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Influenza Activity and Composition of the 2022–23 Influenza Vaccine — United States, 2021–22 Season

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Before the emergence of SARS-CoV-2, the virus that causes COVID-19, influenza activity in the United States typically began to increase in the fall and peaked in February. During the 2021–22 season, influenza activity began to increase in November and remained elevated until mid-June, featuring two distinct waves, with A(H3N2) viruses predominating for the entire season. This report summarizes influenza activity during October 3, 2021–June 11, 2022, in the United States and describes the composition of the Northern Hemisphere 2022–23 influenza vaccine. Although influenza activity is decreasing and circulation during summer is typically low, remaining vigilant for influenza infections, performing testing for seasonal influenza viruses, and monitoring for novel influenza A virus infections are important. An outbreak of highly pathogenic avian influenza A(H5N1) is ongoing; health care providers and persons with exposure to sick or infected birds should remain vigilant for onset of symptoms consistent with influenza. Receiving a seasonal influenza vaccine each year remains the best way to protect against seasonal influenza and its potentially severe consequences.

The United States influenza surveillance system is a collaborative effort between CDC and its many partners in state, local, and territorial health departments, public health and clinical laboratories, vital statistics offices, health care providers, hospitals, clinics, emergency departments, and long-term care facilities. This report is a summary of the 2021–22 influenza season. This report was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[†]

Virus Surveillance

U.S. World Health Organization (WHO) collaborating laboratories and National Respiratory and Enteric Virus Surveillance System laboratories, which include both clinical and public health laboratories throughout the United States,

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

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

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contribute to virologic surveillance for influenza. Clinical laboratories tested 2,850,954 respiratory specimens using clinical diagnostic tests for influenza viruses. Among these, 128,302 (4.5%) specimens tested positive, including 126,477 (98.6%) for influenza A and 1,825 (1.4%) for influenza B. The percentage of specimens testing positive for influenza each week ranged from 0.1% to 9.9% (Figure 1). Public health laboratories tested 877,928 specimens and reported 24,432 (2.8%) positive specimens, with 24,306 (99.5%) positive for influenza A and 126 (0.5%) positive for influenza B viruses. Among 19,127 seasonal influenza A viruses that were subtyped, 25 (0.1%) were influenza A(H1N1)pdm09 viruses, and 19,102 (99.9%) were influenza A(H3N2) viruses. Influenza B lineage information was available for 41 (32.5%) influenza B viruses; 40 (97.6%) were B/Victoria lineage viruses, and one (2.4%) was a B/Yamagata lineage virus.[§] Influenza A(H3N2) was the predominant virus throughout the 2021–22 influenza season nationally and among all 10 U.S. Health and Human Services (HHS) regions.[¶] The percentage of specimens testing positive for influenza in clinical laboratories had two distinct waves in nine of the 10 HHS regions; region 8 (Mountain) experienced a single wave of influenza activity. These nine regions experienced a first wave that peaked in mid-December 2021. A second wave occurred later with peaks ranging from mid-March to May 2022. Regions 6 and 7 (Central and South Central, respectively) peaked in mid-March; regions 2, 3, and 5 (New York/New Jersey/Puerto Rico, mid-Atlantic, and Midwest, respectively) peaked in April 2022; and regions 1, 4, 8, 9, and 10 (New England, Southeast, Mountain, West Coast, and Pacific Northwest, respectively) peaked in May 2022. All 10 regions experienced the highest percentage of positive test results during the later time frame.

Among the A(H3N2) viruses with age data available, 10%, 51%, 28%, and 11% were reported from persons aged 0–4, 5–24, 25–64, and ≥65 years, respectively. The number of A(H1N1)pdm09, B/Victoria, and B/Yamagata viruses reported was too small to analyze by age group.

Novel Influenza A

Novel influenza viruses are influenza A virus subtypes that are different from currently circulating human seasonal influenza H1 and H3 viruses. During the 2021–22 influenza season, four novel influenza A viruses were detected in humans. Three were variant viruses (i.e., a swine influenza virus identified in a person and designated with a "v"); one A(H1N2)v virus was identified in a person in California, one A(H3N2)v in a person in Ohio, and one A(H1)v in a person in Oklahoma. One avian

[§] Additional specimens initially reported as positive for a B/Yamagata lineage virus were found to be associated with recent live attenuated influenza vaccine (LAIV) receipt or upon further testing were found to be a vaccine virus. The one B/Yamagata positive specimen in this report could not be tested further by CDC to determine if it was an LAIV virus.

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

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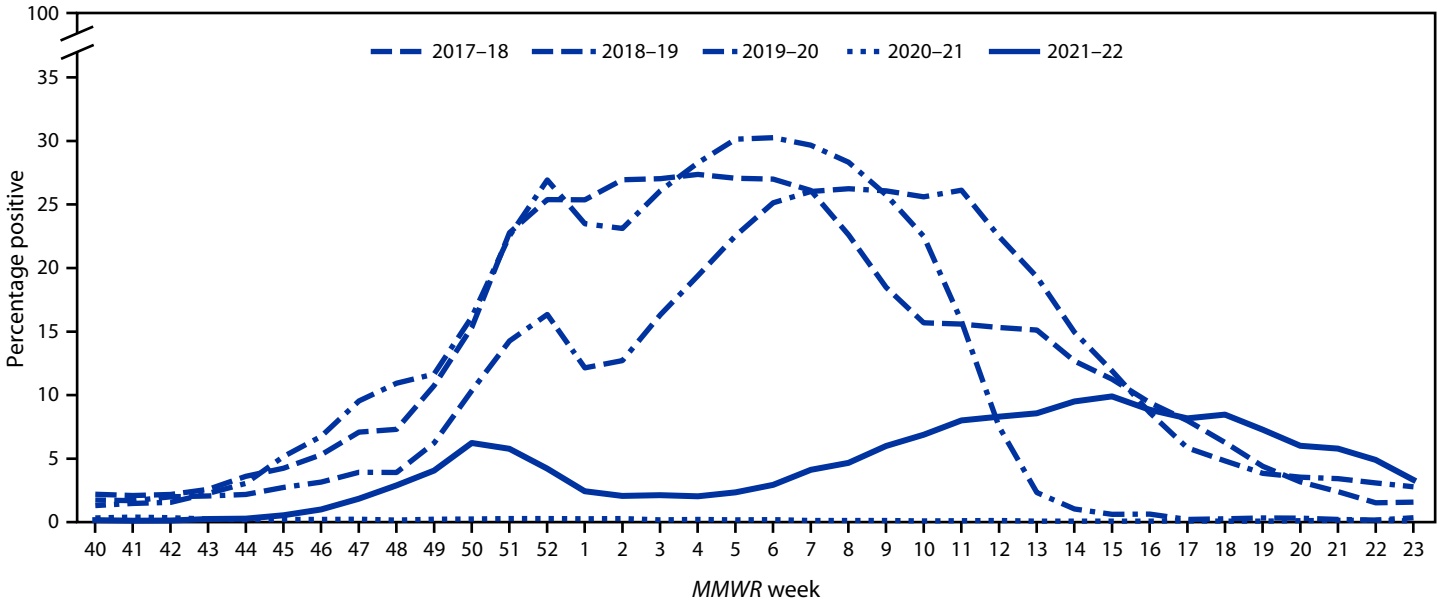
FIGURE 1. Influenza-positive test results reported by clinical laboratories to CDC, by *MMWR* week and influenza season — United States, October–June, 2017–18 to 2021–22



A(H5N1) virus was identified in a person in Colorado who was exposed to birds infected with highly pathogenic avian influenza A(H5N1). The A(H5N1) identification was the first positive test result for avian influenza A(H5) virus in a human in the United States (*1*).

Virus Characterization

Genetic characterization was carried out using next-generation sequencing, and the genomic data were analyzed and submitted to public databases (GenBank: https://www.ncbi.nlm.nih.gov/genbank/ or EpiFlu: https://www.gisaid.org/). Antigenic characterizations were conducted using hemagglutination inhibition assays or virus neutralization–based focus reduction assays to evaluate whether genetic changes in circulating viruses affected antigenicity; substantial differences could affect vaccine effectiveness. CDC genetically characterized 1,757 specimens (1,733 influenza A and 24 influenza B) collected in the United States during October 3, 2021–June 11, 2022, and antigenically characterized a subset of genetically characterized specimens (*2*). All 12 genetically characterized A(H1N1)pdm09 viruses belonged to the 6B.1A clade, with nine belonging to the 5a.1 subclade, and three belonging to the 5a.2 subclade. Of the five A(H1N1)pdm09 viruses antigenically characterized, two were well recognized by ferret antisera raised against cell-grown and egg-grown vaccine reference viruses. All 1,721 influenza A(H3N2) viruses genetically characterized belonged to the 3C.2a1b clade with 1,717 (99.7%) belonging to the 2a.2 subclade. Of the 129 A(H3N2) viruses antigenically characterized, five (3.9%) were well recognized by ferret antisera raised against cell-grown vaccine reference viruses, and 22 (17%) well recognized by ferret antisera raised against egg-grown vaccine reference viruses. Among the 24 influenza B/Victoria viruses that were tested, all belonged to the V1A clade, with 15 (62.5%) belonging to the V1A.3a.2 subclade and nine (37.5%) belonging to the V1A.3 subclade. Eleven (73%) of the 15 B/Victoria viruses antigenically characterized were well recognized by ferret antisera raised against cell-grown and egg-grown vaccine reference viruses.

CDC also analyzes influenza viruses for susceptibility to antivirals. A total of 1,782 viruses were genetically characterized for susceptibility to neuraminidase inhibitors, and a subset of 314 (19%) were tested phenotypically (*2*). All genetically characterized viruses were predicted to be susceptible to the neuraminidase inhibitors, except three A(H1N1)pdm09 viruses that had an NA-H275Y amino acid substitution, a marker of oseltamivir resistance. Among the viruses tested phenotypically, only three A(H1N1)pdm09 viruses that had an NA-H275Y amino acid substitution did not display normal inhibition by neuraminidase inhibitors. A total of 1,757 viruses were genetically characterized for susceptibility to the polymerase acidic (PA) cap-dependent endonuclease inhibitor baloxavir, and a subset of 535 (33%) were tested phenotypically (*2*). One A(H3N2) virus had a PA-I38M amino acid substitution, which conferred reduced baloxavir susceptibility, and all remaining tested viruses were susceptible to baloxavir.

Composition of the 2022–23 Influenza Vaccines

Vaccine strains for the 2022–23 influenza vaccines were selected by the Food and Drug Administration's Vaccines and Related Biologic Products Advisory Committee based on WHO's recommended Northern Hemisphere 2022–23 influenza vaccine composition. No changes were made to the A(H1N1)pdm09 or the B/Yamagata egg-based, cell-based, or recombinant vaccine recommended components. The recommended A(H3N2) component was changed to an A/Darwin/9/2021 (H3N2)–like virus for egg-based vaccines and an A/Darwin/6/2021 (H3N2)–like virus for cell-based or recombinant vaccines. The B/Victoria component recommendation was changed to a B/Austria/1359417/2021–like virus (*3*,*4*). The clade and subclade for the recommended vaccine strains were 6b.1A.5a.2 for A(H1N1)pdm09, 3C.2a1b.2a.2 for A(H3N2), V1A.3a.2 for B/Victoria, and Y3 for B/Yamagata.

Outpatient Illness Surveillance

Nationally, the weekly percentage of outpatient visits for respiratory illness that included fever plus a cough or sore throat, also referred to as influenza-like illness (ILI),** recorded in the U.S. Outpatient Influenza-like Illness Surveillance Network was at or above the national baseline†† (2.5%) for 8 consecutive weeks during December and January and peaked at 4.8% during the week ending January 1, 2022. This peak coincided with the rise in activity of SARS-CoV-2 related to the Omicron variant. ILI activity increased again from mid-February through mid-May, but stayed below baseline. Multiple respiratory viruses were cocirculating during both periods of increasing ILI activity, and the relative contribution of influenza virus infection to ILI varied by week and location.

Long-Term Care Facilities Surveillance

Reporting of influenza among residents of long-term care facilities§§ was added to the national influenza surveillance system for the 2021–22 season. The weekly percentage of facilities reporting at least one influenza-positive test result among residents ranged from 0.1% to 1.4%.

Influenza-Associated Hospitalizations

CDC has monitored hospitalizations associated with laboratory-confirmed influenza infections through the Influenza Hospitalization Surveillance Network (FluSurv-NET),¶¶ which covers approximately 9% of the U.S. population, for many years. During the 2021–22 influenza season, HHS Protect Hospitalization Surveillance,*** which consists of reports from all U.S. hospitals, was added to monitor severe illnesses requiring hospitalization in all 50 states, the District of Columbia, and U.S. territories. During October 1, 2021–June 11, 2022, a total of 5,079 laboratory-confirmed influenza-related hospitalizations were reported by FluSurv-NET sites. Activity occurred in two waves, with hospitalization rates first peaking nationally during the week ending January 1, 2022 (week 52) at 0.9 per 100,000 population and the second, slightly higher peak, during the week ending April 30, 2022 (week 17) at 1.2 per 100,000 population (Figure 2).

The overall cumulative hospitalization rate was 17.3 per 100,000 population, with the highest rate among adults aged ≥65 years (50.0), followed by children aged 0–4 years (21.9), adults aged 50–64 years (16.0), children and adolescents aged 5–17 years (9.0), and was lowest among adults aged 18–49 years (9.1). Most (96.7%) influenza-related hospitalizations were associated with influenza A viruses (98.8% of those subtyped were A[H3N2] viruses). Among patients with information about underlying conditions, 93.3% of adults and 64.8% of children and adolescents reported at least one underlying medical condition.

A total of 62,300 influenza-associated hospitalizations were reported to HHS Protect Hospitalization Surveillance during two waves of activity; the total cumulative rate was 19.0 per 100,000 population. Similar to FluSurv-NET–reported activity, nationwide, the first wave of admissions peaked during late December (week ending January 1, 2022), and the second, higher peak, occurred during mid-April (week ending April 23, 2022). Regionally, the timing of the second wave peak varied; regions 6 and 7 (Central and South Central, respectively) peaked in mid-March, regions 2, 3, and 5 (New York/New Jersey/Puerto Rico, Mid-Atlantic, and Midwest, respectively) peaked in April, regions 1, 8, 9, and 10 (New England, Mountain, West Coast, and Pacific Northwest, respectively) peaked in May, and region 4 (Southeast) peaked in early June.

** ILI is defined as fever (temperature of 100°F [37.8°C] or higher), cough, or sore throat. The case definition no longer includes "without a known cause other than influenza."

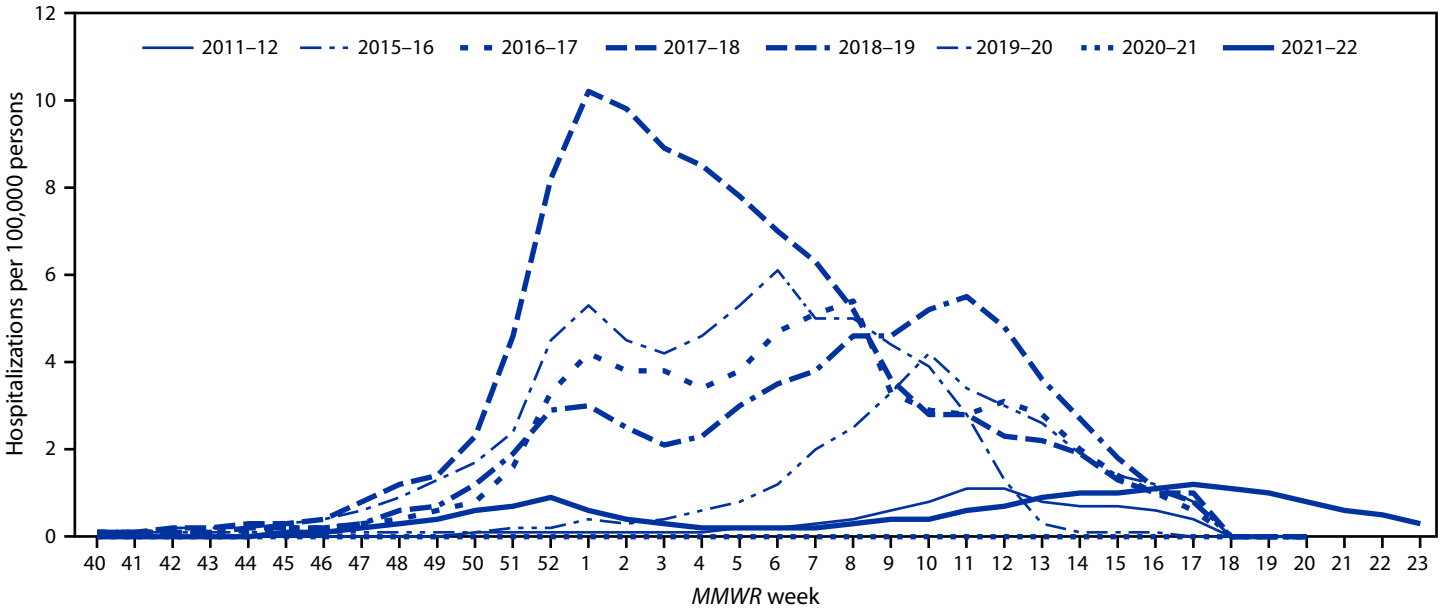
†† https://www.cdc.gov/flu/weekly/overview.htm#anchor_1539281266932

§§ https://www.cdc.gov/flu/weekly/overview.htm#anchor_1633698456778

¶¶ FluSurv-NET conducts population-based surveillance for hospitalizations in children and adolescents aged <18 years (since the 2003–04 influenza season) and adults aged ≥18 years (since the 2005–06 influenza season) associated with laboratory-confirmed influenza. FluSurv-NET covers approximately 70 counties in the 10 Emerging Infections Program states (California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, Oregon, and Tennessee) and four Influenza Hospitalization Surveillance Project states (Iowa, Michigan, Ohio, and Utah) and represents approximately 9% of the U.S. population. https://www.cdc.gov/flu/weekly/influenza-hospitalization-surveillance.htm

*** https://www.cdc.gov/flu/weekly/overview.htm#anchor_1634240269291

FIGURE 2. Weekly rate* of hospitalizations among patients of all ages with laboratory-confirmed influenza — United States, October–June, 2011–12 and 2015–16 to 2021–22



* Weekly rates for all seasons before the 2021–22 season reflect end-of-season rates. For the 2021–22 season, rates for recent hospital admissions are subject to reporting delays. As hospitalization data are received each week, case counts and rates are updated accordingly. Because of late season activity during the 2021–22 season, the Influenza Hospitalization Surveillance Network has extended surveillance beyond the typical end date of April 30 (*MMWR* week 17).

Influenza Mortality

According to the National Center for Health Statistics Mortality Surveillance System, the weekly percentage of deaths due to pneumonia, influenza, or COVID-19 remained above the epidemic threshold††† during the entire 2021–22 season. Among the 387,112 deaths due to pneumonia, influenza, or COVID-19 reported during 2021–22, a total of 277,350 (71.6%) death certificates listed COVID-19 as an underlying or contributing cause of death, and 2,493 (0.6%) listed influenza, indicating that pneumonia, influenza, or COVID-19–associated mortality during 2021–22 was due primarily to COVID-19 and not influenza.

CDC monitors pediatric influenza-associated deaths through the Influenza-Associated Pediatric Mortality Surveillance System. During October 3, 2021–June 11, 2022, a total of 31 laboratory-confirmed influenza-associated pediatric deaths were reported to CDC; all were associated with an influenza A virus infection, and all of the 13 influenza A viruses with subtyping information were A(H3N2) viruses. The mean age was 6 years (range = 2 months–16 years), and 21 (67.7%) children and adolescents died after hospital admission. Among the 29 children and adolescents with a known medical history, 19 (65.5%) had at least one underlying medical condition associated with increased risk for influenza-related complications.

Preliminary Estimates of Influenza Burden

CDC uses the cumulative rates of influenza-associated hospitalizations reported through FluSurv-NET and a mathematical model to estimate the number of persons who have symptomatic influenza illness and who had a medical visit or were hospitalized for or died from influenza (*5*). Using data available during October 1, 2021–June 11, 2022, CDC estimates that influenza virus infection resulted in 8.0–13.0 million symptomatic illnesses, 3.7–6.1 million medical visits, 82,000–170,000 hospitalizations, and 5,000–14,000 deaths in the United States.

Discussion

Since SARS-CoV-2 emerged in the United States in early 2020, influenza activity has been lower than that seen before the pandemic. The adoption of COVID-19–related mitigation measures might have had an impact on the timing or severity of influenza activity. Compared with prepandemic influenza seasons, the 2021–22 influenza season was mild and occurred in two waves, with the second wave having a higher percentage of positive clinical laboratory test results and a higher number

††† The seasonal baseline proportion of pneumonia and influenza deaths is projected using a robust regression procedure, in which a periodic regression model is applied to the observed percentage of deaths from pneumonia, influenza, or COVID-19 that were reported by the National Center for Health Statistics Mortality Surveillance System during the 5 years before the COVID-19 pandemic. The epidemic threshold is set at 1.645 SDs above the seasonal baseline.

of hospitalizations than did the first. Influenza activity peaked later and remained at higher levels than had been reported in previous seasons in late April, May, and early June. During the 2021–22 season, peak percentage of positive influenza test results from clinical laboratories was the lowest in at least 25 years preceding the COVID-19 pandemic, and the cumulative rate of influenza-associated hospitalizations was lower than that in all but the 2011–12 season, the mildest influenza season during the 10 years before the COVID-19 pandemic. The estimate of symptomatic illnesses, medical visits, hospitalizations, and deaths caused by influenza virus infection in the United States during the 2021–22 season is also lower than estimates for any of the 10 influenza seasons preceding the pandemic. The lower level of influenza activity is not because of a decrease in testing for influenza; clinical laboratories reporting to CDC tested ≥1 million more specimens, and public health laboratories tested at least seven times as many specimens during the 2021–22 season than in any of the five seasons preceding the pandemic (2015–16 season to 2019–20 season).

The first wave of influenza activity during the 2021–22 season peaked in mid-December throughout the country, but the timing of peak activity during the second wave varied by region, ranging from mid-March to May. Notably, the second wave peaked and influenza activity remained elevated nationally later than in any previous seasonal influenza epidemic. The predominant influenza virus throughout both waves was influenza A(H3N2) virus. Most of these viruses belonged to the 3C.2a1b.2a.2 subclade and were antigenically distinct from the reference viruses representing the egg-grown and cell-grown A(H3N2) vaccine components for the 2021–22 Northern Hemisphere influenza vaccines; however, based on preliminary vaccine effectiveness estimates, persons who were vaccinated during the 2021–22 season reduced their risk for influenza illness by approximately one third.[§§§] The recommended A(H3N2) component for the 2022–23 influenza vaccine was updated to one that belongs to the 3C.2a1b.2a.2 subclade, the subclade that predominated in the United States during the 2021–22 season. All the influenza viruses collected and tested for antiviral resistance by CDC since October 3, 2022, were susceptible to zanamivir, and the majority (>99%) were susceptible to baloxavir, oseltamivir, and peramivir.

Despite decreasing influenza activity in recent weeks, maintaining vigilance for influenza virus infections throughout the summer is important. Sporadic seasonal influenza virus infections and novel influenza A virus infections associated with exposure to swine during animal exhibitions are often reported during summer months (*6*). In addition, an ongoing outbreak of highly pathogenic avian influenza A(H5N1) virus among birds during the 2021–22 season underscores the importance that providers and persons with exposure to sick or infected birds remain attentive to any new symptoms that could be consistent with influenza virus infection (*7*). Patients with suspected novel influenza A virus should isolate at home away from household members and refrain from going to work or school until they are proven to not be infected or have recovered from their illness. Specimens from patients with suspected novel influenza A virus infection should be collected and referred to state public health departments for testing, and treatment with influenza antiviral medications should be initiated immediately. Treatment is recommended and should be initiated as soon as possible for patients with confirmed or suspected seasonal or swine influenza virus infection who have severe, complicated, or progressive illness; who require hospitalization; or who are at increased risk for influenza-associated complications (*8*). Influenza antiviral drugs are approved by the Food and Drug Administration for treatment of acute uncomplicated influenza within 2 days of illness onset and are recommended for use in the United States during the 2021–22 season. For persons aged ≥6 months, receiving a seasonal influenza vaccine each year remains the best way to protect against seasonal influenza and its potentially severe consequences.

Summary

What is already known about this topic?

CDC collects, compiles, and analyzes data on U.S. influenza activity and viruses.

What is added by this report?

The severity of the 2021–22 influenza season was low, with two waves of influenza A activity. Influenza activity continued from October 2021 through mid-June 2022, with A(H3N2) viruses predominating throughout the season. This report also describes the composition of the Northern Hemisphere 2022–23 influenza vaccine.

What are the implications for public health practice?

Because of the atypical timing and duration of influenza activity, providers and patients should consider influenza infection as a cause of respiratory illness. Testing for seasonal influenza and monitoring for novel viruses, especially avian A(H5N1) and swine viruses, should continue year-round. Receiving a seasonal influenza vaccine each year remains the best way to protect against seasonal influenza and its potentially severe consequences.

[§§§] https://www.cdc.gov/flu/spotlights/2021-2022/specific-vaccines-seniors.htm

Influenza surveillance reports for the United States are posted online weekly (https://www.cdc.gov/flu/weekly). Additional information regarding influenza viruses, surveillance, vaccines, antiviral medications, and novel influenza A infections in humans is available online (https://www.cdc.gov/flu).

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State, county, city, and territorial health departments and public health laboratories; National Influenza Surveillance Reference Centers; U.S. World Health Organization collaborating laboratories; National Respiratory and Enteric Virus Surveillance System laboratories; U.S. Outpatient Influenza-like Illness Surveillance Network sites; National Center for Health Statistics, CDC; National Healthcare Safety Network, FluSurv-NET; HHS Protect.

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Workplace Perceptions and Experiences Related to COVID-19 Response Efforts Among Public Health Workers — Public Health Workforce Interests and Needs Survey, United States, September 2021–January 2022

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The COVID-19 pandemic has strained many essential frontline professionals, including public health workers*; however, few studies have evaluated the specific challenges facing public health workers during this period. Data from the 2021 Public Health Workforce Interests and Needs Survey (PH WINS), a nationally representative survey of individual state and local governmental public health agency workers, provide insight into public health workers' demographic characteristics and experiences during the COVID-19 pandemic, tenure, and intention to leave their organization† (*1*). Surveyed governmental public health workers identified predominantly as non-Hispanic White (White), women, and aged >40 years; however, workforce characteristics differed by agency type. Overall, 72% of respondents reported working fully or partially in a COVID-19 response role at any point during March 2020–January 2022. An estimated 44% of workers reported that they were considering leaving their jobs within the next 5 years for retirement or other reasons. Of those considering leaving, 76% began thinking about leaving since the start of the COVID-19 pandemic. When asked what was needed, besides funding, to respond to the COVID-19 pandemic, 51% selected additional staff capacity. Survey findings highlight the importance of focused attention on recruitment and retention that promotes diversity (*2*) and workers with public health experience, which will be critical as the workforce rebuilds as the COVID-19 pandemic evolves.

All state health agencies, all large local health departments (LHDs) in the Big Cities Health Coalition,§ and a nationally representative sample of LHDs¶ with ≥25 staff members and serving a population of ≥25,000 were invited to participate in PH WINS. The survey was electronically administered using Qualtrics, a web-based survey tool, during September 13, 2021–January 14, 2022. A total of 137,446 surveys were distributed and completed by 44,732 persons (35% of eligible respondents); 9,106 surveys were excluded because they were returned as undeliverable or respondents were otherwise ineligible.** The final sample included 41,890 staff members†† from 47 state health agency central offices (SHA-COs), 190 large LHDs serving populations >250,000 (inclusive of Big Cities Health Coalition departments), and 249 medium LHDs serving populations of 25,000–250,000.

Data were cleaned, managed, and analyzed in STATA (version 17.0; StataCorp). Balanced repeated replication weights were constructed to account for the complex survey design and to adjust for nonresponse. Descriptive statistics were generated, and inferential comparisons were made using Rao-Scott design-adjusted chi-square testing (*3*). Analyses were conducted overall and stratified by agency type: SHA-CO, large LHD, and medium LHD. PH WINS 2021 was determined to be

* https://www.hhs.gov/surgeongeneral/priorities/health-worker-burnout/index.html

† PH WINS was first fielded in 2014 and a second time in 2017. PH WINS 2021 has five major domains: 1) workplace environment, 2) COVID-19 response, 3) training needs, 4) addressing public health issues, and 5) demographics.

§ https://www.bigcitieshealth.org

¶ LHDs for the nationally representative sample were contributed in one of four ways: 1) Probability: a stratified, clustered random sample based on a list of all eligible LHDs. Strata were constructed based on cross-classification of 10 U.S. Department of Health and Human Services (HHS) regions and two population sizes (25,000–250,000 and >250,000); 2) Certainty: LHDs that participated in 2017 through the random sample were invited to participate in the 2021 survey; 3) Certainty: local staff members who participated as an employee of an LHD in a nondecentralized state. Decentralization is a governance structure that refers to the relationship a state health agency has with the LHDs in their state. The four types of governance are decentralized, centralized, mixed, and shared; and 4) Certainty: LHDs that participated through the PH WINS for All pilot program, a partnership with the Region 5 Public Health Training Center and Northwest Center for Public Health Practice's Region 10 Public Health Training Center aimed at recruiting all local health departments in each region (Region 5: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; Region 10: Alaska, Idaho, Oregon, and Washington, including those with <25 staff members and serving a population of <25,000. These small LHDs participating through PH WINS for All were excluded from the LHD sample.

** Persons whose emails were returned as undeliverable or failed or those who left their organizations were considered ineligible.

†† A total of 2,842 staff members were excluded from the nationally representative sample: 1,803 staff members work in LHDs that have <25 staff members and serve <25,000 persons; 1,039 staff members were excluded for other reasons.

exempt from ongoing review by the NORC at the University of Chicago Institutional Review Board.

A majority of the governmental public health workforce self-identify as White (54%), women (79%), and aged >40 years (63%) (Table 1). Women make up 83% of the workforce at medium LHDs,[§§] compared with 76% at SHA-COs, and 79% at large LHDs (p<0.001). The large LHD workforce had the most racial and ethnic diversity, with fewer than one half of workers (41%) identifying as White compared with two thirds at SHA-COs (66%) and medium LHDs (67%) (p<0.001). Employees who identify as White accounted for 66% of all executives in the state and local government public health workforce. Large LHD leadership is also more diverse, with 55% of large LHD executives identifying as White. In comparison, 78% of executives at medium LHDs and 74% of executives in SHA-COs identify as White (p<0.001).

Respondents were relatively new to their agencies and to public health, with approximately 50% having been at their current agency for ≤5 years and 36% in public health practice for ≤5 years. Overall, 37% of respondents reported having a master's or doctoral degree, with 14% reporting having a degree in public health.

Nationwide, 72% of respondents reported working in a COVID-19 response role during March 2020–January 2022 (Table 2). Approximately 80% of staff members at medium LHDs reported working on the COVID-19 response, compared with 75% at large LHDs and 62% at SHA-COs (p<0.001). Nationwide, 27% of the governmental public health workforce reported considering leaving their organization within the next 5 years for reasons other than retirement (Table 3). A total of 44% reported considering leaving their organization to retire or for other reasons; 76% began thinking about leaving since the start of the COVID-19 pandemic.[¶¶] Apart from additional funding, the top three needs reported by workers to effectively respond to the COVID-19 pandemic in their jurisdiction were additional staff capacity (51%), more community support (30%), and more support from elected leaders (26%).[***]

[§§] Large LHDs serve a population >250,000. Medium LHDs serve a population of 25,000–250,000.

[¶¶] Survey completion ranged from September 2021 to January 2022. Eighteen months earlier coincides with the start of the COVID-19 pandemic.

[***] Response options to the question, "Besides funding, what do you need to respond to COVID?" were the following: more support from agency leadership; nonmonetary resources (i.e., know-how and equipment); additional staff capacity (i.e., number or ability of staff members); training; more community support; more support from elected leaders; better messaging alignment with other leaders in my jurisdiction; better alignment with other sectors, such as businesses and schools; and other (please specify).

Discussion

The findings from the 2021 PH WINS survey show that the public health workforce is not as racially and ethnically diverse as the constituents its services target, the workforce perceived more staff members with public health experience were needed to effectively respond to the COVID-19 pandemic, and many public health workers reported an intention to leave their organization in the near future. This finding is concerning, given a recent report that found approximately 80,000 additional full-time staff members are needed throughout the nation's public health agencies to provide foundational public health services (*4*). The public sector faces similar challenges to the public health workforce, with reported increases in voluntary turnover, the need for more staff members to reduce workloads, and increased workplace stress (*5*). With the public health system facing immense pressure because of the prolonged COVID-19 response, worsening national health, increased stress, and burnout (*6*), potential significant staff losses would further strain an overtasked workforce.

The governmental public health workforce is more racially and ethnically diverse than is the overall U.S. workforce (i.e., 77% White)[†††]; however, White employees are still the majority in all state and local health departments (54%). Further, this group remains overrepresented among public health executives, except for large LHDs, which have the most diversity in executive leadership (55% White executives). Diversity at all supervisory levels can facilitate a fuller understanding of the needs of culturally diverse communities (*7*). The disproportionate impact that COVID-19 has had on racial and ethnic minority communities (*8*) underscores the importance of a highly diverse workforce that can better fulfill the essential and emergent needs of all communities (*9*).

Nearly three quarters of respondents reported being deployed for the COVID-19 response. It is unclear what impact the necessary diversion of these resources had on other public health focus areas, many of which, including smoking, alcohol use, and violence, were likely exacerbated during the pandemic (*8*).

With nearly one half of the survey respondents having worked for ≤5 years at their current agency, and approximately one third having been in practice for ≤5 years, findings indicate that the COVID-19 pandemic might have been many employees' first experience with a public health emergency. This finding coupled with the high percentage of the workforce reporting an intention to leave their organization might result in agencies with limited institutional knowledge from the COVID-19 pandemic response for future emergencies.

[†††] https://www.bls.gov/opub/reports/womens-databook/2021/home.htm

TABLE 1. Characteristics of the governmental public health workforce — Public Health Workforce Interests and Needs Survey, United States, 2021

Characteristic	Weighted estimate, % (95% CI)			
	SHA-CO (n = 14,957)	Large LHDs* (n = 19,663)	Medium LHDs† (n = 7,270)	National§ (N = 41,890)
Gender¶,**				
Women	75.7 (74.9–76.5)	78.5 (77.8–79.1)	82.9 (81.7–84.1)	**78.6 (78.1–79.0)**
Men	22.2 (21.5–23.0)	19.8 (19.2–20.5)	15.4 (14.3–16.7)	**19.7 (19.2–20.1)**
Identifies some other way	2.0 (1.8–2.3)	1.7 (1.5–1.9)	1.6 (1.3–2.0)	**1.8 (1.6–1.9)**
Race and ethnicity¶,,††**				
White	65.5 (64.6–66.3)	41.1 (40.3–41.9)	67.2 (65.6–68.7)	**53.7 (53.1–54.3)**
Hispanic or Latino	11.1 (10.5–11.7)	23.3 (22.6–24.0)	15.1 (13.9–16.5)	**18.0 (17.5–18.5)**
Black or African American	10.9 (10.4–11.5)	20.2 (19.5–20.9)	9.9 (8.9–10.9)	**15.3 (14.9–15.8)**
Asian	6.9 (6.5–7.4)	9.4 (8.9–10.0)	3.0 (2.4–3.7)	**7.4 (7.1–7.7)**
Two or more races	4.0 (3.7–4.4)	4.8 (4.4–5.1)	3.6 (3.0–4.2)	**4.3 (4.1,4.5)**
AI/AN	1.2 (1.0–1.4)	0.8 (0.7–1.0)	1.0 (0.7–1.4)	**0.9 (0.8–1.1)**
NH/OPI	0.4 (0.3–0.6)	0.4 (0.3–0.5)	0.2 (0.1–0.4)	**0.4 (0.3–0.5)**
Age group, yrs†				
≤21	0.1 (0.1–0.2)	0.2 (0.2–0.3)	0.3 (0.2–0.6)	**0.2 (0.2–0.3)**
21–30	11.0 (10.4–11.5)	13.7 (13.1–14.3)	14.7 (13.5, 16.0)	**13.1 (12.6–13.5)**
31–40	23.5 (22.7–24.3)	24.9 (24.1–25.7)	22.5 (21.2–23.8)	**24.0 (23.5–24.5)**
41–50	25.0 (24.2–25.8)	25.1 (24.3–25.9)	25.3 (23.9–26.8)	**25.1 (24.6–25.7)**
51–60	26.7 (25.9–27.5)	24.2 (23.5–25.0)	24.6 (23.3–26.0)	**25.0 (24.5–25.6)**
≥61	13.7 (13.0–14.4)	11.9 (11.4–12.5)	12.5 (11.5–13.6)	**12.6 (12.2–13.0)**
Tenure in current agency, yrs**				
0–5	49.0 (48.1–49.9)	50.2 (49.3–51.0)	49.9 (48.4–51.5)	**49.8 (49.2–50.4)**
6–10	18.8 (18.1–19.5)	16.3 (15.7–17.0)	15.2 (14.1–16.3)	**16.8 (16.4–17.3)**
11–15	11.7 (11.2–12.3)	11.2 (10.7–11.8)	11.8 (10.9–12.9)	**11.5 (11.1–11.9)**
16–20	8.9 (8.4–9.4)	9.2 (8.8–9.7)	9.6 (8.6–10.6)	**9.2 (8.9–9.6)**
≥21	11.6 (11.0–12.2)	13.0 (12.5–13.6)	13.5 (12.5–14.6)	**12.7 (12.3–13.1)**
Tenure in public health practice, yrs**				
0–5	33.4 (32.5–34.2)	36.4 (35.6–37.2)	39.5 (37.9–41.1)	**36.1 (35.5–36.7)**
6–10	19.9 (19.1–20.6)	18.5 (17.8–19.1)	17.2 (16.0–18.4)	**18.6 (18.2–19.1)**
11–15	14.1 (13.5–14.7)	13.7 (13.1–14.3)	13.2 (12.2–14.3)	**13.7 (13.3–14.1)**
16–20	11.6 (11.0–12.2)	11.4 (10.8–11.9)	11.1 (10.2–12.2)	**11.4 (11.0–11.8)**
≥21	21.1 (20.4–21.8)	20.1 (19.4–20.8)	19.0 (17.8–20.2)	**20.2 (19.7–20.6)**
Highest educational attainment**				
No college degree	10.9 (10.4–11.5)	15 (14.5–15.6)	19.9 (18.7–21.2)	**14.8 (14.4–15.2)**
Associates	9.2 (8.6–9.7)	10.5 (10.1–11.0)	17.2 (16.0–18.4)	**11.5 (11.1–11.9)**
Bachelor's	35.3 (34.5–36.2)	37.3 (36.5–38.1)	39.8 (38.3–41.3)	**37.2 (36.7–37.8)**
Master's	36.4 (35.5–37.2)	31.4 (30.6–32.2)	20.3 (19.0–21.6)	**30.6 (30.1–31.2)**
Doctorate	8.2 (7.7–8.7)	5.7 (5.3–6.1)	2.8 (2.3–3.4)	**5.9 (5.6–6.1)**
Public health degree (bachelor's, master's, or doctorate)**				
No	82.6 (82.0–83.3)	85.4 (84.8–86.0)	91.7 (90.7–92.5)	**85.9 (85.4–86.3)**
Yes	17.4 (16.7–18.0)	14.6 (14.0–15.2)	8.3 (7.5–9.3)	**14.1 (13.7–14.6)**
Supervisory status**				
Not a supervisor	70.3 (69.4–71.1)	73.2 (72.4–73.9)	76.3 (75.0–77.6)	**73.0 (72.4–73.5)**
Supervisor	17.5 (16.9–18.2)	16.7 (16.1–17.4)	14.9 (13.8–16.0)	**16.6 (16.2–17.0)**
Manager	10.2 (9.7–10.8)	8.0 (7.6–8.5)	5.5 (4.9–6.3)	**8.2 (7.9–8.5)**
Executive	2.0 (1.7–2.3)	2.1 (1.9–2.3)	3.2 (2.7–3.8)	**2.3 (2.1–2.5)**
Race and ethnicity among executives¶,,††**				
White	73.5 (67.2–79.0)	54.9 (49.3–60.3)	77.5 (68.1–84.7)	**66.3 (62.4–70.0)**
Hispanic or Latino	8.0 (5.0–12.6)	15.8 (12.1–20.5)	12.1 (6.5–21.4)	**12.7 (10.0–16.0)**
Black or African American	8.0 (5.3–12.0)	14.9 (11.5–19.2)	5.4 (2.4–11.9)	**10.4 (8.3–13.0)**
Asian	5.6 (3.4–9.1)	7.9 (5.5–11.2)	2.6 (1.1–5.7)	**5.8 (4.3–7.6)**
Two or more races	3.7 (1.6–8.7)	5.0 (2.8–8.5)	0.9 (0.3–3.1)	**3.5 (2.2–5.4)**
AI/AN	1.1 (0.3–3.5)	1.1 (0.4–3.0)	1.5 (0.2–9.9)	**1.2 (0.5–2.8)**
NH/OPI	0 (—)	0.4 (0.1–2.6)	0 (—)	**0.2 (0.0–1.2)**

Abbreviations: AI/AN = American Indian or Alaska Native; LHD = local health department; NH/OPI = Native Hawaiian or other Pacific Islander; SHA-CO = state health agency central office.

* Serving a population of >250,000.

† Serving a population of 25,000–250,000.

§ Entire public health workforce.

¶ Sort order based on the largest to smallest percentage among the entire workforce (denoted as National).

** All estimates are significant at p<0.001.

†† White, Black, Asian, AI/AN, NH/OPI, and persons of two or more races were non-Hispanic; Hispanic or Latino persons could be of any race.

TABLE 2. COVID-19 response role and needs among the governmental public health workforce — Public Health Workforce Interests and Needs Survey, United States, 2021

Characteristic	Weighted estimate, % (95% CI)			
	SHA-CO (n = 14,957)	Large LHDs* (n = 19,663)	Medium LHDs† (n = 7,270)	National§ (N = 41,890)
COVID-19 response workforce role¶				
Working on COVID-19 response	62.3 (61.4–63.1)	74.8 (74.0–75.5)	80.4 (79.0–81.7)	**72.1 (71.6–72.7)**
Reported needs¶,**				
Additional staff capacity (i.e., number or ability of staff members)	48.1 (47.1–49.0)	51.0 (50.1–51.9)	54.0 (52.4–55.6)	**50.7 (50.1–51.3)**
More community support	27.7 (26.8–28.5)	29.0 (28.3–29.8)	37.9 (36.4–39.4)	**30.4 (29.9–31.0)**
More support from elected leaders	28.5 (27.7–29.4)	24.1 (23.3–24.8)	25.2 (23.9–26.6)	**25.6 (25.1–26.1)**
Training	23.8 (23.0–24.7)	27.7 (26.9–28.5)	21.6 (20.3–23.0)	**25.3 (24.8–25.8)**
Better alignment with other sectors, such as businesses and schools	21.5 (20.8–22.3)	24.4 (23.7–25.2)	24.3 (23.0–25.6)	**23.5 (23.0–24.1)**
More support from agency leadership	20.1 (19.3–20.8)	21.7 (21.0–22.5)	16.5 (15.3–17.8)	**20.2 (19.7–20.7)**
Better messaging alignment with other leaders in my jurisdiction	17.5 (16.8–18.2)	18.9 (18.2–19.5)	16.2 (15.1–17.4)	**17.9 (17.5–18.4)**
Nonmonetary resources (i.e., know-how and equipment)	16.8 (16.1–17.6)	15.9 (15.3–16.6)	12.0 (11.0–13.2)	**15.4 (15.0–15.9)**
Other	11.6 (11.0–12.2)	9.7 (9.2–10.2)	8.2 (7.3–9.2)	**9.9 (9.6–10.3)**

Abbreviations: LHD = local health department; SHA-CO = state health agency central office.
* Serving a population of >250,000.
† Serving a population of 25,000–250,000.
§ Entire public health workforce.
¶ All estimates are significant at p<0.001.
** In response to the question, "Besides funding, what do you need to respond to COVID?"

TABLE 3. Intent to leave the governmental public health workforce — Public Health Workforce Interests and Needs Survey, United States, 2021

Intent to leave organization	Weighted estimate, % (95% CI)			
	SHA-CO (n = 14,957)	Large LHDs* (n = 19,663)	Medium LHDs† (n = 7,7270)	National§ (N = 41,890)
Considering leaving within the next year (excluding retirement)¶	28.3 (27.5–29.2)	28.2 (27.4–29.0)	21.5 (20.3–22.9)	**26.9 (26.4–27.4)**
Considering leaving or retiring within the next 5 years¶	46.0 (45.1–46.9)	44.9 (44.0–45.8)	39.8 (38.3–41.4)	**44.2 (43.6–44.8)**
Length of time considering leaving¶				
<3 mos	18.2 (17.0–19.4)	23.1 (21.9–24.4)	21.7 (19.5–24.2)	**21.3 (20.5–22.2)**
6–18 mos	27.5 (26.1–29.0)	26.2 (24.9–27.5)	29.7 (27.1–32.4)	**27.2 (26.3–28.1)**
Since before Mar 2020	26.8 (25.4–28.2)	22.5 (21.3–23.9)	21.7 (19.3–24.3)	**23.7 (22.8–24.6)**
Considering leaving since start of COVID-19 pandemic (≤18 mos)¶	73.2 (71.8–74.6)	77.5 (76.1–78.7)	78.3 (75.7–80.7)	**76.3 (75.4–77.2)**

Abbreviations: LHD = local health department; SHA-CO = state health agency central office.
* Serving a population of >250,000.
† Serving a population of 25,000–250,000.
§ Entire public health workforce.
¶ All estimates are significant at p<0.001.

To grow and diversify the workforce in the face of potentially substantial turnover, agencies should consider redoubling efforts to increase and formalize recruitment pathways between academia and public health. Although hiring surges provide extra capacity, the workforce does not necessarily have the knowledge and expertise needed for an effective pandemic response. Recruitment and retention efforts should emphasize the need to retain knowledgeable and skilled employees with public health experience. Agencies might also want to address stress, burnout, and workplace environment factors[§§§] (*10*).

[§§§] https://debeaumont.org/wp-content/uploads/dlm_uploads/2022/03/Stress-and-Burnout-Brief_final.pdf

The findings in this report are subject to at least four limitations. First, agency nonparticipation and individual nonresponse might pose limitations to generalizability; however, balanced repeated replication weights were applied to account for nonresponse and complex sampling. Second, the survey responses are largely self-reported, with inherent potential for biases, including social desirability bias. To mitigate potential bias, the study used previously used items where possible, and employed cognitive interviews and pretests for new items. Third, the study did not assess specific reasons for seeking leadership roles or retirement from the public health workforce by sociodemographic characteristics. Finally, the survey

Summary

What is already known about this topic?

The COVID-19 pandemic has strained many essential frontline professionals, including public health workers.

What is added by this report?

The 2021 Public Health Workforce Interests and Needs Survey recorded the perspectives of the governmental public health workforce. During March 2020–January 2022, 72% of the workforce fully or partially served in a COVID-19 response role. Apart from funding, 51% of respondents cited a need for additional staff capacity to respond to COVID-19. Approximately 40% of the workforce intends to leave their jobs within the next 5 years.

What are the implications for public health practice?

Purposeful succession planning and focused attention on recruitment and retention that promotes diversity will be critical as the workforce rebuilds while the COVID-19 pandemic evolves.

is of staff members who remained in the workplace, not those who had left. Although the prevalence of an intent to leave is comparable with that identified in previous administrations of PH WINS, actual turnover is plausibly much higher.

PH WINS provides a snapshot of the public health workforce during a period of unprecedented and prolonged emergency response. It is critical that workforce development efforts prioritize purposeful succession planning and recruitment and retention efforts that increase diversity as the workforce fortifies and rebuilds after the COVID-19 pandemic.

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Symptoms of Mental Health Conditions and Suicidal Ideation Among State, Tribal, Local, and Territorial Public Health Workers — United States, March 14–25, 2022

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An increase in adverse mental health symptoms occurred in the general population at the onset of the COVID-19 pandemic, which peaked in 2020 and subsequently decreased (*1*–*3*). The pandemic exacerbated existing stress and fatigue among public health workers responding to the public health crisis.* During March–April 2021, a survey of state, tribal, local, and territorial (STLT) public health workers found that 52.8% of respondents experienced symptoms of at least one of the following mental health conditions: depression, anxiety, or posttraumatic stress disorder (PTSD) (*4*); however, more recent estimates of mental health symptoms among this population are limited. To evaluate trends in these conditions from the previous year, the prevalence of symptoms of mental health conditions and suicidal ideation, a convenience sample of STLT public health workers was surveyed during March 14–25, 2022. In total, 26,069 STLT public health workers responded to the survey. Among respondents,† 6,090 (27.7%) reported symptoms of depression, 6,467 (27.9%) anxiety, 6,324 (28.4%) PTSD, and 1,853 (8.1%) suicidal ideation. Although the prevalences of depression, anxiety, and PTSD among public health workers were lower ($p<0.001$)§ among 2022 survey respondents compared with those of 2021 survey respondents (*4*), the prevalences of symptoms of suicidal ideation, anxiety, depression, and PTSD remained high among those who worked >60 hours per week (range = 11.3%–45.9%) and those who spent ≥76% of their work time on COVID-19 response activities (range = 9.0%–37.6%). Respondents were less likely to report mental health symptoms if they could take time off (prevalence ratio [PR] range = 0.48–0.55), or if they perceived an increase in mental health resources from their employer (PR range = 0.58–0.84). To support the mental health of public health workers, public health agencies can modify work-related factors, including making organizational changes for emergency responses and facilitating access to mental health resources and services.¶

During March 14–25, 2022, a nonprobability-based, self-administered, anonymous, web-based survey was disseminated to a convenience sample of public health workers who worked in U.S. STLT health departments for at least part of 2021.** The electronic survey link was distributed via email to national public health membership organizations, which shared the link with approximately 27,000 members with the request that members in a supervisory role cascade the survey to all public health workers within their respective organizations.†† The survey included questions on demographic characteristics, work history, traumatic events or stressors experienced since March 2021, employer-provided resources, and self-reported mental health symptoms of anxiety, depression, PTSD, or suicidal ideation within the previous 2 weeks. A similar convenience sample approach, survey instrument, and methodology were used in March 2021 (*4*). Mental health conditions were defined using validated instruments to evaluate symptoms of anxiety (2-item General Anxiety Disorder [GAD-2] questionnaire), depression (9-item Patient Health Questionnaire [PHQ-9]), and PTSD (6-item Impact of Event Scale [IES-6])§§ (*4*). One item from PHQ-9 was used to evaluate suicidal ideation.¶¶ Prevalences of depression, anxiety, PTSD, and suicidal ideation were stratified by demographic

* https://www.hhs.gov/about/news/2022/05/23/new-surgeon-general-advisory-sounds-alarm-on-health-worker-burnout-and-resignation.html

† Counts for mental health symptoms might not sum to total number of respondents (26,069) because of missing data. Counts for each category are those who answered all validated survey questions for that outcome: depression (21,965), anxiety (23,176), PTSD (22,261), and suicidal ideation (22,862).

§ Overall prevalence of symptoms of suicidal ideation was not statistically different from 2021 to 2022.

¶ https://www.cdc.gov/niosh/twh/guidelines.html

** Respondents who did not report working at an STLT public health agency or department for any amount of time in 2021 were excluded from the analysis.

†† Member associations and other organizations that participated were Association of Public Health Laboratories, Association of State and Territorial Health Officials, Council of State and Territorial Epidemiologists, National Association of County and City Health Officials, National Association of Community Health Workers, National Network of Public Health Institutes, and CDC Foundation.

§§ The PHQ-9 was used to score depression (score range = 0–27) and suicidal ideation (0–3), and respondents were considered symptomatic for depression if they scored ≥10. GAD-2 was used to score anxiety: each response option was assigned a value from 0 to 3, for a total range of 0–6, and respondents were considered symptomatic at a score of ≥3. To evaluate PTSD, the IES-6 was scored from 0 to 4 for each question for a total score range of 0–24; however, symptoms of PTSD were calculated as the mean of six questions. Respondents were considered symptomatic for PTSD if they scored ≥1.75.

¶¶ One item from PHQ-9, "How many days have you thought that you would be better off dead or thought of hurting yourself?" was used to evaluate suicide-related thoughts (referred to as suicidal ideation in the report).

characteristics, workplace factors, stressors experienced, and coping mechanisms. Bivariate PRs of the four mental health conditions were calculated separately using Poisson regression with 95% CIs. Response frequencies from the 2021 and the 2022 surveys were tabulated, and prevalences (percentages) and 95% CIs of mental health outcomes were compared. Analyses were conducted using SAS (version 9.4; SAS Institute); $p<0.05$ or CIs for the PR that exclude 1.0 were considered statistically significant. This activity was reviewed by CDC and conducted consistent with applicable federal law and CDC policy.[***]

Overall, approximately one half of respondents (48.0% [95% CI = 47.3%–48.7%]) (A Koné, CDC, unpublished data, 2022) experienced symptoms of at least one of the mental health conditions of depression, anxiety, or PTSD.[†††] The most commonly reported mental health condition was PTSD (28.4%) followed by anxiety (27.9%), depression (27.7%), and suicidal ideation (8.1%) (Table 1). The prevalences of depression, anxiety, and PTSD among public health workers were lower (–3.1%, –2.4%, and –8.4%, respectively) ($p<0.001$) among 2022 survey respondents compared with 2021 survey respondents (*4*). Respondents who identified as multiple races reported the highest prevalences of symptoms of depression (31.4%), anxiety (33.5%), and PTSD (34.4%) compared with other races. Most (91.4%) respondents worked ≥1 year in public health. Respondents who had spent ≥76% of work time on COVID-19 response activities were more likely to experience depression (PR = 1.38), anxiety (PR = 1.35), and PTSD (PR = 2.43), compared with public health workers not working on COVID-19. Respondents who worked >60 hours per week were more likely than were respondents working ≤40 hours per week to experience depression (PR = 1.73), anxiety (PR = 1.48), PTSD (PR = 2.07), and suicidal ideation (PR = 1.50). The percentage of symptoms of mental health conditions and suicidal ideation increased with the percentage of time working on COVID-19 response activities, especially among those who spent ≥76% of their work time on COVID-19 (range = 9.0%–37.6%) and for those who worked >60 hours per week (range = 11.3%–45.9%). This difference was most notable for PTSD in both 2021 and 2022 (Table 2). In 2021, among public health workers who had spent ≥76% of work time on COVID-19 response activities and worked ≤40, 41–60, and >60 hours per week, the prevalences of PTSD were 35.8%, 47.3%, and 58.7%, respectively, representing increases of 70.5%, 82.6%, and 109.6%, respectively, over those among public health workers not working on COVID-19. In addition, compared with 2021, the PRs for PTSD increased in 2022 for respondents who worked >60 hours per week and spent any time on COVID-19 activities: among those who spent 1%–25%, 26%–50%, 51%–75%, and ≥76% of time on COVID-19 activities, PTSD PRs during 2021 and 2022 were 1.14 and 1.39, 1.02 and 1.67, 1.67 and 2.19, and 2.10 and 2.48, respectively.

Since March 2022, respondents who reported feeling overwhelmed by workload or family and work balance were 2.35, 2.67, 2.90, and 2.98 times as likely to report symptoms of suicidal ideation, anxiety, depression, and PTSD, respectively, as were those not reporting feeling overwhelmed (Table 3). Public health workers who received job-related threats or felt bullied, threatened, or harassed because of their job reported the highest prevalences of PTSD (53.3% and 47.7%, respectively). Approximately one quarter of respondents (27.8%) who have left or were considering leaving public health were approximately twice as likely to report suicidal ideation (PR = 2.34) compared with those staying in the field. In addition, 73.9% of public health workers knew colleagues who left or were considering leaving public health. A total of 16,462 (75.4%) respondents were able to take time off from work. Public health workers who could take time off from work were less likely to report symptoms of depression (PR = 0.50), anxiety (PR = 0.55), PTSD (PR = 0.51), or suicidal ideation (PR = 0.48) compared with those unable to take time off. According to 75.5% of public health workers, their employer had not increased support for staff members' mental health since March 2021. Respondents who reported an increase in mental health resources were less likely than were those who did not to report symptoms of depression (PR = 0.68), anxiety (PR = 0.71), PTSD (PR = 0.84), and suicidal ideation (PR = 0.58). Among public health workers who did perceive an increase in mental health resources, those considered to be most useful were demonstrating appreciation for staff members' work (63.4%), telework options (58.2%), and flexible work schedules (55.0%) (A Koné, CDC, unpublished data, 2022).

Discussion

Public health workers who spent more time on COVID-19 response activities were more likely to report mental health symptoms, including PTSD. Compared with results of the 2021 survey of STLT public health workers (*4*), in 2022, prevalence of PTSD was 15.7% lower among public health workers who worked >60 hours per week and spent ≥76% on COVID-19. However, the PRs increased, and the prevalence of PTSD (49.5%) was higher for this group than the overall prevalence of

[***] 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.

[†††] One item from PHQ-9, "How many days have you thought that you would be better off dead or thought of hurting yourself?" does not evaluate a condition; therefore, only reported symptoms of depression, anxiety, and PTSD were included in the calculation of respondents who reported at least one mental health condition.

TABLE 1. Symptoms of depression, anxiety, posttraumatic stress disorder, and suicidal ideation among state, tribal, local, and territorial public health workers (N = 26,069) during the preceding 2 weeks, by demographic characteristics — United States, March 14–25, 2022

		Depression* (n = 21,965)†		Anxiety* (n = 23,176)†		PTSD* (n = 22,261)†		Suicidal ideation (n = 22,862)†	
Characteristic	**No. (%)**	**%**	**PR (95% CI)**	**%**	**PR (95% CI)**	**%**	**PR (95% CI)**	**%**	**PR (95% CI)**
Overall	**26,069***	**27.7**	**(27.1–28.3)**	**27.9**	**(27.3–28.5)**	**28.4**	**(27.8–29.0)**	**8.1**	**(7.8–8.5)**
Jurisdiction type									
Local	13,383 (51.3)	27.1	0.95 (0.91–1.00)	27.8	0.99 (0.95–1.03)	29.7	1.11 (1.06–1.15)	7.8	0.93 (0.85–1.01)
Tribal	340 (1.3)	29.0	1.02 (0.85–1.23)	26.3	0.93 (0.77–1.13)	31.1	1.16 (0.97–1.38)	7.5	0.89 (0.59–1.34)
Territorial	104 (0.4)	23.3	0.82 (0.56–1.20)	24.1	0.86 (0.59–1.25)	27.4	1.02 (0.72–1.44)	9.1	1.08 (0.56–2.09)
State	12,242 (47.0)	28.4	Ref	28.1	Ref	26.9	Ref	8.4	Ref
Age group, yrs									
≤29	3,235 (15.4)	34.8	2.10 (1.90–2.32)	41.2	2.91 (2.63–3.23)	33.8	1.80 (1.64–1.97)	13.5	3.17 (2.60–3.87)
30–39	5,124 (24.5)	31.4	1.90 (1.72–2.09)	34.2	2.41 (2.18–2.67)	33.3	1.77 (1.62–1.94)	8.9	2.10 (1.72–2.56)
40–49	4,893 (23.3)	28.9	1.75 (1.58–1.92)	27.8	1.97 (1.77–2.18)	30.0	1.60 (1.46–1.75)	8.3	1.95 (1.59–2.38)
50–59	4,942 (23.6)	25.4	1.53 (1.39–1.69)	21.9	1.55 (1.39–1.72)	25.1	1.33 (1.21–1.47)	6.3	1.47 (1.20–1.82)
≥60	2,763 (13.2)	16.5	Ref	14.2	Ref	18.8	Ref	4.3	Ref
Gender									
Female	19,397 (82.6)	27.8	1.10 (1.03–1.17)	28.2	1.18 (1.11–1.25)	28.5	1.09 (1.02–1.15)	7.2	0.67 (0.60–0.74)
Transgender or nonbinary	220 (0.9)	55.7	2.20 (1.92–2.52)	52.5	2.19 (1.91–2.51)	51.9	1.98 (1.72–2.28)	31.7	2.92 (2.34–3.64)
Male	3,853 (16.4)	25.3	Ref	24.0	Ref	26.3	Ref	10.9	Ref
Race or ethnicity									
Hispanic	2,609 (11.6)	27.8	0.98 (0.91–1.05)	26.6	0.93 (0.87–1.00)	32.1	1.16 (1.09–1.23)	8.8	1.13 (0.98–1.30)
AI/AN, non-Hispanic	184 (0.8)	30.5	1.07 (0.86–1.35)	26.6	0.93 (0.73–1.19)	32.6	1.17 (0.94–1.46)	8.4	1.08 (0.66–1.75)
Asian, non-Hispanic	1,237 (5.5)	25.5	0.90 (0.81–1.00)	27.6	0.97 (0.88–1.06)	29.4	1.06 (0.96–1.16)	10.7	1.37 (1.15–1.63)
Black, non-Hispanic	1,985 (8.8)	20.5	0.72 (0.66–0.80)	20.9	0.73 (0.67–0.80)	23.8	0.86 (0.78–0.93)	5.5	0.71 (0.58–0.86)
NH/OPI, non-Hispanic	132 (0.6)	27.6	0.98 (0.73–1.30)	22.3	0.78 (0.57–1.08)	32.3	1.16 (0.90–1.50)	12.6	1.62 (1.02–2.57)
Multiple races, non-Hispanic	590 (2.6)	31.4	1.11 (0.97–1.26)	33.5	1.17 (1.04–1.32)	34.4	1.24 (1.10–1.39)	12.3	1.58 (1.26–1.98)
White, non-Hispanic	15,765 (70.1)	28.3	Ref	28.5	Ref	27.8	Ref	7.8	Ref
Highest educational degree attained									
Bachelor's	8,967 (38.2)	28.3	1.00 (0.94–1.05)	28.6	1.10 (1.04–1.16)	27.4	1.14 (1.07–1.21)	8.6	1.19 (1.06–1.34)
Graduate	9,093 (38.8)	26.5	0.93 (0.88–0.99)	28.1	1.08 (1.02–1.14)	31.9	1.33 (1.25–1.41)	8.1	1.12 (0.99–1.26)
Less than bachelor's	5,387 (23.0)	28.4	Ref	26.0	Ref	24.0	Ref	7.2	Ref
Hrs worked per wk									
41–60	10,367 (43.2)	30.7	1.29 (1.24–1.35)	30.4	1.23 (1.17–1.28)	33.5	1.51 (1.45–1.58)	8.4	1.13 (1.03–1.23)
>60	1,350 (5.6)	41.2	1.73 (1.61–1.87)	36.8	1.48 (1.37–1.60)	45.9	2.07 (1.93–2.22)	11.3	1.50 (1.27–1.77)
≤40	12,277 (51.2)	23.8	Ref	24.8	Ref	22.2	Ref	7.5	Ref
% Time spent on COVID–19 response activities									
1–25	5,792 (24.4)	25.0	1.11 (1.02–1.22)	25.3	1.10 (1.01–1.20)	19.8	1.28 (1.14–1.43)	8.0	1.37 (1.15–1.63)
26–50	3,343 (14.1)	27.0	1.20 (1.09–1.33)	26.7	1.16 (1.06–1.28)	25.5	1.65 (1.47–1.85)	7.1	1.56 (1.39–1.75)
51–75	3,016 (12.7)	27.6	1.23 (1.11–1.36)	28.7	1.25 (1.14–1.37)	30.7	1.98 (1.77–2.21)	7.2	1.41 (1.23–1.61)
≥76	9,161 (38.6)	31.1	1.38 (1.27–1.51)	30.9	1.35 (1.24–1.46)	37.6	2.43 (2.20–2.69)	9.0	1.16 (0.99–1.37)
0	2,445 (10.3)	22.4	Ref	23.0	Ref	15.5	Ref	7.8	Ref
Yrs worked in public health									
<1	2,106 (8.6)	26.0	1.08 (0.99–1.18)	28.3	1.28 (1.18–1.40)	23.2	0.90 (0.82–0.99)	8.5	1.37 (1.15–1.63)
1–4	7,846 (32.1)	30.3	1.26 (1.19–1.33)	32.0	1.45 (1.37–1.53)	30.2	1.17 (1.10–1.23)	9.7	1.56 (1.39–1.75)
5–9	4,676 (19.1)	29.9	1.24 (1.17–1.33)	30.5	1.38 (1.30–1.47)	30.7	1.19 (1.12–1.26)	8.7	1.41 (1.23–1.61)
10–14	2,905 (11.9)	27.7	1.15 (1.07–1.24)	27.0	1.22 (1.13–1.32)	29.8	1.15 (1.07–1.24)	7.2	1.16 (0.99–1.37)
≥15	6,921 (28.3)	24.1	Ref	22.1	Ref	25.9	Ref	6.2	Ref
Remember completing 2021 survey									
Yes	7,527 (28.9)	28.5	1.04 (0.99–1.09)	28.4	1.03 (0.98–1.07)	31.3	1.15 (1.10–1.21)	8.4	1.06 (0.96–1.16)
No	18,529 (71.1)	27.4	Ref	27.7	Ref	27.1	Ref	8.0	Ref

Abbreviations: AI/AN = American Indian or Alaska Native; GAD-2 = 2-item General Anxiety Disorder; IES-6 = 6-item Impact of Event Scale; NH/OPI = Native Hawaiian or other Pacific Islander; PHQ-9 = 9-item Patient Health Questionnaire; PTSD = posttraumatic stress disorder; PR = prevalence ratio; Ref = referent group.

* Some categories might not sum to total number of respondents (26,069) because of missing data. Counts for each category are those who answered all validated survey questions for that symptom.

† Respondents who scored ≥10.0 out of 27 on the PHQ-9 were categorized as being symptomatic for depression; those who scored ≥3.0 out of 6 on the GAD-2 were categorized as being symptomatic for anxiety; and respondents who scored ≥1.75 out of 4 on IES-6 were categorized as being symptomatic for PTSD. Respondents who indicated that they would be better off dead or thought of hurting themselves at any time in the past 2 weeks on the PHQ-9 were categorized as being symptomatic for suicidal ideation.

TABLE 2. Symptoms of posttraumatic stress disorder among state, tribal, local, and territorial public health workers, by percentage of work time spent on COVID-19 response activities and hours worked in a week — United States, March–April 2021 and March 14–25, 2022

No. of hrs worked per wk	% Time on COVID-19 response	2021 survey (Mar–Apr 2021) (N = 26,174)		2022 survey (Mar 14–25, 2022) (N = 26,069)	
		PTSD* prevalence (%)	PR (95% CI)	PTSD* prevalence (%)	PR (95% CI)
≤40	0	21.0	Ref	15.3	Ref
	1–25	21.4	1.02 (0.89–1.16)	17.8	1.16 (1.01–1.32)
	26–50	28.3	1.35 (1.17–1.55)	22.2	1.45 (1.25–1.68)
	51–75	31.1	1.48 (1.28–1.70)	24.3	1.58 (1.36–1.84)
	≥76	35.8	1.70 (1.50–1.92)	29.4	1.92 (1.70–2.17)
41–60	0	25.9	Ref	15.8	Ref
	1–25	28.7	1.11 (0.92–1.33)	23.2	1.47 (1.19–1.82)
	26–50	35.1	1.35 (1.13–1.63)	28.7	1.82 (1.47–2.25)
	51–75	39.0	1.50 (1.25–1.80)	34.0	2.16 (1.75–2.66)
	≥76	47.3	1.83 (1.54–2.17)	41.5	2.63 (2.15–3.22)
>60	0	28.0	Ref	20.0	Ref
	1–25	31.9	1.14 (0.57–2.28)	27.8	1.39 (0.62–3.11)
	26–50	28.7	1.02 (0.52–2.00)	33.3	1.67 (0.76–3.66)
	51–75	46.7	1.67 (0.88–3.16)	43.8	2.19 (1.05–4.57)
	≥76	58.7	2.10 (1.12–3.94)	49.5	2.48 (1.21–5.08)

Abbreviations: IES-6 = 6-item Impact of Event Scale; PTSD = posttraumatic stress disorder; PR = prevalence ratio; Ref = referent group.
* Self-reported symptoms of PTSD were evaluated; respondents who scored ≥1.75 out of 4 on the IES-6 were considered to be symptomatic for PTSD.

PTSD (28.4%). Previous studies have documented that persons who work long hours are susceptible to experiencing negative mental health or physiologic outcomes (*5*,*6*).

Prolonged exposure to occupational stressors can lead to adverse mental health conditions and has been linked with high health care worker turnover during the COVID-19 pandemic (*7*,*8*). Respondents who left or were considering leaving public health were more likely to report symptoms of mental health conditions and suicidal ideation. Approximately three quarters of public health workers did not perceive an increase in employer-based mental health resources for staff members. According to the 2021 Public Health Workforce Interests and Needs Survey, public health workers were considering leaving their employment because of burnout, stress, and organizational culture (*9*). In addition, in the 2022 CDC survey of public health workers, respondents who expressed feeling bullied or threatened reported some of the highest prevalences of symptoms of mental health conditions and suicidal ideation. It is therefore important that public health agencies identify risk factors for workplace violence, recognize signs that public health workers are being bullied or threatened, and implement strategies to prevent and address these incidents.[§§§]

The findings in this report are subject to at least six limitations. First, the respondents were drawn from a nonprobability-based convenience sample of STLT public health workers who employed partial snowball sampling; thus, these findings are not generalizable to and might not represent the entire STLT public health workforce. Second, because of the survey distribution method and an approximation of the number of public health workers (range = 231,464–341,053) (*10*), a true response rate cannot be calculated. Third, although validated instruments were used to score respondents' mental health symptoms, the score does not confirm a clinical diagnosis of a mental health disorder (*4*). Fourth, the data are subject to recall bias; some questions asked respondents to recall experiences since March 2021. Fifth, data came from cross-sectional surveys; therefore, the findings do not reflect changes in symptoms among the same persons over time. Finally, a multivariable analysis was not conducted, and it is possible that observed differences between surveys could be because of demographic or other variations between the two samples.

Summary

What is already known about this topic?

In 2021, state, tribal, local, and territorial (STLT) public health workers reported high levels of symptoms of at least one mental health condition (depression, anxiety, or posttraumatic stress disorder [PTSD]).

What is added by this report?

In a 2022 survey of 26,069 STLT public health workers, higher PTSD prevalence was associated with more weekly work hours and more time spent on COVID-19 response activities. Most (75.5%) respondents did not think their employer increased mental health support.

What are the implications for public health practice?

To support the mental health of public health workers, public health agencies can modify work-related factors, including making organizational changes for emergency responses and facilitating access to mental health resources and services.

[§§§] https://www.osha.gov/workplace-violence

TABLE 3. Symptoms of depression, anxiety, posttraumatic stress disorder, and suicidal ideation among state, tribal, local, and territorial public health workers (N = 26,069) during the past 2 weeks, by work factors — United States, March 14–25, 2022

		Depression* (n = 21,965)†		Anxiety* (n = 23,176)†		PTSD* (n = 22,261)†		Suicidal ideation (n = 22,862)†	
Work factor	**No. (%)**	**%**	**PR (95% CI)**	**%**	**PR (95% CI)**	**%**	**PR (95% CI)**	**%**	**PR (95% CI)**
Overwhelmed by workload or family and work balance									
Yes	14,916 (65.8)	35.8	2.90 (2.72–3.10)	35.4	2.67 (2.51–2.83)	36.7	2.98 (2.80–3.18)	10.1	2.35 (2.09–2.64)
No	7,738 (34.2)	12.3	Ref	13.3	Ref	12.3	Ref	4.3	Ref
Disconnected from family and friends because of workload									
Yes	11,310 (50.0)	40.1	2.61 (2.48–2.75)	39.4	2.43 (2.32–2.55)	41.5	2.74 (2.61–2.88)	11.7	2.59 (2.34–2.86)
No	11,309 (50.0)	15.4	Ref	16.2	Ref	15.2	Ref	4.5	Ref
Inadequately compensated for work									
Yes	14,120 (62.9)	34.0	1.99 (1.88–2.10)	33.7	1.89 (1.79–1.99)	34.9	2.02 (1.92–2.13)	9.9	1.92 (1.73–2.14)
No	8,325 (37.1)	17.1	Ref	17.8	Ref	17.3	Ref	5.1	Ref
Unappreciated at work									
Yes	12,045 (53.5)	36.9	2.12 (2.02–2.23)	36.4	2.02 (1.92–2.11)	37.1	2.01 (1.91–2.10)	11.0	2.28 (2.06–2.52)
No	10,485 (46.5)	17.4	Ref	18.1	Ref	18.5	Ref	4.8	Ref
Experienced stigma or discrimination because of work									
Yes	6,420 (28.5)	41.1	1.83 (1.75–1.91)	39.6	1.71 (1.64–1.78)	45.5	2.12 (2.04–2.21)	11.7	1.77 (1.62–1.94)
No	16,136 (71.5)	22.4	Ref	23.2	Ref	21.4	Ref	6.6	Ref
Received job-related threats because of work									
Yes	2,523 (11.2)	43.8	1.71 (1.62–1.80)	43.4	1.68 (1.60–1.77)	53.3	2.12 (2.03–2.21)	14.8	2.05 (1.84–2.29)
No	20,071 (88.8)	25.6	Ref	25.9	Ref	25.2	Ref	7.2	Ref
Bullied, threatened, or harassed because of work									
Yes	5,199 (23.0)	42.3	1.81 (1.74–1.89)	41.4	1.74 (1.67–1.82)	47.7	2.12 (2.04–2.21)	13.0	1.97 (1.80–2.16)
No	17,369 (77.0)	23.3	Ref	23.8	Ref	22.5	Ref	6.6	Ref
Can take time off from work									
Yes	16,462 (75.4)	22.3	0.50 (0.48–0.53)	23.1	0.55 (0.53–0.57)	23.1	0.51 (0.49–0.53)	6.4	0.48 (0.44–0.52)
No	5,365 (24.6)	44.2	Ref	42.0	Ref	44.9	Ref	13.4	Ref
Left or considering leaving job									
Yes	6,525 (27.8)	42.3	1.92 (1.84–2.00)	41.3	1.83 (1.76–1.91)	41.9	1.80 (1.73–1.88)	13.8	2.34 (2.14–2.55)
No	16,917 (72.2)	22.0	Ref	22.5	Ref	23.2	Ref	5.9	Ref
Know colleagues who left or considering leaving									
Yes	17,622 (73.9)	31.4	1.78 (1.67–1.89)	30.8	1.55 (1.46–1.64)	32.5	1.85 (1.74–1.97)	8.9	1.55 (1.38–1.74)
No	6,215 (26.1)	17.6	Ref	19.9	Ref	17.5	Ref	5.8	Ref
Employer increased their support or resources for staff members' mental health									
Yes	5,412 (24.5)	20.7	0.68 (0.64–0.72)	21.5	0.71 (0.67–0.75)	24.9	0.84 (0.80–0.88))	5.3	0.58 (0.52–0.66)
No	16,712 (75.5)	30.4	Ref	30.2	Ref	29.7	Ref	9.1	Ref

Abbreviations: GAD-2 = 2-item General Anxiety Disorder; IES-6 = 6-item Impact of Event Scale; PHQ-9 = 9-item Patient Health Questionnaire; PTSD = posttraumatic stress disorder; PR = prevalence ratio; Ref = referent group.

* Some categories might not sum to total number of respondents (26,069) because of missing data. Counts for each category represent those who answered all validated survey questions for that symptom.

† Respondents who scored ≥10.0 out of 27 on the PHQ-9 were categorized as being symptomatic for depression; those who scored ≥3.0 out of 6 on the GAD-2 were categorized as being symptomatic for anxiety; and respondents who scored ≥1.75 out of 4 on IES-6 were categorized as being symptomatic for PTSD. Respondents who indicated that they would be better off dead or thought of hurting themselves at any time in the past 2 weeks on the PHQ-9 were categorized as being symptomatic for suicidal ideation.

It is critical for public health agencies to invest in and develop their STLT public health workforce to address mental health, including symptoms of depression, anxiety, PTSD, and suicidal ideation. Investment in the current and future workforces might include training organizational leaders and supervisors to recognize, understand, and support staff members' mental health needs. Organization-led initiatives, including reducing the number of hours or percentage of time public health workers work on an emergency response might also improve workforce health.

Acknowledgments

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Effectiveness of 2, 3, and 4 COVID-19 mRNA Vaccine Doses Among Immunocompetent Adults During Periods when SARS-CoV-2 Omicron BA.1 and BA.2/BA.2.12.1 Sublineages Predominated — VISION Network, 10 States, December 2021–June 2022

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The Omicron variant (B.1.1.529) of SARS-CoV-2, the virus that causes COVID-19, was first identified in the United States in November 2021, with the BA.1 sublineage (including BA.1.1) causing the largest surge in COVID-19 cases to date. Omicron sublineages BA.2 and BA.2.12.1 emerged later and by late April 2022, accounted for most cases.* Estimates of COVID-19 vaccine effectiveness (VE) can be reduced by newly emerging variants or sublineages that evade vaccine-induced immunity (*1*), protection from previous SARS-CoV-2 infection in unvaccinated persons (*2*), or increasing time since vaccination (*3*). Real-world data comparing VE during the periods when the BA.1 and BA.2/BA.2.12.1 predominated (BA.1 period and BA.2/BA.2.12.1 period, respectively) are limited. The VISION network† examined 214,487 emergency department/urgent care (ED/UC) visits and 58,782 hospitalizations with a COVID-19–like illness§ diagnosis among 10 states during December 18, 2021–June 10, 2022, to evaluate VE of 2, 3, and 4 doses of mRNA COVID-19 vaccines (BNT162b2 [Pfizer-BioNTech] or mRNA-1273 [Moderna]) compared with no vaccination among adults without immunocompromising conditions. VE against COVID-19–associated hospitalization 7–119 days and ≥120 days after receipt of dose 3 was 92% (95% CI = 91%–93%) and 85% (95% CI = 81%–89%), respectively, during the BA.1 period, compared with 69% (95% CI = 58%–76%) and 52% (95% CI = 44%–59%), respectively, during the BA.2/BA.2.12.1 period. Patterns were similar for ED/UC encounters. Among adults aged ≥50 years, VE against COVID-19–associated hospitalization ≥120 days after receipt of dose 3 was 55% (95% CI = 46%–62%) and ≥7 days (median = 27 days) after a fourth dose was 80% (95% CI = 71%–85%) during BA.2/BA.2.12.1 predominance. Immunocompetent persons should receive recommended COVID-19 booster doses to prevent moderate to severe COVID-19, including a first booster dose for all eligible persons and second booster dose for adults aged ≥50 years at least 4 months after an initial booster dose. Booster doses should be obtained immediately when persons become eligible.¶

A 2-dose primary COVID-19 mRNA vaccination series followed by a third (booster) dose at least 5 months after dose 2 is recommended for adults aged ≥18 years without immunocompromising conditions. On March 29, 2022, an additional booster dose (dose 4) was authorized for immunocompetent adults aged ≥50 years at least 4 months after dose 3 (*4*). The VISION Network evaluated the effectiveness of 2, 3, or 4 mRNA vaccine doses during December 2021–June 2022, a period during which different sublineages of Omicron circulated in the United States. VISION methods have been described previously (*5*); briefly, eligible medical encounters include ED/UC visits and hospitalizations among adults with COVID-19–like illness and a SARS-CoV-2 molecular test during the 14 days before through 72 hours after the encounter. Variant predominance was defined as the period when a variant accounted for ≥75% of

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

† Funded by CDC, the VISION Network includes Baylor Scott & White Health (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), Paso Del Norte Health Information Exchange-PHIX (Texas), Regenstrief Institute (Indiana), and University of Colorado (Colorado).

§ 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., 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*.

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

all sequenced specimens at a site (i.e., BA.1, December 2021–March 2022** and BA.2/BA.2.12.1, March–June 2022††). Dates when the prevalence of BA.1 declined to <75% of sequenced specimens and the prevalence of BA.2/BA.2.12.1 had not yet reached 75% were considered a "washout" period; encounters through June 10, 2022, were included unless BA.2/BA.2.12.1 prevalence declined to <75% at a site before that date. Patients were excluded if 1) a medical event occurred during the washout period; 2) a likely immunocompromising condition was present; 3) an mRNA vaccine dose was received before it was recommended§§; 4) any doses of a non–mRNA vaccine such as JNJ-78436735 (Janssen [Johnson & Johnson]) were received; 5) <14 days had elapsed since receipt of dose 2 or <7 days since receipt of dose 3 or dose 4; or 6) a previous SARS-CoV-2 infection was documented in the patient's medical record before the index encounter (to reduce the influence of protection from previous infection).¶¶ VE was estimated using a test-negative case-control design, comparing the odds of being vaccinated (receipt of 2 doses ≥14 days before the encounter, 3 doses ≥7 days before the encounter, or 4 doses ≥7 days before the encounter) versus being unvaccinated (zero doses received) between persons with positive and negative SARS-CoV-2 test results, using multivariable logistic regression, weighted for inverse propensity to be vaccinated, and adjusted for age, calendar time of index date (days since January 1, 2021),*** study site, and local virus circulation. VE for 4 vaccine doses was assessed only for adults aged ≥50 years during the BA.2/BA.2.12.1 period, aligning with the March 29, 2022, authorization for the fourth dose. Nonoverlapping 95% CIs were considered statistically significant. Analyses were conducted using R software (version 4.1.2; R Foundation). The study was reviewed and approved by institutional review boards at participating sites or under reliance agreement with the institutional review board of Westat, Inc. This activity was conducted consistent with applicable federal law and CDC policy.†††

Among 214,487 ED/UC encounters with a COVID-19–like illness diagnosis that met inclusion criteria, 124,033 (57.8%) occurred during the BA.1 period, during which 40,801 (32.9%) patients had a positive SARS-CoV-2 test result; 90,454 (42.2%) occurred during the BA.2/BA.2.12.1 period, during which 10,177 (11.3%) had a positive SARS-CoV-2 test result. During the BA.1 period, 51,359 (41.4%) ED/UC patients were unvaccinated, 40,026 (32.3%) had received 2 mRNA vaccine doses, and 32,648 (26.3%) had received 3 doses (Table 1). During the BA.2/BA.2.12.1 period, 27,907 (30.9%) ED/UC patients were unvaccinated; 22,657 (25.0%) had received 2 mRNA vaccine doses, 35,796 (39.6%) had received 3 doses; and 4,094 (4.5%) had received 4 doses. Receipt of 3 versus 2 doses was associated with a higher VE against an ED/UC encounter during both periods, and VE was higher during the BA.1 period than the BA.2/BA.2.12.1 period (Table 2). During the BA.1 period, VE declined to 73% ≥120 days (median = 132 days) after the third vaccine dose; during the BA.2/BA.12.1 period, VE declined to 26% at ≥120 days (median = 166 days) after the third dose.

Among 58,782 hospitalizations with a COVID-19–like illness diagnosis that met inclusion criteria, 35,399 (60.2%) occurred during the BA.1 period, during which 10,534 (29.8%) patients had a positive SARS-CoV-2 test result; 23,383 (17.9%) occurred during the BA.2/BA.2.12.1 period, during which 1,564 (6.7%) patients had a positive test result (Table 3). During the BA.1 period, 14,742 (41.6%) patients hospitalized with COVID-19–like illness were unvaccinated, 10,086 (28.5%) had received 2 mRNA vaccine doses, and 10,571 (29.9%) had received 3 doses. During the BA.2/BA.2.12.1 period, 6,682 (28.6%) patients hospitalized with COVID-19–like illness were unvaccinated, and 5,461 (23.4%), 10,036 (42.9%), and 1,204 (5.1%)

** Local sequencing data were obtained in the states of participating VISION sites. Partners contributing data on medical events during dates of estimated ≥75% Omicron BA.1 predominance were in California (December 21, 2021–March 6, 2022), Colorado (December 25, 2021–March 12, 2022), Indiana (December 31, 2021–March 4, 2022), Minnesota and Wisconsin (January 1–March 5, 2022), New York (December 18, 2021–February 26, 2022), Oregon and Washington (January 1–March 12, 2022), Texas (Baylor Scott & White Health [December 18, 2021–March 5, 2022] and Paso del Norte Health Information Exchange [January 8–March 19, 2022]), and Utah (December 27, 2021–March 19, 2022).

†† Partners contributing data on medical events during dates of estimated ≥75% Omicron BA.2/BA.2.12.1 prevalence were in California (March 25–June 10, 2022), Colorado (April 9–June 4, 2022), Indiana (March 19–June 10, 2022), Minnesota and Wisconsin (April 9–June 4, 2022), New York (March 26–June 10, 2022), Oregon and Washington (April 9–June 10, 2022), Texas (Baylor Scott & White Health [March 26–June 4, 2022] and Paso del Norte Health Information Exchange [April 23–June 10, 2022]), and Utah (March 28–June 10, 2022).

§§ A booster (third) mRNA vaccine dose was first recommended by CDC for adults without immunocompromising conditions on September 23, 2021, and is currently recommended for all persons aged ≥5 years at least 5 months after a second mRNA vaccine dose. A second booster mRNA vaccine dose (fourth dose) was authorized for adults aged ≥50 years on March 29, 2022, at least 4 months after receiving a third mRNA vaccine dose. After this authorization CDC stated that adults aged ≥50 years may receive this additional booster dose; on May 19, 2022, CDC strengthened this recommendation to state that all adults aged ≥50 years should receive this additional booster dose. https://www.cdc.gov/vaccines/covid-19/clinical-considerations/interim-considerations-us.html

¶¶ Among ED/UC encounters and hospitalizations during the BA.1 period, 15,863 (11.3%) and 3,313 (11.8%), patients, respectively, had previous infection documented in their medical record and were excluded from analysis. Among ED/UC encounters and hospitalizations during the BA.2/BA.2.12.1 period, 17,293 (16.0%) and 3,829 (14.1%), patients, respectively, had previous infection documented in their medical record and were excluded from analysis.

*** 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).

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

TABLE 1. Characteristics of emergency department and urgent care encounters among adults aged ≥18 years with COVID-19–like illness,* by Omicron subvariant–predominant period,†,§ mRNA COVID-19 vaccination status, and SARS-CoV-2 test result — 10 states, December 2021–June 2022

		mRNA COVID-19 vaccination status¶							Positive test result*	
		No. (row %)								
			2 doses		3 doses		4 doses			
Characteristic	Total no. (column %)	Unvaccinated	14–149 days earlier	≥150 days earlier	7–119 days earlier	≥120 days earlier	≥7 days earlier	SMD**	No. (row %)	SMD**
Omicron BA.1–predominant period†										
All ED or UC events	**124,033 (100.0)**	51,359 (41.4)	7,286 (5.9)	32,740 (26.4)	29,333 (23.6)	3,315 (2.7)	N/A	—	40,801 (32.9)	—
Site										
Baylor Scott & White Health	**29,978 (24.2)**	17,365 (57.9)	1,544 (5.2)	7,799 (26.0)	2,970 (9.9)	300 (1.0)	—	0.745	13,279 (44.3)	0.342
Columbia University	**3,116 (2.5)**	1,600 (51.3)	333 (10.7)	740 (23.7)	432 (13.9)	11 (0.4)	—		956 (30.7)	
HealthPartners	**12,579 (10.1)**	3,435 (27.3)	730 (5.8)	3,247 (25.8)	4,720 (37.5)	447 (3.6)	—		3,820 (30.4)	
Intermountain Healthcare	**26,950 (21.7)**	9,717 (36.1)	2,020 (7.5)	7,398 (27.5)	6,844 (25.4)	971 (3.6)	—		6,696 (24.8)	
KPNC	**20,383 (16.4)**	3,862 (18.9)	1,274 (6.3)	5,952 (29.2)	8,411 (41.3)	884 (4.3)	—		5,252 (25.8)	
KPNW	**7,929 (6.4)**	2,417 (30.5)	385 (4.9)	2,166 (27.3)	2,544 (32.1)	417 (5.3)	—		2,686 (33.9)	
PHIX	**1,243 (1.0)**	647 (52.1)	54 (4.3)	322 (25.9)	196 (15.8)	24 (1.9)	—		318 (25.6)	
Regenstrief Institute	**14,003 (11.3)**	8,007 (57.2)	682 (4.9)	2,968 (21.2)	2,213 (15.8)	133 (0.9)	—		4,986 (35.6)	
University of Colorado	**7,852 (6.3)**	4,309 (54.9)	264 (3.4)	2,148 (27.4)	1,003 (12.8)	128 (1.6)	—		2,808 (35.8)	
Age group, yrs										
18–49	**63,406 (51.1)**	33,003 (52.1)	4,909 (7.7)	16,313 (25.7)	8,755 (13.8)	426 (0.7)	—	0.678	23,073 (36.4)	0.219
50–65	**24,832 (20.0)**	9,229 (37.2)	1,415 (5.7)	7,458 (30.0)	6,305 (25.4)	425 (1.7)	—		8,460 (34.1)	
65–74	**15,978 (12.9)**	4,646 (29.1)	507 (3.2)	3,901 (24.4)	5,953 (37.3)	971 (6.1)	—		4,459 (27.9)	
75–84	**12,584 (10.1)**	2,940 (23.4)	302 (2.4)	3,205 (25.5)	5,179 (41.2)	958 (7.6)	—		3,224 (25.6)	
≥85	**7,233 (5.8)**	1,541 (21.3)	153 (2.1)	1,863 (25.8)	3,141 (43.4)	535 (7.4)	—		1,585 (21.9)	
Sex										
Male	**50,479 (40.7)**	22,531 (44.6)	2,536 (5.0)	12,433 (24.6)	11,574 (22.9)	1,405 (2.8)	—	0.107	17,286 (34.2)	0.051
Female	**73,554 (59.3)**	28,828 (39.2)	4,750 (6.5)	20,307 (27.6)	17,759 (24.1)	1,910 (2.6)	—		23,515 (32.0)	
Race or ethnicity										
White, NH	**74,613 (60.2)**	28,365 (38.0)	3,746 (5.0)	19,754 (26.5)	20,145 (27.0)	2,603 (3.5)	—	0.356	21,430 (28.7)	0.255
Black, NH	**15,395 (12.4)**	8,547 (55.5)	1,295 (8.4)	3,505 (22.8)	1,902 (12.4)	146 (0.9)	—		6,529 (42.4)	
Hispanic	**19,508 (15.7)**	8,893 (45.6)	1,451 (7.4)	5,489 (28.1)	3,446 (17.7)	229 (1.2)	—		7,481 (38.3)	
Other,†† NH	**9,368 (7.6)**	2,802 (29.9)	522 (5.6)	2,754 (29.4)	3,011 (32.1)	279 (3.0)	—		3,061 (32.7)	
Unknown	**5,149 (4.2)**	2,752 (53.4)	272 (5.3)	1,238 (24.0)	829 (16.1)	58 (1.1)	—		2,300 (44.7)	
Chronic respiratory condition at discharge§§										
No	**103,754 (83.7)**	43,204 (41.6)	6,287 (6.1)	27,363 (26.4)	24,303 (23.4)	2,597 (2.5)	—	0.065	34,674 (33.4)	0.054
Yes	**20,279 (16.3)**	8,155 (40.2)	999 (4.9)	5,377 (26.5)	5,030 (24.8)	718 (3.5)	—		6,127 (30.2)	
Chronic nonrespiratory condition at discharge¶¶										
No	**91,182 (73.5)**	38,741 (42.5)	5,749 (6.3)	24,157 (26.5)	20,551 (22.5)	1,984 (2.2)	—	0.145	31,826 (34.9)	0.154
Yes	**32,851 (26.5)**	12,618 (38.4)	1,537 (4.7)	8,583 (26.1)	8,782 (26.7)	1,331 (4.1)	—		8,975 (27.3)	
Omicron BA.2/BA.2.12.1–predominant period§										
All ED or UC events	**90,454 (100.0)**	27,907 (30.9)	1,774 (2.0)	20,883 (23.1)	9,142 (10.1)	26,654 (29.5)	4,094 (4.5)	—	10,177 (11.3)	—
Site										
Baylor Scott & White Health	**12,976 (14.3)**	6,786 (52.3)	188 (1.4)	3,687 (28.4)	501 (3.9)	1,720 (13.3)	94 (0.7)	0.925	1,155 (8.9)	0.296
Columbia University	**3,430 (3.8)**	1,452 (42.3)	130 (3.8)	937 (27.3)	344 (10.0)	551 (16.1)	16 (0.5)		232 (6.8)	
HealthPartners	**15,234 (16.8)**	3,269 (21.5)	346 (2.3)	2,868 (18.8)	1,821 (12.0)	5,944 (39.0)	986 (6.5)		2,057 (13.5)	
Intermountain Healthcare	**17,134 (18.9)**	5,262 (30.7)	469 (2.7)	4,359 (25.4)	1,654 (9.7)	4,986 (29.1)	404 (2.4)		2,318 (13.5)	
KPNC	**20,732 (22.9)**	2,531 (12.2)	374 (1.8)	4,114 (19.8)	3,278 (15.8)	8,446 (40.7)	1,989 (9.6)		1,670 (8.1)	
KPNW	**7,211 (8.0)**	1,588 (22.0)	110 (1.5)	1,464 (20.3)	894 (12.4)	2,695 (37.4)	460 (6.4)		1,084 (15.0)	
PHIX	**709 (0.8)**	338 (47.7)	13 (1.8)	176 (24.8)	59 (8.3)	113 (15.9)	10 (1.4)		43 (6.1)	
Regenstrief Institute	**6,064 (6.7)**	3,188 (52.6)	95 (1.6)	1,299 (21.4)	341 (5.6)	1,103 (18.2)	38 (0.6)		575 (9.5)	
University of Colorado	**6,964 (7.7)**	3,493 (50.2)	49 (0.7)	1,979 (28.4)	250 (3.6)	1,096 (15.7)	97 (1.4)		1,043 (15.0)	
Age group, yrs										
18–49	**42,569 (47.1)**	18,429 (43.3)	1,192 (2.8)	11,203 (26.3)	4,132 (9.7)	7,613 (17.9)	0 (0.0)	0.778	5,074 (11.9)	0.099
50–65	**17,598 (19.5)**	4,755 (27.0)	317 (1.8)	4,253 (24.2)	2,232 (12.7)	5,355 (30.4)	686 (3.9)		2,087 (11.9)	
65–74	**12,909 (14.3)**	2,271 (17.6)	137 (1.1)	2,437 (18.9)	1,185 (9.2)	5,542 (42.9)	1337 (10.4)		1,253 (9.7)	
75–84	**11,032 (12.2)**	1,591 (14.4)	71 (0.6)	1,902 (17.2)	994 (9.0)	5,130 (46.5)	1344 (12.2)		1,174 (10.6)	
≥85	**6,346 (7.0)**	861 (13.6)	57 (0.9)	1,088 (17.1)	599 (9.4)	3,014 (47.5)	727 (11.5)		589 (9.3)	
Sex										
Male	**36,191 (40.0)**	11,836 (32.7)	631 (1.7)	8,014 (22.1)	3,406 (9.4)	10,449 (28.9)	1,855 (5.1)	0.090	4,091 (11.3)	0.004
Female	**54,263 (60.0)**	16,071 (29.6)	1,143 (2.1)	12,869 (23.7)	5,736 (10.6)	16,205 (29.9)	2,239 (4.1)		6,086 (11.2)	

See table footnotes on next page.

TABLE 1. (*Continued*) Characteristics of emergency department and urgent care encounters among adults aged ≥18 years with COVID-19–like illness,* by Omicron subvariant–predominant period,†,§ mRNA COVID-19 vaccination status, and SARS-CoV-2 test result — 10 states, December 2021–June 2022

		mRNA COVID-19 vaccination status¶							Positive test result*	
		No. (row %)								
			2 doses		3 doses		4 doses			
Characteristic	Total no. (column %)	Unvaccinated	14–149 days earlier	≥150 days earlier	7–119 days earlier	≥120 days earlier	≥7 days earlier	SMD**	No. (row %)	SMD**
Race or ethnicity										
White, NH	**55,447 (61.3)**	15,386 (27.7)	799 (1.4)	12,474 (22.5)	5,296 (9.6)	18,410 (33.2)	3,082 (5.6)	0.361	6,471 (11.7)	0.128
Black, NH	**9,797 (10.8)**	4,405 (45.0)	368 (3.8)	2,272 (23.2)	898 (9.2)	1,644 (16.8)	210 (2.1)		1,033 (10.5)	
Hispanic	**13,939 (15.4)**	4,780 (34.3)	396 (2.8)	3,693 (26.5)	1,642 (11.8)	3,076 (22.1)	352 (2.5)		1,217 (8.7)	
Other,†† NH	**8,040 (8.9)**	1,769 (22.0)	160 (2.0)	1,670 (20.8)	1,096 (13.6)	2,927 (36.4)	418 (5.2)		1,003 (12.5)	
Unknown	**3,231 (3.6)**	1,567 (48.5)	51 (1.6)	774 (24.0)	210 (6.5)	597 (18.5)	32 (1.0)		453 (14.0)	
Chronic respiratory condition at discharge§§										
No	**75,947 (84.0)**	23,604 (31.1)	1,474 (1.9)	17,438 (23.0)	7,708 (10.1)	22,242 (29.3)	3,481 (4.6)	0.024	9,149 (12.0)	0.197
Yes	**14,507 (16.0)**	4,303 (29.7)	300 (2.1)	3,445 (23.7)	1,434 (9.9)	4,412 (30.4)	613 (4.2)		1,028 (7.1)	
Chronic nonrespiratory condition at discharge¶¶										
No	**67,691 (74.8)**	21,424 (31.6)	1,359 (2.0)	15,621 (23.1)	6,903 (10.2)	19,378 (28.6)	3,006 (4.4)	0.050	8,549 (12.6)	0.255
Yes	**22,763 (25.2)**	6,483 (28.5)	415 (1.8)	5,262 (23.1)	2,239 (9.8)	7,276 (32.0)	1,088 (4.8)		1,628 (7.2)	

Abbreviations: ED = emergency department; ICD-9 = *International Classification of diseases, Ninth Revision*; ICD-10 = *International Classification of diseases, Tenth Revision*; KPNC = Kaiser Permanente Northern California; KPNW = Kaiser Permanente Northwest; N/A = not applicable; NH = non-Hispanic; PHIX = Paso del Norte Health Information Exchange; RT-PCR = reverse transcription–polymerase reaction; SMD = standardized mean or proportion difference; UC = urgent care.

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

† Partners contributing data on medical events during dates of estimated ≥75% Omicron BA.1 predominance were in California (Dec 21, 2021–Mar 6, 2022), Colorado (Dec 25, 2021–Mar 12, 2022), Indiana (Dec 31, 2021–Mar 4, 2022), Minnesota and Wisconsin (Jan 1–Mar 5, 2022), New York (Dec 18, 2021–Feb 26, 2022), Oregon and Washington (Jan 1–Mar 12, 2022), Texas (Baylor Scott & White Health [Dec 18, 2021–Mar 5, 2022] and PHIX [Jan 8–Mar 19, 2022]), and Utah (Dec 27, 2021–Mar 19, 2022).

§ Partners contributing data on medical events during dates of estimated ≥75% Omicron BA.2/BA.2.12.1 predominance were in California (Mar 25–Jun 10, 2022), Colorado (Apr 9–Jun 4, 2022), Indiana (Mar 19–Jun 10, 2022), Minnesota and Wisconsin (Apr 9–Jun 4, 2022), New York (Mar 26–Jun 10, 2022), Oregon and Washington (Apr 9–Jun 10, 2022), Texas (Baylor Scott & White Health [Mar 26–Jun 4, 2022] and PHIX [Apr 23–Jun 10, 2022]), and Utah (Mar 28–Jun 10, 2022).

¶ Vaccination was defined as having received the listed number of doses of an mRNA-based COVID-19 vaccine within the specified range of number of days 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 the admission.

** An absolute SMD ≥0.20 indicates a nonnegligible difference in variable distributions between medical events for vaccinated versus unvaccinated patients or for patients with SARS-CoV-2–positive test result versus those with SARS-CoV-2–negative results. For mRNA COVID-19 vaccination status, a single SMD was calculated by averaging the absolute SMDs obtained from pairwise comparisons of each vaccinated category versus unvaccinated; more specifically as the average of the absolute value of the SMDs for 1) vaccinated with 2 doses 14–149 days earlier versus unvaccinated, 2) vaccinated with 2 doses ≥150 days earlier versus unvaccinated, 3) vaccinated with 3 doses 7–119 days earlier versus unvaccinated, 4) vaccinated with 3 doses ≥120 days earlier versus unvaccinated, and 5) vaccinated with 4 doses ≥7 days earlier versus unvaccinated.

†† Other race includes Asian, Native Hawaiian or other Pacific islander, American Indian or Alaska Native, Other, and multiple races.

§§ Chronic respiratory condition was defined as the presence of discharge code for asthma, chronic obstructive pulmonary disease, or other lung disease using ICD-9 or ICD-10 diagnosis codes.

¶¶ Chronic nonrespiratory condition was defined as the presence of discharge code 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 using ICD-9 and ICD-10 diagnosis codes.

had received 2, 3, and 4 mRNA vaccine doses, respectively. VE against COVID-19–associated hospitalization was 61% ≥150 days after dose 2 during the BA.1 period (median = 289 days) compared with 24% during the BA.2/BA.2.12.1 period (median = 371 days) (Table 2). VE associated with a third mRNA vaccine dose was higher than that associated with a second vaccine dose but declined during both periods at ≥120 days to 85% during the BA.1 period (median = 132 days) and 52% during the BA.2/BA.2.12.1 period (median = 168 days).

Among adults aged ≥50 years eligible to receive a fourth mRNA vaccine dose, VE for COVID-19–associated ED/UC encounters during the BA.2/BA.2.12.1 period was 32% at ≥120 days after the third dose (median interval = 170 days) but increased to 66% ≥7 days after the fourth dose (median interval = 28 days). VE against COVID-19–associated hospitalization was 55% ≥120 days after the third dose but increased to 80% ≥7 days after the fourth dose.

Discussion

Data from the Omicron BA.1 sublineage surge in the United States during December 2021–February 2022 determined that VE was reduced compared with that during the previous Delta-predominant period (*6*). To date, estimates of differences in VE between the Omicron BA.1 and subsequent BA.2/BA.2.12.1 sublineage periods have been limited. In this estimate of VE against ED/UC visits and hospitalizations during the BA.1 and BA.2/BA.2.12.1 periods, VE declined during both periods ≥150 days after the second vaccine dose, highlighting the need for a third dose (i.e., the first booster) for eligible adults. Recent receipt of a third dose increased VE; however, some decline was observed ≥120 days after receipt of the dose. Among eligible adults aged ≥50 years, a fourth vaccine dose ≥120 days after receipt of the third dose improved VE during the BA.2/BA.2.12.1 period, although follow-up time after dose 4 was limited. These findings highlight the

TABLE 2. mRNA COVID-19 vaccine effectiveness* against laboratory-confirmed COVID-19–associated† emergency department and urgent care encounters and hospitalizations among adults aged ≥18 years, by Omicron–predominant period, age group, number and timing of vaccine doses,§ and median interval since last dose — VISION Network, 10 states, December 2021–June 2022

	Omicron BA.1–predominant period¶				Omicron BA.2/BA.2.12.1–predominant period**			
Encounter type	Total	No. (%) of positive test results†	Median interval since last dose, days (IQR)	VE %* (95% CI)	Total	No. (%) of positive test results†	Median interval since last dose, days (IQR)	VE %* (95% CI)
ED or UC, age group (days since last dose)								
All ages, yrs								
Unvaccinated (Ref)	**51,359**	23,175 (45.1)	—	—	**27,907**	3,501 (12.6)	—	—
2 doses (14–149)	**7,286**	2,377 (32.6)	107 (76–129)	47 (44–50)	**1,774**	110 (6.2)	104 (71–128)	51 (38–60)
2 doses (≥150)	**32,740**	11,365 (34.7)	267 (232–306)	39 (37–41)	**20,883**	2,584 (12.4)	352 (278–398)	12 (7–17)
3 doses (7–119)	**29,333**	3,667 (12.5)	66 (41–89)	84 (83–85)	**9,142**	441 (4.8)	94 (72–108)	56 (51–61)
3 doses (≥120)	**3,315**	217 (6.5)	132 (125–142)	73 (68–77)	**26,654**	3,186 (11.9)	166 (145–190)	26 (21–30)
18–49 yrs								
Unvaccinated (Ref)	**33,003**	14,236 (43.1)	—	—	**18,429**	2,269 (12.3)	—	—
2 doses (14–149)	**4,909**	1,621 (33.0)	106 (76–129)	40 (36–44)	**1,192**	75 (6.3)	105 (72–129)	47 (31–60)
2 doses (≥150)	**16,313**	5,918 (36.3)	252 (220–288)	24 (21–28)	**11,203**	1,427 (12.7)	332 (254–379)	7 (0–14)
3 doses (7–119)	**8,755**	1,259 (14.4)	55 (33–79)	76 (75–78)	**4,132**	207 (5.0)	91 (69–107)	55 (47–62)
3 doses (≥120)	**426**	39 (9.2)	130 (124–141)	29 (−1–50)	**7,613**	1,096 (14.4)	159 (140–182)	17 (10–25)
≥50 yrs								
Unvaccinated (Ref)	**18,356**	8,939 (48.7)	—	—	**9,478**	1,232 (13.0)	—	—
2 doses (14–149)	**2,377**	756 (31.8)	109 (77–129)	59 (54–63)	**582**	35 (6.0)	102 (68–128)	59 (40–71)
2 doses (≥150)	**16,427**	5,447 (33.2)	283 (248–316)	52 (50–54)	**9,680**	1,157 (11.9)	376 (319–414)	18 (10–26)
3 doses (7–119)	**20,578**	2,408 (11.7)	71 (46–93)	87 (86–88)	**5,010**	234 (4.7)	96 (73–109)	58 (51–64)
3 doses (≥120)	**2,889**	178 (6.2)	133 (125–143)	81 (77–84)	**19,041**	2,090 (11.0)	170 (147–193)	32 (26–38)
4 doses (≥7)††	**N/A**	—	—	—	**4,094**	355 (8.7)	28 (17–42)	66 (60–71)

See table footnotes on next page.

Summary

What is already known about this topic?

Little is known about COVID-19 vaccine effectiveness (VE) during the Omicron variant BA.2/BA.2.12.2–predominant period or VE of a fourth COVID-19 vaccine dose in persons aged ≥50 years.

What is added by this report?

VE during the BA.2/BA.2.12.2 period was lower than that during the BA.1 period. A third vaccine dose provided additional protection against moderate and severe COVID-19–associated illness in all age groups, and a fourth dose provided additional protection in eligible adults aged ≥50 years.

What are the implications for public health practice?

Immunocompetent persons should receive recommended COVID-19 booster doses to prevent moderate to severe COVID-19, including a first booster dose for all eligible persons and second dose for adults aged ≥50 years at least 4 months after an initial booster dose. Booster doses should be obtained immediately when persons become eligible.

importance of staying up to date with COVID-19 vaccination, including recommended booster doses.

Although data on neutralizing antibodies have found BA.1 and BA.2 to be similar, recent data indicate slightly more immune escape for BA.2.12.1 (*1*). Data reported on Omicron sublineage VE have been limited. A study in the United Kingdom found inconsistent differences in VE for symptomatic COVID-19 and COVID-19–associated hospitalization, with higher VE against symptomatic COVID-19 but larger declines in VE against hospitalization observed during a period of BA.2 predominance versus a period of BA.1 predominance starting 10–14 weeks after a third COVID-19 vaccine dose (*7*). A study in Qatar found that after a second or third mRNA vaccine dose, declines in VE against symptomatic COVID-19 during BA.1 and BA.2 periods were similar, but the study did not identify enough severe cases to separate VE estimates by predominant variant (*8*). Differences between the current study and previous studies, including differences in proportions of persons with previous SARS-CoV-2 infection and the absence of BA.2.12.1 infections outside the United States might account for some variability in findings. After the BA.1 surge in the United States, a larger proportion of adults were found to have experienced a recent SARS-CoV-2 infection during the BA.2/BA.2.12.1 period, with antibody evidence of SARS-CoV-2 infection increasing from 33.5% in December 2021 to 57.7% by February 2022 (*9*). Unvaccinated persons were used as a referent group in VE analyses. If unvaccinated persons were more likely to have experienced recent infection, and infection-induced immunity provides some protection against re-infection, this could result in lower VE observed during the BA.2/BA.2.12.1 period. Although adults with documented past SARS-CoV-2 infection were excluded, infections are likely to be significantly underascertained because of lack of testing or increased at-home testing (*10*). In addition, although time since receipt of the second or third vaccine dose was stratified by time intervals, on average the time since

TABLE 2. (*Continued*) mRNA COVID-19 vaccine effectiveness* against laboratory-confirmed COVID-19–associated† emergency department and urgent care encounters and hospitalizations among adults aged ≥18 years, by Omicron–predominant period, age group, number and timing of vaccine doses,§ and median interval since last dose — VISION Network, 10 states, December 2021–June 2022

	Omicron BA.1–predominant period¶				Omicron BA.2/BA.2.12.1–predominant period**			
Encounter type	Total	No. (%) of positive test results†	Median interval since last dose, days (IQR)	VE %* (95% CI)	Total	No. (%) of positive test results†	Median interval since last dose, days (IQR)	VE %* (95% CI)
Hospitalization, age group (days since last dose)								
All ages, yrs								
Unvaccinated (Ref)	**14,742**	6,829 (46.3)	—	—	**6,682**	494 (7.4)	—	—
2 doses (14–149)	**1,236**	297 (24.0)	105 (73–129)	68 (63–73)	**343**	12 (3.5)	102 (71–128)	57 (19–77)
2 doses (≥150)	**8,850**	2,542 (28.7)	289 (252–322)	61 (58–63)	**5,118**	393 (7.7)	371 (308–413)	24 (12–35)
3 doses (7–119)	**9,146**	786 (8.6)	72 (47–93)	92 (91–93)	**2,350**	72 (3.1)	94 (74–108)	69 (58–76)
3 doses (≥120)	**1,425**	80 (5.6)	132 (125–142)	85 (81–89)	**7,686**	519 (6.8)	168 (146–191)	52 (44–59)
18–49 yrs§§								
Unvaccinated (Ref)	**4,057**	1,515 (37.3)	—	—	**—**	—	—	—
2 doses (14–149)	**392**	83 (21.2)	101 (67–127)	64 (52–73)	**—**	—	—	—
2 doses (≥150)	**1,304**	329 (25.2)	258 (226–294)	52 (43–59)	**—**	—	—	—
3 doses (7–119)	**812**	53 (6.5)	57 (36–81)	91 (87–94)	**—**	—	—	—
3 doses (≥120)	**56**	1 (1.8)	133 (126–142)	94 (62–99)	**—**	—	—	—
≥50 yrs§§								
Unvaccinated (Ref)	**10,685**	5,314 (49.7)	—	—	**4,595**	393 (8.6)	—	—
2 doses (14–149)	**844**	214 (25.4)	108 (76–129)	71 (65–75)	**—**	—	—	—
2 doses (≥150)	**7,546**	2,213 (29.3)	294 (259–325)	63 (60–66)	**4,139**	352 (8.5)	381 (325–418)	22 (8–34)
3 doses (7–119)	**8,334**	733 (8.8)	73 (49–94)	92 (91–93)	**1,957**	57 (2.9)	95 (74–108)	73 (63–81)
3 doses (≥120)	**1,369**	79 (5.8)	132 (125–142)	86 (82–89)	**7,113**	480 (6.8)	169 (147–191)	55 (46–62)
4 doses (≥7)††	**N/A**	—	—	—	**1,204**	74 (6.2)	27 (17–41)	80 (71–85)

Abbreviations: ED = emergency department; ICD-9 = *International Classification of Diseases, Ninth Revision*; ICD-10 = *International Classification of Diseases, Tenth Revision*; N/A = not applicable; PHIX = Paso Del Norte Health Information Exchange; Ref = referent group; RT-PCR = reverse transcription–polymerase chain reaction; UC = urgent care; VE = vaccine effectiveness.

* VE was calculated as ([1−odds ratio] x 100%), estimated using a test-negative design, adjusted for age, geographic region, calendar time (days since January 1, 2021), and local virus circulation (percentage of SARS-CoV-2–positive results from testing within the counties surrounding the facility on the date of the encounter) and weighted for inverse propensity to be vaccinated or unvaccinated (calculated separately for each set of VE estimates among ED or UC encounters and hospitalizations by Omicron–predominant period and age group). Generalized boosted regression trees were used to estimate the propensity to be vaccinated based on sociodemographic characteristics, underlying medical conditions, and facility characteristics.

† 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., respiratory failure or pneumonia) or related signs or symptoms (e.g., cough, fever, dyspnea, vomiting, or diarrhea) using ICD-9 and ICD-10 codes. Clinician-ordered molecular assays (e.g., real-time RT-PCR) for SARS-CoV-2 occurring ≤14 days before to <72 hours after the encounter date were included.

§ Vaccination was defined as having received the listed number of doses of an mRNA-based COVID-19 vaccine within the specified range of number of days 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 the admission.

¶ Partners contributing data on medical events during dates of estimated ≥75% Omicron BA.1 predominance were in California (Dec 21, 2021–Mar 6, 2022), Colorado (Dec 25, 2021–Mar 12, 2022), Indiana (Dec 31, 2021–Mar 4, 2022), Minnesota and Wisconsin (Jan 1–Mar 5, 2022), New York (Dec 18, 2021–Feb 26, 2022), Oregon and Washington (Jan 1–Mar 12, 2022), Texas (Baylor Scott & White Health [Dec 18, 2021–Mar 5, 2022] and PHIX [Jan 8–Mar 19, 2022]), and Utah (Dec 27, 2021–Mar 19, 2022).

** Partners contributing data on medical events during dates of estimated ≥75% Omicron BA.2/BA.2.12.1 predominance were in California (Mar 25–Jun 10, 2022), Colorado (Apr 9–Jun 4, 2022), Indiana (Mar 19–Jun 10, 2022), Minnesota and Wisconsin (Apr 9–Jun 4, 2022), New York (Mar 26–Jun 10, 2022), Oregon and Washington (Apr 9–Jun 10, 2022), Texas (Baylor Scott & White Health [Mar 6–Jun 4, 2022 and PHIX [Apr 23–Jun 10, 2022]), and Utah (Mar 28–Jun 10, 2022).

†† For estimation of 4-dose mRNA VE among patients aged ≥50 years during the Omicron BA.2/BA.2.12.1–predominant period, unvaccinated patients whose medical event index date was before Apr 5, 2022 were excluded from the referent group (1,836 ED or UC encounters and 999 hospitalizations excluded among unvaccinated patients) because the earliest medical event index date included among 4-dose mRNA-vaccinated patients was 7 days after Mar 29, 2022 when a second booster mRNA vaccine dose (fourth dose) was first included in recommendations for adults aged ≥50 years (at least 4 months after receiving a third mRNA dose).

§§ VE estimates with 95% CIs >50 percentage points are not shown because of imprecision.

vaccination was longer during the BA.2/BA.2.12.1 period. These differences were particularly pronounced in the analysis of ≥150 days after the second vaccine dose (median 289 days for hospitalized adults during the BA.1 period compared to 371 days during the BA.2/BA.2.12.1 period), which could account for some differences in VE estimates and highlights the importance of a third dose (first booster) for those who have not yet received it.

The findings in this analysis are subject to at least four limitations. First, previous SARS-CoV-2 infection was likely underascertained and might differentially affect observed VE during the BA.1 and BA.2/BA.2.12.1 periods. Second, residual confounding in VE estimates is possible. Third, no genetic characterization was available for SARS-CoV-2–positive specimens; therefore, date of testing was used to ascribe likely sublineage, and BA.2 and BA.2.12.1 sublineages were combined, given their overlap in circulation. Finally, this report did not assess VE against the most severe COVID-19–associated disease (e.g., respiratory failure) because of smaller numbers of these cases.

VE should continue to be monitored in the setting of newly emerging sublineages and variants, including Omicron sublineages BA.4 and BA.5, which became predominant in the United States in late June 2022. Eligible adults should stay up to date with recommended COVID-19 vaccinations, including a first booster dose for all eligible persons and second booster dose for adults aged ≥50 years. Booster doses should be obtained immediately when persons become eligible.

TABLE 3. Characteristics of hospitalizations among adults aged ≥18 years with COVID-19–like illness,* by Omicron subvariant–predominant period, mRNA COVID-19 vaccination status, and SARS-CoV-2 test result — 10 states, December 2021–June 2022

Characteristic	Total no. (column %)	mRNA COVID-19 vaccination status, no. of doses received¶ No. (row %)							Positive test result*	
			Days since last dose							
			2 doses		3 doses		4 doses			
		Unvaccinated	14–149	≥150	7–119	≥120	≥7	SMD**	No. (row %)	SMD**
Omicron BA.1–predominant period†										
All hospitalizations	**35,399 (100.0)**	14,742 (41.6)	1,236 (3.5)	8,850 (25.0)	9,146 (25.8)	1,425 (4.0)	N/A	—	10,534 (29.8)	—
Site										
Baylor Scott & White Health	**8,697 (24.6)**	4,480 (51.5)	324 (3.7)	2,528 (29.1)	1,190 (13.7)	175 (2.0)	—	0.551	2,904 (33.4)	0.218
Columbia University	**1,419 (4.0)**	668 (47.1)	94 (6.6)	367 (25.9)	274 (19.3)	16 (1.1)	—		536 (37.8)	
HealthPartners	**1,334 (3.8)**	378 (28.3)	40 (3.0)	262 (19.6)	586 (43.9)	68 (5.1)	—		322 (24.1)	
Intermountain Healthcare	**3,224 (9.1)**	1,159 (35.9)	148 (4.6)	701 (21.7)	985 (30.6)	231 (7.2)	—		756 (23.4)	
KPNC	**6,911 (19.5)**	1,501 (21.7)	219 (3.2)	1,748 (25.3)	3,036 (43.9)	407 (5.9)	—		1,940 (28.1)	
KPNW	**1,480 (4.2)**	539 (36.4)	56 (3.8)	288 (19.5)	478 (32.3)	119 (8.0)	—		360 (24.3)	
PHIX	**96 (0.3)**	64 (66.7)	1 (1.0)	19 (19.8)	11 (11.5)	1 (1.0)	—		45 (46.9)	
Regenstrief Institute	**8,980 (25.4)**	4,398 (49.0)	276 (3.1)	1,969 (21.9)	2,076 (23.1)	261 (2.9)	—		2,937 (32.7)	
University of Colorado	**3,258 (9.2)**	1,555 (47.7)	78 (2.4)	968 (29.7)	510 (15.7)	147 (4.5)	—		734 (22.5)	
Age group, yrs										
18–49	**6,621 (18.7)**	4,057 (61.3)	392 (5.9)	1,304 (19.7)	812 (12.3)	56 (0.8)	—	0.540	1,981 (29.9)	0.126
50–65	**7,783 (22.0)**	3,847 (49.4)	328 (4.2)	2,008 (25.8)	1,470 (18.9)	130 (1.7)	—		2,664 (34.2)	
65–74	**8,073 (22.8)**	3,059 (37.9)	233 (2.9)	2,041 (25.3)	2,325 (28.8)	415 (5.1)	—		2,370 (29.4)	
75–84	**7,654 (21.6)**	2,329 (30.4)	178 (2.3)	2,054 (26.8)	2,609 (34.1)	484 (6.3)	—		2,137 (27.9)	
≥85	**5,268 (14.9)**	1,450 (27.5)	105 (2.0)	1,443 (27.4)	1,930 (36.6)	340 (6.5)	—		1,382 (26.2)	
Sex										
Male	**17,164 (48.5)**	7,549 (44.0)	529 (3.1)	4,075 (23.7)	4,308 (25.1)	703 (4.1)	—	0.098	5,428 (31.6)	0.087
Female	**18,235 (51.5)**	7,193 (39.4)	707 (3.9)	4,775 (26.2)	4,838 (26.5)	722 (4.0)	—		5,106 (28.0)	
Race or ethnicity										
White, NH	**22,967 (64.9)**	8,837 (38.5)	697 (3.0)	5,843 (25.4)	6,479 (28.2)	1,111 (4.8)	—	0.285	6,224 (27.1)	0.199
Black, NH	**4,214 (11.9)**	2,279 (54.1)	212 (5.0)	976 (23.2)	676 (16.0)	71 (1.7)	—		1,474 (35.0)	
Hispanic	**3,781 (10.7)**	1,801 (47.6)	188 (5.0)	960 (25.4)	759 (20.1)	73 (1.9)	—		1,491 (39.4)	
Other,†† NH	**2,601 (7.3)**	893 (34.3)	81 (3.1)	628 (24.1)	880 (33.8)	119 (4.6)	—		760 (29.2)	
Unknown	**1,836 (5.2)**	932 (50.8)	58 (3.2)	443 (24.1)	352 (19.2)	51 (2.8)	—		585 (31.9)	
Chronic respiratory condition at discharge§§										
No	**14,763 (41.7)**	6,116 (41.4)	555 (3.8)	3,693 (25.0)	3,818 (25.9)	581 (3.9)	—	0.023	3,482 (23.6)	0.254
Yes	**20,636 (58.3)**	8,626 (41.8)	681 (3.3)	5,157 (25.0)	5,328 (25.8)	844 (4.1)	—		7,052 (34.2)	
Chronic nonrespiratory condition at discharge¶¶										
No	**4,685 (13.2)**	2,516 (53.7)	166 (3.5)	958 (20.4)	949 (20.3)	96 (2.0)	—	0.200	1,522 (32.5)	0.050
Yes	**30,714 (86.8)**	12,226 (39.8)	1,070 (3.5)	7,892 (25.7)	8,197 (26.7)	1,329 (4.3)	—		9,012 (29.3)	
Omicron BA.2/BA.2.12.1–predominant period§										
All hospitalizations	**23,383 (100.0)**	6,682 (28.6)	343 (1.5)	5,118 (21.9)	2,350 (10.1)	7,686 (32.9)	1,204 (5.1)	—	1,564 (6.7)	—
Site										
Baylor Scott & White Health	**4,686 (20.0)**	2,128 (45.4)	55 (1.2)	1,417 (30.2)	227 (4.8)	813 (17.3)	46 (1.0)	0.945	196 (4.2)	0.268
Columbia University	**1,413 (6.0)**	491 (34.7)	48 (3.4)	316 (22.4)	169 (12.0)	375 (26.5)	14 (1.0)		81 (5.7)	
HealthPartners	**1,758 (7.5)**	329 (18.7)	37 (2.1)	261 (14.8)	204 (11.6)	760 (43.2)	167 (9.5)		120 (6.8)	
Intermountain Healthcare	**2,023 (8.7)**	571 (28.2)	35 (1.7)	446 (22.0)	179 (8.8)	733 (36.2)	59 (2.9)		167 (8.3)	
KPNC	**6,866 (29.4)**	677 (9.9)	87 (1.3)	1,164 (17.0)	1,095 (15.9)	3,105 (45.2)	738 (10.7)		584 (8.5)	
KPNW	**1,326 (5.7)**	356 (26.8)	17 (1.3)	210 (15.8)	165 (12.4)	488 (36.8)	90 (6.8)		86 (6.5)	
PHIX	**12 (0.1)**	7 (58.3)	0 (0.0)	3 (25.0)	0 (0.0)	2 (16.7)	0 (0.0)		1 (8.3)	
Regenstrief Institute	**3,947 (16.9)**	1,600 (40.5)	48 (1.2)	869 (22.0)	246 (6.2)	1,128 (28.6)	56 (1.4)		235 (6.0)	
University of Colorado	**1,352 (5.8)**	523 (38.7)	16 (1.2)	432 (32.0)	65 (4.8)	282 (20.9)	34 (2.5)		94 (7.0)	
Age group, yrs										
18–49	**4,162 (17.8)**	2,087 (50.1)	130 (3.1)	979 (23.5)	393 (9.4)	573 (13.8)	0 (0.0)	0.585	199 (4.8)	0.340
50–65	**4,613 (19.7)**	1,621 (35.1)	78 (1.7)	1,171 (25.4)	527 (11.4)	1,077 (23.3)	139 (3.0)		220 (4.8)	
65–74	**5,171 (22.1)**	1,258 (24.3)	63 (1.2)	1,098 (21.2)	506 (9.8)	1,929 (37.3)	317 (6.1)		277 (5.4)	
75–84	**5,539 (23.7)**	1,059 (19.1)	34 (0.6)	1,114 (20.1)	520 (9.4)	2,379 (42.9)	433 (7.8)		468 (8.4)	
≥85	**3,898 (16.7)**	657 (16.9)	38 (1.0)	756 (19.4)	404 (10.4)	1,728 (44.3)	315 (8.1)		400 (10.3)	
Sex										
Male	**10,979 (47.0)**	3,304 (30.1)	149 (1.4)	2,315 (21.1)	1044 (9.5)	3,553 (32.4)	614 (5.6)	0.080	796 (7.3)	0.085
Female	**12,404 (53.0)**	3,378 (27.2)	194 (1.6)	2,803 (22.6)	1306 (10.5)	4,133 (33.3)	590 (4.8)		768 (6.2)	
Race or ethnicity										
White, NH	**14,772 (63.2)**	3,817 (25.8)	162 (1.1)	3,236 (21.9)	1,367 (9.3)	5,304 (35.9)	886 (6.0)	0.362	1,076 (7.3)	0.199
Black, NH	**2,690 (11.5)**	1,157 (43.0)	73 (2.7)	598 (22.2)	266 (9.9)	525 (19.5)	71 (2.6)		117 (4.3)	
Hispanic	**2,708 (11.6)**	815 (30.1)	57 (2.1)	648 (23.9)	353 (13.0)	736 (27.2)	99 (3.7)		139 (5.1)	
Other,†† NH	**2,115 (9.0)**	425 (20.1)	40 (1.9)	376 (17.8)	298 (14.1)	842 (39.8)	134 (6.3)		172 (8.1)	
Unknown	**1,098 (4.7)**	468 (42.6)	11 (1.0)	260 (23.7)	66 (6.0)	279 (25.4)	14 (1.3)		60 (5.5)	

See table footnotes on next page.

TABLE 3. (*Continued*) Characteristics of hospitalizations among adults aged ≥18 years with COVID-19–like illness,* by Omicron subvariant–predominant period, mRNA COVID-19 vaccination status, and SARS-CoV-2 test result — 10 states, December 2021–June 2022

Characteristic	Total no. (column %)	mRNA COVID-19 vaccination status, no. of doses received¶ No. (row %)							Positive test result*	
			Days since last dose							
			2 doses		3 doses		4 doses			
		Unvaccinated	14–149	≥150	7–119	≥120	≥7	SMD**	No. (row %)	SMD**
Chronic respiratory condition at discharge§§										
No	**10,015 (42.8)**	3,085 (30.8)	147 (1.5)	2,179 (21.8)	980 (9.8)	3,142 (31.4)	482 (4.8)	0.092	604 (6.0)	0.092
Yes	**13,368 (57.2)**	3,597 (26.9)	196 (1.5)	2,939 (22.0)	1,370 (10.2)	4,544 (34.0)	722 (5.4)		960 (7.2)	
Chronic nonrespiratory condition at discharge¶¶										
No	**3,010 (12.9)**	1,243 (41.3)	53 (1.8)	690 (22.9)	226 (7.5)	748 (24.9)	50 (1.7)	0.242	174 (5.8)	0.058
Yes	**20,373 (87.1)**	5,439 (26.7)	290 (1.4)	4,428 (21.7)	2,124 (10.4)	6,938 (34.1)	1154 (5.7)		1,390 (6.8)	

Abbreviations: ICD-9 = *International Classification of Diseases, Ninth Revision*; ICD-10 = *International Classification of Diseases, Tenth Revision*; KPNC = Kaiser Permanente of Northern California; KPNW = Kaiser Permanente Northwest; N/A = not applicable; NH = non-Hispanic; PHIX = Paso del Norte Health Information Exchange; RT-PCR = reverse transcription–polymerase chain reaction; SMD = standardized mean or proportion difference.

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

† Partners contributing data on hospitalizations during dates of estimated ≥75% Omicron BA.1 predominance were in California (Dec 21, 2021–Mar 6, 2022), Colorado (Dec 25, 2021–Mar 12, 2022), Indiana (Dec 31, 2021–Mar 4, 2022), Minnesota and Wisconsin (Jan 1–Mar 5, 2022), New York (Dec 18, 2021–Feb 26, 2022), Oregon and Washington (Jan 1–Mar 12, 2022), Texas (Baylor Scott & White Health [Dec 18, 2021–Mar 5, 2022] and PHIX [Jan 8–Mar 19, 2022]), and Utah (Dec 27, 2021–Mar 19, 2022).

§ Partners contributing data on hospitalizations during dates of estimated ≥75% Omicron BA.2/BA.2.12.1 predominance were in California (Mar 25–Jun 10, 2022), Colorado (Apr 9–Jun 4, 2022), Indiana (Mar 19–Jun 10, 2022), Minnesota and Wisconsin (Apr 9–Jun 4, 2022), New York (Mar 26–Jun 10, 2022), Oregon and Washington (Apr 9–Jun 10, 2022), Texas (Baylor Scott & White Health [Mar 26–Jun 4, 2022] and PHIX [Apr 23–Jun 10, 2022]), and Utah (Mar 28–Jun 10, 2022).

¶ Vaccination was defined as having received the listed number of doses of an mRNA-based COVID-19 vaccine within the specified range of number of days before the hospitalization 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 hospitalization or the admission date if testing only occurred after the admission.

** An absolute SMD ≥0.20 indicates a nonnegligible difference in variable distributions between hospitalizations for vaccinated versus unvaccinated patients or for patients with SARS-CoV-2–positive results versus those with SARS-CoV-2–negative results. For mRNA COVID-19 vaccination status, a single SMD was calculated by averaging the absolute SMDs obtained from pairwise comparisons of each vaccinated category versus unvaccinated; more specifically, as the average of the absolute value of the SMDs for 1) vaccinated with 2 doses 14–149 days earlier versus unvaccinated, 2) vaccinated with 2 doses ≥150 days earlier versus unvaccinated, 3) vaccinated with 3 doses 7–119 days earlier versus unvaccinated, 4) vaccinated with 3 doses ≥120 days earlier versus unvaccinated, and 5) vaccinated with 4 doses ≥7 days earlier versus unvaccinated.

†† Other race includes Asian, Native Hawaiian or other Pacific islander, American Indian or Alaska Native, Other, and multiple races.

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

¶¶ Chronic nonrespiratory condition was defined as the presence of discharge code 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 using ICD-9 and ICD-10 diagnosis.

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Vital Signs: Drug Overdose Deaths, by Selected Sociodemographic and Social Determinants of Health Characteristics — 25 States and the District of Columbia, 2019–2020

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Abstract

Introduction: Drug overdose deaths increased approximately 30% from 2019 to 2020 in the United States. Examining rates by demographic and social determinants of health characteristics can identify disproportionately affected populations and inform strategies to reduce drug overdose deaths.

Methods: Data from the State Unintentional Drug Overdose Reporting System (SUDORS) were used to analyze overdose death rates from 2019 to 2020 in 25 states and the District of Columbia. Rates were examined by race and ethnicity and county-level social determinants of health (e.g., income inequality and treatment provider availability).

Results: From 2019 to 2020, drug overdose death rates increased by 44% and 39% among non-Hispanic Black (Black) and non-Hispanic American Indian or Alaska Native (AI/AN) persons, respectively. Significant disparities were found across sex, age, and racial and ethnic subgroups. In particular, the rate in 2020 among Black males aged ≥65 years (52.6 per 100,000) was nearly seven times that of non-Hispanic White males aged ≥65 years (7.7). A history of substance use was frequently reported. Evidence of previous substance use treatment was lowest for Black persons (8.3%). Disparities in overdose deaths, particularly among Black persons, were larger in counties with greater income inequality. Opioid overdose rates in 2020 were higher in areas with more opioid treatment program availability compared with areas with lower opioid treatment availability, particularly among Black (34.3 versus 16.6) and AI/AN (33.4 versus 16.2) persons.

Conclusions and Implications for Public Health Practice: Health disparities in overdose rates continue to worsen, particularly among Black and AI/AN persons; social determinants of health, such as income inequality, exacerbate these inequities. Implementation of available, evidence-based, culturally responsive overdose prevention and response efforts that address health disparities impacting disproportionately affected populations are urgently needed.

Introduction

The 91,799 drug overdose deaths that occurred in the United States in 2020 represent an approximately 30% increase from 2019 (*1*). The COVID-19 pandemic and disruption in access to prevention, treatment, and harm reduction services have likely contributed to this increase (*2*). Recent increases in drug overdose deaths were largely driven by illicitly manufactured fentanyl and fentanyl analogs (collectively referred to as IMFs) (*1*,*3*,*4*). Deaths involving stimulants, such as cocaine and psychostimulants with abuse potential, (e.g., methamphetamine) also increased in recent years and often co-occurred with opioids (*1*,*3*,*5*,*6*); some racial and ethnic minority groups were disproportionately affected (*6*).

Disparities in overdose mortality rates are not fully explained by substance use patterns (*7*,*8*) and might result from unequal access to substance use treatment services (*9*), socioeconomic inequities, and social determinants of health (*10*). Non-Hispanic Black (Black) and non-Hispanic American Indian or Alaska Native (AI/AN) persons report barriers to accessing mental health services and substance use treatment (*9*). However, the impact of treatment access and income inequality on drug overdose mortality has not been fully explored, particularly during the COVID-19 pandemic, which exacerbated disparities (*11*).

This report describes changes in drug overdose death rates from 2019 to 2020, stratified by sex, age group, and race and ethnicity. In addition, it examines differences in circumstances surrounding drug overdose, and assesses differences in overdose death rates by county-level income inequality and availability of mental health treatment providers and providers of medications for opioid use disorder.

Methods

Data on drug overdose deaths of unintentional and undetermined intent during 2019–2020 were obtained from the State Unintentional Drug Overdose Reporting System (SUDORS). This system includes information collected from death certificates and medical examiner or coroner reports (e.g., full postmortem toxicology results and death scene investigation findings).* Analyses were limited to 26 jurisdictions (25 states and the District of Columbia [DC]) that submitted complete 2019–2020 data.† Death rates (overdose deaths per 100,000 population) were age-adjusted to the 2000 U.S. standard population, and rate ratios were calculated.§ U.S. Census Bureau bridged-race population estimates were assessed for the following racial and ethnic groups: non-Hispanic Asian or Pacific Islander (A/PI), AI/AN, Black, non-Hispanic White (White), and Hispanic persons. Rates based on <20 deaths and counts <10 were suppressed.

Information on income inequality and mental health provider availability (number of mental health providers per 100,000 population) was obtained from the 2021 County Health Rankings and analyzed by tertile.¶ The Drug Enforcement Administration's controlled substance registration database was used to ascertain whether a county had at least one opioid treatment program and to estimate Drug Addiction Treatment Act of 2000 (DATA)-waived provider capacity (qualified clinicians who can prescribe buprenorphine in office-based settings for opioid use disorder treatment) by county.**

Differences in age-adjusted death rates from 2019 to 2020 were considered statistically significant if CIs did not overlap; a gamma distribution was used if <100 deaths occurred in either year.†† Analyses were conducted using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.§§

Results

From 2019 to 2020, overall drug overdose death rates increased in 25 states and DC; the largest increases occurred among certain racial/ethnic minority populations. Relative rate increases were highest among Black (44%) and AI/AN persons (39%) (Table 1). Among White persons, the rate increased by 22%. Within racial/ethnic groups, overdose death rates also varied by age. Black persons aged 15–24 years experienced the largest relative rate increase from 2019 to 2020 (86%). Among AI/AN persons, the highest relative rate increase occurred among those aged 25–44 years (49%). Among White persons, those aged 15–24 years experienced the largest relative rate increase (34%).

* SUDORS began in 2016 as part of CDC's Enhanced State Opioid Overdose Surveillance (ESOOS) program, which funded 12 states, with an additional 20 states and DC funded in 2017 to abstract data on opioid overdose deaths. In 2019, SUDORS expanded to collect data on all drug overdose deaths from 47 states and DC (collectively referred to as jurisdictions) as part of CDC's Overdose Data to Action (OD2A) program. https://www.cdc.gov/drugoverdose/od2a/index.html

† Alaska, Connecticut, DC, Delaware, Georgia, Kentucky, Maine, Massachusetts, Minnesota, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, Tennessee, Utah, Vermont, Virginia, and West Virginia were funded to report cause of death data on all overdose deaths within the jurisdiction in 2019 and 2020. Illinois, Missouri, Pennsylvania, and Washington were funded to report cause of death data on ≥75% of all overdose deaths within a jurisdiction in 2019 and 2020. Jurisdictions were included in rate calculations if they met data submission deadlines and addressed data entry errors in 2019 and 2020. The analysis of circumstance data was limited to jurisdictions with medical examiner/coroner information and focused primarily on the most common characteristics of drug overdose deaths. Data for July–December 2020 for Tennessee were not included because the overall percentage of decedents with a medical examiner or coroner report was <75%, which is the cutoff used in SUDORS for inclusion in analyses of overdose circumstances. There were <1% of decedents with an unknown race/ethnicity.

§ Rates (deaths per 100,000 population) were age-adjusted to the 2000 U.S. standard population using the vintage year population of the data year. Rate ratios were calculated by dividing the rate for persons who were not White by the rate for White persons. For example, the 2019 rate ratio for Black persons was determined by dividing their rate in 2019 by the rate of White persons in that same year. Rates were based on occurrent deaths and resident population. Persons might possibly not have resided in the states where they died; however, a sensitivity analysis showed that in 2020, >95% of overdose deaths occurred in the state where the decedent resided.

¶ The 2021 County Health Rankings used data from the 2015–2019 American Community Survey for the income inequality ratio. Income inequality is defined as the ratio of household income at the 80th percentile to income at the 20th percentile (i.e., when the incomes of all households in a county are listed from highest to lowest, the 80th percentile is the level of income at which only 20% of households have higher incomes, and the 20th percentile is the level of income at which only 20% of households have lower incomes). A higher inequality ratio indicates greater division between the top and bottom ends of the income spectrum. The specific ranges for income inequality groups are defined as low-income inequality (2.7–4.1), middle-income inequality (4.2–4.7), and high-income inequality (4.8–10.5). The 2021 County Health Rankings used 2020 data from the Centers for Medicare & Medicaid Services National Provider Identification registry for the number of mental health providers.

** In 2000, DATA granted waivers to qualified physicians to prescribe buprenorphine in in-office settings for opioid use disorder treatment. In 2016, the Comprehensive Addiction and Recovery Act permitted nurse practitioners and physician assistants to obtain DATA waivers to prescribe buprenorphine. DATA-waived clinicians can provide office-based opioid treatment to 30, 100, or 275 patients at a given time. Potential treatment capacity was calculated by multiplying the number of DATA-waived providers by their maximum patient limit (30, 100, or 275 patients) and presented by tertile. The ranges for DATA-waived provider capacity are lowest capacity (0–119), middle capacity (120–769), and highest capacity (770–64,105).

†† Absolute rate change is the difference between 2019 and 2020 rates. Relative rate change is the absolute rate change divided by the 2019 rate, multiplied by 100.

§§ 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.

When stratified by sex and age group, higher overdose death rates occurred among older Black males, with the highest rate in 2020 among those aged 45–64 years (124.9) (Supplementary Table, https://stacks.cdc.gov/view/cdc/118656). In addition, rates among Black males aged ≥65 years were nearly six times as high as those among White males of the same age in 2019 (35.7 versus 6.2), increasing to nearly seven times as high in 2020 (52.6 versus 7.7). Among AI/AN males, those aged 25–44 years experienced the highest rates in 2019 (67.5) and 2020 (87.2), similar to rates among White males in this age group (2019 = 72.7; 2020 = 87.0). Among Hispanic males, those aged 25–44 years had the highest rates in 2019 (47.6) and 2020 (57.3). The rate for Hispanic males aged 15–24 years increased 47% from 12.9 in 2019 to 18.9 in 2020.

Among females, the largest rate disparities between AI/AN and White decedents were observed among those aged 25–44 years, with the disparity increasing nearly 57% from 2019 to 2020 (2019 rate ratio = 1.06; 2020 rate ratio = 1.66). AI/AN females aged 25–44 years also had the largest relative increase in overdose death rate from 2019 to 2020 (88%).

A documented history of substance use was commonly reported for most decedents, with the highest proportion

TABLE 1. Annual number and age-adjusted rate of drug overdose deaths,* by age and race and Hispanic origin† — 25 states and the District of Columbia,§ 2019–2020

Race and ethnicity/ Age group, yrs	No. (rate)		Absolute change¶	Relative change (%)¶	Rate ratio**	
	2019	2020			2019	2020
White						
All ages	21,921 (25.2)	26,625 (30.7)	5.5††	22††	Ref	Ref
15–24	1,315 (12.3)	1,749 (16.5)	4.2††	34††	Ref	Ref
25–44	11,641 (52.3)	14,016 (62.7)	10.4††	20††	Ref	Ref
45–64	8,187 (32.9)	9,901 (40.5)	7.6††	23††	Ref	Ref
≥65	761 (4.3)	932 (5.1)	0.8††	19††	Ref	Ref
Black						
All ages	5,146 (27.0)	7,467 (38.9)	11.9††	44††	1.07	1.27
15–24	221 (7.8)	411 (14.5)	6.7††	86††	0.63	0.88
25–44	1,891 (35.4)	2,972 (54.7)	19.3††	55††	0.68	0.87
45–64	2,626 (58.5)	3,477 (77.6)	19.1††	33††	1.78	1.92
≥65	390 (17.8)	587 (25.7)	7.9††	44††	4.14	5.04
AI/AN						
All ages	327 (26.2)	456 (36.4)	10.2††	39††	1.04	1.19
15–24	28 (14.4)	31 (16.0)	1.6	11	1.17	0.97
25–44	179 (50.5)	270 (75.1)	24.6††	49††	0.97	1.20
45–64	107 (36.1)	145 (49.3)	13.2	37	1.10	1.22
≥65	13§§	—§§	—§§	—§§	—§§	—§§
A/PI						
All ages	203 (2.7)	252 (3.3)	0.6	22	0.11	0.11
15–24	27 (2.9)	31 (3.3)	0.4	14	0.24	0.20
25–44	136 (5.7)	160 (6.6)	0.9	16	0.11	0.11
45–64	37 (2.3)	55 (3.3)	1.0	43	0.07	0.08
≥65	—§§	—§§	—§§	—§§	—§§	—§§
Hispanic						
All ages	2,473 (17.3)	3,081 (21.0)	3.7††	21††	0.69	0.68
15–24	209 (8.3)	323 (12.5)	4.2††	51††	0.67	0.76
25–44	1,399 (30.7)	1,716 (37.1)	6.4††	21††	0.59	0.59
45–64	812 (28.5)	965 (32.7)	4.2	15	0.87	0.81
≥65	49 (5.2)	76 (7.6)	2.4	46	1.21	1.49

Source: State Unintentional Drug Overdose Reporting System.
Abbreviations: A/PI = Asian or Pacific Islander; AI/AN = American Indian or Alaska Native; Ref = referent group.
* Rates are age-adjusted using the direct method and the 2000 U.S. standard population, except for age-specific crude rates. All rates are deaths per 100,000 population.
† A/PI, AI/AN, Black, and White persons are non-Hispanic; Hispanic persons could be of any race. Data for Hispanic origin should be interpreted with caution; studies comparing Hispanic origin on death certificates and on U.S. Census Bureau surveys have shown inconsistent reporting on Hispanic ethnicity. Potential race misclassification might lead to underestimates for certain categories, primarily non-Hispanic A/PI and non-Hispanic AI/AN decedents. https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf
§ Includes 26 jurisdictions with complete data in 2019 and 2020: Alaska, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Kentucky, Maine, Massachusetts, Minnesota, Missouri, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, Tennessee, Utah, Vermont, Virginia, Washington, and West Virginia.
¶ Absolute rate change is the difference between 2019 and 2020 rates. Relative change is the absolute rate change divided by the 2019 rate, multiplied by 100.
** Rate ratio is calculated by dividing the rate for persons of race/ethnicities other than White by the rate for White persons. For example, the 2019 rate ratio for Black persons is determined by dividing their rate in 2019 by the rate of White persons in that same year.
†† Statistically significant (p value <0.05). Nonoverlapping CIs were used to assess statistical significance between 2019 and 2020. The method of comparing CIs is a conservative method for statistical significance; caution should be observed when interpreting a nonsignificant difference when the lower and upper limits being compared overlap only slightly.
§§ Cells with nine or fewer deaths are not reported. Rates based on <20 deaths are not considered reliable and are not reported.

among White (78.3%), AI/AN (77.4%), and Hispanic (74.8%) decedents (Table 2). However, the proportion of decedents with documented evidence of previous substance use treatment was low overall, with the lowest proportions among Black (8.3%), Hispanic (10.2%), and AI/AN (10.7%) decedents. Evidence of injection drug use was most prevalent among White (28.0%) and AI/AN (22.9%) decedents. Evidence of naloxone administration was highest among AI/AN (21.5%) decedents and lowest among A/PI (16.4%) decedents but was low in all groups.

In 2020, overdose death rates increased with increasing county-level income inequality ratios (the ratio of household income at the 80th percentile to income at the 20th percentile) across most racial/ethnic groups, but Black and Hispanic persons were disproportionally affected (Figure 1). Among Black persons, the overdose rate for counties with the highest income inequality (46.5) was more than twice that of counties with the lowest income inequality (19.3). In counties with the lowest income inequality, the rate was highest among AI/AN persons (35.2); in counties with the highest income inequality, the rate was highest among Black persons (46.5). Among Hispanic persons, the overdose rate in counties with the highest income inequality (28.1) was more than twice that of counties with the lowest income inequality (11.4).

Drug overdose death rates were higher in counties with a higher potential capacity for treatment of mental health conditions (based on mental health provider availability), and this varied by race and ethnicity. Among Black persons, the drug overdose rate during 2020 in areas with the highest mental health provider availability (46.7) was more than 2.5 times as high as the rate in areas with the lowest rate of providers (17.2) (Supplementary Figure 1, https://stacks.cdc.gov/view/cdc/118654).

In 2020, the rates of opioid-involved deaths among Black and AI/AN persons in counties with at least one opioid treatment program were more than twice those in counties without opioid treatment programs (Black = 34.3 versus 16.6; AI/AN = 33.4 versus 16.2) (Supplementary Figure 2, https://stacks.cdc.gov/view/cdc/118655). In addition, the opioid-involved death rate among Black persons in counties with higher potential buprenorphine capacity from DATA-waived providers (35.4) was nearly triple that in counties with low potential capacity (12.3). Among counties with higher potential treatment capacity, overdose death rates increased 49% among Black persons from 2019 (23.7) to 2020 (35.4) and 55% among AI/AN persons (from 20.7 to 32.1) compared with 19% among White persons (from 24.0 to 28.6) (Figure 2).

Discussion

This study highlights five critical findings on health disparities and inequities related to drug overdose deaths in the United States. First, from 2019 to 2020, disproportionate

TABLE 2. Characteristics of drug overdose deaths, overall and by race and Hispanic origin*,† — 25 states and the District of Columbia,§ 2019–2020

Characteristic¶	No. (%)					
	White	Black	AI/AN	A/PI	Hispanic	Total
Other substance use problem**	37,128 (78.3)	9,127 (74.0)	603 (77.4)	320 (71.0)	4,119 (74.8)	**52,052 (77.2)**
Treatment for substance use/misuse††	7,780 (16.4)	1,024 (8.3)	82 (10.7)	58 (12.9)	560 (10.2)	**9,621 (14.3)**
Bystander present	19,460 (41.0)	5,259 (42.7)	413 (53.0)	186 (41.2)	2,475 (44.9)	**28,246 (41.9)**
Naloxone administered	9,353 (19.7)	2,501 (20.3)	166 (21.5)	74 (16.4)	1,025 (18.6)	**13,311 (19.8)**
Recent relapse	3,895 (8.2)	424 (3.4)	48 (6.2)	18 (4.0)	350 (6.4)	**4,793 (7.1)**
Previous overdose	5,489 (11.6)	1,094 (8.9)	80 (10.3)	26 (5.8)	476 (8.6)	**7,256 (10.8)**
Recent release from jail	1,497 (3.2)	400 (3.2)	30 (3.9)	—§§	215 (3.9)	**2,173 (3.2)**
Current treatment for pain	4,453 (9.4)	810 (6.6)	65 (8.4)	20 (4.4)	293 (5.3)	**5,709 (8.5)**
Evidence of injection	13,255 (28.0)	1,366 (11.1)	177 (22.9)	77 (17.1)	1,075 (19.5)	**16,188 (24.0)**

Source: SUDORS.

Abbreviations: A/PI = Asian or Pacific Islander; AI/AN = American Indian or Alaska Native; SUDORS = State Unintentional Drug Overdose Reporting System.

* Totals include persons who are multiracial or have an unknown race and ethnicity.

† A/PI, AI/AN, Black, and White persons were non-Hispanic. Hispanic persons could be of any race. Data for Hispanic origin should be interpreted with caution; studies comparing Hispanic origin on death certificates and on U.S. Census Bureau census surveys have shown inconsistent reporting on Hispanic ethnicity. Potential race misclassification might lead to underestimates for certain categories, primarily non-Hispanic A/PI and non-Hispanic AI/AN decedents. https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf

§ Includes 26 jurisdictions with complete data in 2019 and 2020: Alaska, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Kentucky, Maine, Massachusetts, Minnesota, Missouri, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, Tennessee, Utah, Vermont, Virginia, Washington, and West Virginia. Analysis of circumstance data was limited to cases with a medical examiner/coroner report and focused primarily on the most common characteristics of drug overdose deaths. Data for July–December 2020 for Tennessee were not included because the overall percentage of decedents with a medical examiner or coroner report was <75%, which is the cutoff used in SUDORS for inclusion in analyses of overdose circumstances.

¶ Missing values were excluded from calculations of percentages. Percentages might not sum to 100% because of rounding. A total of 445 decedents were of an unknown race/ethnicity.

** Includes documented evidence of a substance use disorder for substances other than alcohol.

†† Includes documented evidence of past or current substance use disorder treatment.

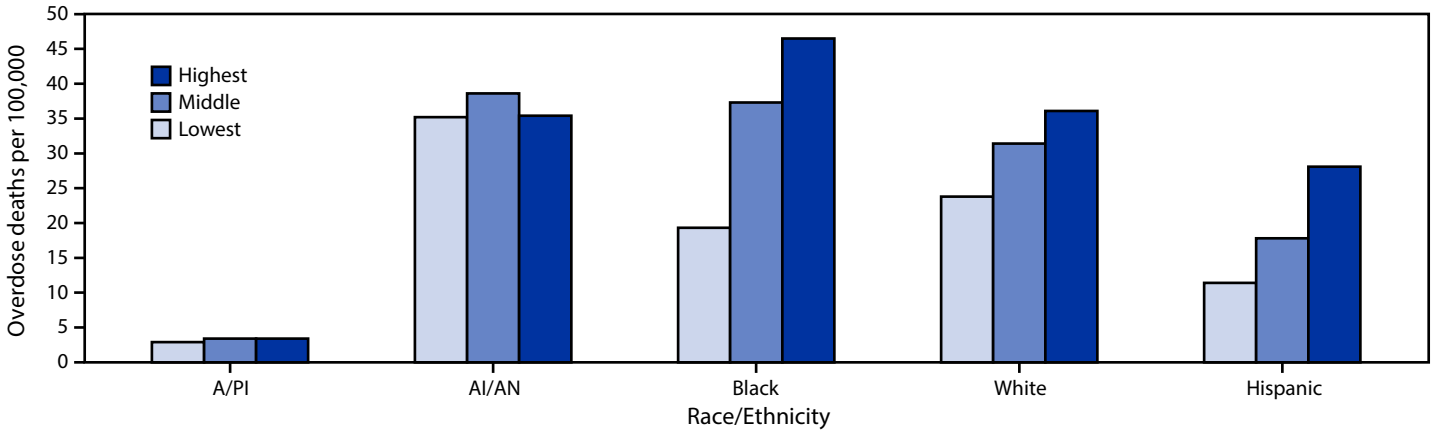
§§ Cells with nine or fewer deaths are not reported.

increases occurred among Black (44%) and AI/AN (39%) persons compared with those among White persons (22%). Among demographic subgroups, the rate among Black males aged ≥65 years increased to nearly seven times that of White males of the same age, and the rate among AI/AN females aged 25–44 years increased to nearly twice that of White females of the same age in 2020. Second, drug overdose death rates increased with increasing county-level income inequality, particularly among Black persons, among whom the overdose death rate was more than twice as high in areas with the highest income inequality as in areas with the lowest income inequality. Third, evidence of previous substance use treatment was lowest among Black decedents and approximately one half that of White decedents. Fourth, overdose death rates were highest in counties with higher potential substance use treatment capacity and mental health providers, and rates were more pronounced among Black and AI/AN persons than among White persons, likely associated with long-standing inequities in access to mental health and substance use care, including medications for opioid use disorder. Finally, evidence of naloxone administration was highest among AI/AN (21.5%) decedents and lowest among A/PI (16.4%) decedents but was low in all groups. These findings can help guide the implementation of equitable overdose prevention and response efforts.

Prioritizing prevention and substance use disorder treatment for persons in areas with higher economic inequities is particularly important for certain groups. Higher drug use has been reported in areas with more economic distress, which increases the risk for fatal overdose (*12*). Further, impacts of income inequality (e.g., housing instability, transportation access, and insurance status), long-standing mistrust in the health care system, stigma, and bias contribute to treatment access barriers (*12–14*). In this analysis, Black decedents were the least likely racial or ethnic group to have evidence of substance use treatment, and 2020 overdose rates were highest among Black and AI/AN persons in areas with high treatment provider availability. Although high-prevalence areas might have a greater proportion of treatment services, this higher potential treatment capacity might not reflect treatment services that are accessible to community members, especially in counties that cover large geographic areas. The clustering of providers in denser population centers could result in transportation barriers for persons residing in less populated areas of the county.[¶¶] Structural and policy-level interventions are essential to address these access barriers. These include expanding linkage to and retention in care, equitable access to treatment (e.g., medication

[¶¶] https://oig.hhs.gov/oei/reports/oei-12-17-00240.pdf

FIGURE 1. Age-adjusted rates* of drug overdose deaths, by race/ethnicity[†] and income inequality ratio[§] — 25 states and the District of Columbia,[¶] 2020



Abbreviations: A/PI = Asian or Pacific Islander; AI/AN = American Indian or Alaska Native.

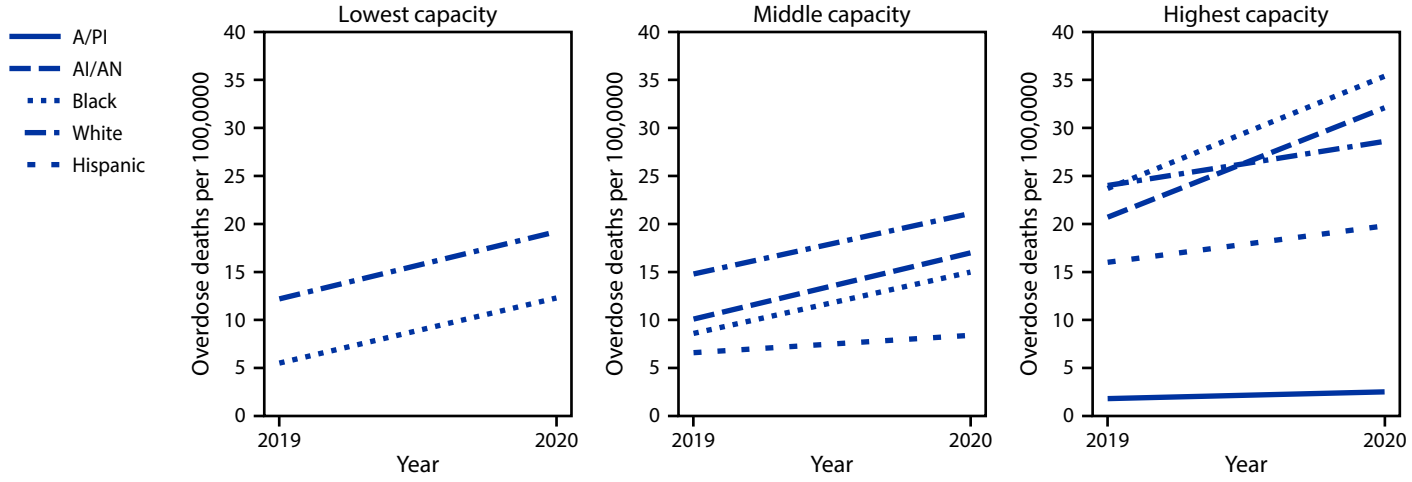
* Rates (overdose deaths per 100,000 population) age-adjusted to the 2000 U.S. standard population using the vintage year population of the data year.

† A/PI, AI/AN, Black, and White persons are non-Hispanic; Hispanic persons could be of any race. Data for Hispanic origin should be interpreted with caution; studies comparing Hispanic origin on death certificates and on U.S. Census Bureau surveys have shown inconsistent reporting on Hispanic ethnicity. Potential race misclassification might lead to underestimates for certain categories, primarily non-Hispanic A/PI and non-Hispanic AI/AN decedents. https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf

§ The 2021 County Health Rankings used data from the 2015–2019 American Community Survey for the income inequality ratio. Income inequality is defined as the ratio of household income at the 80th percentile to income at the 20th percentile (i.e., when the incomes of all households in a county are listed from highest to lowest, the 80th percentile is the level of income at which only 20% of households have higher incomes, and the 20th percentile is the level of income at which only 20% of households have lower incomes). A higher inequality ratio indicates greater division between the top and bottom ends of the income spectrum. The specific ranges for income inequality groups are defined as lowest (2.7–4.1), middle (4.2–4.7), and highest (4.8–10.5).

¶ Alaska, Connecticut, Delaware, District of Columbia, Georgia, Kentucky, Maine, Massachusetts, Minnesota, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, Tennessee, Utah, Vermont, Virginia, and West Virginia were funded to report cause of death data on all overdose deaths within the jurisdiction in 2019 and 2020. Illinois, Missouri, Pennsylvania, and Washington were funded to report cause of death data on ≥75% of all overdose deaths within a jurisdiction in 2019 and 2020. Jurisdictions were included in rate calculations if they met data submission deadlines and addressed data entry errors in 2019 and 2020.

FIGURE 2. Changes in age-adjusted* rates† of opioid overdose deaths, by race/ethnicity§ and Drug Addiction Treatment Act–waived provider capacity¶ tertile — 25 states and the District of Columbia, 2019–2020**



Abbreviations: A/PI = Asian or Pacific Islander; AI/AN = American Indian or Alaska Native; DATA = Drug Addiction Treatment Act.

* Rates (overdose deaths per 100,000 population) age-adjusted to the 2000 U.S. standard population using the vintage year population of the data year.

† Rates based on <20 deaths are not considered reliable and not reported. This suppression rule applied to A/PI and AI/AN persons in the lowest-capacity tertile as well as A/PI persons in the medium-capacity tertile for 2019 and 2020. The suppression rule also applied to Hispanic persons in the lowest-capacity tertile in 2019; however, the age-adjusted rate for Hispanic persons in 2020 (8.9 per 100,000) was not presented because it could not be compared with a 2019 rate.

§ A/PI, AI/AN, Black, and White persons are non-Hispanic; Hispanic persons could be of any race. Data for Hispanic origin should be interpreted with caution; studies comparing Hispanic origin on death certificates and on U.S. Census Bureau surveys have shown inconsistent reporting of Hispanic ethnicity. Potential race misclassification might lead to underestimates for certain categories, primarily non-Hispanic A/PI and non-Hispanic AI/AN decedents. https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf

¶ In 2000, DATA granted waivers to qualified physicians to prescribe buprenorphine in in-office settings for opioid use disorder treatment. In 2016, the Comprehensive Addiction and Recovery Act permitted nurse practitioners and physician assistants to obtain DATA waivers to prescribe buprenorphine. DATA-waived clinicians can provide office-based opioid treatment to 30, 100, or 275 patients at a given time. Potential treatment capacity was calculated by multiplying the number of DATA-waived providers by their maximum patient limit (30, 100, or 275 patients) and presented by tertile. The specific ranges for DATA-waived provider capacity are lowest capacity (0–119), middle capacity (120–769), and highest capacity (770–64,105).

** Alaska, Connecticut, Delaware, District of Columbia, Georgia, Kentucky, Maine, Massachusetts, Minnesota, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, Tennessee, Utah, Vermont, Virginia, and West Virginia were funded to report cause of death data on all overdose deaths within the jurisdiction in 2019 and 2020. Illinois, Missouri, Pennsylvania, and Washington were funded to report cause of death data on ≥75% of all overdose deaths within a jurisdiction in 2019 and 2020. Jurisdictions were included in rate calculations if they met data submission deadlines and addressed data entry errors in 2019 and 2020.

for opioid use disorder) and behavioral health interventions, and harm reduction services (e.g., naloxone, comprehensive syringe services programs, and fentanyl test strips).

The COVID-19 pandemic has highlighted long-neglected disparities in access to and provision of health care among AI/AN, Black, and Hispanic persons (*11*). The findings in this report underscore the increasing impact of the escalating overdose crisis on these populations. More stigmatization, criminalization, and lack of access to evidence-based treatments among racial/ethnic minority groups with substance use disorders have been well-documented (*15*). These barriers might further elucidate the disparities observed in reported history of substance use treatment and overdose death rates by income inequality and mental health provider availability among Black and AI/AN persons. For example, Black persons have more limited access to buprenorphine treatment than do White persons, and in AI/AN communities underfunding of tribal clinics has affected the availability of mental health treatment (*9*,*14*). In addition, polysubstance use and the increasing proliferation of IMFs in the drug supply have exacerbated the surge in overdose deaths (*5*).

Prevention efforts must rapidly incorporate existing, evidence-based, culturally responsive interventions that address polysubstance use and social determinants of health to reduce inequities around prevention, treatment, and harm reduction. Integration of evidence-based substance use disorder treatment with culturally tailored traditional practices, spirituality, and religion might improve treatment acceptance among Black and AI/AN populations (*16*,*17*,*18*). Culturally specific awareness campaigns, employment in nontraditional and community settings, and trusted community prevention messengers to assist with linkages to treatment and harm reduction services could reduce stigma and mistrust as well as improve access and provision of care (*18*,*19*). In addition, expanding the current evidence base to address upstream drivers of inequity and implementing primary prevention efforts that focus on

Summary

What is already known about this topic?

Drug overdose deaths increased 30% in the United States from 2019 to 2020. Known health disparities exist in overdose mortality rates, particularly among certain racial/ethnic minority populations.

What is added by this report?

From 2019 to 2020, overdose death rates increased by 44% and 39% among non-Hispanic Black (Black) and non-Hispanic American Indian or Alaska Native persons, respectively. As county-level income inequality increased, overdose rates increased, particularly among Black persons. Evidence of previous substance use treatment was lowest for Black decedents (8.3%).

What are the implications for public health practice?

Implementation of an evidence-based, culturally responsive, multisectoral approach is critical to reducing disparities in overdose rates. This includes addressing structural barriers and enhancing efforts such as linkage to care and harm reduction services.

adverse childhood experiences that predispose persons to risk for substance use and substance use disorder as well as implementing trauma-informed care and services are critical.[***]

The findings in this report are subject to at least four limitations. First, analyses were limited to 26 jurisdictions reporting data to SUDORS, do not include all overdose deaths in the United States, and might not be generalizable. Second, overdose circumstance data are limited to information provided in investigative reports; therefore, overdose risk factors might be underestimated. Third, potential race and ethnicity misclassification might underestimate rates for certain populations, primarily Hispanic, AI/AN, and A/PI persons.[†††] Finally, because of low counts, rates for multiracial groups were not included in analyses.

Provisional estimates indicate continued increases in drug overdose deaths in 2021 (*20*). Health disparities and inequities are likely exacerbating these increases, particularly among racial/ethnic minority groups. Drug overdoses are preventable, and rapidly scaling up multisectoral, culturally responsive prevention efforts across federal, state, local, and tribal entities that place equity as a central tenet to address the escalating overdose crisis is urgently needed.

[***] https://www.cdc.gov/violenceprevention/pdf/preventingACES.pdf

[†††] The categorization of race and ethnicity in SUDORS data was limited to the following classifications: American Indian or Alaska Native, Asian or Pacific Islander, Black, White, Hispanic, Multiracial, and Other. Separating the Hispanic category into different racial groups was not performed because it would yield small numbers and the inability to calculate stable rates.

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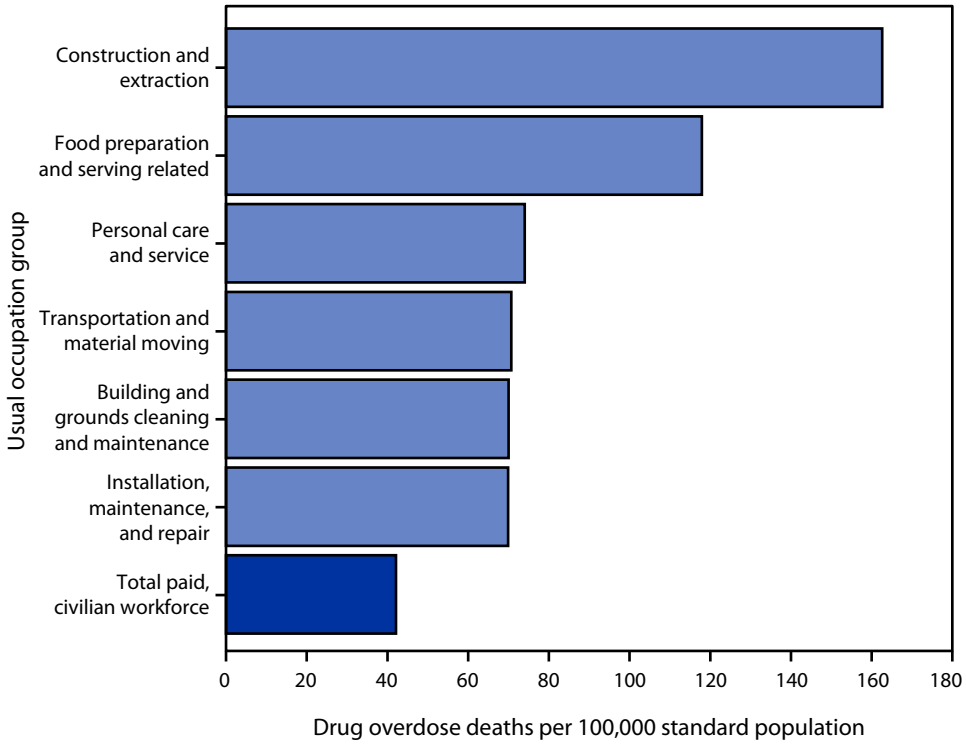
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Drug Overdose Death Rates* Among Workers Aged 16–64 Years in Usual Occupation† Groups with the Highest Drug Overdose Death Rates — National Vital Statistics System, United States,§ 2020



* Age-adjusted death rates are per 100,000 standard population. Deaths from drug overdoses were classified using *International Classification of Diseases, Tenth Revision* codes X40–X44, X60–X64, X85, and Y10–Y14. The denominators for these rates are paid, civilian worker populations aged 16–64 years in each usual occupation group, estimated using the April 2020 vintage population in the Current Population Survey Basic Monthly Public Use Microdata Custom Table generator.

† The U.S. Standard Certificate of Death records usual occupation, or the occupation in which the decedent spent most of their working life, as a free-text narrative. Usual occupation narratives were coded to standardized 2012 Census Occupation Codes, then collapsed into 22 broad occupation groups. Decedents with unpaid or military usual occupations were excluded.

§ Occupation data for deaths among 46 states and New York City; data not available for Arizona, Iowa, North Carolina, Rhode Island, and the District of Columbia.

In 2020, the age-adjusted drug overdose death rate among workers with paid, civilian usual occupations was 42.1 deaths per 100,000. Drug overdose death rates were highest among workers in the following occupations: construction and extraction (162.6); food preparation and serving related (117.9); personal care and service (74.0); transportation and material moving (70.7); building and grounds cleaning and maintenance (70.0); and installation, maintenance, and repair (69.9).

Source: National Vital Statistics System, Mortality Data. https://www.cdc.gov/nchs/deaths.htm

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For more information on this topic, CDC recommends the following links: https://www.cdc.gov/drugoverdose/deaths/index.html and https://www.cdc.gov/niosh/topics/opioids/default.html

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