to offer HepB vaccination to patients in that cohort, rather than wait for a patient to request vaccination, thus shifting the responsibility of initiating the consideration of HepB vaccination from the patient to the provider.

Persons who have completed a HepB vaccination series at any point or who have a history of HBV infection should not receive additional HepB vaccination, although there is no evidence that receiving additional vaccine doses is harmful.[¶] However, there are cases where revaccination might be indicated as specified in the 2018 ACIP recommendation (e.g., nonresponder infants born to persons testing positive for hepatitis B surface antigen [HBsAg], health care providers, and persons on hemodialysis) (*2*). Providers should only accept dated records as evidence of HepB vaccination. Vaccination of persons immune to HBV infection because of current or previous infection or HepB vaccination does not increase the risk for adverse events. However, in settings in which the patient population has a high rate of previous HBV infection,[**] prevaccination testing, which may be performed concomitantly with administration of the first dose of vaccine, might reduce costs by avoiding complete vaccination of persons who are

[§] https://www.cdc.gov/vaccines/acip/meetings/downloads/slides-2021-11-2-3/02-HepWG-weng-508.pdf

[¶] https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/index.html

[**] https://cdafound.org/polaris/ (Accessed November 19, 2021).

BOX. Persons recommended to receive hepatitis B vaccination

All infants

Persons aged <19 years

Adults aged 19–59 years

Adults aged ≥60 years with risk factors for hepatitis B:

- Persons at risk for infection by sexual exposure
  - Sex partners of persons testing positive for HBsAg
  - Sexually active persons who are not in a long-term, mutually monogamous relationship (e.g., persons with more than one sex partner during the previous 6 months)
  - Persons seeking evaluation or treatment for a sexually transmitted infection
  - Men who have sex with men
- Persons at risk for infection by percutaneous or mucosal exposure to blood
  - Persons with current or recent injection drug use
  - Household contacts of persons testing positive for HBsAg
  - Residents and staff members of facilities for persons with developmental disabilities
  - Health care and public safety personnel with reasonably anticipated risk for exposure to blood or blood-contaminated body fluids
  - Persons on maintenance dialysis, including in-center or home hemodialysis and peritoneal dialysis, and persons who are predialysis
  - Persons with diabetes at the discretion of the treating clinician
- Others
  - International travelers to countries with high or intermediate levels of endemic hepatitis B virus infection (HBsAg prevalence of ≥2%)
  - Persons with hepatitis C virus infection
  - Persons with chronic liver disease (including, but not limited to, persons with cirrhosis, fatty liver disease, alcoholic liver disease, autoimmune hepatitis, and an alanine aminotransferase or aspartate aminotransferase level greater than twice the upper limit of normal)
  - Persons with HIV infection
  - Persons who are incarcerated

Adults aged ≥60 years without known risk factors for hepatitis B may receive hepatitis B vaccines

Abbreviation: HBsAg = hepatitis B surface antigen.

Summary

What is already known about this topic?

Vaccination with hepatitis B (HepB) vaccines shows well-established safety and efficacy. However, because of risk factor–based approaches of previous vaccination recommendations, coverage among adults has been suboptimal.

What is added by this report?

In addition to groups for whom HepB vaccination is already recommended, the Advisory Committee on Immunization Practices recommends that all adults aged 19–59 years should receive HepB vaccines.

What are the implications for public health practice?

Universal adult HepB vaccination through age 59 years removes the need for risk factor screening and disclosure and could increase vaccination coverage and decrease hepatitis B cases.

already immune. Prevaccination testing consists of testing for HBsAg, antibody to HBsAg (anti-HBs), and antibody to hepatitis B core antigen (anti-HBc). The presence of HBsAg indicates current HBV infection. The presence of anti-HBs is generally interpreted as indicating immunity, either from HepB vaccination after a complete series or after recovery from HBV infection. The presence of total anti-HBc indicates previous or ongoing infection with HBV. Detailed interpretations of serologic markers for HBV infection are available (*2*). Lack of access to serologic testing should not be a barrier to vaccination of susceptible persons, especially in populations that are difficult to reach. Testing is not a requirement for vaccination, and in settings where testing is not feasible, vaccination of persons recommended to receive the vaccine should continue (*2*).

The safety and effectiveness of Heplisav-B and PreHevbrio have not been established in adults on hemodialysis (Table). Data are not available to assess the effects of Heplisav-B and PreHevbrio on the breastfed infant or on milk production and excretion. Data on Heplisav-B and PreHevbrio are currently insufficient to inform vaccine-associated risks in pregnancy (*8*,*15*). Thus, providers should vaccinate pregnant women needing HepB vaccination with Engerix-B, Recombivax HB, or Twinrix.

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Advisory Committee on Immunization Practices (ACIP)

Grace Lee, Lucile Packard Children's Hospital, Chair; Melinda Wharton, National Center for Immunization and Respiratory Diseases, CDC, Executive Secretary; Members: Kevin Ault,

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TABLE. Recommended doses and schedules of hepatitis B vaccine for adults aged ≥18 years and persons aged 11–19 years, by vaccine type and age group*

HepB vaccine*/Age group, yrs	Dose (μg)	Volume (mL)	Schedule
Recombivax HB			
11–15	10	1	2 doses at 0 and 4–6 mos†
11–19	5	0.5	3 doses at 0, 1, and 6 mos†
≥20	10	1	
Adults on hemodialysis and other immunocompromised adults aged ≥20	40	1	
Engerix-B			
11–19	10	0.5	3 doses at 0, 1, and 6 mos
≥20	20	1	
Adults on hemodialysis and other immunocompromised adults aged ≥20	40	2	4 doses at 0, 1, 2, and 6 mos§
Heplisav-B			
≥18¶	20	0.5	2 doses at 0 and 1 mos
Twinrix (HepA-HepB combination vaccine)			
≥18	20	1	3 doses at 0, 1, and 6 mos (standard) or 4 doses at 0 d, 7 d, 21–30 d, and 12 mos (accelerated)
PreHevbrio (ACIP-recommended in 2022)			
≥18¶	10	1	3 doses at 0, 1, and 6 mos

Abbreviations: ACIP = Advisory Committee on Immunization Practices; HepA = hepatitis A; HepB = hepatitis B.

* If the HepB vaccination schedule is interrupted, the series does not need to be restarted. If a 3-dose series is interrupted after the first dose, the second dose should be administered as soon as possible; the second and third doses should be separated by an interval of ≥8 weeks. If only the third dose has been delayed, it should be administered as soon as possible. The final dose of a 3-dose series must be administered ≥8 weeks after the second dose and ≥16 weeks after the first dose; the minimum interval between the first and second doses is 4 weeks. Inadequate doses of hepatitis B vaccine or doses received after a shorter-than-recommended dosing interval should be readministered, using the correct dosage or schedule. Vaccine doses administered ≤4 days before the minimum interval or age are considered valid. Because of the unique accelerated schedule for Twinrix (https://www.fda.gov/media/119351/download), the 4-day guideline does not apply to the first 3 doses of this vaccine when administered on a 0-day, 7-day, 21–30-day, and 12-month schedule. PreHevbrio (https://www.fda.gov/media/154561/download) is a three-antigen HepB vaccine approved by the Food and Drug Administration in 2021 and recommended by ACIP in 2022.

† A 2-dose schedule of Recombivax HB adult formulation (10 μg) (https://www.fda.gov/media/74274/download) is licensed for children and adolescents aged 11–15 years. When scheduled to receive the second dose, persons aged ≥16 years should be switched to a 3-dose series, with doses 2 and 3 consisting of the pediatric formulation administered on an appropriate schedule.

§ Engerix-B (https://www.fda.gov/media/119403/download) for adults on hemodialysis and is administered as a series of 4 doses (2 mL each) as a single 2-mL dose or as two 1-mL doses on a 0-, 1-, 2-, and 6-month schedule. Recombivax HB for adults on dialysis is a 3-dose series.

¶ The safety and effectiveness of Heplisav-B and PreHevbrio have not been established in adults on hemodialysis. Data are not available to assess the effects of Heplisav-B and PreHevbrio on breastfed infants or on maternal milk production and excretion. Data on Heplisav-B (https://www.fda.gov/media/108745/download) and PreHevbrio are currently insufficient to inform vaccine-associated risks in pregnancy. Thus, providers should vaccinate pregnant persons needing HepB vaccination with Engerix-B, Recombivax HB, or Twinrix.

ACIP Hepatitis Vaccines Work Group

Kevin Ault; Elizabeth Barnett; Sybil Cineas; Marci Drees; Susan Even; Darci Everett; Christine Finley; Robert Frenck; Sharon Frey; Prabhu Gounder; Kathleen Harriman; Brenna Hughes; Rajen Koshy; Susan Lett; Marian Major; Brian McMahon; Kelly Moore; David Nace; Pamela Rockwell; Jennifer Rosen; Ann Thomas; David Weber; Matthew Zahn; Jennifer Zipprich; CDC Lead: Mark K. Weng; Work Group Contributors: Erin E. Conners; Mona Doshani; Penina Haber; Megan Hofmeister; Neil Murthy; Noele P. Nelson; Lakshmi Panagiotakopoulos; Priti Patel; Philip Spradling; Carolyn Wester.

[1]Division of Viral Hepatitis, National Center for HIV, Viral Hepatitis, STD, and TB Prevention, CDC; [2]Saint Louis University School of Medicine, St. Louis, Missouri; [3]University of Kansas Medical Center, Kansas City, Kansas; [4]Immunize.org, Saint Paul, Minnesota; [5]School of Public Health, Oregon Health & Science University, Portland, Oregon; [6]Department of Health Research Methods, Evidence, and Impact, McMaster University, Hamilton, Ontario, Canada; [7]College of Medicine and Public Health, University of Arizona, Phoenix, Arizona.

Corresponding author: Mark K. Weng, mweng@cdc.gov, 404-718-5498.

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Assessment of Epidemiology Capacity in State Health Departments — United States, 2021

Jessica Arrazola, DrPH[1]; Sarah Auer, MPH[1]

In 2021, during the COVID-19 response, the Council of State and Territorial Epidemiologists (CSTE) conducted its seventh periodic Epidemiology Capacity Assessment (ECA), a national assessment that evaluates trends in applied epidemiology workforce size, funding, and epidemiology capacity at state health departments.* A standardized web-based questionnaire was sent to state epidemiologists in 50 states and the District of Columbia (DC). The questionnaire assessed the number of current and optimal epidemiologist positions; sources of epidemiology activity and personnel funding; and each health department's self-perceived capacity to lead activities, provide subject matter expertise, and obtain and manage resources for the three essential public health services (EPHS) most closely linked to epidemiology.† CSTE enumerated 4,136 epidemiology positions across the United States, with an additional 2,196 positions needed to provide basic public health services. From 2017 to 2021, the number of epidemiologists in state health departments increased 23%, an increase primarily accounted for by the number of those supporting the COVID-19 response§. The number of staff members decreased in program areas of infectious diseases, chronic diseases, and maternal and child health (MCH). Federal funding supports most epidemiology activities (85%) and epidemiology personnel (83%). Overall capacity to deliver the EPHS has declined, and epidemiology workforce and capacity needs remain unmet. More epidemiologists and sustainable funding are needed to consistently and effectively deliver EPHS. Additional resources (e.g., funding for competitive compensation and pathways for career advancement) are essential for recruitment and retention of epidemiologists to support public health activities across all program areas.

The ECA questionnaire instrument was updated in 2021 to include new epidemiology program areas for generalists and COVID-19 specialists and the revised EPHS (*1*). The COVID-19 program area sought to capture epidemiologists who were added for the COVID-19 response or reallocated for response efforts, separate from general infectious disease capacity. A set of core questions has remained essentially unchanged and permits monitoring of trends in the epidemiology workforce employed by the 50 states, DC, U.S. territories, and freely associated states, including current funding sources for epidemiology activities and personnel, capacity in the three EPHS relevant to epidemiology, and issues faced by health departments in recruitment, retention, and training of skilled epidemiologists to meet current needs and evolving priorities.

After CSTE pilot-tested the questionnaire instrument, the 2021 ECA was disseminated electronically to the lead state and territorial epidemiologist for each jurisdiction, using Qualtrics,¶ an online survey tool. Data collection began January 11, 2021, and was completed April 1, 2021. Virtual technical assistance was provided to support the completion of the ECA. All 50 states, DC, and four territories responded to the assessment; this analysis includes responses only from U.S. states and DC. The number of full-time equivalent (FTE) epidemiologist positions (rounded to the nearest 0.1 FTE) by program area and source of funding was collected. For purposes of the ECA, CSTE defined capacity as "the state health department's ability to lead activities, provide subject matter expertise, and apply for, receive, and manage resources to conduct key activities." Respondents subjectively evaluated their capacity** as none (0%), minimal (1%–24%), partial (25%–49%), substantial (50%–74%), almost full (75%–99%), and full (100%). Data were analyzed using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.††

* ECAs were conducted in 2001, 2004, 2006, 2009, 2013, and 2017, with supplementary workforce enumeration conducted in 2010. Since 2004, 100% of states and DC have responded to the assessment. When referring to state health departments, the ECA includes data from DC.

† The three EPHS capacities evaluated in the ECA were 1) assess and monitor population health status, factors that influence health, and community needs and assets (EPHS 1); 2) investigate, diagnose, and address health problems and hazards affecting the population (EPHS 2); and 3) improve and innovate public health functions through ongoing evaluation, research, and continuous quality improvement (EPHS 9).

§ Epidemiologists were defined in the ECA as "all those employed by the state; all those working at the state level who are either federal assignees (e.g., [Epidemic Intelligence Services officer], [Career Epidemiology Field officer], [Public Health Associate Program associate]) or contract employees (e.g., [Council of State and Territorial Epidemiologists] trainee, contracted from school of public health to work at or for the State Health Department); and state employees assigned to work at a local or regional level (e.g., to conduct investigations for a region of the state)" who should focus on the functions performed by the individual person rather than the job title, using as guidance the Applied Epidemiology Competencies.

¶ https://www.qualtrics.com/

** Capacity was defined in the ECA as "the state health department's ability to lead activities, provide subject matter expertise, and apply for, receive, and manage resources to conduct key activities."

†† 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

Respondents from 50 states and DC reported that 4,136 FTE epidemiologists were working in state health departments in 2021, a 23% increase over the 3,370 reported in 2017 (*2*). Overall, the number of epidemiologists per 100,000 population was 1.26 (range = 0.13–7.58), 21% higher than the 1.04 per 100,000 calculated in 2017. The size of the epidemiology workforce in each jurisdiction ranged from four to 255 FTEs.

Epidemiology activities in 2021 were supported in large part by federal funds (85%, an increase of 8% from 2017), followed by state funds (12%) and other sources (3%). As part of the federal funding for epidemiology activities, 39% was designated for COVID-19 activities with time-limited funding. The federal government funds 85% of epidemiology personnel positions, with 33% of these funds designated specifically for COVID-19 personnel. The remaining epidemiology personnel positions are funded by state government (15%) and other sources of funding (2%). Federal funding supports approximately 80% of epidemiology positions for COVID-19 response, preparedness, and substance use. In contrast, state and other sources of funding support approximately 50% of informatics, environmental health, generalist, and vital statistics positions.

Among program areas, infectious disease accounted for 1,498 (36%) of the 4,136 epidemiology positions, followed by COVID-19 response (24%) and MCH (7%) (Table 1). Program areas with the fewest epidemiologists included genomics, mental health, oral health, and occupational health. Most of the overall increase in workforce size can be attributed to new positions supporting the COVID-19 response.

The largest absolute and relative increases between 2017 and 2021 were in informatics, where 103 positions were added, representing a 107% increase (Table 2). Since 2017, infectious diseases positions decreased 19% (loss of 341 epidemiologists), chronic diseases decreased 18% (loss of 55 epidemiologists), and MCH decreased 9% (loss of 29 epidemiologists).

Participating state epidemiologists expressed the need for an additional 2,196 epidemiologists to deliver the EPHS, a 53% increase over the current number (Table 1). The largest number of positions needed were in infectious diseases (562), COVID-19 response (454), informatics (166), chronic diseases (153), MCH (135), and environmental health (135). The largest proportional increases needed were in genomics (922% increase, from five to 51), mental health (656% increase, from nine to 66), oral health (155% increase, from 20 to 52), and occupational health (143% increase, from 34 to 82). At the time of the assessment, among 852 position vacancies nationwide, 688 (81%) were being actively recruited. Filling these vacancies will address only 31% of the estimated additional 2,196 positions needed.

In 2021, 75% of jurisdictions had substantial-to-full capacity for monitoring health status (EPHS 1) and 88% capacity for diagnosing and investigating health problems and hazards (EPHS 2); both represented declines from 2017 (84% and

TABLE 1. Full-time equivalent epidemiologist positions, by program area — Council of State and Territorial Epidemiologists Epidemiology Capacity Assessment, United States, 2021

Program area	Current no. (%)	Additional positions needed	Optimal no.* (%)†	Vacant positions§	Positions actively recruiting, no. (% of vacant positions)¶
Infectious diseases	1,498 (36.2)	562	2,059 (72.7)	182	137 (75.2)
COVID-19 response	978 (23.7)	454	1,432 (68.3)	362	304 (83.9)
Maternal and child health	292 (7.1)	135	428 (68.3)	40	27 (67.5)
Chronic disease	250 (6.0)	153	402 (62.1)	40	30 (75.0)
Environmental health	231 (5.6)	135	366 (63.2)	18	13 (72.2)
Informatics	198 (4.8)	166	364 (54.4)	45	37 (82.2)
Preparedness	128 (3.1)	74	201 (63.4)	10	10 (100.0)
Injury	126 (3.0)	66	192 (65.8)	10	8 (80.0)
Vital statistics	117 (2.8)	62	179 (65.2)	13	10 (76.9)
Substance use	114 (2.8)	64	178 (64.2)	14	8 (57.1)
Generalist	81 (2.0)	85	166 (49.1)	7	3 (42.8)
Other	55 (1.3)	60	115 (48.1)	102	93 (91.1)
Occupational health	34 (0.8)	48	82 (41.2)	2	1 (50.0)
Oral health	20 (0.5)	31	52 (39.2)	2	0 (NA)
Mental health	9 (0.2)	57	66 (13.2)	2	2 (100.0)
Genomics**	5 (0.1)	46	51 (9.8)	3	5 (NA)
Total	**4,136**	**2,196**	**6,333 (65.3)**	**852**	**688 (80.8)**

Abbreviation: NA = not applicable.

* Positions currently filled plus additional positions needed.

† Positions currently filled as a percentage of the ideal number of positions.

§ Positions to be filled at a state health department for which work was available and the job could begin within 30 days.

¶ Vacant positions that human resource organizations were actively working to fill.

** The difference in the number of vacant positions and positions actively being recruited for this program area is likely because of new positions that are going to be created versus existing vacancies.

TABLE 2. Full-time equivalent epidemiologist positions and absolute and percent change, by program area during 2017 and 2021 — Council of State and Territorial Epidemiologists Epidemiology Capacity Assessment, United States, 2021

Program area	2017	2021	Change, no. (%)
Other*	143.4	55.2	−88.2 (−61.5)
Infectious diseases	1,838.2	1,497.7	−340.5 (−18.5)
Chronic disease	304.4	249.9	−54.5 (−17.9)
Maternal and child health	321.2	292.2	−29.0 (−9.0)
Environmental health	221.7	231.4	9.6 (4.3)
Vital statistics	110.7	116.7	6.0 (5.4)
Preparedness	117.6	127.5	9.9 (8.4)
Oral health	18.0	20.2	2.2 (12.2)
Genomics	4.4	5.0	0.6 (13.6)
Occupational health	28.4	33.8	5.4 (19.0)
Injury	102.5	126.1	23.6 (22.9)
Substance use	58.6	114.0	55.4 (94.6)
Informatics	95.7	198.4	102.7 (107.3)
Mental health	4.0	8.7	4.7 (117.5)
COVID-19 response†	NA	977.5	NA
Generalist†	NA	81.4	NA

Abbreviations: FTE = full-time equivalent; NA = not applicable.
* The other program area included FTEs from program areas including, but not limited to, health equity, community health, health disparities, refugee health, and minority health.
† COVID-19 response and generalist program areas were added to the 2021 Epidemiology Capacity Assessment to capture data for epidemiologists working on the COVID-19 response and epidemiologists working across a variety of program areas.

92%, respectively). Substantial-to-full capacity to conduct research and evaluation (EPHS 9) was 43%.[§§]

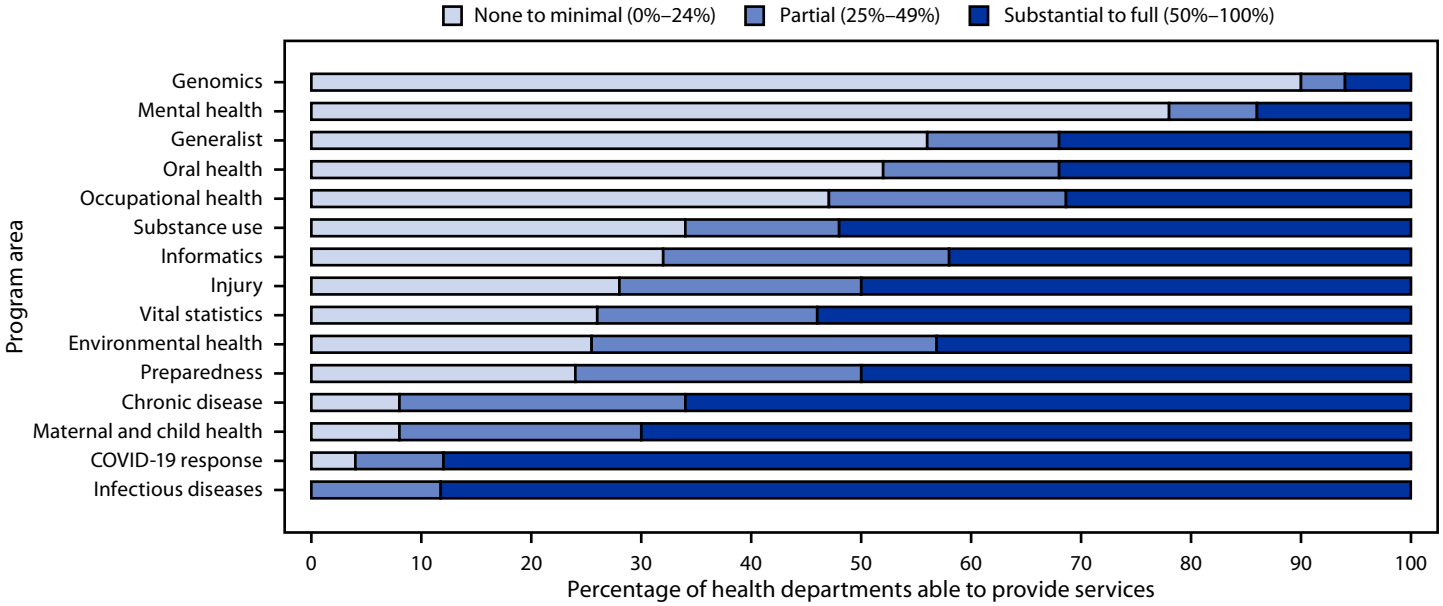
When overall capacity was examined by program area, substantial-to-full capacity was highest for infectious diseases (88%), MCH (70%), chronic diseases (66%), vital statistics (54%), substance use (52%), injury (50%), and preparedness (50%) (Figure). States reported minimal-to-no capacity in genomics (90%) and mental health (78%). Since 2017, there was a decline in the proportion of states reporting substantial-to-full capacity in preparedness (17%), chronic disease (12%), and infectious disease (8%). In contrast, there was an increase in the proportion of states reporting substantial-to-full capacity in the areas of substance use (36%), informatics (17%), mental health (12%), occupational health (10%), and oral health (10%).

Discussion

Despite achieving the largest applied epidemiology workforce since tracking began in 2001, reported decreases in

[§§] In 2017, 39% of states and DC had substantial capacity in EPHS 9, and 43% had substantial capacity in 2021; however, EPHS 9 now measures both research and evaluation, unlike in 2017 when these program areas were measured separately.

FIGURE. Overall epidemiologic capacity to provide essential public health services* — Council of State and Territorial Epidemiologists Epidemiology Capacity Assessment, United States, 2021



Abbreviations: ECA = Epidemiology Capacity Assessment; EPHS = essential public health service.
* The 2021 ECA measured EPHS 1 (assess and monitor population health status, factors that influence health, and community needs and assets), EPHS 2 (investigate, diagnose, and address health problems and hazards affecting the population), and EPHS 9 (improve and innovate public health functions through ongoing evaluation, research, and continuous quality improvement).

Summary

What is already known about this topic?

The COVID-19 response has strained the U.S. public health system. Although the state health department epidemiology workforce has increased since 2017, workforce and capacity needs remain unmet.

What is added by this report?

From 2017 to 2021, the number of epidemiologists in state health departments increased 23%, primarily because of those supporting the COVID-19 response. The epidemiology workforce remains substantially understaffed, and core program areas have experienced staffing declines. Temporary federal funding has increased to support 85% of epidemiology activities and 83% of personnel. Overall capacity to deliver essential public health services has declined.

What are the implications for public health practice?

More epidemiologists and sustainable resources are needed to deliver essential public health services consistently and effectively.

current staffing levels and an increased need for staff members by state health departments are concerning. Decreases in the number of staff members have important impacts on the ability of public health agencies to detect, investigate, and respond (*3*) to a myriad of critical threats, including infectious and chronic diseases and environmental hazards. Without accurate information about these conditions and the populations they affect, public health agencies cannot take appropriate actions to reduce or prevent illnesses, long-term sequelae, and death. The decline in the number of existing workers to support areas outside of COVID-19 is further compounded by the need for more skilled epidemiologists across all program areas. Limited staffing adversely affects public health workforce morale, mental health (*4*), and the ability to engage with and support non–COVID-19 priorities.

Despite the influx of COVID-19 epidemiologists, COVID-19 funding is short-term and unable to support staffing and programmatic capacity beyond 2026 (*5*). Across the country, COVID-19 funding supports an average of 33% (range = 0%–94%) of epidemiology personnel, leaving these positions vulnerable without sustainable funding. Jurisdictions need to develop strategies to integrate the temporary COVID-19 workforce into long-term positions and to invest in core capacity to address future emergencies and public health threats. Staffing strategies should consider positions with specialized and diverse skill sets, including epidemiologists, data scientists, laboratorians, and informaticians to support the data and systems infrastructure. Technologies such as genomic sequencing and electronic laboratory reports should be leveraged to support the development and use of data infrastructure supporting epidemiological investigation and response. Epidemiology leaders can demonstrate the value and utility of epidemiologists and epidemiology services across programs and the broader public health department. The growth of epidemiology infrastructure requires the integration of epidemiologists across programs and their budgets; provision of opportunities to learn and apply new skills among existing staff members, especially development of epidemiology leaders; creation of expedited hiring career pathways to retain temporary staff members, and incorporation of standard epidemiology job classifications and career ladders, such as those based on the Applied Epidemiology Competencies.¶¶

The findings in this report are subject to at least two limitations. First, the number of epidemiology positions is measured only for state health departments and does not include epidemiologists working in other state agencies (e.g., occupational health epidemiologists working in state departments of labor). Second, data on public health capacity are subjective; the data reflect the jurisdiction's needs at the time of fielding, which might be biased toward immediate priorities, such as the COVID-19 response, rather than toward routine public health activities and planned strategic priorities or the resources to support public health transformation.

The Coronavirus Aid, Relief, and Economic Security Act has authorized $500 million for public health data surveillance and analytics infrastructure modernization.*** The American Rescue Plan Act of 2021 authorized $7.66 billion for public health response activities including, but not limited to, workforce recruitment, hiring, retention, and training.††† These are essential investments to bolster public health infrastructure; however, this cannot be accomplished without long-term sustainable support that does not rely on temporary emergency public health funding. Transforming the public health infrastructure by harnessing the power of technology and building a permanent workforce capable to deliver EPHS in a post–COVID-19 era is critical.

¶¶ https://www.cste.org/group/CSTECDCAEC
*** https://www.congress.gov/bill/116th-congress/house-bill/748/text
††† https://www.congress.gov/bill/117th-congress/house-bill/1319/text#toc-H1858361F2D3F4367B9C0A3F11D488654

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Matthew Masiello, Council of State and Territorial Epidemiologists.

Corresponding author: Jessica Arrazola, jarrazola@cste.org, 770-458-3811.

[1]Council of State and Territorial Epidemiologists, Atlanta, Georgia.

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Use of At-Home COVID-19 Tests — United States, August 23, 2021–March 12, 2022

Benjamin Rader, MPH[1,2,*]; Autumn Gertz, MS[1,*]; A. Danielle Iuliano, PhD[3,*]; Matthew Gilmer, MS[3,4]; Laura Wronski, MS[5]; Christina M. Astley, MD, ScD[1,6,7]; Kara Sewalk, MPH[1]; Tanner J. Varrelman, PhD[1]; Jon Cohen, MA[5]; Rishika Parikh, MPH[3,8]; Heather E. Reese, PhD[3]; Carrie Reed, DSc[3]; John S. Brownstein, PhD[1,7]

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COVID-19 testing provides information regarding exposure and transmission risks, guides preventative measures (e.g., if and when to start and end isolation and quarantine), identifies opportunities for appropriate treatments, and helps assess disease prevalence (*1*). At-home rapid COVID-19 antigen tests (at-home tests) are a convenient and accessible alternative to laboratory-based diagnostic nucleic acid amplification tests (NAATs) for SARS-CoV-2, the virus that causes COVID-19 (*2–4*). With the emergence of the SARS-CoV-2 B.1.617.2 (Delta) and B.1.1.529 (Omicron) variants in 2021, demand for at-home tests increased† (*5*). At-home tests are commonly used for school- or employer-mandated testing and for confirmation of SARS-CoV-2 infection in a COVID-19–like illness or following exposure (*6*). Mandated COVID-19 reporting requirements omit at-home tests, and there are no standard processes for test takers or manufacturers to share results with appropriate health officials (*2*). Therefore, with increased COVID-19 at-home test use, laboratory-based reporting systems might increasingly underreport the actual incidence of infection. Data from a cross-sectional, nonprobability–based online survey (August 23, 2021–March 12, 2022) of U.S. adults aged ≥18 years were used to estimate self-reported at-home test use over time, and by demographic characteristics, geography, symptoms/syndromes, and reasons for testing. From the Delta-predominant period (August 23–December 11, 2021) to the Omicron-predominant period (December 19, 2021–March 12, 2022)§ (*7*), at-home test use among respondents with self-reported COVID-19–like illness¶ more than tripled from 5.7% to 20.1%. The two most commonly reported reasons for testing among persons who used an at-home test were COVID-19 exposure (39.4%) and COVID-19–like symptoms (28.9%). At-home test use differed by race (e.g., self-identified as White [5.9%] versus self-identified as Black [2.8%]), age (adults aged 30–39 years [6.4%] versus adults aged ≥75 years [3.6%]), household income (>$150,000 [9.5%] versus $50,000–$74,999 [4.7%]), education (postgraduate degree [8.4%] versus high school or less [3.5%]), and geography (New England division [9.6%] versus West South Central division [3.7%]). COVID-19 testing, including at-home tests, along with prevention measures, such as quarantine and isolation when warranted, wearing a well-fitted mask when recommended after a positive test or known exposure, and staying up to date with vaccination,** can help reduce the spread of COVID-19. Further, providing reliable and low-cost or free at-home test kits to underserved populations with otherwise limited access to COVID-19 testing could assist with continued prevention efforts.

Information regarding COVID-19 symptoms, testing practices, demographics, and geography were collected from an ongoing, prospective, nonprobability–based cross-sectional online survey†† among 418,279 U.S. adults aged ≥18 years during August 23, 2021–March 12, 2022. This previously validated (*8*) COVID-19 survey is a collaboration between the OutbreaksNearMe (a participatory surveillance system) team,§§ and Momentive, the developers of the online survey platform SurveyMonkey. Persons were invited at random to participate in the COVID-19 survey following completion of an unrelated survey on the SurveyMonkey platform, which has a diverse user base of approximately 2 million daily respondents¶¶ (*8*). Respondents at each unique Internet Protocol address (as a proxy for a unique household) could

* These authors contributed equally to this report.

† https://www.whitehouse.gov/briefing-room/press-briefings/2022/01/14/background-press-call-on-the-rollout-of-500-million-free-tests-to-american-homes/

§ Predominance defined as weeks when single variant represented >70% of sequenced specimens. Weeks in which no variant represented >70% of the sequenced specimens were not included in the Delta or Omicron variant periods. Delta-predominant period was defined as August 23–December 11, 2021. The proportions of sequenced viruses that were Delta during the week ending December 4 exceeded 99% and during the week ending December 11 was 92.5%. Omicron-predominant period was defined as December 19, 2021–March 12, 2022. The proportions of sequenced isolates that were Omicron late December 2021 to mid-January 2022 were as follows: week ending December 25 = 71.6%; January 1 = 92.3%; January 8 = 98.3%; and January 15 = 99.5%. Variant co-circulation was observed during the week ending December 18 (Delta = 62.1%, Omicron = 37.6%); therefore, this week was not classified as either Delta- or Omicron-predominant. https://covid.cdc.gov/covid-data-tracker/#variant-proportions

¶ COVID-19–like illness was defined as either cough, shortness of breath, gasping for air, or loss/change of taste/smell or two of the following: fever, chills, aches, headache, sore throat, nausea/vomiting, diarrhea, and fatigue. Syndromic case definitions, including COVID-19–like illness, were applied by researchers posthoc by mapping individually endorsed symptoms to syndromic case definitions. Respondents were included in multiple syndromic categories if their reported signs and symptoms met more than one case definition.

** https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html

†† Full survey is available at https://doi.org/10.6084/m9.figshare.13568648.v4 and the interactive version is available at https://www.surveymonkey.com/r/J8Y7HT7.

§§ https://outbreaksnearme.org/

¶¶ https://www.surveymonkey.com/mp/survey-methodology/

participate once. Respondents were not compensated or offered incentives. Survey data were weighted for age, race/ethnicity,*** sex, education, and geography††† using the U.S. Census Bureau's American Community Survey§§§ to approximate the demographic composition of U.S. adults (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/115598). Respondents with missing demographic information required to generate weights (e.g., age) (3,435; 0.8%) were excluded from analysis. Persons who reported symptoms¶¶¶ during the preceding 7 days were asked if they had been tested for COVID-19 in the preceding 30 days, and, if yes, the type of test used. Starting September 13, 2021, respondents who did not report symptoms were also asked if they had been tested for COVID-19 during the preceding 30 days and, if yes, the type of test used. Respondents could only report a single test and result. Respondents who reported a COVID-19 test were asked the reasons for testing and could select multiple reasons from nine options including "other." Descriptive analyses of the proportion and associated 95% CI**** of adults reporting at-home test use across self-reported demographic characteristics, geography, and Delta- and Omicron-predominant periods were conducted. Two subgroups were analyzed: 1) those with COVID-19–like illness, to assess symptomatic at-home test use and the symptoms associated with testing, and 2) those who used any diagnostic COVID-19 test, to compare at-home test use with tests administered in other settings. Finally, reasons for using at-home tests and other COVID-19 diagnostic tests were compared. R (version 3.6.2; R Foundation) was used to conduct analyses. This study was approved by the Boston Children's Hospital Institutional Review Board and received a waiver of informed consent.

Self-reported at-home test use increased during the study period (Figure). At-home test use peaked in January 2022, with 11.0% (95% CI = 10.7%–11.3%) of the surveyed population reporting at-home test use within the preceding 30 days compared with 2.0% (95% CI = 1.8%–2.1%) in October 2021 and 7.5% (95% CI = 7.1%–8.0%) in March 2022. Among persons with COVID-19–like illness, at-home test use increased from an average of 5.7% (95% CI = 5.2%–6.3%) during the Delta-predominant period to 20.1% (95% CI = 19.0%–21.2%) during the Omicron-predominant period.

Persons who identified as White were approximately twice as likely to report at-home test use (5.9%) compared with those who identified as Black (2.8%) (Table 1). Adults aged 30–39 years were more likely to report at-home test use (6.4%) than were those aged 18–29 years (5.1%) and ≥75 years (3.6%). At-home test use also increased with higher levels of household income and education. At-home test use was reported by a higher percentage of persons with annual U.S. household incomes >$150,000 (9.5%) compared with the $50,000–$74,999 (U.S. median household income) range (4.7%), as well as persons with a postgraduate degree (8.4%) compared to person with a high school degree or less (3.5%). By U.S. Census Division, respondents in the New England division reported the highest at-home test use over the study period (9.6%; 95% CI = 9.0%–10.1%), and those in the West South Central division reported the lowest use (3.7%; 95% CI = 3.5%–4.0%) (Supplementary Figure, https://stacks.cdc.gov/view/cdc/115600).

Among the surveyed population, the most common reported reasons for at-home test use were for risk assessments, such as COVID-19 exposure concerns (39.4%) and experiencing self-assessed COVID-19 symptoms (28.9%) (Table 2). Risk assessment was reported more often than were logistical or mandated testing reasons (e.g., required for work or school [10.6%] and before traveling [9.2%]). Among persons who were symptomatic, at-home test use was more likely among those whose symptoms were consistent with influenza-like illness (17.0%) than among those whose symptoms were consistent with the COVID-19–like illness case definition (12.2%) (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/115599).

Discussion

This analysis of data from a nonprobability–based sample of U.S. adults found that during August 23, 2021–March 12, 2022, adults increasingly used at-home tests to evaluate their COVID-19 status. At-home test use especially increased among those with COVID-19–like illness from the period of Delta (5.7%) to Omicron (20.1%) predominance; the latter period coincided with increased availability of at-home test kits and the winter holiday season. As COVID-19 prevalence started to decline in February 2022,†††† overall at-home test use also declined. However, among those who reported COVID-19 testing, including those with COVID-19–like illness, the proportion using at-home tests remained stable.

*** Persons self-identified race/ethnicity based on a list that included U.S. Census Bureau categories for race and Hispanic ethnicity. Options included category for other single race. Persons who selected multiple categories were considered multiracial. Persons that did not select Hispanic were assumed to be non-Hispanic.

††† U.S Census Bureau divisions: Division 1 (New England), Division 2 (Middle Atlantic), Division 3 (East North Central), Division 4 (West North Central), Division 5 (South Atlantic), Division 6 (East South Central), Division 7 (West South Central), Division 8 (Mountain), Division 9 (Pacific). https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

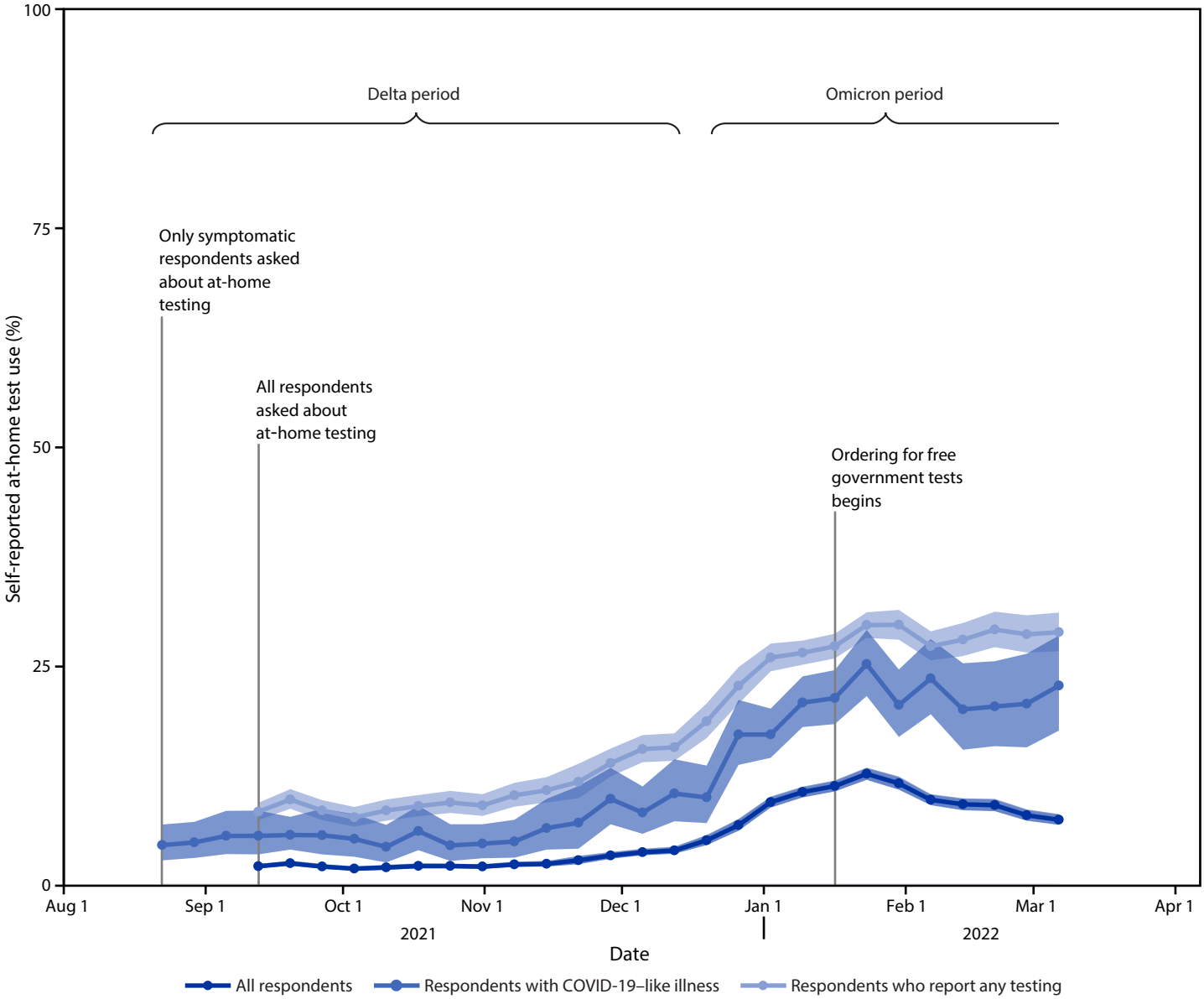
§§§ https://www.census.gov/programs-surveys/acs/data/summary-file.2019.html

¶¶¶ Influenza-like illness was defined as fever in addition to sore throat or cough. Syndromic case definitions, including influenza-like illness, were applied by researchers posthoc by mapping individually endorsed symptoms to syndromic case definitions. Respondents were included in multiple syndromic categories if their reported signs and symptoms met more than one case definition.

**** https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

†††† https://covid.cdc.gov/covid-data-tracker/#cases

FIGURE. Proportion* of adults aged ≥18 years who reported at-home rapid COVID-19 antigen test use during the preceding 30 days — United States, August 23, 2021–March 12, 2022†,§



* 95% CI indicated by shading.
† B.1.617.2 (Delta)-predominant period = August 23–December 11, 2021; B.1.1.529 (Omicron)-predominant period = December 19, 2021–March 12, 2022 (end of study period).
§ Data aggregated by epidemiologic week to reduce noise related to daily estimates. Data points for each week displayed on the first day of respective *MMWR* week.

This report found demographic differences in at-home test use. At-home test use was highest among persons who identified as White, adults aged 30–39 years, those with annual household incomes >$150,000, those with postgraduate degrees, and New England division residents. Observed differences might reflect the price point, marketing, education, or disparities in availability and accessibility of at-home tests. Equitable access to COVID-19 testing is important to reduce disease spread. In January 2022, the U.S. government began distributing free at-home tests,[§§§§] which, if complemented with outreach and communication, might help reduce disparities in COVID-19 testing by alleviating some supply and access barriers (*9*). Additional studies are needed to better understand challenges with testing access, including at-home tests, to develop interventions to reduce barriers and improve access.

[§§§§] https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/14/fact-sheet-the-biden-administration-to-begin-distributing-at-home-rapid-covid-19-tests-to-americans-for-free/

TABLE 1. Percentage of survey respondents reporting at-home rapid COVID-19 antigen test use in the preceding 30 days among a cross-section of adults (N = 359,399*) aged ≥18 years, by demographic and other characteristics† — United States, September 13, 2021–March 12, 2022

Characteristic	Reported at-home test use, % (95% CI)		
	All survey respondents§	Respondents reporting COVID-19 test¶	Respondents reporting COVID-19–like illness symptoms**
Race††			
American Indian or Alaska Native	3.3 (2.6–4.1)	10.0 (8.0–12.4)	7.8 (3.9–13.7)
Asian	4.7 (4.3–5.1)	18.3 (16.9–19.8)	15.3 (11.1–20.3)
Black or African American	2.8 (2.6–3.0)	8.8 (8.2– 9.3)	7.6 (5.9– 9.6)
Hispanic or Latino	4.5 (4.2–4.7)	14.1 (13.4–14.9)	13.9 (11.9–16.0)
Native Hawaiian or other Pacific Islander	3.5 (2.5–4.8)	11.2 (8.0–15.2)	8.0 (3.2–16.0)
White	5.9 (5.8–6.1)	22.8 (22.4–23.2)	13.6 (12.9–14.4)
Multiracial	5.4 (4.3–6.7)	17.9 (14.4–21.9)	20.1 (10.6–33.0)
Single other race	4.6 (4.1–5.2)	17.3 (15.5–19.3)	11.8 (8.2–16.2)
Gender†			
Female	5.4 (5.2–5.5)	19.2 (18.8–19.6)	12.8 (12.1–13.6)
Male	4.9 (4.8–5.1)	18.0 (17.5–18.5)	13.2 (11.9–14.5)
Transgender or nonbinary	6.5 (5.7–7.5)	21.3 (18.7–24.0)	17.7 (13.4–22.6)
Highest level of education†			
High school or less	3.5 (3.3–3.7)	13.0 (12.4–13.6)	9.7 (8.5–11.0)
Some college	4.8 (4.6–4.9)	17.3 (16.8–17.9)	11.5 (10.5–12.5)
College or more	7.2 (7.0–7.4)	25.7 (25.1–26.4)	18.8 (17.5–20.2)
Postgraduate degree	8.4 (8.1–8.6)	27.8 (27.2–28.5)	20.3 (18.7–21.9)
Age group, yrs†			
18–29	5.1 (4.9–5.4)	16.9 (16.1–17.7)	13.4 (11.6–15.3)
30–39	6.4 (6.1–6.6)	19.7 (19.0–20.5)	15.3 (13.8–16.9)
40–49	5.8 (5.6–6.0)	19.3 (18.6–20.0)	14.8 (13.4–16.3)
50–64	4.9 (4.8–5.1)	18.8 (18.3–19.3)	11.8 (10.8–12.9)
65–74	4.2 (4.0–4.4)	19.4 (18.5–20.2)	10.0 (8.5–11.7)
≥75	3.6 (3.2–3.9)	17.7 (16.1–19.3)	12.4 (8.9–16.6)
Annual household income†			
<$15,000	3.1 (2.9–3.4)	10.3 (9.6–11.1)	6.9 (5.6– 8.4)
$15,000–$29,999	3.4 (3.2–3.7)	12.2 (11.4–13.0)	7.2 (5.9– 8.6)
$30,000–$49,999	4.0 (3.8–4.2)	14.9 (14.1–15.7)	11.3 (9.7–12.9)
$50,000–$74,999	4.7 (4.5–5.0)	18.1 (17.3–18.9)	13.1 (11.5–14.9)
$75,000–$99,999	5.6 (5.3–5.8)	20.7 (19.7–21.6)	16.2 (14.2–18.4)
$100,000–$150,000	6.8 (6.5–7.0)	24.7 (23.8–25.6)	20.0 (17.9–22.2)
>$150,000	9.5 (9.2–9.8)	30.0 (29.2–30.9)	25.4 (23.0–27.9)
Did not respond	4.2 (3.9–4.5)	17.5 (16.3–18.8)	12.8 (10.0–16.2)
COVID-19 vaccination status†			
Unvaccinated	3.5 (3.3–3.7)	13.2 (12.5–13.8)	8.5 (7.3– 9.8)
Partially vaccinated	3.8 (3.5–4.1)	12.9 (12.0–13.9)	11.7 (9.5–14.1)
Fully vaccinated	4.1 (4.0–4.3)	15.7 (15.2–16.1)	11.8 (10.8–12.8)
Fully vaccinated plus booster dose	9.2 (9.0–9.5)	30.0 (29.4–30.6)	21.7 (20.2–23.2)
Did not respond	3.7 (3.0–4.6)	12.1 (9.7–14.9)	8.1 (3.6–15.3)
Essential worker†			
Yes	5.3 (5.2–5.5)	17.9 (17.5–18.4)	15.8 (14.6–16.9)
No	6.8 (6.6–7.0)	24.0 (23.4–24.7)	17.7 (16.2–19.3)
Did not respond	3.9 (3.8–4.1)	15.8 (15.3–16.4)	8.5 (7.6– 9.4)

* Respondent numbers do not match total for complete survey because the data in this table are restricted to September 13, 2021–March 12, 2022, the time frame when all respondents (not just those who reported being symptomatic) were asked to report their at-home test use.

† The Rao-Scott chi-square test was used to test differences in proportion of respondents that reported having used an at-home test separately, across each of seven categorical variables (i.e., race, gender, age group, income, education, vaccination status, and being an essential worker). Differences were evaluated within each of three subpopulations of interest (i.e., all respondents, those who reported a COVID-19 test, and those who reported COVID19–like illness). All chi-square tests were statistically significant at the Bonferroni corrected p-value threshold of 0.0024 (0.05 over 21 comparisons performed).

§ Percentage of respondents who used an at-home test among the entire population of survey respondents, which includes those who used at-home tests, those who used other types of COVID-19 tests, and those who did not test for COVID-19.

¶ Percentage of persons who reported at-home test use among the portion of the surveyed population that reported being tested for COVID-19 including those who used at-home tests and those who used other types of COVID-19 tests.

** Percentage of persons who used an at-home test among the portion of the surveyed population that reported symptoms that were consistent with COVID-19–like illness.

†† Persons self-identified race/ethnicity based on a list that included U.S. Census Bureau categories for race and Hispanic ethnicity. Persons who selected multiple categories were considered multiracial. Persons who did not select Hispanic were assumed to be non-Hispanic.

TABLE 2. Self-reported reasons for COVID-19 testing among adults aged ≥18 years who reported having received COVID-19 testing in the preceding 30 days, by test type — United States, September 13, 2021–March 12, 2022

Reported reason for testing*	% Reporting (95% CI)	
	Among those using at-home rapid COVID-19 antigen test (n = 18,578†)	Among those using other COVID-19 test (n = 80,851†)
Exposed to COVID-19	39.4 (38.5–40.3)	19.4 (19.0–19.7)
Had COVID-19 symptoms	28.9 (28.1–29.7)	16.7 (16.3–17.0)
Didn't feel well	28.6 (27.8–29.4)	7.0 (6.7–7.2)
To visit family	17.0 (16.4–17.7)	5.5 (5.3–5.7)
For work/school	10.6 (10.1–11.3)	17.4 (17.0–17.7)
Wanted to travel	9.2 (8.7–9.8)	23.2 (22.8–23.6)
Returning from travel	8.8 (8.3–9.3)	7.8 (7.5–8.0)
Doctor suggested	3.7 (3.4–4.2)	8.4 (8.2–8.7)
Surgery required testing	2.0 (1.7–2.3)	6.4 (6.2–6.6)
Other reported reason	10.3 (9.8–10.9)	13.0 (12.7–13.3)

* Additional response options were added after the question was first implemented on the survey. These response categories were not analyzed because of incomplete data for the study period.

† Eighteen respondents that reported using an at-home test and 86 respondents who reported using other COVID-19 tests did not select any reasons for testing and were excluded from these counts and respective column percentages.

Summary

What is already known about this topic?

At-home rapid COVID-19 antigen tests (at-home tests) have become widely available in the United States.

What is added by this report?

A rapid increase in U.S. at-home test use occurred between the SARS-CoV-2 Delta- and Omicron-predominant periods; at-home test use was lower among persons who self-identified as Black, were aged ≥75 years, had lower incomes, and had a high school level education or less. Commonly reported reasons for using at-home tests included exposure concerns and symptoms.

What are the implications for public health practice?

COVID-19 testing, including at-home tests, along with prevention measures such as quarantine and isolation when warranted, wearing a well-fitted mask when recommended after a positive test or known exposure, and staying up to date with vaccination can help reduce the spread of COVID-19. Providing reliable and low-cost or free at-home test kits to underserved populations with otherwise limited access to COVID-19 testing could assist with continued prevention efforts.

With variable access to timely, medically administered tests (e.g., NAATs), coupled with pandemic fatigue, U.S. residents might increasingly rely on at-home tests if such tests are readily available (*2*,*5*). These self-administered at-home tests have a high specificity and moderate sensitivity, which peaks during viral shedding and symptomatic illness. At-home tests can provide valuable information related to community infection incidence and prevalence, even among asymptomatic persons (*2*,*3*). Official COVID-19 surveillance systems aim to capture a comprehensive count of infections. Thus, measuring at-home test use can help quantify the proportion of SARS-CoV-2 infections that might be missed by these systems. These data can also be used to understand reasons for using at-home tests, which were different from those for using tests administered in other settings, and to adapt future surveillance priorities to prevent disease spread. Some manufacturers are providing users with an online process for voluntary reporting of test results to improve tracking of COVID-19 cases. However, implementation of consistent, simple at-home test reporting procedures from all manufacturers could help the continued monitoring of use trends, collect information on new infections, and assist in evaluating interventions (e.g., government test distribution).

The findings in this report are subject to at least seven limitations. First, the survey uses a nonprobability–based sample and the results might not be generalizable to the U.S. population. In addition, information on potential confounders was not collected. For example, information on household size or internet access were neither collected nor adjusted for in weighting. Second, the survey only includes U.S. adults aged ≥18 years. At-home testing patterns among children and adolescents might differ. Third, the survey queried respondents about at-home test use, which was assumed to be at-home rapid antigen tests, although there might be some misclassification given limited but available alternative at-home COVID-19 tests (e.g., concierge and mail-in NAATs). Fourth, the study assessed self-reported at-home test use and did not evaluate the drivers of at-home test use, such as secular trends in accessibility, supply, and ability to locate or afford at-home tests, which might explain observed changes in at-home test use (*10*). Fifth, respondents were asked to report on testing in the preceding 30 days and symptoms in the last 7 days. Those who completed a test in the preceding 30 days but before the appearance of symptoms would be misclassified as testing while symptomatic despite having tested while asymptomatic. Sixth, persons were limited to reporting one test. If persons confirmed the results of an at-home test with a NAAT, they might be more likely to report the latter, more recent one. Finally, respondents were asked to report on past experiences (e.g., testing in preceding 30 days), which might have included periods when a different variant was predominant.

Rapid, at-home diagnostic testing can provide convenient access to assessment of SARS-CoV-2 infection. An increase in U.S. at-home test use from the Delta- to the Omicron-predominant period was observed, with variable use among different demographic groups. Data on at-home test use can provide necessary information to form disease burden estimates. With greater population immunity from vaccines and previous infection, CDC recommends the use of COVID-19 Community Levels to monitor community burden, which include metrics for

disease severity and health care system strain.***** Staying up to date with vaccination; testing, including with at-home tests, for persons exposed or with symptoms of COVID-19; appropriate isolation and quarantine; and wearing a well-fitted mask when recommended after a positive test or known exposure are recommended at all COVID-19 Community Levels. Further, providing reliable and low-cost or free at-home test kits to underserved populations with otherwise limited access to COVID-19 testing could assist with continued prevention efforts.

***** https://www.cdc.gov/coronavirus/2019-ncov/science/community-levels.html

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Chris Remmel, Boston Children's Hospital; Jack Chen, Tim Gravelle, Momentive.

Corresponding author: John S. Brownstein, John.Brownstein@childrens.harvard.edu.

[1]Boston Children's Hospital, Boston, Massachusetts; [2]Boston University School of Public Health, Boston, Massachusetts; [3]CDC COVID-19 Emergency Response Team; [4]General Dynamics Information Technology, Atlanta, Georgia; [5]Momentive, San Mateo, California; [6]Broad Institute of Harvard and MIT, Cambridge, Massachusetts; [7]Harvard Medical School, Boston, Massachusetts; [8]Goldbelt C6, Chesapeake, Virginia.

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Effectiveness of Homologous and Heterologous COVID-19 Booster Doses Following 1 Ad.26.COV2.S (Janssen [Johnson & Johnson]) Vaccine Dose Against COVID-19–Associated Emergency Department and Urgent Care Encounters and Hospitalizations Among Adults — VISION Network, 10 States, December 2021–March 2022

Karthik Natarajan, PhD[1,2,*]; Namrata Prasad, PhD[3,4,*]; Kristin Dascomb, MD[5]; Stephanie A. Irving, MHS[6]; Duck-Hye Yang, PhD[7]; Manjusha Gaglani, MBBS[8,9]; Nicola P. Klein, MD[10]; Malini B. DeSilva, MD[11]; Toan C. Ong, PhD[12]; Shaun J. Grannis, MD[13,14]; Edward Stenehjem, MD[5]; Ruth Link-Gelles, PhD[3]; Elizabeth A. Rowley, DrPH[7]; Allison L. Naleway, PhD[6]; Jungmi Han[1]; Chandni Raiyani, MPH[8]; Gabriela Vazquez Benitez, PhD[11]; Suchitra Rao, MBBS[12]; Ned Lewis, MPH[10]; William F. Fadel, PhD[13,15]; Nancy Grisel, MPP[5]; Eric P. Griggs, MPH[3]; Margaret M. Dunne, MSc[7]; Melissa S. Stockwell, MD[2,16,17]; Mufaddal Mamawala, MBBS[8]; Charlene McEvoy, MD[11]; Michelle A. Barron, MD[12]; Kristin Goddard, MPH[10]; Nimish R. Valvi, DrPH[13]; Julie Arndorfer, MPH[5]; Palak Patel, MBBS[3]; Patrick K Mitchell, ScD[7]; Michael Smith[8]; Anupam B. Kharbanda, MD[18]; Bruce Fireman[10]; Peter J. Embi, MD[13,19]; Monica Dickerson[3]; Jonathan M. Davis, PhD[7]; Ousseny Zerbo, PhD[10]; Alexandra F. Dalton, PhD[3]; Mehiret H. Wondimu, MPH3; Eduardo Azziz-Baumgartner, MD[3]; Catherine H. Bozio, PhD[3]; Sue Reynolds, PhD[3]; Jill Ferdinands, PhD[3]; Jeremiah Williams, MPH[3]; Stephanie J. Schrag, DPhil[3]; Jennifer R. Verani, MD[3]; Sarah Ball, ScD[7]; Mark G. Thompson, PhD[3]; Brian E. Dixon, PhD[13,15]

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CDC recommends that all persons aged ≥18 years receive a single COVID-19 vaccine booster dose ≥2 months after receipt of an Ad.26.COV2.S (Janssen [Johnson & Johnson]) adenovirus vector-based primary series vaccine; a heterologous COVID-19 mRNA vaccine is preferred over a homologous (matching) Janssen vaccine for booster vaccination. This recommendation was made in light of the risks for rare but serious adverse events following receipt of a Janssen vaccine, including thrombosis with thrombocytopenia syndrome and Guillain-Barré syndrome[†] (*1*), and clinical trial data indicating similar or higher neutralizing antibody response following heterologous boosting compared with homologous boosting (*2*). Data on real-world vaccine effectiveness (VE) of different booster strategies following a primary Janssen vaccine dose are limited, particularly during the period of Omicron variant predominance. The VISION Network[§] determined real-world VE of 1 Janssen vaccine dose and 2 alternative booster dose strategies: 1) a homologous booster (i.e., 2 Janssen doses) and 2) a heterologous mRNA booster (i.e., 1 Janssen dose/1 mRNA dose). In addition, VE of these booster strategies was compared with VE of a homologous booster following mRNA primary series vaccination (i.e., 3 mRNA doses). The study examined 80,287 emergency department/urgent care (ED/UC) visits[¶] and 25,244 hospitalizations across 10 states during December 16, 2021–March 7, 2022, when Omicron was the predominant circulating variant.[**] VE against laboratory-confirmed COVID-19–associated ED/UC encounters was 24% after 1 Janssen dose, 54% after 2 Janssen doses, 79% after 1 Janssen/1 mRNA dose, and 83% after 3 mRNA doses. VE for the same vaccination strategies against laboratory-confirmed COVID-19–associated hospitalizations were 31%, 67%, 78%, and 90%, respectively. All booster strategies provided higher protection than a single Janssen dose against ED/UC visits and hospitalizations during Omicron variant predominance. Vaccination with 1 Janssen/1 mRNA dose provided higher protection than did 2 Janssen doses against COVID-19–associated ED/UC visits and was comparable to protection provided by 3 mRNA doses during

[*] These authors contributed equally to this report.

[†] On October 15, 2021, the Food and Drug Administration (FDA) authorized a single Janssen COVID-19 vaccine booster dose in persons aged ≥18 years who received a Janssen COVID-19 vaccine dose ≥2 months earlier. On October 20, 2021, FDA released an amendment allowing for heterologous boosting of all currently authorized COVID-19 vaccines (BNT162b2 [Pfizer-BioNTech], mRNA-1273 [Moderna], and Janssen) (https://www.fda.gov/media/153441/download). On October 21, 2021, CDC recommended that adults aged ≥18 years who received a Janssen COVID-19 vaccine should receive a single COVID-19 vaccine booster dose ≥2 months later (https://www.cdc.gov/media/releases/2021/p1021-covid-booster.html). On December 16, 2021, following an updated benefit-risk assessment which accounted for risks of thrombosis with thrombocytopenia syndrome and Guillain-Barré syndrome following receipt of a Janssen vaccine, CDC recommended preferential use of mRNA COVID-19 vaccines over the Janssen COVID-19 vaccine, for both primary and booster doses among adults aged ≥18 years (https://www.cdc.gov/media/releases/2021/s1216-covid-19-vaccines.html). Current COVID-19 vaccine booster dose recommendations are available at https://www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html.

[§] The VISION Network includes Baylor Scott & White Healthcare (Texas), Columbia University Irving Medical Center (New York), HealthPartners (Minnesota and Wisconsin), Intermountain Healthcare (Utah), Kaiser Permanente Northern California (California), Kaiser Permanente Northwest (Oregon and Washington), Regenstrief Institute (Indiana), and University of Colorado (Colorado).

[¶] ED data at Columbia University Irving Medical Center and HealthPartners exclude encounters that were transferred to an in-network hospital.

[**] Partners contributing data on medical events (and estimated dates of Omicron predominance) were in California (December 21), Colorado (December 19), Indiana (December 26), Minnesota and Wisconsin (December 25), New York (December 18), Oregon (December 24), Texas (December 16), Utah (December 24), and Washington (December 24).

the first 120 days after a booster dose. However, 3 mRNA doses provided higher protection against COVID-19–associated hospitalizations than did other booster strategies during the same time interval since booster dose. All adults who have received mRNA vaccines for their COVID-19 primary series vaccination should receive an mRNA booster dose when eligible. Adults who received a primary Janssen vaccine dose should preferentially receive a heterologous mRNA vaccine booster dose ≥2 months later, or a homologous Janssen vaccine booster dose if mRNA vaccine is contraindicated or unavailable. Further investigation of the durability of protection afforded by different booster strategies is warranted.

VISION Network methods have been previously published (*3*). Across 306 ED/UC clinics and 164 hospitals from 10 states, all medical encounters among adults aged ≥18 years with a COVID-19–like illness diagnosis[††] who had received molecular testing (primarily with reverse transcription–polymerase chain reaction) for SARS-CoV-2 during the 14 days before through 72 hours after the medical encounter were considered eligible. The study period began on the earliest day the Omicron variant accounted for ≥50% of sequenced isolates at each site based on state and national surveillance data (state range = December 16–26, 2021). Vaccination status was categorized based on number and type of vaccine doses received (1 Janssen dose, 2 Janssen doses, 1 Janssen/1 mRNA dose, and 3 mRNA doses[§§]). Patients with no record of vaccination were considered unvaccinated. Because a booster dose following a primary Janssen dose was recommended on October 15, 2021, to ensure accurate comparisons across booster strategies, patients vaccinated with a booster dose >120 days before the index date[¶¶] were excluded. In addition, patients were excluded if they 1) received only 1 or 2 primary mRNA vaccine doses or >3 mRNA vaccine doses, or received >2 mRNA doses following a primary Janssen dose; 2) received the first Janssen dose 1–13 days earlier or a booster dose 1–6 days earlier; or 3) received a booster dose following a primary Janssen dose earlier than the recommended interval (<2 months after dose 1) or an mRNA booster dose earlier than the recommended interval (<5 months after dose 2).[***]

Using a test-negative design, investigators estimated VE by comparing the odds of a positive SARS-CoV-2 test result between vaccinated and unvaccinated patients using multivariable logistic regression models (*3*,*4*). Models were adjusted using inverse propensity to be vaccinated weights (calculated separately for each VE estimate) and with age, calendar week of index date, geographic area, local virus circulation (percentage of SARS-CoV-2–positive results from testing within the counties surrounding the facility on the date of the encounter), patient comorbidities including immunocompromise[†††] (*4*), and factors not balanced by propensity to be vaccinated included as covariates.[§§§] A statistically significant difference was indicated by nonoverlapping 95% CIs or standardized mean or proportion differences ≥0.2, indicating nonnegligible difference in distributions of vaccination or infection status. All statistical analyses were conducted using R software (version 4.1.2; R Foundation). This study was reviewed and approved by the institutional review boards at participating sites or under a reliance agreement with the Westat, Inc. institutional review board.[¶¶¶]

The study included 80,287 encounters among patients with COVID-19–like illness seeking care at ED/UC facilities (Table 1); 64.8% were unvaccinated, 5.6% had received 1 Janssen dose, 0.6% had received 2 Janssen doses, 1.6% had received 1 Jansen/1 mRNA dose, and 27.4% had received 3 mRNA doses. Among booster strategies, the median interval between receipt of the most recent dose and the ED/UC encounter ranged from 49 to 59 days.

[††] COVID-19–like illness diagnoses included acute respiratory illness (e.g., COVID-19, respiratory failure, or pneumonia) or related signs or symptoms (e.g., cough, fever, dyspnea, vomiting, or diarrhea) using diagnosis codes from the *International Classification of Diseases, Ninth Revision* and *International Classification of Diseases, Tenth Revision*.

[§§] Both Pfizer-BioNTech and Moderna COVID-19 vaccines were included in mRNA vaccine categories. Among eligible ED/UC encounters and hospitalizations, among recipients of 1 Janssen/1 mRNA dose, 48% had received a Pfizer-BioNTech mRNA booster dose, and 52% had received a Moderna booster dose. Among recipients of 3 mRNA doses, 42% had received all Pfizer-BioNTech mRNA vaccines, 49% had received all Moderna vaccines, and 9% had received a mix of mRNA vaccine doses.

[¶¶] The index date for each medical visit was defined as either the date of collection of a respiratory specimen associated with the most recent positive or negative SARS-CoV-2 test result before the medical visit or the date of the medical visit (if testing occurred only after the admission or visit date).

[***] Among 84,813 eligible ED/UC encounters, 4,526 (5.3%) were removed based on these exclusion criteria. Among 27,308 eligible hospitalizations, 2,064 (7.6%) were removed. The third mentioned exclusion criterion would remove persons who were moderately or severely immunocompromised and had received a second mRNA dose 4 weeks after a primary Janssen vaccine dose or a third mRNA dose 4 weeks after a second dose as part of a primary mRNA series. https://www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html#vaccination-people-immunocompromised

[†††] Immunocompromising conditions were derived from lists used in previous studies of large hospital-based or administrative databases and included 1) solid malignancies, 2) hematologic malignancies, 3) rheumatologic or inflammatory disorders, 4) other intrinsic immune conditions or immunodeficiencies, and 5) organ or stem cell transplants.

[§§§] With a test-negative design, vaccine performance is assessed by comparing the odds of antecedent vaccination among case-patients with acute laboratory-confirmed COVID-19 and control-patients without acute laboratory-confirmed COVID-19. VE was calculated as [1 – odds ratio] x 100%. Generalized boosted regression trees were used to estimate the propensity to be vaccinated based on sociodemographic characteristics, underlying medical conditions, and patient and facility characteristics. Of the variables included in the propensity score, previous SARS-CoV-2 testing and test positivity were not balanced after applying inverse propensity weights and thus were added to covariates included in the adjusted VE model.

[¶¶¶] 45 C.F.R. part 46; 21 C.F.R. part 56.

Overall, VE against laboratory-confirmed COVID-19–associated ED/UC encounters was significantly higher among patients who had received any booster dose (range = 54%–83%) compared with those who had received only 1 Janssen dose (24%) (Table 2). Among booster strategies, VE against laboratory-confirmed COVID-19–associated ED/UC encounters was significantly higher among patients who had received 1 Janssen/1 mRNA (79%) or 3 mRNA doses (83%) than among patients who had received 2 Janssen doses (54%).

The study included 25,244 hospitalizations among patients with COVID-19–like illness (Table 3); 61.1% were unvaccinated, 5.7% had received 1 Janssen dose, 0.6% had received 2 Janssen doses, 1.5% had received 1 Janssen/1 mRNA dose, and 31.0% had received 3 mRNA doses. Among booster strategies, the median interval between receipt of the most recent dose and hospitalization ranged from 48 to 59 days.

Overall, VE against laboratory-confirmed COVID-19–associated hospitalization was significantly higher among patients who had received any booster dose (range = 67%–90%) compared with patients who had received 1 Janssen dose (31%) (Table 2). Among booster strategies, VE against hospitalizations was significantly higher among patients who had received 3 mRNA doses (90%). VE against hospitalizations was 78% after 1 Janssen/1 mRNA dose and 67% after 2 Janssen doses; however, CIs overlapped.

TABLE 1. Characteristics of emergency department and urgent care encounters among adults with COVID-19–like illness,* by COVID-19 vaccination status† and SARS-CoV-2 test result — 10 states, December 2021–March 2022§

Characteristic	Total no. (column %)	No. (row %)					SMD¶	No. (row %)	SMD¶
		Unvaccinated	1 Janssen dose (≥14 days)	2 Janssen doses (7–120 days)	1 Janssen/ 1 mRNA dose (7–120 days)	3 mRNA doses (7–120 days)		Positive SARS-CoV-2 test result	
All ED/UC events	**80,287 (100.0)**	**52,025 (64.8)**	**4,514 (5.6)**	**467 (0.6)**	**1,271 (1.6)**	**22,010 (27.4)**	—	**28,127 (35.0)**	—
Month and year									
Dec 2021	**17,474 (21.8)**	12,431 (71.1)	1,038 (5.9)	60 (0.3)	200 (1.1)	3,745 (21.4)	0.34	5,785 (33.1)	0.48
Jan 2022	**45,444 (56.6)**	30,812 (67.8)	2,620 (5.8)	242 (0.5)	654 (1.4)	11,116 (24.5)		19,358 (42.6)	
Feb 2022	**16,592 (20.7)**	8,625 (52.0)	806 (4.9)	157 (0.9)	384 (2.3)	6,620 (39.9)		2,953 (17.8)	
Mar 2022	**777 (1.0)**	157 (20.2)	50 (6.4)	8 (1.0)	33 (4.2)	529 (68.1)		31 (4.0)	
Site									
Baylor Scott & White Health	**22,536 (28.1)**	18,806 (83.4)	1,068 (4.7)	41 (0.2)	166 (0.7)	2,455 (10.9)	0.89	10,483 (46.5)	0.39
Columbia University**	**1,627 (2.0)**	1,201 (73.8)	70 (4.3)	8 (0.5)	20 (1.2)	328 (20.2)		453 (27.8)	
HealthPartners**	**404 (0.5)**	194 (48.0)	36 (8.9)	3 (0.7)	15 (3.7)	156 (38.6)		156 (38.6)	
Intermountain Healthcare	**18,469 (23.0)**	10,657 (57.7)	1,227 (6.6)	117 (0.6)	427 (2.3)	6,041 (32.7)		5,198 (28.1)	
Kaiser Permanente Northern California	**13,958 (17.4)**	4,366 (31.3)	970 (6.9)	192 (1.4)	387 (2.8)	8,043 (57.6)		3,200 (22.9)	
Kaiser Permanente Northwest	**5,448 (6.8)**	2,729 (50.1)	370 (6.8)	53 (1.0)	112 (2.1)	2,184 (40.1)		1,954 (35.9)	
Regenstrief Institute	**10,975 (13.7)**	8,443 (76.9)	500 (4.6)	42 (0.4)	117 (1.1)	1,873 (17.1)		3,954 (36.0)	
University of Colorado	**6,870 (8.6)**	5,629 (81.9)	273 (4.0)	11 (0.2)	27 (0.4)	930 (13.5)		2,729 (39.7)	
Age group, yrs									
18–44	**37,204 (46.3)**	29,740 (79.9)	1,836 (4.9)	68 (0.2)	373 (1.0)	5,187 (13.9)	0.69	14,290 (38.4)	0.2
45–64	**21,457 (26.7)**	12,951 (60.4)	1,623 (7.6)	207 (1.0)	543 (2.5)	6,133 (28.6)		7,752 (36.1)	
65–74	**10,047 (12.5)**	4,789 (47.7)	556 (5.5)	109 (1.1)	181 (1.8)	4,412 (43.9)		3,029 (30.1)	
75–84	**7,392 (9.2)**	3,064 (41.5)	332 (4.5)	61 (0.8)	113 (1.5)	3,822 (51.7)		2,088 (28.2)	
≥85	**4,187 (5.2)**	1,481 (35.4)	167 (4.0)	22 (0.5)	61 (1.5)	2,456 (58.7)		968 (23.1)	
Sex									
Male	**33,623 (41.9)**	22,216 (66.1)	2,032 (6.0)	206 (0.6)	519 (1.5)	8,650 (25.7)	0.05	12,313 (36.6)	0.06
Female	**46,644 (58.1)**	29,792 (63.9)	2,481 (5.3)	261 (0.6)	752 (1.6)	13,358 (28.6)		15,807 (33.9)	
Other/Unknown	**20 (—)**	17 (85.0)	1 (5.0)	0 (—)	0 (—)	2 (10.0)		7 (35.0)	
Race/Ethnicity									
White, non-Hispanic	**47,305 (58.9)**	28,998 (61.3)	2,890 (6.1)	276 (0.6)	795 (1.7)	14,346 (30.3)	0.29	14,814 (31.3)	0.23
Hispanic	**13,951 (17.4)**	9,836 (70.5)	661 (4.7)	77 (0.6)	215 (1.5)	3,162 (22.7)		5,544 (39.7)	
Black, non-Hispanic	**10,365 (12.9)**	8,185 (79.0)	517 (5.0)	49 (0.5)	117 (1.1)	1,497 (14.4)		4,623 (44.6)	
Other, non-Hispanic	**5,555 (6.9)**	2,738 (49.3)	285 (5.1)	55 (1.0)	107 (1.9)	2,370 (42.7)		1,769 (31.8)	
Unknown††	**3,111 (3.9)**	2,268 (72.9)	161 (5.2)	10 (0.3)	37 (1.2)	635 (20.4)		1,377 (44.3)	
Underlying respiratory condition at discharge§§									
Chronic respiratory condition	**13,761 (17.1)**	8,448 (61.4)	859 (6.2)	107 (0.8)	241 (1.8)	4,106 (29.8)	0.09	4,516 (32.8)	0.04
None	**66,526 (82.9)**	43,577 (65.5)	3,655 (5.5)	360 (0.5)	1,030 (1.5)	17,904 (26.9)		23,611 (35.5)	
Underlying nonrespiratory condition at discharge¶¶									
Chronic nonrespiratory condition	**22,917 (28.5)**	13,466 (58.8)	1,417 (6.2)	177 (0.8)	448 (2.0)	7,409 (32.3)	0.19	6,953 (30.3)	0.13
None	**57,370 (71.5)**	38,559 (67.2)	3,097 (5.4)	290 (0.5)	823 (1.4)	14,601 (25.5)		21,174 (36.9)	

See table footnotes on the next page.

TABLE 1. (*Continued*) Characteristics of emergency department and urgent care encounters among adults with COVID-19–like illness,* by COVID-19 vaccination status† and SARS-CoV-2 test result — 10 states, December 2021–March 2022§

Characteristic	Total no. (column %)	No. (row %)					SMD¶	No. (row %)	SMD¶
		Unvaccinated	1 Janssen dose (≥14 days)	2 Janssen doses (7–120 days)	1 Janssen/ 1 mRNA dose (7–120 days)	3 mRNA doses (7–120 days)		Positive SARS-CoV-2 test result	
Any likely immunocompromise status* **									
Yes	**3,399 (4.2)**	1,968 (57.9)	228 (6.7)	29 (0.9)	96 (2.8)	1,078 (31.7)	0.1	996 (29.3)	0.05
No	**76,888 (95.8)**	50,057 (65.1)	4,286 (5.6)	438 (0.6)	1,175 (1.5)	20,932 (27.2)		27,131 (35.3)	
No. of days from most recent dose to index date, median (IQR)	—	—	262 (196–293)	59 (34–80)	49 (29–70)	57 (35–77)	—	—	—

Abbreviations: ED = emergency department; ICD-9 = *International Classification of Diseases, Ninth Revision*; ICD-10 = *International Classification of Diseases, Tenth Revision*; SMD = standardized mean or proportion difference; UC = urgent care.

* Medical events with a discharge code consistent with COVID-19–like illness were included. COVID-19–like illness diagnoses included acute respiratory illness (e.g., COVID-19, respiratory failure, or pneumonia) or related signs or symptoms (e.g., cough, fever, dyspnea, vomiting, or diarrhea) using ICD-9 and ICD-10 diagnosis codes. Clinician-ordered molecular assays (e.g., real-time reverse transcription–polymerase chain reaction) for SARS-CoV-2 infection occurring ≤14 days before to <72 hours after admission were included.

† Vaccination status was categorized based on number and type of vaccine doses received before the medical event index date, which was the date of respiratory specimen collection associated with the most recent positive or negative SARS-CoV-2 test result before the medical event or the admission date if testing only occurred after admission. A primary Janssen vaccine dose was defined as 1 Janssen dose; a homologous booster dose following a primary Janssen dose was defined as 2 Janssen doses; a heterologous booster dose following a primary Janssen dose was defined as 1 Janssen/1 mRNA dose; a homologous booster dose following a primary mRNA series vaccination was defined as 3 mRNA doses.

§ Partners contributing data on medical events and estimated dates of Omicron variant predominance were in California (December 21), Colorado (December 19), Indiana (December 26), Minnesota and Wisconsin (December 25), New York (December 18), Oregon (December 24), Texas (December 16), Utah (December 24), and Washington (December 24).

¶ An absolute SMD ≥0.20 indicates a nonnegligible difference in variable distributions between medical events for vaccinated versus unvaccinated patients and for positive versus negative test results. When calculating SMDs for differences in characteristics across COVID-19 vaccination status, investigators calculated SMD as the average of the absolute value of the SMD for unvaccinated versus each vaccination status category individually (1 Janssen, 2 Janssen, 1 Janssen/1 mRNA, and 3 mRNA doses). All SMDs are reported as the absolute SMD.

** ED data at Columbia University Irving Medical Center and HealthPartners exclude encounters that were transferred to an in-network hospital.

†† Unknown race/ethnicity includes Asian, Native Hawaiian or other Pacific islander, American Indian or Alaska Native, other not listed, and multiple races.

§§ Underlying respiratory condition at discharge was defined as the presence of ICD-9 and ICD-10 discharge codes for asthma, chronic obstructive pulmonary disease, or other lung disease.

¶¶ Underlying nonrespiratory condition at discharge was defined as the presence of ICD-9 and ICD-10 discharge codes for heart failure, ischemic heart disease, hypertension, other heart disease, stroke, other cerebrovascular disease, diabetes type I or II, other diabetes, metabolic disease, clinical obesity, clinically underweight, renal disease, liver disease, blood disorder, immunosuppression, organ transplant, cancer, dementia, neurologic disorder, musculoskeletal disorder, or Down syndrome.

*** Immunocompromise status was defined as the presence of ICD-9 and ICD-10 discharge codes for solid malignancy, hematologic malignancy, rheumatologic or inflammatory disorder, other intrinsic immune condition or immunodeficiency, or organ or stem cell transplant.

Summary

What is already known about this topic?

Little is known about vaccine effectiveness (VE) of different booster strategies following Ad.26.COV2.S (Janssen [Johnson & Johnson]) vaccination, especially during Omicron variant predominance.

What is added by this report?

VE against COVID-19–associated emergency department/ urgent care visits was 24% after 1 Jansen dose, 54% after 2 Jansen doses, and 79% after 1 Janssen/1 mRNA dose, compared to 83% after 3 mRNA doses. VE for the same strategies against COVID-19–associated hospitalization was 31%, 67%, 78%, and 90% respectively.

What are the implications for public health practice?

All eligible persons should receive recommended COVID-19 booster doses to prevent moderate to severe COVID-19. Adult Janssen primary vaccine recipients should preferentially receive a heterologous mRNA vaccine booster dose ≥2 months later.

Discussion

In a multivariate analysis of 80,287 ED/UC encounters and 25,244 hospitalizations among adults with COVID-19–like illness during Omicron variant predominance, VE for all booster strategies against ED/UC encounters and hospitalizations were higher than VE after 1 Janssen dose. Against ED/UC visits, the VE of a 1 Janssen/1 mRNA booster strategy was higher than that of 2 Janssen doses (79% versus 54%) and provided similar protection to 3 mRNA doses (2 primary mRNA doses followed by a homologous booster dose) (83%). Against hospitalizations, VE following 3 mRNA doses (90%) was higher than that following 1 Janssen/1 mRNA dose (78%) or 2 Janssen doses (67%).

The finding that a 1 Janssen/1 mRNA booster strategy had higher effectiveness than 2 Janssen doses against ED/UC visits and provided similar protection to 3 mRNA doses is consistent with data from a cohort study among U.S. veterans that indicated higher protection from 1 Janssen/1 mRNA dose against

TABLE 2. Vaccine effectiveness* of 1 primary Janssen vaccine dose, homologous and heterologous boosters following primary Janssen vaccination, and 3 mRNA COVID-19 vaccine doses† against laboratory-confirmed COVID-19–associated emergency department and urgent care encounters and hospitalizations among adults aged ≥18 years§ — VISION Network, 10 states, December 2021–March 2022¶

Medical event, vaccination status (days since most recent dose)	Total	Positive SARS-CoV-2 result, no. (%)	VE %* (95% CI)
ED/UC events (N = 80,287)			
Unvaccinated (Ref)	**52,025**	23,560 (45.3)	Ref
1 Janssen dose ≥14 days earlier (median = 262 days [range = 196–293])	**4,514**	1,652 (36.6)	24 (18–29)
2 Janssen doses (7–120 days)	**467**	135 (28.9)	54 (43–63)
1 Janssen/1 mRNA dose (7–120 days)	**1,271**	166 (13.1)	79 (74–82)
3 mRNA doses (7–120 days)	**22,010**	2,614 (11.9)	83 (82–84)
Hospitalizations (N = 25,244)			
Unvaccinated (Ref)	**15,424**	7,271 (47.1)	Ref
1 Janssen dose ≥14 days earlier (median = 264 days [range = 199–294])	**1,451**	518 (35.7)	31 (21–40)
2 Janssen doses (7–120 days)	**164**	47 (28.7)	67 (52–77)
1 Janssen/1 mRNA dose (7–120 days)	**373**	59 (15.8)	78 (70–84)
3 mRNA doses (7–120 days)	**7,832**	775 (9.9)	90 (88–91)

Abbreviations: ED = emergency department; UC = urgent care; Ref = referent group; VE = vaccine effectiveness.

* VE was calculated as [1 − odds ratio] x 100%. Odds ratios were estimated using multivariable logistic regression. Models were adjusted using inverse propensity to be vaccinated (weights calculated separately for each VE estimate) and with age, calendar week of index date, geographic area, local virus circulation (percentage of SARS-CoV-2–positive results from testing within the counties surrounding the facility on the date of the encounter), patient comorbidities including immunocompromise, and factors not balanced by propensity to be vaccinated included as covariates. Of the variables included in the propensity score, previous SARS-CoV-2 testing and test positivity were not balanced after applying inverse propensity weights and thus were added to covariates included in the adjusted VE model.

† Vaccination status was categorized based on number and type of vaccine doses received before the medical event index date, which was the date of respiratory specimen collection associated with the most recent positive or negative SARS-CoV-2 test result before the medical event or the admission date if testing only occurred after admission. A primary Janssen dose was defined as 1 Janssen dose; a homologous booster dose following a primary Janssen dose was defined as 2 Janssen doses; a heterologous booster dose following a primary Janssen dose was defined as 1 Janssen/1 mRNA dose; a homologous booster dose following a primary mRNA series vaccination was defined as 3 mRNA doses.

§ Medical events with a discharge code consistent with COVID-19–like illness were included. COVID-19–like illness diagnoses included acute respiratory illness (e.g., COVID-19, respiratory failure, or pneumonia) or related signs or symptoms (e.g., cough, fever, dyspnea, vomiting, or diarrhea) using ICD-9 and ICD-10 diagnosis codes. Clinician-ordered molecular assays (e.g., real-time reverse transcription–polymerase chain reaction) for SARS-CoV-2 infection occurring ≤14 days before to <72 hours after admission were included.

¶ Partners contributing data on medical events and estimated dates of Omicron predominance were in California (December 21), Colorado (December 19), Indiana (December 26), Minnesota and Wisconsin (December 25), New York (December 18), Oregon (December 24), Texas (December 16), Utah (December 24), and Washington (December 24).

documented Omicron infection compared with 2 Janssen doses (*5*), as well as data from a recent test-negative design study that found both 1 Janssen/1 mRNA and 3 mRNA doses to have comparable effectiveness against symptomatic Omicron infection (CDC, unpublished data, 2022). This study adds to these findings by providing timely data on VE of different booster strategies against medically attended COVID-19–associated events from multiple health care systems and geographic regions of the U.S.

The findings in this report are subject to at least five limitations. First, among booster strategies, the median interval from receipt of most recent dose to medical event was 48–59 days and at most 120 days; thus, the observed effectiveness of these strategies is limited to a relatively short period after vaccination. Previous analysis within the VISION network identified waning of 3-mRNA–dose VE with increasing time since vaccination (*6*); continual investigations on the durability of protection provided by different booster strategies are warranted. Second, the small number of Janssen vaccine recipients reduced the precision of VE estimates across both primary series and booster strategy groups. The small number of recipients also precluded estimation of VE stratified by demographic factors including age and race, or assessment for potential effect modification due to underlying conditions, including immunocompromise; however, sensitivity analysis limited to immunocompetent persons found no significant change in results. Third, although adjustments to account for differences between unvaccinated and vaccinated persons were made, they did not account for differences among persons vaccinated with different strategies. In addition, residual bias might exist from misclassification or incomplete ascertainment of data on the presence of immunocompromise, other health conditions, vaccination status, and unmeasured behaviors (e.g., mask use and close contact with persons with COVID-19). Fourth, genetic characterization of viral variants causing infection among patients was not available, and analyses relied on dates when the Omicron variant became locally predominant based on surveillance data; therefore, the early phase of Omicron variant predominance in this study likely includes some medical encounters associated with the B.1.617.2 (Delta) variant. Finally, although the facilities in this study serve heterogeneous populations in 10 states, the findings might not be generalizable to the entire U.S. population.

TABLE 3. Characteristics of hospitalizations among adults with COVID-19–like illness,* by COVID-19 vaccination status† and SARS-CoV-2 test result — 10 states, December 2021– March 2022§

Characteristic	Total no. (column %)	No. (row %)						No. (row %)	
		Unvaccinated	1 Janssen dose (≥14 days)	2 Janssen doses (7–120 days)	1 Janssen/ 1 mRNA dose (7–120 days)	3 mRNA doses (7–120 days)	SMD¶	Positive SARS-CoV-2 test result	SMD¶
All hospitalizations	**25,244 (100.0)**	**15,424 (61.1)**	**1,451 (5.7)**	**164 (0.6)**	**373 (1.5)**	**7,832 (31.0)**	—	**8,670 (34.3)**	—
Month and year									
Dec 2021	**4,728 (18.7)**	3,048 (64.5)	308 (6.5)	29 (0.6)	46 (1.0)	1,297 (27.4)	0.21	1,370 (29.0)	0.41
Jan 2022	**15,067 (59.7)**	9,631 (63.9)	875 (5.8)	97 (0.6)	206 (1.4)	4,258 (28.3)		6,208 (41.2)	
Feb 2022	**5,438 (21.5)**	2,744 (50.5)	266 (4.9)	38 (0.7)	120 (2.2)	2,270 (41.7)		1,092 (20.1)	
Mar 2022	**11 (—)**	1 (9.1)	2 (18.2)	0 (—)	1 (9.1)	7 (63.6)		0 (—)	
Site									
Baylor Scott & White Health	**6,777 (26.8)**	5,198 (76.7)	390 (5.8)	15 (0.2)	77 (1.1)	1,097 (16.2)	0.77	2,523 (37.2)	0.18
Columbia University	**894 (3.5)**	579 (64.8)	65 (7.3)	8 (0.9)	16 (1.8)	226 (25.3)		354 (39.6)	
HealthPartners	**38 (0.2)**	9 (23.7)	5 (13.2)	0 (—)	1 (2.6)	23 (60.5)		9 (23.7)	
Intermountain Healthcare	**2,408 (9.5)**	1,288 (53.5)	133 (5.5)	20 (0.8)	57 (2.4)	910 (37.8)		730 (30.3)	
Kaiser Permanente Northern California	**5,460 (21.6)**	1,791 (32.8)	364 (6.7)	78 (1.4)	138 (2.5)	3,089 (56.6)		1,621 (29.7)	
Kaiser Permanente Northwest	**932 (3.7)**	522 (56.0)	59 (6.3)	11 (1.2)	23 (2.5)	317 (34.0)		264 (28.3)	
Regenstrief Institute	**6,272 (24.8)**	4,320 (68.9)	267 (4.3)	19 (0.3)	48 (0.8)	1,618 (25.8)		2,407 (38.4)	
University of Colorado	**2,463 (9.8)**	1,717 (69.7)	168 (6.8)	13 (0.5)	13 (0.5)	552 (22.4)		762 (30.9)	
Age group, yrs									
18–44	**3,976 (15.8)**	3,241 (81.5)	203 (5.1)	5 (0.1)	41 (1.0)	486 (12.2)	0.43	1,353 (34.0)	0.13
45–64	**7,334 (29.1)**	5,046 (68.8)	517 (7.0)	58 (0.8)	158 (2.2)	1,555 (21.2)		2,814 (38.4)	
65–74	**5,813 (23.0)**	3,268 (56.2)	347 (6.0)	49 (0.8)	78 (1.3)	2,071 (35.6)		1,967 (33.8)	
75–84	**4,971 (19.7)**	2,490 (50.1)	249 (5.0)	36 (0.7)	63 (1.3)	2,133 (42.9)		1,621 (32.6)	
≥85	**3,150 (12.5)**	1,379 (43.8)	135 (4.3)	16 (0.5)	33 (1.0)	1,587 (50.4)		915 (29.0)	
Sex									
Male	**12,521 (49.6)**	7,767 (62.0)	778 (6.2)	81 (0.6)	178 (1.4)	3,717 (29.7)	0.05	4,489 (35.9)	0.07
Female	**12,720 (50.4)**	7,655 (60.2)	673 (5.3)	83 (0.7)	195 (1.5)	4,114 (32.3)		4,180 (32.9)	
Other/Unknown	**3 (—)**	2 (66.7)	0 (—)	0 (—)	0 (—)	1 (33.3)		1 (33.3)	
Race/Ethnicity									
White, non-Hispanic	**15,834 (62.7)**	9,288 (58.7)	910 (5.7)	94 (0.6)	229 (1.4)	5,313 (33.6)	0.22	5,061 (32.0)	0.16
Hispanic	**3,311 (13.1)**	2,200 (66.4)	200 (6.0)	24 (0.7)	48 (1.4)	839 (25.3)		1,344 (40.6)	
Black, non-Hispanic	**3,305 (13.1)**	2,386 (72.2)	200 (6.1)	18 (0.5)	44 (1.3)	657 (19.9)		1,299 (39.3)	
Other, non-Hispanic	**1,841 (7.3)**	906 (49.2)	95 (5.2)	24 (1.3)	37 (2.0)	779 (42.3)		608 (33.0)	
Unknown**	**953 (3.8)**	644 (67.6)	46 (4.8)	4 (0.4)	15 (1.6)	244 (25.6)		358 (37.6)	
Underlying respiratory condition at discharge††									
Chronic respiratory condition	**14,842 (58.8)**	9,002 (60.7)	896 (6.0)	106 (0.7)	225 (1.5)	4,613 (31.1)	0.06	5,725 (38.6)	0.23
None	**10,402 (41.2)**	6,422 (61.7)	555 (5.3)	58 (0.6)	148 (1.4)	3,219 (30.9)		2,945 (28.3)	
Underlying nonrespiratory condition at discharge§§									
Chronic nonrespiratory condition	**22,131 (87.7)**	13,138 (59.4)	1,331 (6.0)	152 (0.7)	349 (1.6)	7,161 (32.4)	0.23	7,423 (33.5)	0.09
None	**3,113 (12.3)**	2,286 (73.4)	120 (3.9)	12 (0.4)	24 (0.8)	671 (21.6)		1,247 (40.1)	

See table footnotes on the next page.

These findings underscore the importance of receiving recommended COVID-19 booster doses, when eligible, to prevent moderate to severe COVID-19 during Omicron variant predominance. All adults who have received mRNA vaccines for their COVID-19 primary series vaccination should receive an mRNA booster dose when they are eligible. Adults who received a Janssen vaccine as their first dose should preferentially receive a heterologous mRNA vaccine booster dose ≥2 months later, or a homologous Janssen vaccine booster dose if mRNA vaccine is contraindicated or unavailable.

TABLE 3. (*Continued*) Characteristics of hospitalizations among adults with COVID-19–like illness,* by COVID-19 vaccination status† and SARS-CoV-2 test result — 10 states, December 2021– March 2022§

Characteristic	Total no. (column %)	No. (row %)						No. (row %)	
		Unvaccinated	1 Janssen dose (≥14 days)	2 Janssen doses (7–120 days)	1 Janssen/ 1 mRNA dose (7–120 days)	3 mRNA doses (7–120 days)	SMD¶	Positive SARS-CoV-2 test result	SMD¶
Any likely immunocompromise status¶¶									
Yes	**4,942 (19.6)**	2,636 (53.3)	330 (6.7)	40 (0.8)	103 (2.1)	1,833 (37.1)	0.18	1,346 (27.2)	0.16
No	**20,302 (80.4)**	12,788 (63.0)	1,121 (5.5)	124 (0.6)	270 (1.3)	5,999 (29.5)		7,324 (36.1)	
No. of days from most recent dose to index date, median (IQR)	—	—	264 (199–294)	52 (33–71)	48 (32–71)	59 (38–79)	—	—	—

Abbreviations: ICD-9 = *International Classification of Diseases, Ninth Revision*; ICD-10 = *International Classification of Diseases, Tenth Revision*; SMD = standardized mean or proportion difference.

* Medical events with a discharge code consistent with COVID-19–like illness were included. COVID-19–like illness diagnoses included acute respiratory illness (e.g., COVID-19, respiratory failure, or pneumonia) or related signs or symptoms (e.g., cough, fever, dyspnea, vomiting, or diarrhea) using ICD-9 and ICD-10 diagnosis codes. Clinician-ordered molecular assays (e.g., real-time reverse transcription–polymerase chain reaction) for SARS-CoV-2 infection occurring ≤14 days before to <72 hours after admission were included.

† Vaccination status was categorized based on number and type of vaccine dose received before the medical event index date, which was the date of respiratory specimen collection associated with the most recent positive or negative SARS-CoV-2 test result before the medical event or the admission date if testing only occurred after admission. A primary Janssen vaccine dose was defined as 1 Janssen dose; a homologous booster dose following a primary Janssen dose was defined as 2 Janssen doses; a heterologous booster dose following a primary Janssen dose was defined as 1 Janssen/1 mRNA dose; a homologous booster dose following a primary mRNA series vaccination was defined as 3 mRNA doses.

§ Partners contributing data on medical events and estimated dates of Omicron variant predominance were in California (December 21), Colorado (December 19), Indiana (December 26), Minnesota and Wisconsin (December 25), New York (December 18), Oregon (December 24), Texas (December 16), Utah (December 24), and Washington (December 24).

¶ An absolute SMD ≥0.20 indicates a nonnegligible difference in variable distributions between medical events for vaccinated versus unvaccinated patients and for positive versus negative test results. When calculating SMDs for differences in characteristics across COVID-19 vaccination status, investigators calculated the SMD as the average of the absolute value of the SMD for unvaccinated versus each vaccination status category individually (1 Janssen, 2 Janssen, 1 Janssen/1 mRNA, and 3 mRNA doses). All SMDs are reported as the absolute SMD.

** Unknown race/ethnicity includes Asian, Native Hawaiian or other Pacific islander, American Indian or Alaska Native, other not listed, and multiple races.

†† Underlying respiratory condition at discharge was defined as the presence of ICD-9 and ICD-10 discharge codes for asthma, chronic obstructive pulmonary disease, or other lung disease.

§§ Underlying nonrespiratory condition at discharge was defined as the presence of ICD-9 and ICD-10 discharge codes for heart failure, ischemic heart disease, hypertension, other heart disease, stroke, other cerebrovascular disease, diabetes type I or II, other diabetes, metabolic disease, clinical obesity, clinically underweight, renal disease, liver disease, blood disorder, immunosuppression, organ transplant, cancer, dementia, neurologic disorder, musculoskeletal disorder, or Down syndrome.

¶¶ Immunocompromise status was defined as the presence of ICD-9 and ICD-10 discharge codes for solid malignancy, hematologic malignancy, rheumatologic or inflammatory disorder, other intrinsic immune condition or immunodeficiency, or organ or stem cell transplant.

Corresponding author: Namrata Prasad, riz9@cdc.gov.

[1]Department of Biomedical Informatics, Columbia University Irving Medical Center, New York, New York; [2]NewYork-Presbyterian Hospital, New York, New York; [3]CDC COVID-19 Emergency Response Team; [4]Epidemic Intelligence Service, CDC; [5]Division of Infectious Diseases and Clinical Epidemiology, Intermountain Healthcare, Salt Lake City, Utah; [6]Center for Health Research, Kaiser Permanente Northwest, Portland, Oregon; [7]Westat, Rockville, Maryland; [8]Baylor Scott & White Health, Temple, Texas; [9]Texas A&M University College of Medicine, Temple, Texas; [10]Kaiser Permanente Vaccine Study Center, Kaiser Permanente Northern California Division of Research, Oakland, California; [11]HealthPartners Institute, Minneapolis, Minnesota; [12]School of Medicine, University of Colorado Anschutz Medical Campus, Aurora, Colorado; [13]Center for Biomedical Informatics, Regenstrief Institute, Indianapolis, Indiana; [14]Indiana University School of Medicine, Indianapolis, Indiana; [15]Fairbanks School of Public Health, Indiana University, Indianapolis, Indiana; [16]Division of Child and Adolescent Health, Department of Pediatrics, Columbia University Vagelos College of Physicians and Surgeons, New York, New York; [17]Department of Population and Family Health, Columbia University Mailman School of Public Health, New York, New York; [18]Children's Minnesota, Minneapolis, Minnesota; [19]Vanderbilt University Medical Center, Nashville, Tennessee.

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Notes From the Field

Xylazine-Related Deaths — Cook County, Illinois, 2017–2021

Neeraj Chhabra, MD[1,2]; Mojde Mir, MPH[3]; Miao Jenny Hua, MD, PhD[4,5]; Sarah Berg, MD[2]; Juleigh Nowinski-Konchak, MD[4,5,6]; Steve Aks, DO[1,2]; Ponni Arunkumar, MD[3]; Keiki Hinami, MD[6]

Xylazine, an alpha-2 receptor agonist, is used in veterinary medicine as a sedative and muscle relaxant; it is not approved for use in humans. However, reports of adulteration of illicit opioids with xylazine have been increasing in the United States (*1*–*3*). In humans, xylazine can cause respiratory depression, bradycardia, and hypotension (*4*). Typical doses of naloxone are not expected to reverse the effects of xylazine; therefore, persons who use xylazine-adulterated opioids are at high-risk for fatal overdose. Although some regions of the United States have reported increases in xylazine-involved deaths, xylazine was involved in <2% of overdose deaths nationally in 2019 (*2*,*5*). Most xylazine-involved deaths are associated with fentanyls, including fentanyl analogs (*1*,*5*). Cook County, Illinois, is the second largest county in the United States and has a high incidence of opioid-related deaths involving fentanyl (*6*). To determine temporal trends in xylazine-involved deaths in Cook County, the Cook County Medical Examiner's Office and Cook County Health analyzed suspected substance-related deaths from January 2017 to October 2021 for the presence of xylazine and co-occurring substances.

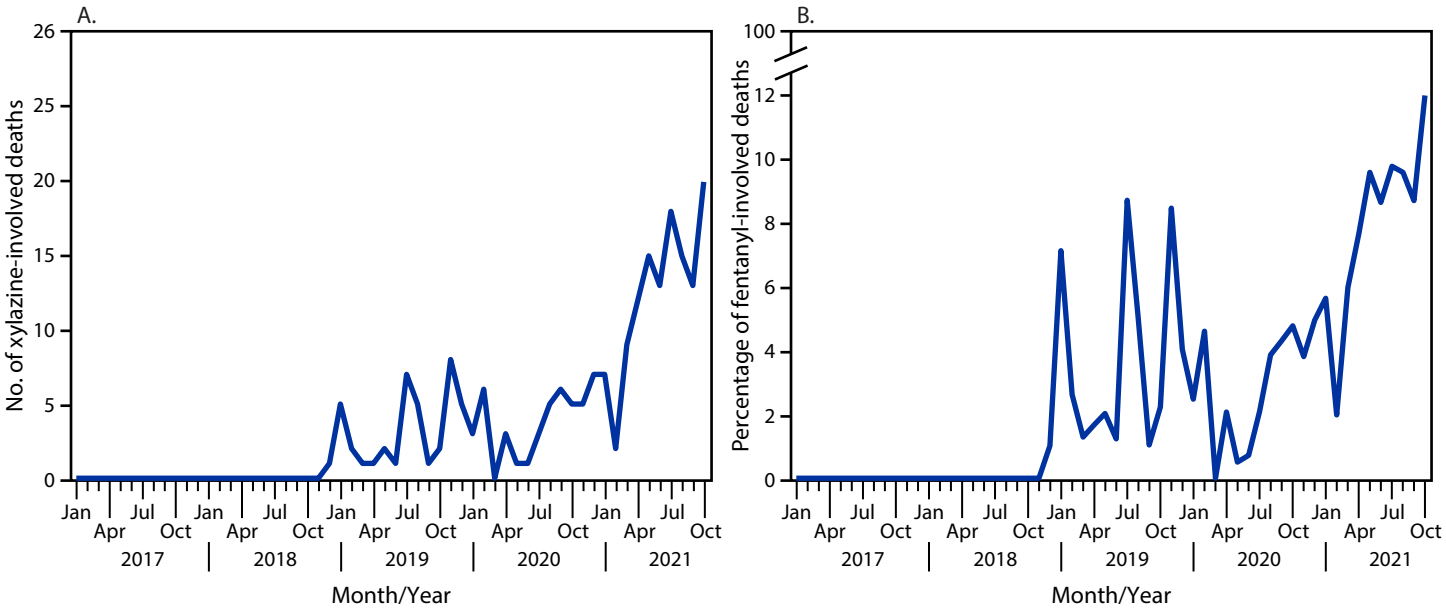
A xylazine-associated death was defined as a positive postmortem xylazine serum toxicology test result in an unintentional, undetermined, or pending intent substance-related death during January 2017–October 2021. Routine postmortem tests were conducted for other substances including fentanyl, fentanyl analogs, cocaine, and naloxone. Xylazine testing is standard in Cook County for suspected drug overdose deaths. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.*

A total of 210 xylazine-associated deaths were reported during the study period. Xylazine-associated deaths increased throughout the study period; incidence peaked during October 2021 (Figure). The percentage of fentanyl-associated deaths involving xylazine also increased throughout the study period, rising to a peak of 12.2% of fentanyl-related deaths assessed by the Cook County Medical Examiner's Office during October 2021. Fentanyl or fentanyl analogs were detected on forensic testing in most xylazine-involved deaths (99.1%). Other common co-occurring substances included diphenhydramine (78.1%), cocaine (41.9%), and quinine (33.8%). Naloxone was detected in 33.3% of xylazine-associated deaths.

These findings highlight a concerning trend in xylazine-involved deaths in Cook County, Illinois. Increased monitoring

* 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.

FIGURE. Number of xylazine-involved deaths (A) and percentage of fentanyl-involved deaths with detectable xylazine (B), by month — Cook County, Illinois, 2017–2021



and public education within Cook County are warranted along with expanded surveillance in other jurisdictions, particularly those in which fentanyl use is highly prevalent. These findings can be helpful in guiding overdose prevention and response efforts because naloxone has not been shown to reverse the effects of xylazine. Although a specific antidote is not available for xylazine, naloxone should still be administered in suspected cases of potentially fatal overdose because most cases co-occur with opioids. Cardiovascular and respiratory support are critical to the management of serious xylazine toxicity; health care providers should be made aware that cases of suspected fentanyl overdose that are refractory to naloxone administration might involve xylazine toxicity. Designation of xylazine as a controlled substance has occurred in some states and would be an important policy to be considered more broadly.[†] In addition, expanded postmortem testing for xylazine and co-occurring substances across jurisdictions could better define the role of xylazine in opioid-related deaths.

[†] https://www.nysenate.gov/newsroom/press-releases/terrence-murphy/slaying-monster-senate-passes-murphys-bill-designating

[1]Division of Medical Toxicology, Department of Emergency Medicine, Cook County Health, Chicago, Illinois; [2]Toxikon Consortium, Chicago, Illinois; [3]Cook County Medical Examiner's Office, Chicago, Illinois; [4]Department of Preventive Medicine, Cook County Health, Chicago, Illinois; [5]Feinberg School of Medicine, Northwestern University, Chicago Illinois; [6]Center for Health Equity and Innovation, Cook County Health, Chicago, Illinois.

Corresponding author: Neeraj Chhabra, Nchhabra@cookcountyhhs.org, 312-864-0065.

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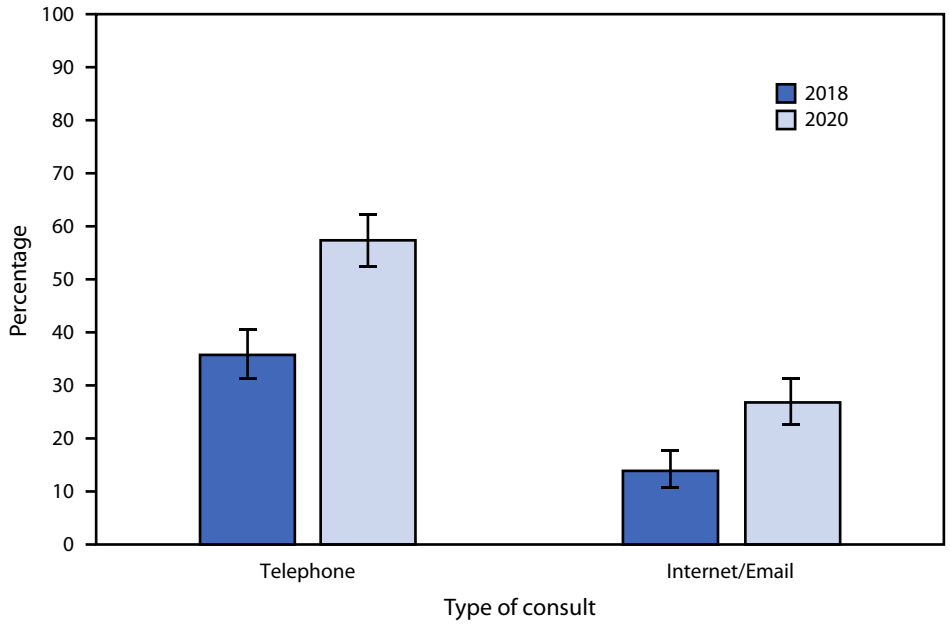
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Office-Based Physicians Who Had Telephone or Internet/Email Consults with Patients† — National Ambulatory Medical Care Survey, United States, 2018 and 2020§



* With 95% CIs indicated by error bars.
† Defined as the percentage of physicians who reported having at least one telephone consult or at least one Internet/email consult with patients, in response to the survey question, "During your last normal week of practice, about how many encounters of the following type did you make with patients: a) telephone consults?, b) Internet or email consults?"
§ Based on samples of nonfederally employed office-based physicians who were primarily engaged in direct patient care. Physicians in the specialties of anesthesiology, pathology, and radiology were excluded from the survey.

The percentage of office-based physicians who reported having telephone consults with patients during their last normal week of practice increased from 35.8% in 2018 to 57.4% in 2020. The percentage who reported having Internet/email consults with patients also increased from 13.9% in 2018 to 26.8% in 2020. In both years, physicians were more likely to report having telephone than Internet/email consults.

Source: National Center for Health Statistics, National Ambulatory Medical Care Survey, 2018 and 2020. https://www.cdc.gov/nchs/ahcd/ahcd_questionnaires.htm

Reported by: Zachary J. Peters, MPH, zpeters@cdc.gov, 301-458-4130; Susan Schappert, MA; Donald Cherry, MS.

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