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Respiratory Virus Surveillance Among Children with Acute Respiratory Illnesses — New Vaccine Surveillance Network, United States, 2016–2021

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The New Vaccine Surveillance Network (NVSN) is a prospective, active, population-based surveillance platform that enrolls children with acute respiratory illnesses (ARIs) at seven pediatric medical centers. ARIs are caused by respiratory viruses including influenza virus, respiratory syncytial virus (RSV), human metapneumovirus (HMPV), human parainfluenza viruses (HPIVs), and most recently SARS-CoV-2 (the virus that causes COVID-19), which result in morbidity among infants and young children (*1*–*6*). NVSN estimates the incidence of pathogen-specific pediatric ARIs and collects clinical data (e.g., underlying medical conditions and vaccination status) to assess risk factors for severe disease and calculate influenza and COVID-19 vaccine effectiveness. Current NVSN inpatient (i.e., hospital) surveillance began in 2015, expanded to emergency departments (EDs) in 2016, and to outpatient clinics in 2018. This report describes demographic characteristics of enrolled children who received care in these settings, and yearly circulation of influenza, RSV, HMPV, HPIV1–3, adenovirus, human rhinovirus and enterovirus (RV/EV),* and SARS-CoV-2 during December 2016–August 2021. Among 90,085 eligible infants, children, and adolescents aged <18 years† (children) with ARI, 51,441 (57%) were enrolled, nearly 75% of whom were aged <5 years; 43% were hospitalized. Infants aged <1 year accounted for the largest

*Diagnostic assays used for RV/EV might detect only rhinovirus, only enterovirus, or rhinovirus and enterovirus combined.

†Surveillance sites in Kansas City, Pittsburgh, and Seattle restricted ED enrollment primarily to children aged <5 years annually during winter–spring (2016–2019).

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proportion (38%) of those hospitalized. The most common pathogens detected were RV/EV and RSV. Before the emergence of SARS-CoV-2, detected respiratory viruses followed previously described seasonal trends, with annual peaks of influenza and RSV in late fall and winter (*7*,*8*). After the emergence of SARS-CoV-2 and implementation of associated pandemic nonpharmaceutical interventions and community mitigation measures, many respiratory viruses circulated at lower-than-expected levels during April 2020–May 2021. Beginning in summer 2021, NVSN detected higher than anticipated enrollment of hospitalized children as well as atypical interseasonal circulation of RSV. Further analyses of NVSN data and continued surveillance are vital in highlighting risk factors for severe disease and health disparities, measuring the effectiveness of vaccines and monoclonal antibody–based prophylactics, and guiding policies to protect young children from pathogens such as SARS-CoV-2, influenza, and RSV.

During December 1, 2016–August 31, 2021, NVSN enrolled children aged <18 years in inpatient and ED settings at seven surveillance sites (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/121550). Children were eligible for enrollment if they had an illness duration of <14 days, were enrolled within 48 hours of admission (inpatient only), had at least one qualifying ARI sign or symptom (e.g., apnea, cough, earache, fever, myalgia, nasal congestion, runny nose, sore throat, vomiting after coughing, shortness of breath [rapid or shallow breathing], wheezing, or apparent life-threatening event or brief resolved unexplained event), and resided in a surveillance site area.[§] Children were excluded if they had a known nonrespiratory cause for hospitalization, had fever and neutropenia from chemotherapy, were admitted <5 days after a previous hospitalization, were transferred from another hospital after an admission of >48 hours, were a newborn who had never been discharged home from the hospital, or had previously enrolled in this study <14 days before their current visit or hospitalization. Children could be enrolled in inpatient units ≥5 days per week and in the ED ≥4 days per week for ≥6 hours per day.

Outpatient clinic enrollment began in November 2018, with enrollment limited to children aged <2 years and testing for RSV only. Enrollment and testing were later expanded to include children aged <18 years and multipathogen testing.[¶] Outpatient enrollment was paused during May–October 2019, and weekly enrollment targets of approximately 150 patients were required before July 2020. Outpatient eligibility and exclusion criteria differed slightly from that of other clinical

[§] The seven U.S. pediatric medical center NVSN surveillance sites were in Cincinnati, Ohio; Houston, Texas; Kansas City, Missouri; Nashville, Tennessee; Pittsburgh, Pennsylvania; Rochester, New York; and Seattle, Washington.

[¶] Outpatient enrollment of children aged <2 years began in November 2018 and expanded to enroll children aged <18 years during July–August 2020; testing in outpatient settings expanded from RSV alone to multipanel testing in November 2019.

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settings.** Beginning in April 2020, outpatient surveillance was expanded in Houston, Texas to include drive-through testing for SARS-CoV-2 (*9*). Data in this report are summarized by highest level of care received by each child, irrespective of the child's enrollment setting.

Midturbinate (MT) nasal or oropharyngeal (OP) specimens were obtained using flocked swabs; if both nasal and OP swabs were collected, they were combined and placed in universal transport medium. A tracheal aspirate was accepted as an alternative specimen for patients who were intubated. Among patients from whom research MT nasal and OP or tracheal aspirate specimens could not be obtained, clinically obtained respiratory specimens were salvaged.†† Specimens were transported to the laboratory at each site and stored at a temperature of 35.6°F–46.4°F (2°C–8°C) until they were processed (within 72 hours). Specimen aliquots were subsequently frozen at –94°F (–70°C) or lower. Specimens underwent molecular testing at each study site for respiratory pathogens including RSV, influenza, HMPV, HPIV1–3, RV/EV, and adenovirus. SARS-CoV-2 surveillance and associated testing methodologies§§ began in 2020.¶¶ Molecular diagnostic assay methods used for respiratory pathogens varied by site (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/121551) (Supplementary Table 3, https://stacks.cdc.gov/view/cdc/121552. All assays met CDC-sponsored proficiency testing standards.

Pearson's chi-square tests compared the percentage of positive results during the 2020–2021 season against previous seasons combined, among inpatients and those treated in the ED. All analyses were performed using SAS software (version 9.4; SAS Institute). Informed consent was obtained from a parent or legal guardian of eligible children before conducting a standardized parent or guardian interview; medical chart review; and collection, testing, and storage of respiratory specimens. Assent from eligible children was obtained at each site, according to local regulations. This study was reviewed and approved by the institutional review boards at each of the seven study sites.***

During December 2016–August 2021, a total of 90,085 eligible children with ARI were identified and 51,441 (57%) were enrolled. Within the highest clinical care setting received, enrolled children included 22,093 (43%) inpatients, 23,145 (45%) patients evaluated in the ED, and 6,203 (12%) evaluated in outpatient clinics (Table 1). Among all enrolled children,

** In general, children were eligible for enrollment if they met some of the same criteria as inpatient and ED patients, which included apnea, myalgia, vomiting after coughing, or apparent life-threatening event or brief resolved unexplained event. Outpatient exclusion criteria also differed; children were excluded if they were seen at an outpatient, inpatient, or ED setting <5 days after an acute respiratory illness, or had been enrolled as outpatients within the previous 4 days.

†† Surveillance sites were provided with instructions on how to properly obtain respiratory specimens and a list of specimen types that might be acceptable to use when a clinical salvage was the only option (i.e., tracheal aspirate, MT, OP, bronchoalveolar lavage, sputum, or nasal wash). Investigators were asked to consult with CDC to determine acceptability of clinically salvaged specimens.

§§ SARS-CoV-2 research testing began during March–April 2020 and was not implemented systematically during the onset of the pandemic because of suspension of enrollment and surveillance activities for 1–3 weeks across sites.

¶¶ Each site performed retrospective SARS-CoV-2 testing on respiratory specimens from children who were enrolled and had specimens collected beginning either January 1 or February 1, 2020.

*** 45 C.F.R. part 46; 21 C.F.R. part 56.

TABLE 1. Demographic characteristics of enrolled children and adolescents aged <18 years, by highest level of care setting — New Vaccine Surveillance Network, United States, December 2016–August 2021*,†

Characteristic	Highest care level setting, no. (column %)			
	All	Inpatient	ED†	Outpatient§
Overall	**51,441 (100.0)**	**22,093 (100.0)**	**23,145 (100.0)**	**6,203 (100.0)**
Age group				
0–11 mos	**15,986 (31.1)**	8,280 (37.5)	6,150 (26.6)	1,556 (25.1)
12–23 mos	**10,339 (20.1)**	4,023 (18.2)	4,997 (21.6)	1,319 (21.3)
24–59 mos	**11,942 (23.2)**	4,356 (19.7)	6,433 (27.8)	1,153 (18.6)
5–17 yrs	**13,174 (25.6)**	5,434 (24.6)	5,565 (24.0)	2,175 (35.1)
Sex				
Male	**28,473 (55.4)**	12,623 (57.1)	12,639 (54.6)	3,211 (51.8)
Female	**22,967 (44.7)**	9,470 (42.9)	10,506 (45.4)	2,991 (48.2)
Unknown	**1 (0.0)**	0 (—)	0 (—)	1 (0.0)
Race or ethnicity				
Black or African American, non-Hispanic	**16,582 (32.3)**	5,249 (23.8)	9,879 (42.7)	1,454 (23.4)
Hispanic or Latino	**13,771 (26.8)**	5,476 (24.8)	6,012 (26.0)	2,283 (36.8)
Other	**4,615 (9.0)**	2,135 (9.7)	1,863 (8.1)	617 (10.0)
White, non-Hispanic	**16,028 (31.2)**	9,042 (40.9)	5,214 (22.5)	1,772 (28.6)
Unknown	**445 (0.8)**	191 (0.7)	177 (0.8)	77 (1.2)

Abbreviations: ED = emergency department; RSV = respiratory syncytial virus.

* Among ED surveillance sites, enrollment was restricted to children aged <5 years during the following periods: Seattle during December 2016–June 2017, November 2017–June 2018, November 2018–June 2019, and December 2019–March 2020; Pittsburgh during December 2016–June 2018, November 2018–June 2019, and December 2019–March 2020; Kansas City during December 2016–June 2017, November 2017–June 2018, and November 2018–June 2019.

† Outpatient enrollment began in November 2018, paused during May–October 2019, and resumed with enrolled children aged <2 years during November 2018–July 2020; RSV testing was prioritized during November 2018–April 2019.

38,267 (74%) were aged <5 years, 15,986 (42%) of whom were aged <1 year. The majority of enrolled children (55%) were male; 32% were non-Hispanic Black or African American (Black), 31% were non-Hispanic White (White) and 27% were Hispanic or Latino (Hispanic) children. Among hospitalized children, 8,280 (38%) were aged <1 year, 12,623 (57%) were male, and 9,042 (41%) were White.

Across all settings, 32,259 (63%) specimens had at least one viral pathogen detected, 4,492 (9%) had more than one viral pathogen detected, and 19,182 (37%) had no viral pathogen detected. The pathogens most frequently detected were RV/EV (14,906; 31%) and RSV (8,461; 17%) (Table 2). Total proportions for each virus varied by setting; RSV was detected most frequently in inpatient settings (24%), influenza in EDs (11%), and RV/EV in outpatient clinics (39%). During the COVID-19 pandemic period (March 2020–August 31, 2021), 1,171 (7%) children received a positive SARS-CoV-2 test result, 411 (35%) of whom were outpatients. During the 2020–2021 season (September 15, 2020–August 31, 2021), lower total proportions of test results were positive for seasonal viruses compared with previous seasons combined among inpatient and ED settings, except for HPIV1–3 (8%) and RV/EV (36%) (p<0.001). Enrollment during December 2016–February 2020, peaked in inpatient and ED settings, with concurrent peaks in RSV and influenza detections. Other viruses such as adenovirus and HMPV circulated throughout this period, but smaller peaks occurred later in winter and early spring (Figure). After onset of the COVID-19 pandemic in March 2020, inpatient and ED enrollment did not follow previously observed seasonal patterns; enrollment and virus circulation during winter months of 2020 was lower than expected and a distinct peak in RSV circulation and overall enrollment occurred during summer months of 2021.

Discussion

During 2016–2021, approximately 51,000 children with ARI were prospectively enrolled in NVSN. Nearly 75% of enrolled children were aged <5 years, and children aged <1 year accounted for approximately one third of those hospitalized, consistent with previous studies among this age group (*1*–*5*). NVSN enrollees were racially and ethnically diverse, with nearly one third being Black children followed by slightly lower percentages of White and Hispanic children. Before the COVID-19 pandemic, seasonal patterns of respiratory virus circulation followed previously described trends, including annual peaks of influenza and RSV during late fall and winter months (*7*,*8*). RV/EV and RSV were the most frequently detected viruses in children in all settings; however, by setting, RSV was more commonly detected among hospitalized children than it was in ED or outpatient clinics. During the 2020–2021 season, the total proportion of seasonal respiratory viruses was lower than that during previous seasons for all except HPIV1–3 and RV/EV. These declines support previous studies, which postulated that community mitigation measures (e.g., school and child care facility closures) during the COVID-19 pandemic had contributed to decreased circulation of respiratory viruses such as influenza and RSV (*10*). Pandemic period enrollment did not follow seasonal trends,

TABLE 2. Respiratory virus detections* among enrolled children and adolescents aged <18 years, by highest level of care setting and surveillance season† — New Vaccine Surveillance Network, United States, December 2016–August 2021

	Viral pathogen, no. (column %)						
	Adenovirus	Influenza	HMPV	HPIV1–3	RSV	RV/EV	SARS-CoV-2§
Characteristic	**N = 48,859**	**N = 49,045**	**N = 48,859**	**N = 48,859**	**N = 49,994**	**N = 48,847**	**N = 16,386**
Highest care setting							
Inpatient	872 (4.1)	1,122 (5.2)	930 (4.3)	1,081 (5.0)	5,085 (23.7)	6,551 (30.6)	377 (7.1)
ED	1,622 (7.2)	2,451 (10.8)	960 (4.2)	1,903 (8.4)	2,936 (12.9)	6,493 (28.6)	383 (5.9)
Outpatient¶	122 (2.6)	75 (1.5)	47 (1.0)	195 (4.1)	440 (7.6)	1,862 (39.3)	411 (9.0)
Surveillance season							
2016–2017	600 (6.0)	797 (8.0)	565 (5.7)	696 (7.0)	1,803 (18.1)	2,888 (29.1)	NA
2017–2018	538 (6.3)	856 (10.1)	451 (5.3)	599 (7.0)	1,512 (17.8)	2,618 (30.8)	NA
2018–2019	643 (6.8)	816 (8.6)	524 (5.5)	784 (8.2)	1,859 (17.9)	3,023 (31.8)	NA
2019–2020	458 (5.1)	1,169 (12.7)	368 (4.1)	166 (1.8)	1,845 (20.0)	2,108 (23.4)	258 (6.8)
2020–2021	377 (3.2)	10 (0.1)	29 (0.3)	934 (7.9)	1,442 (12.1)	4,269 (35.9)	913 (7.3)
All years	**2,616 (5.4)**	**3,648 (7.4)**	**1,937 (4.0)**	**3,179 (6.5)**	**8,461 (16.9)**	**14,906 (30.5)**	**1,171 (7.1)**

Abbreviations: ED = emergency department; HMPV = human metapneumovirus; HPIV1–3 = human parainfluenza virus types 1–3; NA = not applicable; RSV = respiratory syncytial virus; RV/EV = rhinovirus and enterovirus.

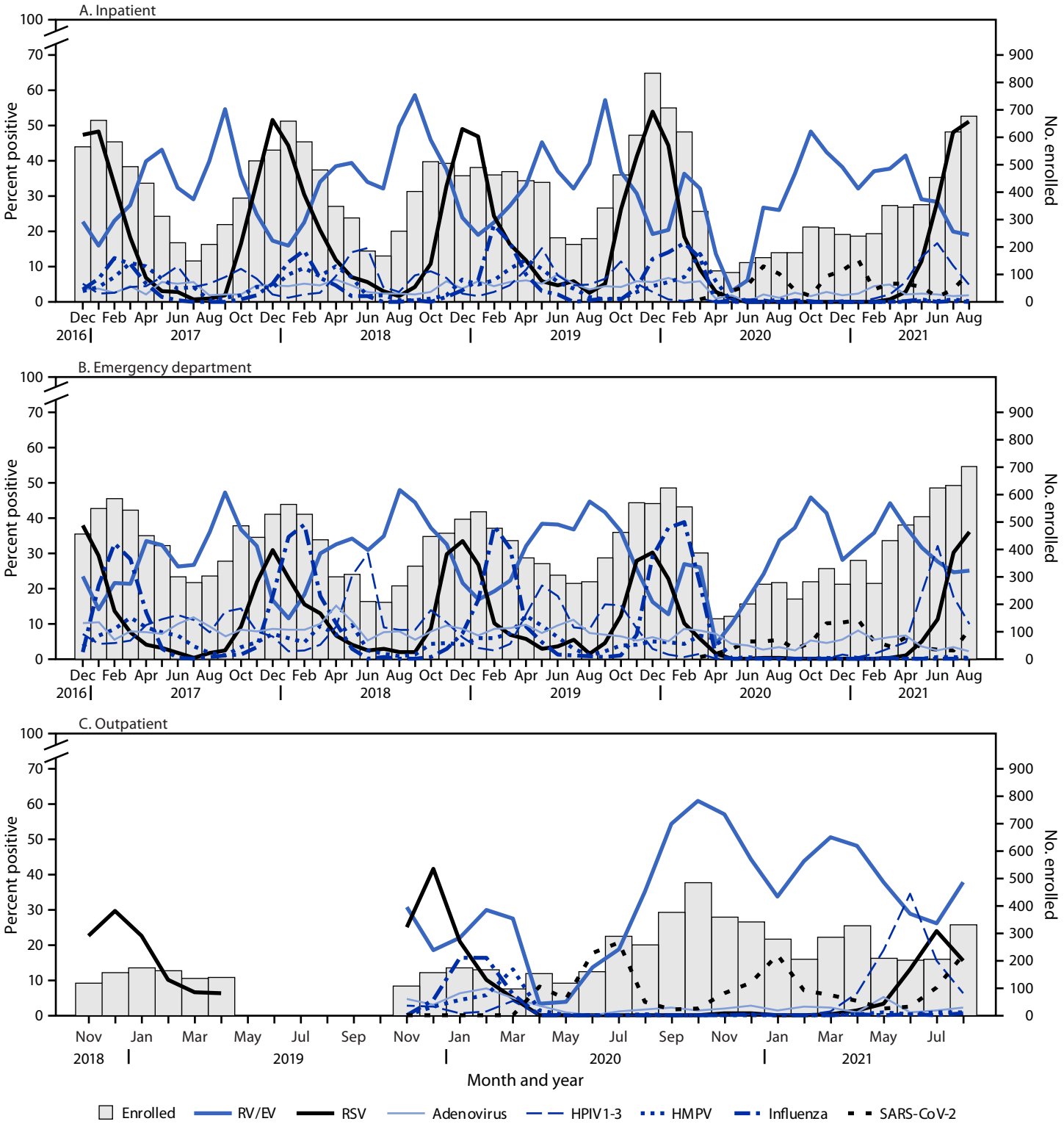
* Respiratory virus detection results are from research swab specimens that underwent molecular testing, except for SARS-CoV-2, which included both research and clinical specimens to most accurately represent viral detections across surveillance years. Denominators for positivity rates are pathogen-specific.

† Surveillance seasons during 2016–2017 were December 1, 2016–November 30, 2017; 2017–2018: December 1, 2017–October 31, 2018; 2018–2019: November 1, 2018–October 31, 2019; 2019–2020: November 1, 2019–September 14, 2020; 2020–2021: September 15, 2020–August 31, 2021.

§ SARS-CoV-2 was first detected in 2020, test results for SARS-CoV-2 reported in this table are from the pandemic period (March 2020–August 2021); surveillance years 2016–2017 through 2018–2019 were not applicable.

¶ Outpatient data were not included for seasons 2016–2017 and 2017–2018 because outpatient enrollment did not begin until November 2018.

FIGURE. Respiratory virus detections among enrolled children and adolescents aged <18 years with research tested specimens, by highest level of care in inpatient (A), emergency department (B), and outpatient (C) settings — New Vaccine Surveillance Network, United States, December 2016–August 2021*,†,§



Abbreviations: ED = emergency department; HPMV = human metapneumovirus; HPIV = HPIV1–3 = human parainfluenza virus types 1–3; RSV = respiratory syncytial virus; RV/EV = rhinovirus and enterovirus.

* Outpatient enrollment began in November 2018, paused during May–October 2019, and resumed with enrolled children aged <2 years during November 2018–July 2020; RSV testing was prioritized during November 2018–April 2019.

† SARS-CoV-2 detections only included research positive test results for consistency across pathogens; therefore, total detections are underrepresented.

§ Surveillance was paused at these sites during the COVID-19 pandemic: Cincinnati (inpatient: March 25–30, 2020; ED: March 24–30, 2020; and outpatient: March 25, 2020); Seattle (outpatient: March 2–12, 2020 and March 13–31, 2020); Houston (inpatient, ED, and outpatient: March 23–31, 2020); Kansas City (inpatient: March 18–29, 2020; ED: March 18–28, 2020; outpatient: March 18–31, 2020); and Pittsburgh (inpatient and ED: March 22–29, 2020 and outpatient: March 13–31, 2020).

Summary

What is already known about this topic?

Acute respiratory illness (ARI) caused by viruses including respiratory syncytial virus (RSV) and SARS-CoV-2 (the virus that causes COVID-19) results in pediatric morbidity.

What is added by this report?

Rhinovirus and enterovirus and RSV were the most frequently detected viruses among children enrolled in the New Vaccine Surveillance Network during 2016–2021 through inpatient, outpatient, and emergency department settings. Throughout the COVID-19 pandemic, respiratory viruses exhibited uncharacteristic seasonality, with lower-than-expected circulation during April 2020–May 2021, and atypical RSV circulation and inpatient enrollment in summer 2021.

What are the implications for public health practice?

Continued ARI surveillance is critical as vaccines and therapeutics are introduced to protect children from SARS-CoV-2 and RSV to elucidate risk factors, health disparities, and to guide prevention policies.

with a notable increase in inpatient and ED enrollments during summer months of 2021. This increase was largely associated with the return of RSV after nearly a year without community circulation.

The findings in this report are subject to at least four limitations. First, NVSN data are limited to enrolled and consented participants who might not be representative of all children seeking care at a healthcare facility. Second, although NVSN surveillance sites are located across the United States, they might not be representative of the entire country. Third, outpatient clinic surveillance differed from the more consistent inpatient and ED surveillance in several ways, including a later start date, prioritized RSV testing during first year of enrollment, paused enrollment during May 2019–October 2019, and age restrictions in several sites, making it difficult to establish trends during the surveillance period. Finally, new approaches to outpatient surveillance (e.g., drive-through clinics) were implemented during the COVID-19 pandemic, which affected enrollment and proportion of positive SARS-CoV-2 test results in this setting.

Prospective ARI surveillance in NVSN measured seasonal trends in respiratory virus circulation before and during the COVID-19 pandemic. These data have the potential to estimate population-based rates of SARS-CoV-2, RSV, and other respiratory virus hospitalizations, ED, and outpatient visits. Further analyses of NVSN data and continued surveillance are vital in highlighting risk factors for severe disease and health disparities, measuring the effectiveness of vaccines and monoclonal antibody–based prophylactics, and guiding policies to protect young children from pathogens such as SARS-CoV-2, influenza, and RSV.

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Preliminary Incidence and Trends of Infections Caused by Pathogens Transmitted Commonly Through Food — Foodborne Diseases Active Surveillance Network, 10 U.S. Sites, 2016–2021

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To evaluate progress toward prevention of enteric infections in the United States, the Foodborne Diseases Active Surveillance Network (FoodNet) conducts active population-based surveillance for laboratory-diagnosed infections caused by *Campylobacter*, *Cyclospora*, *Listeria*, *Salmonella*, Shiga toxin-producing *Escherichia coli* (STEC), *Shigella, Vibrio*, and *Yersinia* at 10 U.S. sites. This report summarizes preliminary 2021 data and describes changes in annual incidence compared with the average annual incidence for 2016–2018, the reference period for the U.S. Department of Health and Human Services' (HHS) Healthy People 2030 goals for some pathogens (*1*). During 2021, the incidence of infections caused by *Salmonella* decreased, incidence of infections caused by *Cyclospora*, *Yersinia*, and *Vibrio* increased, and incidence of infections caused by other pathogens did not change. As in 2020, behavioral modifications and public health interventions implemented to control the COVID-19 pandemic might have decreased transmission of enteric infections (*2*). Other factors (e.g., increased use of telemedicine and continued increase in use of culture-independent diagnostic tests [CIDTs]) might have altered their detection or reporting (*2*). Much work remains to achieve HHS Healthy People 2030 goals, particularly for *Salmonella* infections, which are frequently attributed to poultry products and produce, and *Campylobacter* infections, which are frequently attributed to chicken products (*3*).

FoodNet is a collaboration among CDC, 10 state health departments, the U.S. Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS), and the Food and Drug Administration (FDA). FoodNet's catchment area (Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York) includes approximately 15% of the U.S. population (an estimated 50 million persons in 2020). Bacterial infections were diagnosed by culture or CIDT; *Cyclospora* infections were diagnosed by microscopy or polymerase chain reaction (*2*). The frequencies of hospitalizations,* deaths,† outbreak-associated infections,§ and international travel–associated infections¶ were calculated overall and by pathogen; unknown results were classified as "no." Incidence was calculated by dividing the number of laboratory-diagnosed infections in 2021 by 2020 U.S. Census Bureau population estimates for the surveillance area. The percentage change in incidence during 2021 compared with the average annual incidence during 2016–2018 was estimated using a new Bayesian, negative binomial model with penalized thin plate splines that adjusted for state-specific trends and changes in population over time (*4*).

Surveillance for physician-diagnosed postdiarrheal hemolytic uremic syndrome (HUS), a complication of STEC infection, is conducted through a network of nephrologists and infection preventionists and by hospital discharge data review. This report includes HUS cases in children and adolescents aged <18 years for 2020, the most recent year with available data. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.**

During 2021, FoodNet identified 22,019 infections, 5,359 hospitalizations, and 153 deaths (Table 1). Incidence was highest for *Campylobacter* (17.8 cases per 100,000 population) and *Salmonella* (14.2). Overall, 8% fewer infections were reported during 2021 than the average during 2016–2018; incidence decreased for *Salmonella,* increased for *Cyclospora, Vibrio*, and *Yersinia,* and was unchanged for *Campylobacter, Listeria*, *Shigella,* and STEC. The percentage of infections resulting in hospitalization and the percentage of outbreak-associated infections were stable. Overall, 7% of infections in 2021 were associated with international travel compared with 13% during 2016–2018 (Figure).

Two thirds (67%) of bacterial infections were diagnosed using CIDT in 2021, compared with approximately one half (49%)

* Admission to an inpatient unit or an observation stay of >24 hours within 7 days before or after specimen collection or determined to be related to the infection if beyond this time frame.

† Attributed to infection when they occurred during hospitalization or within 7 days after specimen collection for nonhospitalized patients.

§ Generally defined as two or more cases of similar illness associated with a common exposure; some sites also stipulate that illnesses be from more than one household.

¶ International travel before illness began: 30 days for *Listeria* and *Salmonella* serotypes Typhi and Paratyphi, 14 days for *Cyclospora,* and 7 days for other pathogens.

** 45 C.F.R. part 46. 102(I)(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.

during 2016–2018 (Table 2). In 2021, 37% of bacterial infections were diagnosed using only CIDT (i.e., the specimen had a negative culture result or was not cultured) compared with 26% during 2016–2018. A reflex culture[††] was performed for 70% of infections diagnosed by CIDT in 2021, similar to 2016–2018. Reflex culture attempts decreased for *Campylobacter, Listeria,* STEC, *Vibrio*, and *Yersinia*. The percentage of reflex cultures that yielded a pathogen ranged from 24% for *Yersinia* to 89% for *Listeria*.

Among 6,110 *Salmonella* isolates, 5,442 (89%) were serotyped in 2021. The seven most common serotypes were Enteritidis (908; 17%), Newport (596; 11%), Typhimurium (510; 9%), Javiana (406; 7%), I 4,[5],12:i:- (304; 6%), Oranienburg (247; 5%), and Infantis (232; 4%). Compared with 2016–2018, incidence[§§] was higher for Oranienburg (38.6% increase; 95% credible interval [CrI] = 14.2% to 72.1%) and Infantis (23.7%; 95% CrI = 2.9% to 48.7%), lower for I 4,[5],12:i:- (–33.4%; 95% CrI = –45.4% to –17.9%), Typhimurium (–29.2%; 95% CrI = –35.7% to –22.4%), and Enteritidis (–24.7%; 95% CrI = –33.6% to –15.6%), and unchanged for Javiana (–23.0%; 95% CrI = –44.0% to 12.4%) and Newport (–8.7%; 95% CrI = –28.5% to 19.2%). Enteritidis, Newport, Typhimurium, Javiana, and I 4,[5],12:i:- have been among the five most common serotypes since 2010. Infantis has been among the 10 most common since 2013. During 2021, Oranienburg caused a multistate outbreak linked to onions;[¶¶] before that, Oranienburg had last been among the 10 most common serotypes in 2009.

Among 1,203 STEC isolates in 2021, serogroup O157 was most common (314; 26%), followed by O26 (179; 15%), O103 (140; 12%), and O111 (116; 10%). During 2020, FoodNet identified 49 cases of postdiarrheal HUS in children and adolescents aged <18 years (0.4 cases per 100,000),

[††] Culture of a specimen with a positive CIDT result.

[§§] 2021 incidence (per 100,000): Enteritidis (1.8), Newport (1.2), Typhimurium (1.0), Javiana (0.8), I 4,[5],12:i:- (0.6), Oranienburg (0.5), and Infantis (0.5).

[¶¶] https://www.cdc.gov/salmonella/oranienburg-09-21/details.html

TABLE 1. Number of laboratory-diagnosed bacterial and parasitic infections, hospitalizations, deaths, outbreak-associated infections, crude incidence, and percentage change compared with 2016–2018 average annual incidence, by pathogen — Foodborne Diseases Active Surveillance Network, 10 U.S. sites,* 2021†

	2021					
		No. (%)				
Pathogen	No. of Infections§	Hospitalizations¶	Deaths**	Outbreak-associated infections††	Crude incidence§§	% Change in infection incidence (95% CrI¶¶), 2016–2018 to 2021
Total	**22,019**	**5,359 (24)**	**153 (0.7)**	**861 (4)**	—	—
Bacteria						
Campylobacter	8,974	1,822 (20)	33 (0.4)	51 (0.6)	17.8	–5.5 (–11.4 to 0.9)
Salmonella	7,148	1,974 (28)	52 (0.7)	597 (8)	14.2	–10.0 (–16.9 to –3.2)
STEC***	2,542	600 (24)	10 (0.4)	79 (3)	5.0	8.8 (–6.8 to 27.0)
Shigella	1,699	532 (31)	8 (0.5)	67 (4)	3.4	–14.8 (–33.8 to 6.0)
Yersinia	683	146 (21)	3 (0.4)	2 (0.3)	1.4	79.0 (49.4 to 116.1)
Vibrio	461	117 (25)	9 (2)	8 (2)	0.9	45.5 (26.9 to 66.3)
Listeria	148	140 (95)	37 (25)	9 (6)	0.3	4.6 (–8.5 to 20.1)
Parasite						
Cyclospora	364	28 (8)	1 (0.3)	48 (13)	0.7	443.2 (195.9 to 1,134.2)

Abbreviations: CIDT = culture-independent diagnostic test; CrI = credible interval; STEC = Shiga toxin–producing *Escherichia coli*.

* Data were obtained from laboratories in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.

† 2021 data are preliminary.

§ Bacterial infections diagnosed by culture or CIDT. *Cyclospora* infections diagnosed by microcopy or polymerase chain reaction.

¶ Admission to an inpatient unit or an observation stay of >24 hours within 7 days before or after specimen collection or determined to be related to the infection if beyond this time frame. Absolute change in percentage of infections resulting in hospitalization during 2021 compared with annual average for 2016–2018: *Campylobacter* (0.3), *Salmonella* (0.3), STEC (1), *Shigella* (8), *Yersinia* (–4), *Vibrio* (–5), *Listeria* (–2), *Cyclospora* (2), and overall (0.6). Unknown hospitalization status (10% of infections during 2021 and 4% during 2016–2018) was classified as not hospitalized.

** Attributed to infection when deaths occurred during hospitalization or within 7 days after specimen collection for nonhospitalized patients. Absolute change in percentage of infections resulting in death during 2021 compared with annual average for 2016–2018: *Campylobacter* (<0.1), *Salmonella* (0.3), STEC (<0.1), *Shigella* (0.4), *Yersinia* (–0.7), *Vibrio* (–0.2), *Listeria* (6), *Cyclospora* (0.1), and overall (0.2). Unknown death status (8% of infections during 2021 and 3% during 2016–2018) was not classified as a death.

†† Generally defined as two or more cases of similar illness associated with a common exposure; some sites also stipulate that illnesses be from more than one household. Absolute change in percentage of outbreak-associated infections during 2021 compared with annual average for 2016–2018: *Campylobacter* (0.2) *Salmonella* (1), STEC (–1), *Shigella* (–1), *Yersinia* (0.2), *Vibrio* (–2), *Listeria* (1), *Cyclospora* (–10), and overall (<0.1). Unknown outbreak-association status (0.02% of infections during 2021 and 0% during 2016–2018) was classified as not outbreak-associated.

§§ Cases per 100,000 population. Domestic incidences (cases with no or unknown travel) by pathogen during 2021: *Campylobacter* (17.0), *Salmonella* (13.1), STEC (4.6), *Shigella* (3.0), *Yersinia* (1.3), *Vibrio* (0.8), *Listeria* (0.3), and *Cyclospora* (0.6).

¶¶ Percentage change reported as increase or decrease. Some increases are likely due to increasing use of CIDTs by clinical laboratories.

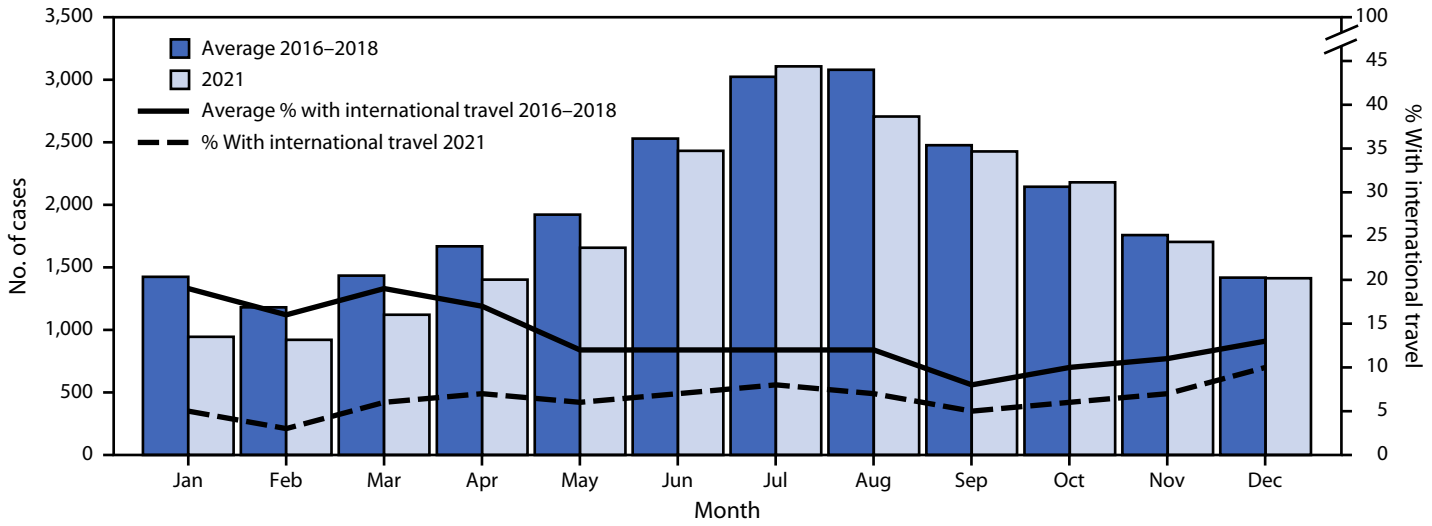
*** Compared with the annual average for 2016–2018, the incidence of STEC O157 infections (0.6 per 100,000) changed by –21.7% (95% CrI = –32.4% to –11.5%), and the incidence of non-O157 STEC infections (1.8) changed by –11.6% (95% CrI = –26.2% to 7.0%).

including 21 (43%) in children aged <5 years (0.7 per 100,000). The overall incidence of HUS was similar to that during 2016–2018 (–7.6% change; 95% CrI = –21.1% to 8.4%). The 2020 incidence of STEC O157 infections decreased 16.8% (95% CrI = –25.0% to –9.3%) compared with the average during 2016–2018. Overall, 37 (76%) HUS cases had evidence of STEC infection; 18 of 23 (78%) HUS cases with culture-confirmed STEC infection were serogroup O157.

Discussion

The 8% decrease in enteric infections reported to FoodNet during 2021 compared with the annual average during 2016–2018 suggests ongoing effects of the COVID-19 pandemic. Previously published FoodNet data (*2*) and other studies using data from 2020 (*5*–*7*) support the occurrence of two pandemic-related phenomena: decreased transmission and incidence of enteric infections (i.e., due to pandemic control measures) and underascertainment of infections related to changes in health care–seeking behaviors (e.g., increased use

FIGURE. Number of laboratory-diagnosed bacterial and parasitic infections and percentage of persons with international travel,* by month — Foodborne Diseases Active Surveillance Network,10 U.S. sites,† 2016–2018 and 2021§



* History of international travel before illness began: 30 days for *Listeria* and *Salmonella* serotypes Typhi and Paratyphi, 14 days for *Cyclospora*, and 7 days for other pathogens. Unknown international travel (25% of infections during 2021 and 17% during 2016–2018) was classified as no travel.
† Data were obtained from laboratories in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.
§ 2021 data are preliminary.

TABLE 2. Percentage of bacterial infections diagnosed by a culture-independent diagnostic test, only by a culture-independent diagnostic test, with a reflex culture, and percentage of reflex cultures that yielded a pathogen — Foodborne Diseases Active Surveillance Network, 10 U.S. sites,* 2016–2018 and 2021†

	Infections diagnosed by CIDT, %§		Infections diagnosed only by CIDT, %¶		Infections with a reflex culture, %**		Reflex culture yielded a pathogen, %††	
Pathogen	**2016–2018**	**2021**	**2016–2018**	**2021**	**2016–2018**	**2021**	**2016–2018**	**2021**
Overall	**49**	**67**	**26**	**37**	**71**	**70**	**65**	**64**
Campylobacter	53	70	36	46	60	56	55	62
Listeria	4	13	0	2	100	95	88	89
Salmonella	30	49	9	15	79	85	88	83
Shigella	49	76	29	44	69	83	58	51
STEC	100	100	43	53	88	80	65	59
Vibrio	45	61	31	46	83	73	38	33
Yersinia	69	85	46	71	69	68	48	24

Abbreviations: CIDT = culture-independent diagnostic test; STEC = Shiga toxin–producing *Escherichia coli*.
* Data were obtained from laboratories in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.
† 2021 data are preliminary.
§ Includes specimens that had a culture performed, regardless of the result, and those not cultured. Denominator is total infections.
¶ Includes specimens that had a negative culture result and those not cultured. Denominator is total infections.
** Specimens with a positive CIDT result that had a culture performed, regardless of the result. Denominator is infections diagnosed by CIDT.
†† Denominator is specimens with a reflex culture.

of telemedicine). The relatively low percentage of infections associated with international travel during 2021 (7%) and 2020 (5%) (*2*) support occurrence of the former. Lifting of pandemic control measures might have contributed to the stable or increased incidence for some pathogens during 2021. The stable percentage of hospitalizations during 2021 suggests that underascertainment was similar to baseline levels. However, the stable incidence of HUS coincident with a decrease in incidence of STEC O157 infections during 2020 suggests that these infections and perhaps others were underascertained; the severity of HUS makes it a more reliable measure (i.e., less affected by changes in health care delivery or health care–seeking behaviors). A better understanding of how pandemic control measures influenced enteric infections might help identify interventions to sustainably decrease their incidence.

Increasing use of CIDTs complicates the interpretation of surveillance trends, with factors such as test platform and pathogen affecting the accuracy of results. Molecular tests have high sensitivity for many pathogens (*8*) but might not indicate viable organisms. Variable specificity of CIDTs for FoodNet pathogens can result in false-positive results, most notably for *Vibrio* (*9*). Reflex cultures remain essential for public health functions, including determining antibiotic resistance, detecting outbreaks, and determining serotypes.

Comprehensive efforts are needed to address the root causes of foodborne illness, and substantial progress is needed to achieve HHS Healthy People 2030 goals, particularly for *Salmonella* and *Campylobacter* (*1*). The most recent report from the Interagency Food Safety Analytics Collaboration attributed 23% of foodborne *Salmonella* illnesses to chicken and turkey and 42% to produce items (*3*). The predominance of five *Salmonella* serotypes for >10 years emphasizes the need for more robust measures to identify and address *Salmonella* contamination in food by serotype. In October 2021, USDA-FSIS announced plans for stronger efforts to reduce *Salmonella* infections associated with poultry products, including before harvest and in slaughter and processing facilities, and began working with a national advisory committee*** (*10*). Targeted efforts are also needed to address *Salmonella* contamination of produce and *Campylobacter* infections from chicken products (*3*). Improving agricultural water safety, as FDA has proposed,††† might decrease infections with pathogens transmitted commonly by produce, including *Salmonella*, STEC O157, and *Listeria*.

*** The National Advisory Committee on Microbiological Criteria for Foods.
††† https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-proposed-rule-agricultural-water

Summary

What is already known about this topic?

During 2020, the number of infections reported to the Foodborne Diseases Active Surveillance Network (FoodNet) decreased compared with the average reported during 2016–2018. Pandemic-related measures likely decreased occurrence of some infections and limited ascertainment of others.

What is added by this report?

During 2021, the number of infections reported to FoodNet decreased 8% compared with the 2016–2018 average, likely related to the pandemic. Most infections were caused by *Campylobacter* or *Salmonella;* the five most common *Salmonella* serotypes remained predominant. Use of culture-independent diagnostic tests increased.

What are the implications for public health practice?

Comprehensive efforts are needed to improve food safety. Substantial progress is needed to achieve national goals, particularly for *Salmonella* and *Campylobacter*. Reflex cultures remain essential for surveillance of enteric infections.

The findings in this report are subject to at least three limitations. First, infections resulting from all modes of transmission (i.e., not exclusively foodborne) are included. Second, changes in incidence might not reflect sustained trends, particularly in the context of the COVID-19 pandemic. Finally, the percentage of cases with hospitalization, death, and international travel might be underestimated because unknown results were classified as "no"; preliminary 2021 data have a higher percentage of unknown results than do finalized 2016–2018 data.

FoodNet's 2021 data demonstrate ongoing effects of the COVID-19 pandemic on reported cases of infections transmitted commonly through food. As CIDT use continues to increase, reflex cultures remain essential for public health functions. Identifying novel strategies and implementing known strategies to address the root causes of illness are needed to sustainably decrease infections and achieve HHS Healthy People 2030 goals.

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Increase in Acute Respiratory Illnesses Among Children and Adolescents Associated with Rhinoviruses and Enteroviruses, Including Enterovirus D68 — United States, July–September 2022

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Increases in severe respiratory illness and acute flaccid myelitis (AFM) among children and adolescents resulting from enterovirus D68 (EV-D68) infections occurred biennially in the United States during 2014, 2016, and 2018, primarily in late summer and fall. Although EV-D68 annual trends are not fully understood, EV-D68 levels were lower than expected in 2020, potentially because of implementation of COVID-19 mitigation measures (e.g., wearing face masks, enhanced hand hygiene, and physical distancing) (*1*). In August 2022, clinicians in several geographic areas notified CDC of an increase in hospitalizations of pediatric patients with severe respiratory illness and positive rhinovirus/enterovirus (RV/EV) test results.* Surveillance data were analyzed from multiple national data sources to characterize reported trends in acute respiratory illness (ARI), asthma/reactive airway disease (RAD) exacerbations, and the percentage of positive RV/EV and EV-D68 test results during 2022 compared with previous years. These data demonstrated an increase in emergency department (ED) visits by children and adolescents with ARI and asthma/RAD in late summer 2022. The percentage of positive RV/EV test results in national laboratory-based surveillance and the percentage of positive EV-D68 test results in pediatric sentinel surveillance also increased during this time. Previous increases in EV-D68 respiratory illness have led to substantial resource demands in some hospitals and have also coincided with increases in cases of AFM (*2*), a rare but serious neurologic disease affecting the spinal cord. Therefore, clinicians should consider AFM in patients with acute flaccid limb weakness, especially after respiratory illness or fever, and ensure prompt hospitalization and referral to specialty care for such cases. Clinicians should also test for poliovirus infection in patients suspected of having AFM because of the clinical similarity to acute flaccid paralysis caused by poliovirus. Ongoing surveillance for EV-D68 is critical to ensuring preparedness for possible future increases in ARI and AFM.

* https://emergency.cdc.gov/han/2022/han00474.asp

ARI caused by EV-D68 primarily affects young children with varying severity. Typical signs and symptoms include cough, nasal congestion, wheezing, and dyspnea; infection can exacerbate asthma or RAD (*1*,*3*,*4*). Children with a history of asthma/RAD might be more likely to require medical care, although any child with ARI caused by EV-D68 can have severe illness (*3*,*4*). Importantly, EV-D68 is associated with AFM, a severe condition that can lead to muscle weakness and paralysis (*2*). Standard multiplex respiratory panels cannot distinguish between RVs and EVs or identify specific virus types. Thus, EV-D68 cases are likely undercounted because type identification is not routinely performed and reporting is not mandatory.†

Weekly data from three sources were analyzed for this report. First, weekly ED visits from week 1 of 2018 through week 37 of 2022 by children and adolescents aged <18 years from the National Syndromic Surveillance Program (NSSP) were assessed§; visits with ARI¶ and asthma/RAD** were identified, and quality control filters were applied to allow comparison

† Additional challenges are that 1) RV/EV testing is available primarily as part of respiratory viral panels, which are expensive, limiting widespread clinical use; 2) RV/EVs include multiple virus types that cannot be distinguished clinically or in most respiratory viral panels; and 3) clinical facilities with EV-D68–specific testing are uncommon, and test use is primarily limited to RV/EV–positive specimens.

§ NSSP is a network comprising CDC representatives, state and local health departments, and academic and private sector health partners jointly collecting and sharing electronic patient encounter data. NSSP's BioSense Platform includes approximately 6,000 health care facilities with coverage for 49 states and the District of Columbia. NSSP includes ED visit data from approximately 71% of U.S. EDs.

¶ The CDC "Broad Acute Respiratory Discharge Diagnosis (DD) v1" definition identifies ED visits associated with general respiratory infections (e.g., influenza, respiratory syncytial virus, or coronavirus) as well as general respiratory illness such as cough or pneumonia. These are identified in International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) discharge diagnoses.

** The syndrome definition used for asthma/RAD is the ESSENCE "CDC Asthma Chief Complaint/Discharge Diagnosis (CCDD) v1" and contains query criteria for terms related to asthma, bronchospasm, and reactive airway disease and selected misspellings appearing in the chief complaint. Discharge diagnosis codes were also included in this query for ICD-10-CM and SNOMED CT.

across years.[††] Second, weekly percentages of positive RV/EV test results from week 1 of 2014 through week 35 of 2022 were analyzed from the National Respiratory and Enteric Virus Surveillance System (NREVSS),[§§] a network of 473 laboratories that passively report aggregated testing data. Third, RV/EV and EV-D68 detections were assessed among children and adolescents aged <18 years who visited an ED or were hospitalized for ARI within the New Vaccine Surveillance Network (NVSN)[¶¶] during 2017–2022; the weekly percentages of pediatric patients with a positive RV/EV test result who also had a positive EV-D68 test result were characterized. For all platforms, descriptive analyses of longitudinal trends compared with previous years were conducted and stratified by age group and geographic region, where available. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[***]

The percentage of ED visits among children and adolescents aged 0–4 and 5–17 years that were associated with ARI has been qualitatively elevated from week 15 through week 37 of 2022 (the endpoint of available data) compared with 2018–2020; levels were comparable with summer 2021, when respiratory syncytial virus circulation was elevated (Figure 1) (Supplementary Figure 1, https://stacks.cdc.gov/view/cdc/121524).[†††] A more recent increase in the percentage of ED visits with ARI began on week 31 among both age groups. The percentage of ED visits associated with asthma/RAD in 2022 among children aged 0–4 years was qualitatively higher in all weeks from week 29 to 37 compared with the corresponding weeks during 2018–2021, and by week 37

[††] For extended historic timeseries and analysis, NSSP applies data quality filters to account for fluctuations attributable to site and facility onboarding and outages. Data quality filters for these time series include an indicator of an Emergency Patient Class, an average weekly percentage of visits with informative discharge diagnosis ≥70%, and a data quality coefficient of variance ≤30 over the last 4 years to date.

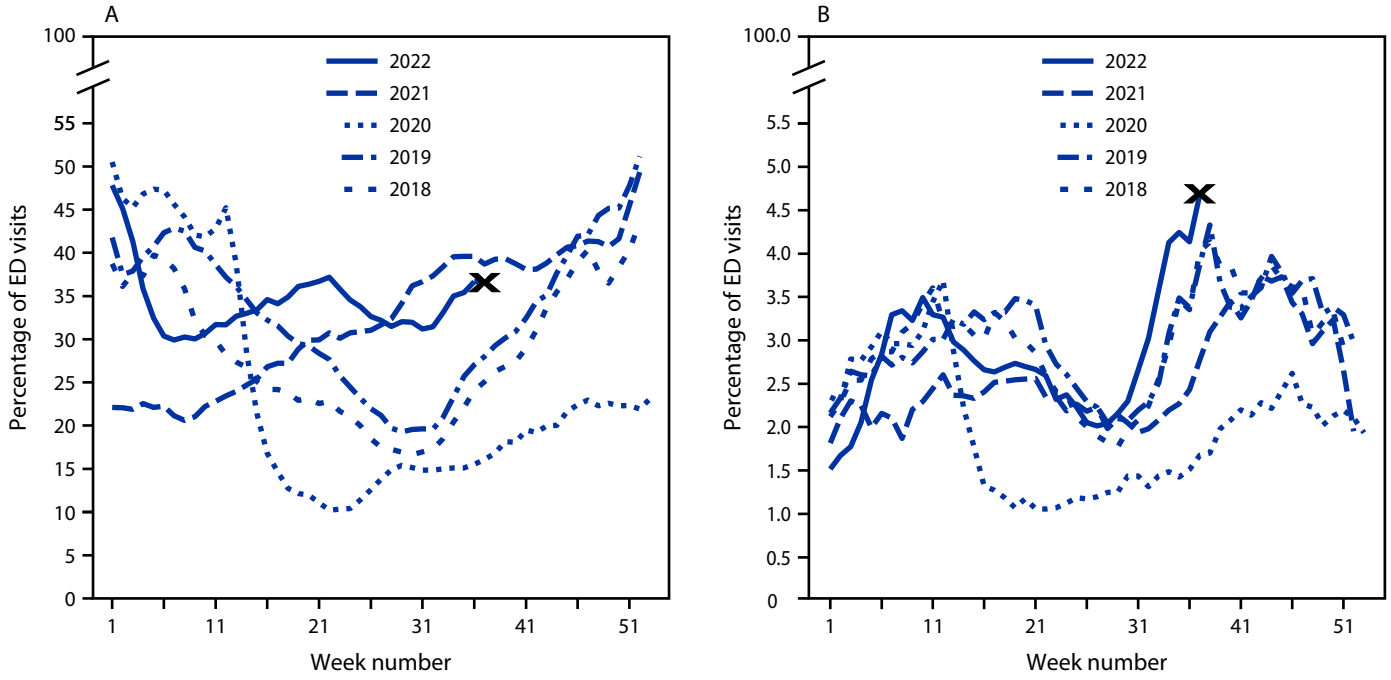
[§§] Untyped RV/EV results are reported to NREVSS, a voluntary, passive surveillance system of 473 U.S. public health, clinical, and reference laboratories, which report weekly aggregate RV/EV nucleic acid amplification tests performed and the number of positive RV/EV detections. RV/EV results were first reported to NREVSS in July 2006. NREVSS only collects untyped RV/EV results.

[¶¶] NVSN includes seven U.S. medical centers that perform active surveillance for pediatric ARI. EV-D68 testing occurred July–October 2017, July–November of 2018–2020, and July 2021 onwards, when year-round testing began. Retrospective testing is still underway for 2021 and early 2022. Two sites conduct parallel testing with a pan-RV and EV-D68 assay; five sites do sequential testing with either a pan-RV, pan-EV, or RV/EV test followed by an EV-D68 assay. All sites use the CDC-developed EV-D68 reverse transcription–polymerase chain reaction assay.

[***] 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.

[†††] https://emergency.cdc.gov/han/2021/han00443.asp

FIGURE 1. Weekly trends in the reported percentage of emergency department visits associated with acute respiratory illness (A) and asthma/reactive airway disease (B), in children aged 0–4 years, by age group and year — National Syndromic Surveillance Program, United States, January 2018–September 2022*



Abbreviation: ED = emergency department.

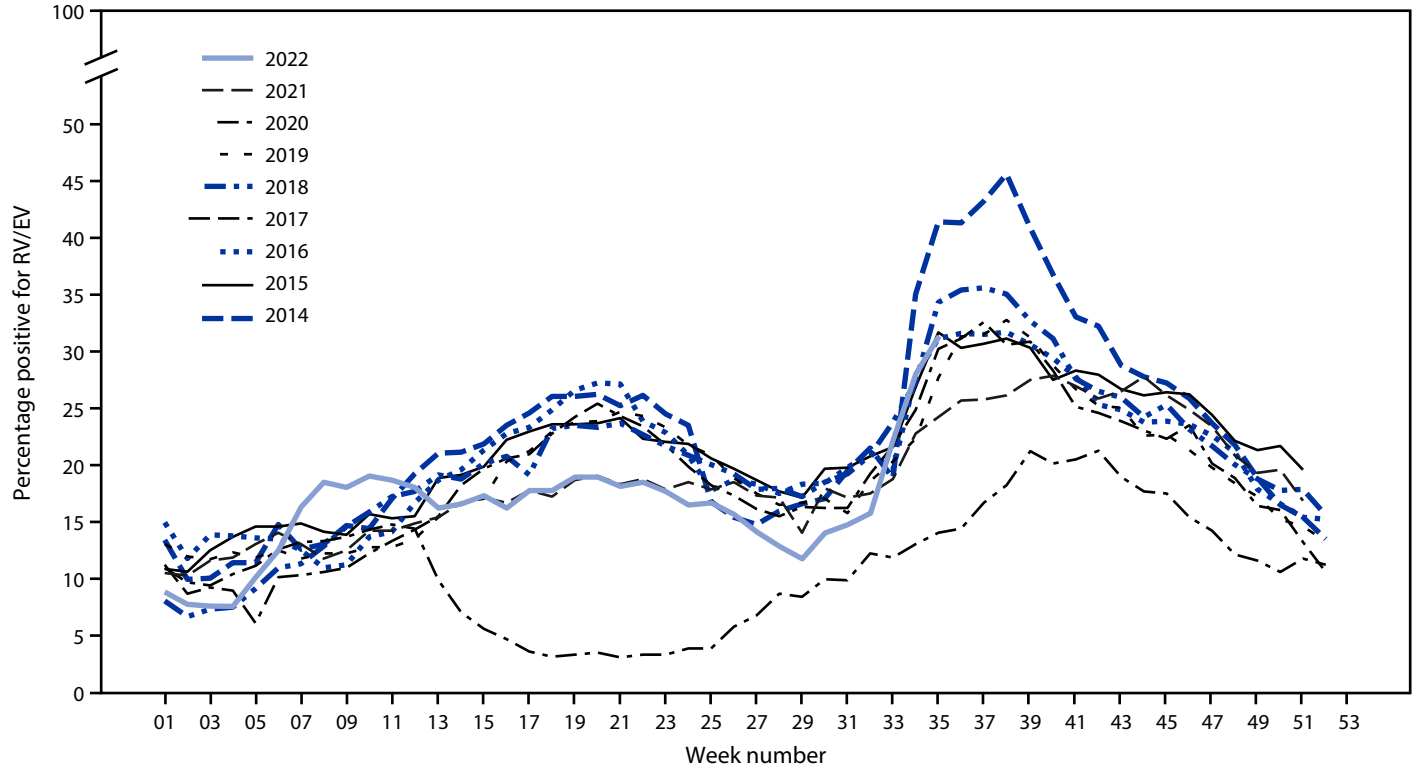
* The last reporting week (week 37) ended on September 17, 2022; data from this week are considered preliminary.

had reached levels higher than observed at any other point in 2018–2022, although data from this week are preliminary (Figure 1). Percentages of ED visits with asthma/RAD among children and adolescents aged 5–17 years during these weeks were also qualitatively higher than those during 2020–2021 but were similar to what was reported during 2018–2019 (Supplementary Figure 1, https://stacks.cdc.gov/view/cdc/121524). These observations were consistent when assessing numbers of ED visits with ARI and asthma/RAD rather than percentages (Supplementary Figure 2, https://stacks.cdc.gov/view/cdc/121525). By week 37, the percentage of ED visits with asthma/RAD for either age group had exceeded, at some recent point, levels observed at any time during 2018–2021 in most Health and Human Services regions (Supplementary Figure 3, https://stacks.cdc.gov/view/cdc/121526).

The percentage of positive RV/EV nucleic acid amplification test results in NREVSS has been elevated during late summer and early fall during 2014–2022 except in 2020 (Figure 2), and particularly high rates were noted either in late spring or late summer during years with increased EV-D68 detections in the United States (2014, 2016, and 2018). The weekly percentage of positive RV/EV test results in 2022 appears to be increasing at a rate comparable to that in past EV-D68 outbreak years: the percentage of positive RV/EV test results approximately doubled from week 32 (15.8%) to 35 (31.4%), which was the fourth highest value observed for that week after 2014 (41.5%), 2018 (34.4%), and 2015 (31.7%).

During March 1–September 20, 2022, NVSN enrolled 5,633 children and adolescents with ARI seeking emergency care or requiring hospitalization. Testing is ongoing; however, as of September 20, 2022, RV/EV was detected in 1,492 (26.4%) of these patients, among whom 260 (17.4%) had a positive EV-D68 test result. The percentage of positive EV-D68 test results among children and adolescents with ARI and positive RV/EV test results increased to 56% during week 32 (Figure 3). The percentage of positive EV-D68 test results during July and August 2022 was higher than that during the same months of 2017 and 2019–2021 and similar to peak levels observed in 2018. The number of EV-D68 detections and rates of increase varied by geographic location of sentinel sites (Supplementary Figure 4, https://stacks.cdc.gov/view/cdc/121527). The median age of the 260 pediatric patients in NVSN with EV-D68 detected was 2.6 years (IQR = 0–15 years), and the most common signs and

FIGURE 2. Weekly trends in the reported percentage of positive rhinovirus/enterovirus nucleic acid amplification test results, by year — National Respiratory and Enteric Virus Surveillance System, United States, January 2014–August 2022*,†



Abbreviation: RV-EV rhinovirus/enterovirus.
* The last complete reporting week (week 35) ended on September 3, 2022.
† Enterovirus D68 detections were high during 2014, 2016, and 2018.

symptoms were shortness of breath or rapid shallow breathing, wheezing, cough, and nasal congestion.

Discussion

Using data from three separate surveillance systems, this analysis found an increase in medically attended ARI and asthma/RAD exacerbations in children and adolescents during summer 2022. This rise might be attributable, in part, to increased RV/EV circulation and specifically circulation of EV-D68. In 2014, a widespread EV-D68 outbreak in the United States caused similar increases in medically attended severe respiratory illnesses and asthma exacerbations and was associated with an increase in AFM cases (*2*,*3*). Surveillance efforts for EV-D68 were enhanced after this outbreak, including the establishment of active, prospective sentinel surveillance (*2*,*5*,*6*). The seasonality of EV-D68 and associated AFM cases remains poorly characterized, but biennial peaks occurred in 2014, 2016, and 2018, before the COVID-19 pandemic (*7*).

Summary

What is already known about this topic?

Enterovirus D68 (EV-D68) caused biennial outbreaks of severe respiratory illness and acute flaccid myelitis (AFM) in the United States in 2014, 2016, and 2018.

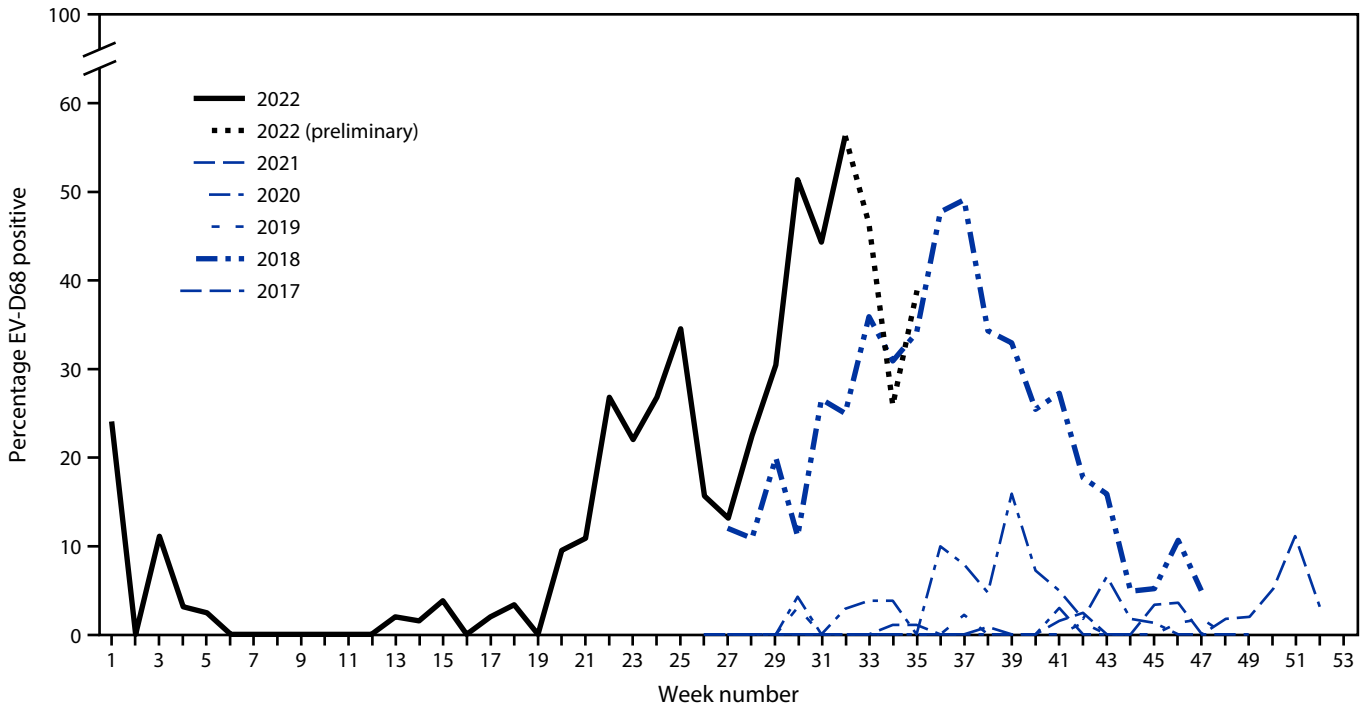
What is added by this report?

After an extended period of low EV-D68 circulation during the COVID-19 pandemic, surveillance data suggest increased detection of rhinovirus/enterovirus and EV-D68, concurrent with increased emergency department visits by children and adolescents with acute respiratory illness and asthma/reactive airway disease during summer 2022.

What are the implications for public health practice?

Clinicians should consider EV-D68 as a possible cause of acute respiratory illness and AFM in children and adolescents this fall and be aware of guidance for prompt testing and referral for patients with suspected AFM.

FIGURE 3. Weekly trends in reported percentage of positive enterovirus D68 test results among children and adolescents aged <18 years with acute respiratory illness and positive rhinovirus/enterovirus test results who received care in the emergency department or inpatient units — New Vaccine Surveillance Network,* United States, 2017–2022†



Abbreviation: EV-D68 = enterovirus D68.

* The seven sites in the New Vaccine Surveillance Network are located in Kansas City, Missouri; Rochester, New York; Cincinnati, Ohio; Pittsburgh, Pennsylvania; Nashville, Tennessee; Houston, Texas; and Seattle, Washington. Two sites do parallel testing with a pan-rhinovirus and EV-D68 assay; fives sites do sequential testing with a pan-rhinovirus and pan-enterovirus assay or a rhinovirus/enterovirus assay, followed by an EV-D68 assay. All sites use the same CDC-developed EV-D68 reverse-transcription–polymerase chain reaction assay.

† Testing for EV-D68 occurred at all seven sites during July–October 2017 and during July–November 2018–2020. Year-round testing began at most sites in July 2021 and was fully implemented at all sites during June 2022. EV-D68 testing windows in NVSN have changed over time, limiting annual comparisons outside of these windows. Retrospective testing is still in process for 2021 and early 2022, and data are current as of September 22, 2022. Weeks 33–35 are subject to delays in reporting.

Ongoing surveillance is necessary to understand when and where future circulation and EV-D68–associated severe illness might occur, given the potential changes in virus circulation and population immunity related to COVID-19 mitigation measures (*1*).

The findings in this report are subject to at least five limitations. First, differences in surveillance catchment populations and representativeness limit direct comparisons across systems and generalizability of findings. Second, delays in reporting vary by system and might result in underestimates of recently reported data. Third, in the ED data, ARI is a broad definition designed to capture all diagnoses related to respiratory illness, including SARS-CoV-2, influenza, pneumonia, and cough, potentially limiting specificity for identifying visits with EV-D68-associated respiratory illnesses. Fourth, the COVID-19 pandemic likely affected health care–seeking behaviors and testing practices in multiple ways; these differences could affect comparability of recent data to 2019 and previous years. Finally, comparable NSSP data on hospitalizations or trends before 2018 are unavailable, as are NVSN data before 2017.

Clinicians are advised to consider EV-D68 as a possible cause of severe respiratory illness in children and adolescents, particularly those with wheezing or who require respiratory support. Health care facilities should be prepared for possible increases in pediatric health care use associated with severe EV-D68–associated respiratory illness (*8*). Past increases in EV-D68 circulation were also associated with increased reports of AFM.[§§§] Providers should have a high index of clinical suspicion for AFM in patients with acute flaccid limb weakness, neurologic signs and symptoms, or neck or back pain who have a recent history of respiratory illness or fever. Children with AFM can experience rapid progression of weakness and should be promptly hospitalized and referred to specialty care.[¶¶¶] Given the detection of a paralytic polio case and wastewater samples positive for poliovirus in New York during summer 2022 (*9*), clinicians should also test for poliovirus infection in patients suspected of having AFM because of the clinical similarity to acute flaccid paralysis caused by poliovirus. Providers should immediately report possible AFM cases and acute flaccid paralysis cases suspected of polio to local and state health departments and coordinate with health departments and CDC for testing protocols.[****]

[§§§] As of September 21, 2022, among 45 patients under investigation, 15 (33%) cases of AFM had been confirmed in ten states during 2022. In years of increased EV-68 circulation, 120 (2014), 153 (2016), and 238 (2018) cases of AFM had been reported in each year, compared with 22 (2015), 38 (2017), 47 (2019), 33 (2020), and 28 (2021) in years of low EV-68 circulation. https://www.cdc.gov/acute-flaccid-myelitis/cases-in-us.html

[¶¶¶] https://www.cdc.gov/acute-flaccid-myelitis/hcp/clinicians-health-departments/clinical-presentation.html

[****] https://www.cdc.gov/acute-flaccid-myelitis/hcp/specimen-collection.html

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Monkeypox Case Investigation — Cook County Jail, Chicago, Illinois, July–August 2022

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On September 30, 2022, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Knowledge about monkeypox transmission risk in congregate settings is limited. In July 2022, the Chicago Department of Public Health (CDPH) confirmed a case of monkeypox in a person detained in Cook County Jail (CCJ) in Chicago, Illinois. This case was the first identified in a correctional setting in the United States and reported to CDC during the 2022 multinational monkeypox outbreak. CDPH collaborated with CCJ, the Illinois Department of Public Health (IDPH), and CDC to evaluate transmission risk within the facility. Fifty-seven residents were classified as having intermediate-risk exposures to the patient with monkeypox during the 7-day interval between the patient's symptom onset and his isolation. (Intermediate-risk exposure was defined as potentially being within 6 ft of the patient with monkeypox for a total of ≥3 hours cumulatively, without wearing a surgical mask or respirator, or potentially having contact between their own intact skin or clothing and the skin lesions or body fluids from the patient or with materials that were in contact with the patient's skin lesions or body fluids.) No secondary cases were identified among a subset of 62% of these potentially exposed residents who received symptom monitoring, serologic testing, or both. Thirteen residents accepted postexposure prophylaxis (PEP), with higher acceptance among those who were offered counseling individually or in small groups than among those who were offered PEP together in a large group. *Monkeypox virus* (MPXV) DNA, but no viable virus, was detected on one surface in a dormitory where the patient had been housed with other residents before he was isolated. Although monkeypox transmission might be limited in similar congregate settings in the absence of higher-risk exposures, congregate facilities should maintain recommended infection control practices in response to monkeypox cases, including placing the person with monkeypox in medical isolation and promptly and thoroughly cleaning and disinfecting spaces where the person has spent time. In addition, officials should provide information to residents and staff members about monkeypox symptoms and transmission modes, facilitate confidential monkeypox risk and symptom disclosure and prompt medical evaluation for symptoms that are reported, and provide PEP counseling in a private setting.

Investigation and Results

CCJ houses approximately 6,000 residents in cell-based and dormitory-based units across 16 buildings. The monkeypox case occurred in a resident who was booked into jail in mid-July 2022 (investigation day 1) and assigned to two congregate dormitories used for intake (dormitories A and B)[†] during the 7 days preceding his isolation for suspected monkeypox. On day 7, the resident placed a written request for health services, reporting swollen genitals, and CCJ health care personnel ordered a sexually transmitted infection laboratory panel. On day 8, health care administrators received a call from one of the patient's family members alerting them to the possibility that the patient might have monkeypox; he was then evaluated in person and isolated. Lesion swab specimens collected for nonvariola *Orthopoxvirus* (NVO) testing on day 9 returned a positive result on day 11. During evaluation, the patient reported first noticing a localized rash on day 2, which subsequently spread over much of his body and was accompanied by fatigue and body aches before he was isolated. IDPH requested a CDC deployment team to assist with the investigation. This activity was reviewed and approved by CDC and conducted consistent with applicable federal law and CDC policy.[§]

Fifty-seven other residents were housed with the patient for 1–7 nights (median = 5 nights) before he was isolated (Table) (Figure). Although CCJ policy required indoor mask use as a COVID-19 prevention strategy during the period of this investigation, enforcing mask use 24 hours per day in correctional facilities is challenging and mask usage is often low; the patient and other residents were not observed wearing masks

* These authors contributed equally to this report.

† Dormitories A and B are each 2,950 ft^2 with 10.5-ft high ceilings and a congregate bathroom with five combination toilet-sink units and five shower stalls. Each has 39 fixed single bed platforms spaced a minimum of 3 ft apart. During the investigation period, the ventilation system typically provided five to six air changes per hour for both dormitories; when outdoor air temperature was >90°F (>32°C) for brief periods on 2 days, three to four air changes per hour occurred. During the period when the patient with monkeypox was housed in dormitories A and B, residents were served meals at communal tables inside the dormitories and spent an average of 20–24 hrs per day in the dormitories.

§ 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.

consistently during this time. The patient reported during an interview that he had had no skin-to-skin or sexual contact with other residents, and no such contact between the patient and other residents was observed during review of security video footage. Because of the difficulty in ascertaining whether each resident sharing a dormitory with the patient met criteria for intermediate-risk exposure versus lower-risk exposure (simply entering the living space of a person with monkeypox), all 57 residents were conservatively categorized as having had intermediate-risk exposure.[¶]

On investigation day 15, serologic testing was offered to the 36 potentially exposed residents who were still in detention. One week later, on investigation day 22, serologic testing was again offered to those who had declined the first offer. Among all 36 residents still in detention, a total of 14 (39%) consented to testing. Specimens were tested by enzyme-linked immunosorbent assay for anti-*Orthopoxvirus* immunoglobulin (Ig) M (a transient marker of acute infection or recent vaccination) and IgG (a long-lived marker generated during infection or vaccination) (*1*). None of the specimens tested positive for IgM. Specimens from three residents tested positive for IgG; all three were old enough to have received routine childhood smallpox vaccination, although their previous smallpox vaccination history could not be confirmed.[**]

On investigation day 8, after the patient was isolated, CCJ resident-workers cleaned and disinfected dormitories A and B. To evaluate the extent of remaining surface contamination, 54 environmental samples were collected from both dormitories on investigation day 21, which was 18 days after the patient had been in dormitory A and 13 days after he had been in dormitory B.[††] One dormitory B sample, collected from a vertical, painted concrete slab at the head of the patient's bed, tested positive for NVO DNA by real-time polymerase chain reaction (PCR) and was confirmed by Clade II MPXV-specific PCR; viral culture was negative[§§] (*2*).

To identify possible exposure patterns in the dormitories and to assess residents' knowledge about monkeypox, 16 potentially exposed residents were interviewed individually.[¶¶] The majority of residents (12) reported washing their clothes in communal showers or sinks in the dormitory. Some residents reported sharing personal hygiene items (five) or eating utensils (four) with other residents, engaging in physical altercations (four), sitting on other residents' beds (three), or sharing or touching other residents' linens (two). None reported sexual contact with others while in CCJ. The majority (13) also reported hearing

[¶] https://www.cdc.gov/poxvirus/monkeypox/clinicians/monitoring.html

[**] One resident had an equivocal IgM result 7 days after last potential exposure to the patient but reported no symptoms at the time of specimen collection or during his 21-day incubation period. Because he received PEP, repeat serologic testing was not performed; seroconversion in progress cannot be definitively ruled out.

[††] Surfaces included painted concrete bed platforms, desks, and stools in the spaces assigned to the patient before he was isolated, as well as metal toilet rims and flush buttons, metal sink and shower buttons, and plastic telephone receivers shared in communal spaces.

[§§] Polyester-tipped applicator swabs were prewetted with phosphate buffered saline (PBS) solution before swabbing environmental surfaces, then stored and transported in 300 μL of PBS solution and kept frozen until processing using the swab extraction tube system (Roche); DNA was extracted from the swab eluate before PCR testing.

[¶¶] Residents were asked about their monkeypox knowledge (including transmission modes, prevention, and symptoms) and the types of contact they had with other persons in the jail or with shared objects. The identity of the patient with monkeypox was not disclosed; thus, questions about contact with others in the jail did not specify whether it occurred with the patient versus with other persons in the dormitory.

TABLE. Characteristics of residents potentially exposed to *Monkeypox virus* and who participated in elements of a field investigation (N = 57) — Cook County Jail, Chicago, Illinois, July–August 2022

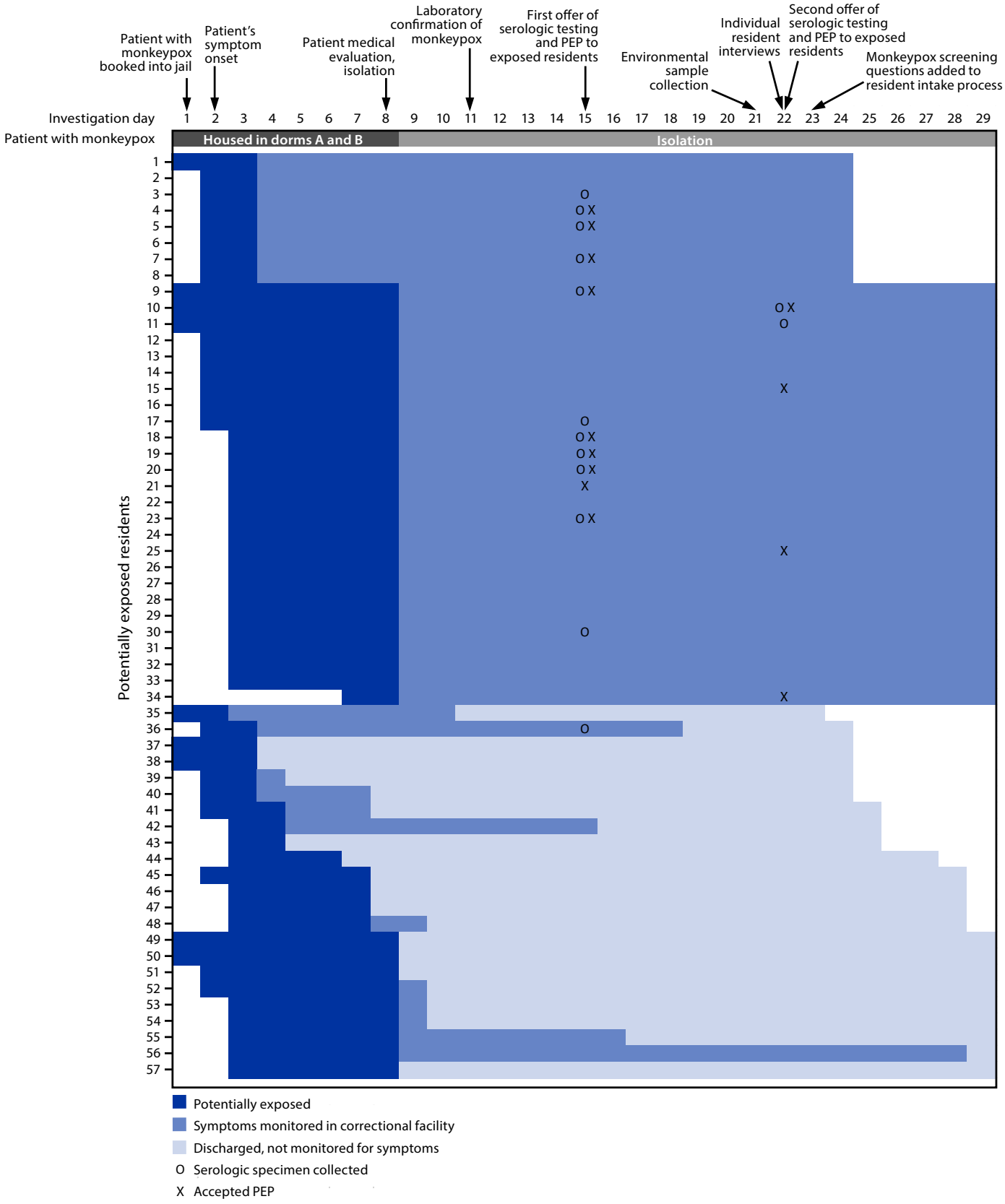
Characteristic	No. (%)				
	Potentially exposed*	Offered PEP†	Accepted PEP†	Accepted testing	Individually interviewed
Total	**57**	**36**	**13**	**14**	**16**
Age, yrs, median (range)	38 (21–63)	38 (21–62)	33 (22–58)	38 (21–62)	43 (21–62)
No. of nights potentially exposed, median (range)	5 (1–7)	5 (1–7)	5 (1–6)	5 (1–7)	5 (1–7)
Sex					
Male	57 (100)	36 (100)	13 (100)	14 (100)	16 (100)
Race or ethnicity					
Black or African American, non-Hispanic	30 (53)	18 (50)	4 (31)	7 (50)	9 (56)
White or Caucasian, non-Hispanic	17 (30)	12 (33)	4 (31)	4 (29)	4 (25)
Hispanic or Latino	8 (14)	5 (14)	4 (31)	2 (14)	2 (13)
Asian, non-Hispanic	2 (4)	1 (3)	1 (8)	1 (7)	1 (6)

Abbreviation: PEP = postexposure prophylaxis.

* Classified as having intermediate-risk exposure to the patient with monkeypox (i.e., were potentially within 6 ft of the patient for a cumulative period of ≥3 hours without wearing a surgical mask or respirator, or potentially had contact between their own intact skin or clothing and the skin lesions or body fluids from the patient with monkeypox or with materials that were in contact with the patient's skin lesions or body fluids).

† JYNNEOS vaccine.

FIGURE. Follow-up of 57 residents exposed to *Monkeypox virus* — Cook County Jail, Chicago, Illinois, July 12–August 5, 2022



Abbreviation: PEP = postexposure prophylaxis.

about monkeypox for the first time while detained in CCJ. Residents' knowledge about monkeypox symptoms, transmission modes, and exposure risks varied but was generally low.

Public Health Response

CDPH recommended PEP and daily symptom monitoring for 21 days after last exposure for all 57 potentially exposed residents.*** CCJ notified the residents of their potential exposure and, out of an abundance of caution, placed them under quarantine precautions within dormitories A and B. One resident reported a rash on investigation day 22 and was evaluated the same day; test results for NVO were negative. Among the 57 residents, 35 (61%) remained in detention for their full 21-day monitoring period (33 in CCJ and two transferred to a state prison). The remaining 22 (39%) residents were discharged to the community before conclusion of their 21-day monitoring period and were lost to follow-up. However, CDPH cross-checked the names of the discharged residents with the Illinois state testing database and confirmed that none had a record of monkeypox testing in the 30 days after their last potential exposure in CCJ.†††

On investigation day 15, PEP with JYNNEOS vaccine was offered to the 36 (63%) potentially exposed residents who were still in detention at that time (the same 36 residents who were also offered serologic testing on day 15 as part of the investigation). Dormitory B residents received PEP information as a large group, followed by a public roll call offering PEP to each resident. Staff members reported difficulty communicating effectively in the large group; only three of 25 (12%) residents who were offered PEP in this setting accepted. In subsequent individual interviews, several dormitory B residents indicated they did not want to receive the vaccine in front of others, did not know enough about the vaccine or potential side effects, or thought they were being offered a COVID-19 vaccine. In contrast, dormitory A residents were escorted to a separate room individually or in groups of two, where they were counseled and offered PEP; six of 11 offered PEP in this setting accepted. On day 22, PEP was reoffered individually to eight residents from dormitories A and B participating in individual interviews who had declined the first PEP offer; four accepted. Overall, 13 (23%) of 57 residents received PEP 7–14 days after their last potential exposure (median = 12 days).

In early August, CCJ added monkeypox screening questions (presence of rash or known close contact with someone with monkeypox) to the intake process for new residents entering CCJ. Shortly thereafter, a newly detained resident answered "no" to all screening questions but later, in a private exam room with a medical provider, disclosed that he had been hospitalized with monkeypox 2 weeks before his arrest.

Discussion

After a CCJ resident with symptomatic monkeypox spent 7 days in congregate housing, no additional cases were detected among a subset of residents classified as having intermediate-risk exposures (62%) who were monitored for symptoms or who received serologic testing. Although the patient reported no skin-to-skin or sexual contact with other residents, all residents slept in the same room with the patient and shared living and dining spaces and bathroom facilities. These findings suggest that monkeypox transmission might be limited in similar congregate settings in the absence of higher-risk exposures such as skin-to-skin or sexual contact (the primary transmission modes identified during the current multinational outbreak). Current CDC guidance does not recommend quarantine for exposed persons who remain asymptomatic; these findings affirm application of this guidance within congregate settings.§§§

Although this investigation found no evidence of skin-to-skin or sexual contact among residents in CCJ, previous research emphasizes that persons who are incarcerated might not disclose intimate or sexual contact within the facility because of potential stigma, retaliation, or disciplinary consequences (*3*). Furthermore, monkeypox transmission has been documented in correctional settings previously, including a cluster of five cases and an outbreak of 21 cases in Nigerian prisons in 2017 and 2022, respectively, where the transmission modes could not be definitively ascertained (*4*,*5*). In this investigation, some residents disclosed contact patterns in the dormitory overall (not necessarily with the patient with monkeypox) that have previously been associated with transmission in household studies (e.g., sharing eating utensils and linens) (*6*). Thus, correctional facilities need to remain vigilant for potential cases of monkeypox while transmission continues to occur in the United States.

Results of PCR testing of surfaces in the shared CCJ dormitories indicate that at least one surface retained MPXV DNA at the time of sampling: a vertical, painted concrete slab at the head of the patient's bed. Residents commonly lean against this type of surface while sitting in bed, or drape damp clothing and

*** Nursing staff members checked vital signs and asked residents about symptoms once daily. During days 11–13, monitoring included symptoms of influenza-like illness and COVID-19; on day 15, new-onset rash was added. Staff members who worked in dormitories A or B were determined to have lower-risk exposures and were not offered PEP or advised to self-monitor for symptoms.

††† Telephone numbers were available for 17 of the 22 potentially exposed residents discharged to the community before their 21-day monitoring period ended. CDPH staff members called all 17 numbers but were unable to reach any of the discharged residents to ask about monkeypox symptoms they might have experienced during the monitoring period.

§§§ https://www.cdc.gov/poxvirus/monkeypox/clinicians/monitoring.html; https://www.cdc.gov/poxvirus/monkeypox/community/congregate.htm

Summary

What is already known about this topic?

Knowledge about monkeypox transmission risk in congregate settings is limited.

What is added by this report?

After a jail resident with symptomatic monkeypox spent 7 days in congregate housing, no cases were detected among a subset of residents with intermediate-risk exposures (being within 6 ft of the patient for ≥3 hours without wearing a mask) who received symptom monitoring or serologic testing. *Monkeypox virus* DNA, but no viable virus, was detected on one surface. Postexposure prophylaxis (PEP) acceptance was highest when offered privately.

What are the implications for public health practice?

Although monkeypox transmission might be limited in similar congregate settings without higher-risk exposures, facilities should implement recommended infection control practices and provide prevention education including confidential PEP counseling.

towels over it to dry. Although no viable virus was detected on the surface at the time of sampling, studies with vaccinia virus have found viable virus persisting up to 28 days on a similar surface, indicating the importance of thoroughly disinfecting all areas where a person with monkeypox has spent time, including all surfaces they might have touched or that might have had contact with their clothing or linens (*7*). Facilities should ensure that residents and staff members responsible for cleaning and disinfection receive adequate training, supplies, and oversight to complete these tasks.

Approximately one third of CCJ residents who were exposed to the patient with monkeypox were discharged before PEP was offered, and those who accepted PEP received it 7–14 days after exposure, outside the 4-day window recommended to prevent infection. Among residents offered PEP, approximately one third accepted it, a rate lower than that reported among community and health care contacts during previous monkeypox outbreaks (*8*). Notably, PEP acceptance was higher among residents who received individual or small group counseling (55%) than among those who were offered PEP while in a large group (12%). Similarly, a resident booked into CCJ after the conclusion of this investigation privately disclosed a recent hospitalization for monkeypox after previously answering "no" to all screening questions asked in a semipublic intake space.

The findings in this report are subject to at least five limitations. First, exposure risk assessment was challenging in the congregate housing setting, and some residents classified as having intermediate-risk exposure actually could have had a lower-risk exposure. Second, serologic testing and symptom monitoring were completed for only 25% and 62% of exposed residents, respectively. Third, serologic testing was performed 7 days after potential exposure for some residents, when they might not yet have seroconverted, possibly resulting in misclassification of secondary cases. Fourth, monkeypox-related stigma or desire to avoid isolation could have limited self-report of symptoms or higher-risk contact such as sexual activity. Finally, findings might not be generalizable to all congregate settings because of variation in facility layout, ventilation, housing density, laundry practices, and adherence to infection prevention and control protocols, and because of differences in viral shedding and infectious period among persons with monkeypox. Additional data can further elucidate transmission risk in congregate settings overall.

Correctional facilities can reduce monkeypox transmission risk by following public health recommendations (Box). First, facilities should maintain infection control protocols in response to cases, including isolation of persons with suspected monkeypox and prompt and thorough cleaning and disinfection of all areas where the person has spent time[¶¶¶] (*9*). Second, facilities should provide monkeypox prevention information to residents and staff members, including information about avoiding sexual contact in the custody setting and avoiding common practices such as sharing eating utensils and linens. Third, facility officials should follow health department guidance for postexposure symptom monitoring and PEP, provide information about monkeypox signs and symptoms and how to report them confidentially, and ensure prompt evaluation when residents do report symptoms. Using private spaces during intake screening, exposure notification, and PEP counseling can support disclosure of sensitive information and could improve acceptance of public health recommendations.

[¶¶¶] Using an Environmental Protection Agency (EPA)–registered disinfectant with an Emerging Viral Pathogens claim (https://www.epa.gov/coronavirus/what-emerging-viral-pathogen-claim) found on EPA's List Q (https://www.epa.gov/pesticide-registration/disinfectants-emerging-viral-pathogens-evps-list-q).

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BOX. Public health messages related to monkeypox prevention in correctional settings — United States, 2022

When monkeypox is suspected, promptly isolate the affected person, evaluate them for testing, and alert the health department for further support and guidance (https://www.cdc.gov/poxvirus/monkeypox/clinicians/clinical-recognition.html).

- Multiple residents with confirmed monkeypox can be housed together.
- Persons entering the isolation space or handling laundry from persons with monkeypox should wear recommended PPE (https://www.cdc.gov/poxvirus/monkeypox/community/congregate.html). Patients should wear a mask and cover lesions if they leave the isolation space.
- Collect and contain soiled laundry and linens from a person with monkeypox in a container that can be disinfected, or a laundry bag that can be laundered along with the soiled items from the person with monkeypox. Do not shake or handle laundry in a manner that might disperse infectious material. Launder separately from other residents' laundry using regular detergent.
- Support patients' mental health during isolation, and ensure they have regular access to showers, hygiene supplies, and clean clothing and linens.

Surface contamination with *Monkeypox virus* can occur and can contribute to transmission.

- Ensure prompt and thorough cleaning and disinfection in spaces where a person with monkeypox has spent time. Include all surfaces that someone with monkeypox might have touched or places they might have stored or placed soiled clothing, towels, or linens.
- Perform disinfection using an EPA-registered disinfectant with an Emerging Viral Pathogens claim (https://www.epa.gov/coronavirus/what-emerging-viral-pathogen-claim) found on EPA's List Q (https://www.epa.gov/pesticide-registration/disinfectants-emerging-viral-pathogens-evps-list-q), according to instructions on the product label.
- Provide sufficient training, supplies, oversight, and PPE (https://www.cdc.gov/poxvirus/monkeypox/clinicians/clinical-recognition.html) to residents and staff members responsible for cleaning and disinfection. For more information, see Workplace Solutions: Safe and Proper Use of Disinfectants to Reduce Viral Surface Contamination in Correctional Facilities (https://www.cdc.gov/niosh/docs/wp-solutions/2021-121/).

Contact tracing can help to prevent further transmission. However, persons exposed to *Monkeypox virus* do not need to quarantine if they do not have signs or symptoms consistent with monkeypox.

Confidentially inform residents and staff members of potential exposure to prevent stigma and to encourage disclosure of high-risk contact that might have occurred (https://www.cdc.gov/poxvirus/monkeypox/clinicians/monitoring.html).

Follow health department guidance for symptom monitoring and PEP for residents and staff members who have been exposed. Ensure that residents and staff members know the symptoms of monkeypox and ensure that residents can confidentially report symptoms or contact with a person with monkeypox. Evaluate residents promptly when they report symptoms.

When indicated, offer PEP as soon as possible after exposure to prevent loss to follow-up (especially in high-throughput settings like jails) and to best prevent infection.

- For maximum effectiveness, PEP should be offered within 4 days of exposure.
- Discuss options with the health department for offering PrEP vaccination to residents who might be at increased risk for monkeypox in the facility or after release (https://www.cdc.gov/poxvirus/monkeypox/vaccines/vaccine-basics.html).
- PEP acceptability might be lower in some correctional environments than in other settings and can be supported through individual, confidential discussions between residents and trusted communicators, such as medical providers.

Facilitate disclosure of a known monkeypox diagnosis, symptoms, or risk factors at intake by asking screening questions in private spaces.

Residents and staff members might not have adequate information about monkeypox or adequate access to hygiene and cleaning supplies to protect themselves. Provide correctional facility residents with no-cost supplies to enable them to wash their hands and clean their living areas frequently and provide information about avoiding skin-to-skin and sexual contact in custody settings and avoiding common interactions that could lead to exposure, such as sharing personal items, clothing, linens, eating utensils, cups, and bowls.

Abbreviations: EPA = Environmental Protection Agency; PEP = postexposure prophylaxis; PPE = personal protective equipment; PrEP = preexposure prophylaxis.

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Incidence of Monkeypox Among Unvaccinated Persons Compared with Persons Receiving ≥1 JYNNEOS Vaccine Dose — 32 U.S. Jurisdictions, July 31–September 3, 2022

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Human monkeypox is caused by *Monkeypox virus* (MPXV), an Orthopoxvirus, previously rare in the United States (*1*). The first U.S. case of monkeypox during the current outbreak was identified on May 17, 2022 (*2*). As of September 28, 2022, a total of 25,341 monkeypox cases have been reported in the United States.* The outbreak has disproportionately affected gay, bisexual, and other men who have sex with men (MSM) (*3*). JYNNEOS vaccine (Modified Vaccinia Ankara vaccine, Bavarian Nordic), administered subcutaneously as a 2-dose (0.5 mL per dose) series with doses administered 4 weeks apart, was approved by the Food and Drug Administration (FDA) in 2019 to prevent smallpox and monkeypox infection (*4*). U.S. distribution of JYNNEOS vaccine as postexposure prophylaxis (PEP) for persons with known exposures to MPXV began in May 2022. A U.S. national vaccination strategy† for expanded PEP, announced on June 28, 2022, recommended subcutaneous vaccination of persons with known or presumed exposure to MPXV, broadening vaccination eligibility. FDA emergency use authorization (EUA) of intradermal administration of 0.1 mL of JYNNEOS on August 9, 2022, increased vaccine supply (*5*). As of September 28, 2022, most vaccine has been administered as PEP or expanded PEP. Because of the limited amount of time that has elapsed since administration of initial vaccine doses, as of September 28, 2022, relatively few persons in the current outbreak have completed the recommended 2-dose series.§ To examine the incidence of monkeypox among persons who were unvaccinated and those who had received ≥1 JYNNEOS vaccine dose, 5,402 reported monkeypox cases occurring among males¶ aged 18–49 years during July 31–September 3, 2022, were analyzed by vaccination status across 32 U.S. jurisdictions.** Average monkeypox incidence (cases per 100,000) among unvaccinated persons was 14.3 (95% CI = 5.0–41.0) times that among persons who received 1 dose of JYNNEOS vaccine ≥14 days earlier. Monitoring monkeypox incidence by vaccination status in timely surveillance data might provide early indications of vaccine-related protection that can be confirmed through other well-controlled vaccine effectiveness studies. This early finding suggests that a single dose of JYNNEOS vaccine provides some protection against monkeypox infection. The degree and durability of such protection is unknown, and it is recommended that people who are eligible for monkeypox vaccination receive the complete 2-dose series.

Aggregate weekly numbers of confirmed and probable monkeypox cases†† among males aged 18–49 years with illness onset§§ during July 31–September 3, 2022, were analyzed across 32 public health jurisdictions. These jurisdictions routinely ascertain vaccination status¶¶ through patient interview or link cases with vaccination data from their immunization registries and separately submit deidentified vaccine administration data to CDC. The analysis was limited to males aged 18–49 years to exclude persons who might have received routine smallpox vaccination in childhood. Persons with monkeypox were categorized

* https://www.cdc.gov/poxvirus/monkeypox/response/2022/us-map.html

† https://www.hhs.gov/about/news/2022/06/28/hhs-announces-enhanced-strategy-vaccinate-protect-at-risk-individuals-from-current-monkeypox-outbreak.html

§ https://www.cdc.gov/poxvirus/monkeypox/response/2022/vaccines_data.html

¶ Cases reflect infections occurring among persons who self-reported sex assigned at birth or self-reported gender identity as male.

** Alaska, California, Colorado, Georgia, Hawaii, Idaho, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Virginia, West Virginia, and Wisconsin. Jurisdictions were included if age and sex assigned at birth or gender identity was available for ≥70% of cases reported, vaccination status was available for ≥50% of cases in males (defined by either sex assigned at birth or gender identity) aged 18–49 years or the jurisdiction confirmed cases are linked to immunization registry entries, and de-identified vaccination administration data were submitted to CDC.

†† Confirmed (presence of *Monkeypox virus* DNA by polymerase chain reaction [PCR] testing or Next-Generation sequencing of a clinical specimen OR isolation of *Monkeypox virus* in culture from a clinical specimen) and probable (presence of *Orthopoxvirus* DNA by PCR, or *Orthopoxvirus* using immunohistochemical or electron microscopy or detectable levels of anti-*Orthopoxvirus* immunoglobulin M antibody) monkeypox cases.

§§ Illness onset date refers to the earliest date available for each case. Dates available for selection varied by how the case was reported to the system and include illness onset, specimen collection, lab test completion, admission, diagnosis, discharge, case investigation start date, or date first electronically submitted or reported to the county, state, or public health department.

¶¶ Receipt of ≥1 dose of JYNNEOS vaccine.

as 1) unvaccinated; 2) potentially vaccinated, without date of vaccination; 3) vaccinated, with illness onset ≤13 days after their first dose; or 4) vaccinated, with illness onset ≥14 days after their first dose.***

Vaccination coverage was estimated as the total number of persons vaccinated as of 2 weeks before the start date of a week, divided by the estimated population eligible for vaccination.††† This underlying population included persons in each jurisdiction who might benefit from expanded vaccination in the context of the outbreak and was estimated as the number of MSM with HIV or who are eligible for HIV preexposure prophylaxis (HIV-PrEP) (*6*). The number of eligible unvaccinated persons was obtained by subtracting the number of vaccinated persons from estimates of the vaccine-eligible population. Weekly§§§ incidence by vaccination status was calculated as the number of cases divided by the number of persons either unvaccinated as of that week or vaccinated as of 2 weeks earlier.¶¶¶ Because relatively few persons had received a second vaccine dose within the time frame of this analysis, incidence among persons who had received their first JYNNEOS vaccine dose ≥14 days earlier is reported. Persons with illness onset ≤13 days after receipt of their first dose of vaccine, potentially vaccinated persons (those without a documented date of vaccination), and persons vaccinated before 2022 were excluded from the analysis. The average incidence rate ratio (IRR) during the study period was calculated by dividing the weighted average incidence across all weeks among unvaccinated persons by that among vaccinated persons; a 95% CI for the average IRR was calculated to account for variation in weekly rates. Weighting was based on the population size in each vaccination status category.

Two sensitivity analyses were conducted. The first examined changes in IRR when considering the total estimated MSM population as eligible for vaccination. The second examined changes in IRR under the assumptions that 50% or 100% of persons with monkeypox with unknown vaccination date received vaccine ≥14 days before illness onset. SAS (version 9.4; SAS Institute) and R (version 4.0.3; R Foundation) were used to conduct all analyses. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.****

During July 31–September 3, 2022, among 32 jurisdictions reporting 6,471 monkeypox cases (range across jurisdictions = 2–2,186 cases), a total of 5,402 (83.5%) were reported among males aged 18–49 years (Table). Among these, a total of 4,606 (85.3%) cases were among unvaccinated persons, 269 (5.0%) were among persons whose illness onset occurred ≤13 days after receipt of their first vaccine dose, 77 (1.4%) were among persons with illness onset ≥14 days after receipt of their first vaccine dose, and 450 (8.3%) were among persons without a known vaccination date. No persons vaccinated before 2022 were identified. Population coverage with 1 vaccine dose as of 2 weeks before the start of each week increased from 5.2% (July 31) to 29.9% (August 28) in the 32 jurisdictions; coverage with two vaccine doses increased from 0.1% to 1.9%. As of September 23, 2022, 10 and 2 cases had been reported in persons who had received a second JYNNEOS vaccine ≤13 days and ≥14 days before illness onset, respectively.

Weekly monkeypox incidence during July 31–September 3 was higher among unvaccinated persons than among those who had received their first JYNNEOS vaccine dose ≥14 days earlier (Figure). Average IRR comparing unvaccinated persons with those who received 1 dose of vaccine ≥14 days earlier was 14.3 (95% CI = 5.0–41.0). A sensitivity analysis expanding the estimated number of persons eligible for vaccination yielded similar trends but lower average IRR (Supplementary Figure, https://stacks.cdc.gov/view/cdc/121578). A sensitivity analysis examining changes to IRR assuming 50% or 100% of persons with unknown vaccination date received their vaccine dose ≥14 days before illness onset yielded similar trends but lower average IRR (Supplementary Table, https://stacks.cdc.gov/view/cdc/121579).

Discussion

Among 32 U.S. jurisdictions, monkeypox incidence among persons who were currently recommended to receive PEP or

*** Unvaccinated: No evidence in case record of receipt of JYNNEOS vaccine or vaccination date after illness onset, including records for which vaccination information was unknown. Potentially vaccinated: case record reflected some indication of vaccination, but without dose number or date. Vaccinated, illness onset ≤13 days after first dose: illness onset ≤13 days of receiving first dose of JYNNEOS vaccine. Vaccinated, illness onset ≥14 days after first dose: illness onset ≥14 days after receiving first dose of JYNNEOS vaccine, excluding persons vaccinated for smallpox before 2022.

††† The population aged 18–49 years that might benefit from expanded vaccination includes MSM with HIV infection (jurisdiction-specific estimates of 2020 HIV prevalence are from CDC's Atlas Plus [https://www.cdc.gov/nchhstp/atlas/index.htm] describing MSM who acquired HIV through male-to-male sexual contact or male-to-male sexual contact and injection drug use) or who are eligible for HIV-PrEP (estimated as the ratio of the jurisdiction-specific number of MSM receiving HIV preexposure prophylaxis (HIV-PrEP) and the jurisdiction-specific HIV-PrEP coverage. The number of MSM with HIV or who are eligible for HIV-PrEP aged 18–49 years was estimated by aggregating 2021 U.S. Census Bureau estimates for males aged 0–12, 13–17, 18–49, and ≥50 years, calculating the state proportion in each age group, and multiplying by the estimated number of MSM with HIV or who are eligible for HIV-PrEP in each state to obtain proportional distributions. Additional details about these methods can be obtained by contacting the corresponding author.

§§§ Cases and vaccine doses administered were aggregated by MMWR week. Weeks begin on Sunday and end on Saturday.

¶¶¶ Because most vaccine administered during the study period was PEP, this time point was chosen to account for the incubation period after exposure. Further, immunogenicity data submitted to FDA indicated that antibody titers 2 weeks after the first dose were similar to titers 4 weeks after the first dose and were significantly higher than prevaccination antibody titers.

**** 5 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.

expanded PEP with JYNNEOS vaccine was higher among unvaccinated persons compared with those who had received their first vaccine dose ≥14 days earlier. Data for this analysis were collected during a period when vaccine was widely available, reducing potential bias from limited vaccine accessibility. Findings are consistent with recent studies reporting that a single dose of JYNNEOS vaccine for prevention of MPXV infection in males aged 18–42 years who were prescribed HIV-PrEP or with diagnosed HIV infection and one or more other sexually transmitted infection might provide some protection (*7*) and modest induction of antibody levels after a single dose (*8*).

The findings in this report are subject to at least six limitations. First, linkage of monkeypox case surveillance and vaccination administration data might result in misclassifications that could influence IRR estimates. Some patients might not be linkable within a jurisdiction's immunization registry because of receipt of vaccine outside the jurisdiction, or interviewed persons with monkeypox might have incorrectly reported their own vaccination status. This approach assumes that persons with unknown vaccination status were unvaccinated and excludes those with unknown date of vaccination because timing between vaccination and illness onset could not be established. Second, this analysis was unable to control for possible differences in testing or behaviors that increase risk for MPXV exposure or possible differences in risk because of patient characteristics (e.g., age and underlying medical conditions, including HIV status); consequently, causality and a full attribution of these results to vaccination cannot be inferred from these data. Third, incidence among persons who received 2 JYNNEOS vaccine doses could not be assessed, because of low second dose coverage and sparse data during the study period precluded these estimates. Fourth, temporality of exposures causing infection are not known. Vaccination strategies focused on PEP and expanded PEP during the study period; however, some patients might have received vaccine before exposure, or might have had additional exposures after vaccination. Fifth, confirmation that all identified persons with monkeypox were members of the population eligible for vaccination was not possible. Finally, data assessed from 32 jurisdictions accounted for 56% of the U.S. population eligible for vaccination and might not be generalizable.

These data are intended to provide an early indication of the real-world impact of vaccination with JYNNEOS for preventing monkeypox and to guide public health prevention interventions (e.g., vaccinating persons at high risk for infection

TABLE. JYNNEOS vaccination coverage among males* aged 18–49 years and monkeypox cases by first-dose vaccination status† — 32 U.S. jurisdictions,§,¶ July 31–September 3, 2022

Characteristic	No. (%), by week beginning					Total
	Jul 31	Aug 7	Aug 14	Aug 21	Aug 28	
1-dose vaccination coverage, %**	5.2	9.8	16.2	23.9	29.9	**NA**
2-dose vaccination coverage,%††	0.1	0.2	0.3	0.8	1.9	**NA**
Total monkeypox cases§§	**1,284**	**1,313**	**1,034**	**1,013**	**758**	**5,402**
Vaccination status						
Unvaccinated	1,097 (85.4)	1,103 (84.0)	872 (84.3)	881 (87.0)	653 (86.1)	**4,606 (85.3)**
Vaccinated	187 (14.6)	210 (16.0)	162 (15.7)	132 (13.0)	105 (13.9)	**796 (14.7)**
Vaccination date known						
No	121 (9.4)	118 (9.0)	79 (7.6)	78 (7.7)	54 (7.1)	**450 (8.3)**
Yes	66 (5.1)	92 (7.0)	83 (8.0)	54 (5.3)	51 (6.7)	**346 (6.4)**
Illness onset relative to vaccination (among those with known vaccination date)						
0–13 days after first dose	62 (4.8)	73 (5.6)	65 (6.3)	39 (3.8)	30 (4.0)	**269 (5.0)**
≥14 days after first dose	4 (0.3)	19 (1.4)	18 (1.7)	15 (1.5)	21 (2.8)	**77 (1.4)**
Before second dose	4 (0.3)	17 (1.3)	16 (1.5)	11 (1.1)	17 (2.2)	**65 (1.2)**
0–13 days after second dose	0 (—)	2 (0.2)	1 (0.1)	4 (0.4)	3 (0.4)	**10 (0.2)**
≥14 days after second dose	0 (—)	0 (—)	1 (0.1)	0 (—)	1 (0.1)	**2 (0.1)**

Abbreviations: NA = not applicable; PCR = polymerase chain reaction.

* Defined as sex assigned at birth or gender identity.

† Vaccinated: persons who had received ≥ 1 dose of JYNNEOS vaccine.

§ Alaska, California, Colorado, Georgia, Hawaii, Idaho, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Virginia, West Virginia, and Wisconsin.

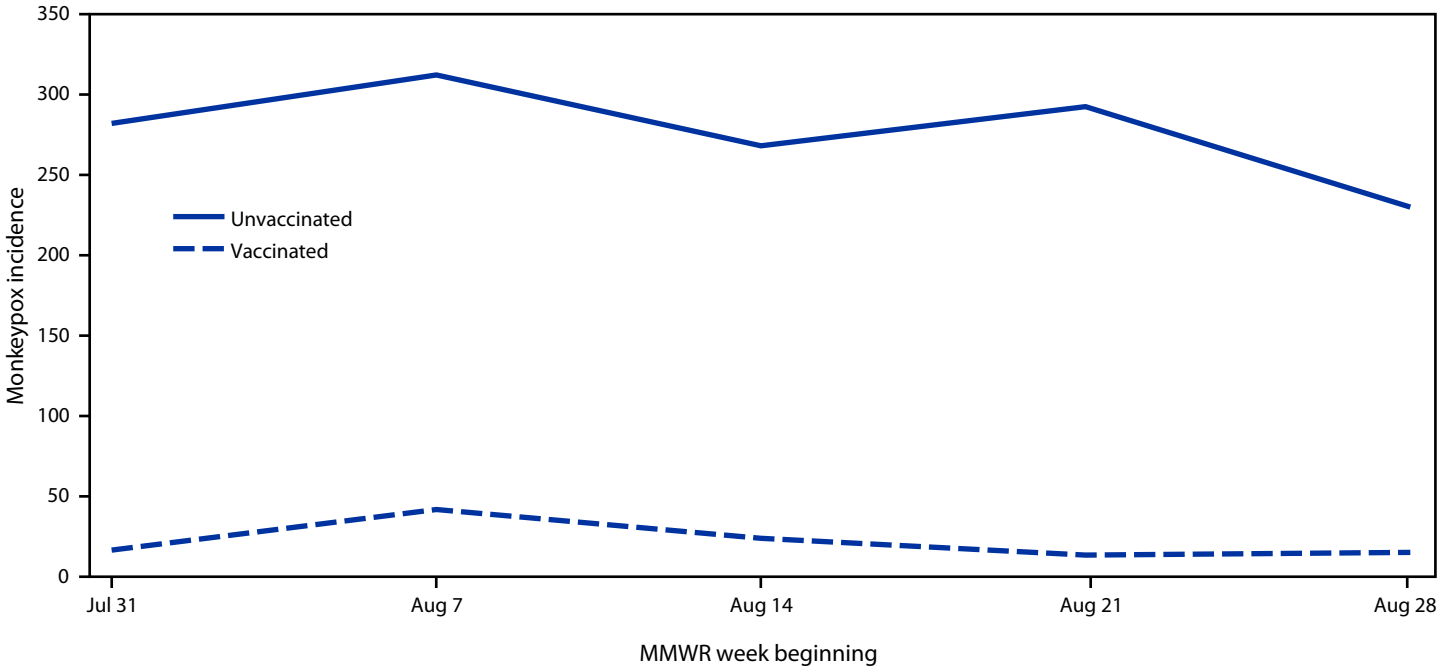
¶ Jurisdictions were included if age and sex assigned at birth or gender identity were available for ≥70% of cases reported, vaccination status was available for ≥50% of cases in males (defined by either sex assigned at birth or gender identity) aged 18–49 years or the jurisdiction confirmed that cases are linked to immunization registry entries, and de-identified vaccination administration data were submitted to CDC.

** Proportion of population eligible for vaccination that had received 1 dose of JYNNEOS vaccine as of 2 weeks before the start of the week.

†† Proportion of population eligible for vaccination that had received 2 doses of JYNNEOS vaccine as of 2 weeks before the start of the week.

§§ Confirmed (presence of *Monkeypox virus* DNA by PCR testing or Next-Generation sequencing of a clinical specimen or isolation of *Monkeypox virus* in culture from a clinical specimen) and probable (presence of *Orthopoxvirus* DNA by PCR testing, or *Orthopoxvirus* using immunohistochemical or electron microscopy or detectable levels of anti-*Orthopoxvirus* immunoglobulin M antibody) monkeypox cases.

FIGURE. Weekly monkeypox incidence,* by first-dose vaccination status†,§ among males aged 18–49 years eligible for vaccination¶ — 32 U.S. jurisdictions,†† July 31–September 3, 2022**



Abbreviation: IRR = incidence rate ratio.

* Cases per 100,000 population. Rate in vaccinated persons = number of probable or confirmed cases reported to CDC with date of illness onset, specimen collection, lab test completion, admission, diagnosis, discharge, case investigation start date, or date first electronically submitted or reported to the county, state, or public health department (earliest available date) ≥14 days after receiving the first dose of JYNNEOS vaccine among total vaccinated population as of 2 weeks previously. Rate in unvaccinated persons = number of probable or confirmed cases reported to CDC without evidence of vaccination among total unvaccinated population.

† Vaccinated = persons who had received ≥1 dose of JYNNEOS ≥14 days earlier.

§ Average IRR comparing unvaccinated persons with those who received 1 dose of vaccine ≥14 days earlier was 14.3.

¶ Gay, bisexual, and other men who have sex with men who have HIV infection or who are eligible to receive HIV preexposure prophylaxis were considered eligible for vaccination.

** Alaska, California, Colorado, Georgia, Hawaii, Idaho, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Virginia, West Virginia, and Wisconsin.

†† Jurisdictions were included if age and sex assigned at birth or gender identity was available for ≥70% of cases reported, vaccination status was available for ≥50% of cases in males (defined by either sex assigned at birth or gender identity) aged 18–49 years or the jurisdiction confirmed cases were linked to immunization registry entries, and de-identified vaccination administration data were submitted to CDC.

while still encouraging harm reduction strategies, including reducing the number of sexual partners and one-time sexual encounters) (*9*). The framework used in this analysis allows for ongoing comparison of observed IRRs over time and can be used to monitor vaccine performance after a second dose. Durability of immunity after a single dose is not yet known, and because vaccine effectiveness and duration of protection are anticipated to be better after 2 doses, it remains important that all vaccinated persons receive their second dose. Monitoring monkeypox incidence by vaccination status using currently available surveillance data might provide early estimates of vaccine performance for rapid public health decision making. Although the findings are encouraging, corroboration and confirmation through planned epidemiologic studies that are better able to account for potential biases are needed. This

Summary

What is already known about this topic?

Real-world monkeypox vaccine performance data are limited in the context of the ongoing monkeypox outbreak.

What is added by this report?

Across 32 U.S. jurisdictions, among males aged 18–49 years eligible for JYNNEOS vaccination, monkeypox incidence was 14 times as high among unvaccinated males compared with those who had received a first vaccine dose ≥14 days earlier.

What are the implications for public health practice?

These early findings suggest that a single JYNNEOS dose provides some protection against monkeypox infection. The degree and durability of such protection is unknown, and it is recommended that persons who are eligible for monkeypox vaccination receive the complete 2-dose series.

early finding suggests that a single dose of JYNNEOS vaccine provides some protection against monkeypox infection. It is recommended people who are eligible for monkeypox vaccination receive the complete 2-dose series.

Acknowledgements

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Notes from the Field

E-cigarette Use Among Middle and High School Students — United States, 2022

Maria Cooper, PhD[1]; Eunice Park-Lee, PhD[1]; Chunfeng Ren, PhD[1]; Monica Cornelius, PhD[2]; Ahmed Jamal, MBBS[2]; Karen A. Cullen, PhD[1]

Since 2014, e-cigarettes have been the most commonly used tobacco product among U.S. middle and high school students (*1*). Most e-cigarettes contain nicotine, which is highly addictive, can harm the developing adolescent brain, and can increase risk for future addiction to other drugs (*2*). Among middle and high school current e-cigarette users (i.e., use on ≥1 day during the past 30 days), use of disposable e-cigarette devices* increased significantly between 2019 and 2020 (*3*) and was the most commonly used device type reported in 2021 (*4*). In 2020 and 2021, approximately eight in 10 middle and high school students who used e-cigarettes reported using flavored e-cigarettes (*4,5*). CDC and the Food and Drug Administration (FDA) analyzed nationally representative data from the 2022 National Youth Tobacco Survey (NYTS), a school-based, cross-sectional, self-administered survey conducted during January 18–May 31, 2022,† using a web-based survey instrument and administered to U.S. middle school (grades 6–8) and high school (grades 9–12) students.§ Participating students could complete the survey whether they were physically in school or at home engaging in remote learning; 99.3% of students reported completing the survey in school. Current e-cigarette use was assessed overall and by frequency of use, device type, flavors, and brands used (any brand used and usual brand used).¶ Weighted prevalence estimates and population totals were calculated.** The NYTS study protocol was reviewed and approved by CDC's institutional review board.††

In 2022, 14.1% of high school students and 3.3% of middle school students reported current e-cigarette use (Table). Among current e-cigarette users, 42.3% reported using e-cigarettes frequently,§§ including 46.0% of high school students and 20.8% of middle school students; daily use was reported among 27.6% of current e-cigarette users, including 30.1% of high school students and 11.7% of middle school students. Among current e-cigarette users, the types of devices most often used were disposables (high school = 57.2%; middle school = 45.8%), followed by prefilled or refillable pods or cartridges (high school = 25.7%; middle school = 21.6%), and tanks or mod systems (high school = 5.9%; middle school = 9.8%), with 11.2% of high school students and nearly 23% of middle school students reporting not knowing the type of e-cigarette device used.

Among current e-cigarette users, Puff Bar was the most commonly reported brand used in the past 30 days by both middle and high school students (29.7%), followed by Vuse (23.6%), JUUL (22.0%), SMOK (13.5%), NJOY (8.3%), Hyde (7.3%), and blu (6.5%). Among current e-cigarette users, 14.5% reported that the brand they usually used was Puff Bar, followed by Vuse (12.5%), Hyde (5.5%), and SMOK (4.0%). Approximately one fifth (21.8%) of current e-cigarette users reported "some other brand" as their usual brand.

Among current e-cigarette users overall, 84.9% used flavored e-cigarettes; of these, the reported flavor types, in descending order of use, were fruit (69.1%); candy, desserts, or other sweets (38.3%); mint (29.4%); and menthol (26.6%). A similar pattern was observed among current users of flavored disposable e-cigarettes: fruit (75.2%); candy, desserts, or other sweets (40.4%); mint (29.6%); and menthol (16.7%) (Supplementary Table, https://stacks.cdc.gov/view/cdc/121630). Among current users of flavored pods or cartridges, the reported flavor types used were fruit (58.4%); menthol (53.9%); candy, desserts, or other sweets (30.3%); and mint (27.6%). Among current users of flavored tanks or mod systems, the reported flavor types used were fruit (69.6%); candy, desserts, or other sweets (47.7%); mint (40.1%); and menthol (35.2%).

* Disposable e-cigarettes come prefilled with e-liquid, and the entire device is designed to be discarded after a single use. Other devices have pods or cartridges that hold the e-liquid. Some pods or cartridges come prefilled with e-liquid and are replaced after use, and others can be refilled by the user. Tank or mod-type devices can also be refilled, but are also usually customizable, allowing the user to change the temperature or voltage, nicotine concentrations, and add accessories.

† In 2022, 28,291 students from 341 schools participated (overall response rate = 45.2%).

§ Because of changes in methodology, including differences in survey administration and data collection procedures, the ability to compare estimates from 2022 with those from previous NYTS waves is limited; differences between estimates might be due to changes in methodology, actual behavior, or both. The NYTS was conducted in schools using an electronic tablet in 2019 and 2020. Because of COVID-19 concerns, the 2021 NYTS was conducted using web-based data collection, with approximately one half (50.8%) of students completing it in school. The 2022 NYTS was also conducted using web-based data collection; however, nearly all (99.3%) students completed the survey in school.

¶ Brand response options were as follows: blu, Eonsmoke, JUUL, Leap, Logic, Mojo, NJOY, Posh, Puff Bar, SMOK (including NOVO), STIG, Suorin, Vuse, "some other brand(s) not listed here," and "I don't know the brand." Those who selected "some other brand(s) not listed here" could provide a write-in response. Write-in responses were recoded into valid responses. One additional brand, Hyde, is reported based on the write-in responses. As a result, estimates of Hyde use might be underestimated.

** Weighted population estimates were rounded down to the nearest 10,000 students.

†† 45 C.F.R. part 46; 21 C.F.R. part 56.

§§ Frequent e-cigarette use was defined as use on ≥20 days in the past 30 days. Daily e-cigarette use was defined as use on all of the past 30 days. These estimates are not mutually exclusive.

TABLE. Prevalence of current (past 30-day) e-cigarette use,* overall and by selected characteristics and school level — National Youth Tobacco Survey, United States, 2022

Characteristic	Overall		High school		Middle school	
	Estimated weighted no.†	% (95% CI)	Estimated weighted no.†	% (95% CI)	Estimated weighted no.†	% (95% CI)
Among all students (N = 28,291)						
Current use of e-cigarettes	**2,550,000**	**9.4 (8.0–11.1)**	2,140,000	14.1 (12.4–16.0)	380,000	3.3 (2.6–4.2)
Among current e-cigarette users						
Frequency of use during past 30 days						
1–5 days	**1,030,000**	**40.6 (37.2–44.1)**	790,000	37.2 (33.4–41.1)	230,000	60.0 (53.3–66.3)
6–19 days	**430,000**	**17.1 (14.2–20.4)**	360,000	16.8 (13.9–20.2)	70,000	19.3 (12.7–28.3)
20–30 days	**1,080,000**	**42.3 (38.5–46.3)**	980,000	46.0 (41.6–50.4)	80,000	20.8 (15.8–26.8)
Daily e-cigarette use§	**700,000**	**27.6 (24.5–31.0)**	640,000	30.1 (26.6–33.9)	40,000	11.7 (8.0–16.7)
Device type most often used¶						
Disposables	**1,390,000**	**55.3 (49.5–61.0)**	1,210,000	57.2 (51.7–62.6)	170,000	45.8 (34.5–57.6)
Prefilled or refillable pods or cartridges	**630,000**	**25.2 (19.7–31.5)**	540,000	25.7 (20.2–32.0)	80,000	21.6 (12.8–33.9)
Tanks or mod system	**160,000**	**6.7 (5.3–8.4)**	120,000	5.9 (4.5–7.8)	30,000	9.8 (7.1–13.5)
Don't know the type	**320,000**	**12.8 (10.2–16.1)**	230,000	11.2 (8.6–14.4)	80,000	22.8 (17.0–29.9)
Any brand**						
Puff Bar	**730,000**	**29.7 (25.5–34.4)**	610,000	29.3 (25.0–34.0)	110,000	30.9 (21.3–42.4)
Vuse	**580,000**	**23.6 (17.9–30.3)**	490,000	23.8 (17.9–30.9)	70,000	20.9 (13.2–31.3)
JUUL	**540,000**	**22.0 (17.8–26.9)**	440,000	21.2 (16.3–27.1)	80,000	23.8 (17.8–30.9)
SMOK (including NOVO)	**330,000**	**13.5 (10.8–16.6)**	290,000	14.3 (11.4–17.9)	20,000	7.8 (4.4–13.5)
NJOY	**200,000**	**8.3 (6.0–11.4)**	170,000	8.2 (5.6–11.7)	20,000	7.3 (4.3–12.1)
Hyde††	**180,000**	**7.3 (4.4–12.0)**	160,000	7.9 (4.6–13.3)	—§§	—§§
blu	**160,000**	**6.5 (4.9–8.6)**	110,000	5.6 (3.9–7.8)	30,000	10.2 (5.7–17.6)
STIG	**120,000**	**5.0 (3.6–6.8)**	90,000	4.7 (3.2–6.7)	—§§	—§§
Suorin	**110,000**	**4.8 (3.6–6.5)**	90,000	4.8 (3.5–6.5)	—§§	—§§
Logic	**100,000**	**4.3 (3.0–6.1)**	70,000	3.8 (2.5–5.6)	—§§	—§§
Mojo	**90,000**	**4.0 (2.8–5.5)**	70,000	3.7 (2.6–5.3)	—§§	—§§
Leap	**90,000**	**3.7 (2.6–5.2)**	60,000	3.0 (2.0–4.4)	—§§	—§§
Eonsmoke	**80,000**	**3.6 (2.4–5.3)**	60,000	2.9 (1.8–4.7)	—§§	—§§
Some other brand not listed	**790,000**	**32.2 (27.8–37.0)**	670,000	32.2 (27.4–37.4)	120,000	32.8 (25.5–41.0)
Not sure/Don't know the brand	**700,000**	**28.3 (24.8–32.0)**	550,000	26.7 (22.7–31.1)	140,000	37.4 (29.7–45.8)
Usual brand¶¶						
Puff Bar	**350,000**	**14.5 (11.5–18.3)**	280,000	14.0 (10.9–17.9)	60,000	17.7 (11.0–27.2)
Vuse	**300,000**	**12.5 (8.3–18.3)**	260,000	13.1 (8.8–19.1)	—§§	—§§
Hyde††	**130,000**	**5.5 (3.1–9.6)**	—§§	—§§	—§§	—§§
SMOK (including NOVO)	**90,000**	**4.0 (2.8–5.8)**	80,000	4.4 (3.0–6.5)	—§§	—§§
JUUL	—§§	—§§	—§§	—§§	20,000	6.7 (3.8–11.5)
No usual brand	**80,000**	**3.3 (2.3–4.7)**	50,000	2.9 (1.9–4.4)	—§§	—§§
Some other brand not listed	**520,000**	**21.8 (17.7–26.6)**	450,000	22.6 (17.9–28.1)	60,000	17.5 (12.2–24.3)
Not sure/Don't know the brand	**590,000**	**24.8 (21.2–28.8)**	470,000	23.6 (19.5–28.2)	110,000	31.9 (25.4–39.0)
Flavored e-cigarette use***						
Yes	**2,110,000**	**84.9 (82.4–87.2)**	1,790,000	85.5 (82.9–87.8)	300,000	81.5 (75.0–86.6)
No	**230,000**	**9.3 (7.7–11.2)**	190,000	9.3 (7.5–11.6)	30,000	9.5 (6.5–13.8)
Don't know	**140,000**	**5.7 (4.5–7.3)**	100,000	5.2 (4.1–6.5)	30,000	9.0 (5.7–13.9)
Among current flavored e-cigarette users						
Flavor type used†††						
Fruit	**1,450,000**	**69.1 (65.4–72.6)**	1,220,000	68.5 (64.4–72.3)	210,000	71.1 (63.9–77.3)
Candy, desserts, or other sweets	**800,000**	**38.3 (33.8–42.9)**	660,000	37.3 (32.6–42.2)	130,000	43.6 (36.3–51.3)
Mint	**610,000**	**29.4 (25.6–33.5)**	540,000	30.3 (25.9–35.1)	70,000	23.7 (18.9–29.3)
Menthol	**550,000**	**26.6 (21.0–33.1)**	500,000	28.2 (22.2–35.2)	40,000	16.2 (10.3–24.6)
Alcoholic drinks	**150,000**	**7.6 (5.6–10.2)**	120,000	6.8 (4.7–9.8)	30,000	10.8 (7.0–16.1)
Chocolate	**80,000**	**4.3 (3.1–5.9)**	60,000	3.8 (2.7–5.3)	—§§	—§§
Clove or spice	**60,000**	**2.9 (1.9–4.6)**	40,000	2.6 (1.6–4.2)	—§§	—§§
Some other flavor not listed	**240,000**	**11.7 (10.1–13.6)**	200,000	11.7 (9.9–13.7)	30,000	11.9 (8.0–17.5)

See table footnotes on the next page.

TABLE. (*Continued*) Prevalence of current (past 30-day) e-cigarette use,* overall and by selected characteristics and school level — National Youth Tobacco Survey, United States, 2022

* Past 30-day use of e-cigarettes was determined by the question, "During the past 30 days, on how many days did you use e-cigarettes?" Current use was defined as use on ≥1 day during the past 30 days.
† Estimated total number of users was rounded down to the nearest 10,000 students. Overall population totals might not directly sum to corresponding estimates by school level because of rounding or inclusion of students who did not self-report grade level.
§ Daily e-cigarette use was defined as use on all 30 of the past 30 days.
¶ Device type was determined by the question, "Which of the following best describes the type of e-cigarette you have used in the past 30 days? If you have used more than one type, please think about the one you use most often."
** All current e-cigarette users were asked, "During the past 30 days, what e-cigarette brands did you use? (Select one or more)." Those who selected "some other brand(s) not listed here" could provide a write-in response. Write-in responses corresponding to an original response option were recoded. Data for Posh are not shown because of statistically unreliable estimates.
†† Hyde was not included in the list of prespecified response options, but it was the most commonly provided write-in response for "some other brand." Write-in responses for Hyde were recoded, and all remaining responses were maintained as "some other brand."
§§ Data were statistically unreliable because of unweighted denominator <50 or a relative SE >30%.
¶¶ If a single brand was selected for the question, "During the past 30 days, what e-cigarette brands did you use (Select one or more)," it was reported as their usual brand. Those who selected one or more brand were asked, "During the past 30 days, what brand of e-cigarettes did you usually use? (Choose only one answer)." Those who selected "some other brand(s) not listed here" could provide a write-in response. Write-in responses corresponding to an original response option were recoded. Data for blu, Eonsmoke, Leap, Logic, Mojo, NJOY, Posh, STIG, and Suorin are not shown because of statistically unreliable estimates.
*** Flavored e-cigarette use was assessed by response to the question, "Were any of the e-cigarettes that you used in the past 30 days flavored to taste like menthol, mint, clove or spice, alcoholic drinks, candy, fruit, chocolate, or any other flavor?"
††† Flavor type was determined by response to the question, "What flavors were the e-cigarettes that you have used in the past 30 days? (Select one or more)." Those who selected "some other flavor not listed here" could provide a write-in response. Write-in responses corresponding to an original response option were recoded.

In 2022, 2.55 million U.S. middle and high school students currently used e-cigarettes. Most reported using flavored products, and, among those students, approximately seven of 10 used fruit flavors. Disposable products were the most commonly reported device type. Further, among middle and high school students who used e-cigarettes, approximately four in 10 reported frequent use, and approximately one in four reported daily use. The use of tobacco products in any form, including e-cigarettes, by middle and high school students is unsafe. Sustained implementation of comprehensive tobacco prevention and control strategies at the national, state, and local levels,¶¶ coupled with FDA regulation and enforcement, is critical to addressing e-cigarette use among middle and high school students (*2*).

¶¶ CDC's website has resources and information related to tobacco prevention and control at the local, state, and national levels, including information to guide parents, teachers, and school administrators and coaches in an informed discussion on e-cigarettes with young persons. https://www.cdc.gov/tobacco/index.htm

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Notes from the Field

Increases in Firearm Homicide and Suicide Rates — United States, 2020–2021

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The firearm homicide rate in the United States increased nearly 35% from 2019 to 2020, coinciding with the emergence of the COVID-19 pandemic (*1*). This increase affected all ages and most population groups, but not equally: existing disparities, including racial and ethnic disparities, widened. The firearm suicide rate was higher than the firearm homicide rate in 2020 and remained consistent with recent years overall; however, increases were observed in some groups (*1*). To assess potential increases from 2020 to 2021, final 2020 and provisional 2021, National Vital Statistics System mortality data and U.S. Census Bureau population estimates were used to examine all-cause homicide and suicide rates; firearm homicide and suicide rates overall and by sex, age,* race and ethnicity; and the percentage of homicides and suicides from firearm injuries.† This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.§

An estimated 20,966 firearm homicides and 26,320 firearm suicides occurred in the United States during 2021 (Table). From 2020 to 2021, the percentage of homicides and suicides attributed to firearm injuries increased from 79% to 81% and from 53% to 55%, respectively, resulting in the highest percentage for homicide in more than 50 years and the highest percentage for suicide since 2001.

The firearm homicide rate in 2021 was 8.3% higher than it was in 2020 (Table); increases occurred among both males and females. The highest rates were generally among persons aged 25–44 years, with increases occurring in each racial and ethnic population in that age group (Supplementary Table, https://stacks.cdc.gov/view/cdc/121555). Non-Hispanic Black or African American persons continued to experience the highest firearm homicide rates in every age group.

The firearm suicide rate among persons aged ≥10 years also increased 8.3% from 2020 to 2021 (Table), with increases among males and females, and most age by race and ethnicity groups (Supplementary Table, https://stacks.cdc.gov/view/cdc/121555). The highest firearm suicide rates for persons aged <45 years were among non-Hispanic American Indian or Alaska Native (AI/AN) persons, and the highest rates for those aged ≥45 years were among non-Hispanic White persons.

The overall U.S. firearm homicide and firearm suicide rates in 2021 were the highest documented since 1993 and 1990, respectively. Some racial and ethnic groups experienced substantially higher rates in 2021, and among some groups, disparities continued to widen. This analysis cannot explain the reasons for the increases; however, multiple social and structural conditions are associated with risk for homicide and suicide. Systemic inequities (e.g., in economic, educational, housing, and employment opportunities) and structural racism have contributed to disparities in outcomes, and the COVID-19 pandemic could have worsened these conditions, especially in some racial and ethnic communities (*1*,*2*).

The findings in this report are subject to at least three limitations. First, the 2021 data in this report are provisional and might change when final data are available; however, reported rates are unlikely to shift downward. Second, rates for some population groups could not be reported because of small counts. Finally, some racial and ethnic groups, particularly AI/AN persons, might be undercounted because of misclassification (*3*).

Increases since 2020 and record high rates of firearm homicide and suicide in 2021 underscore the urgent need for prevention efforts. Public health can facilitate collaboration across sectors, including health, law enforcement, education, social services, and community organizations, to implement a coordinated and comprehensive approach based on the best available evidence. To help communities make use of the best available evidence for violence prevention, CDC has released Technical Packages for Violence Prevention.¶ Prevention efforts can include street outreach and hospital-based interventions, efforts to enhance secure firearm storage and reduce access to firearms among those at risk for harming themselves or others, changes to the physical environment (e.g., remediating vacant lots to enhance safe spaces), programs that enhance positive

* Children aged <10 years were excluded from analysis of suicides because self-harm intent can be difficult to ascertain in young children.

† CDC, National Center for Health Statistics, National Vital Statistics System, Provisional Mortality on CDC WONDER Online Database, https://wonder.cdc.gov (Accessed August 11, 2022); CDC, National Center for Injury Prevention and Control, Web-based Injury Statistics Query and Reporting System (WISQARS), https://www.cdc.gov/injury/wisqars/index.html (Accessed August 11, 2022); U.S. Census Bureau, Population Division, Annual Estimates of the Resident Population by Single Year of Age and Sex for the United States: April 1, 2020 to July 1, 2021 (NC-EST2021-AGESEX-RES), https://www.census.gov (Accessed July 9, 2022); U.S. Census Bureau, Population Division, Annual Estimates of the Resident Population by Sex, Age, Race, and Hispanic Origin for the United States: April 1, 2020 to July 1, 2021 (NC-EST2021-ASR6H), https://www.census.gov (Accessed August 7, 2022).

§ 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.

¶ https://www.cdc.gov/violenceprevention/communicationresources/pub/technical-packages.html

TABLE. All-cause and firearm-related homicides and suicides — United States, 2020–2021

Event/Sex	2020		2021*		% Change in rate from 2020 to 2021
	No. (rate[†,§])	% By firearm[¶,**]	No. (rate[†,§])	% By firearm[¶,**]	
All-cause homicides					
Total	**24,574 (7.69)**	**78.9**	**25,987 (8.14)**	**80.7**	**5.9**
Firearm homicides					
Total	**19,383 (6.12)**	—	**20,966 (6.63)**	—	**8.3**
Male	16,427 (10.29)	—	17,604 (11.04)	—	7.3
Female	2,956 (1.85)	—	3,362 (2.11)	—	14.0
All-cause suicides					
Total	**45,957 (15.63)**	**52.9**	**48,023 (16.31)**	**54.8**	**4.3**
Firearm suicides					
Total	**24,292 (8.07)**	—	**26,320 (8.75)**	—	**8.3**
Male	21,180 (14.50)	—	22,930 (15.65)	—	8.0
Female	3,112 (2.08)	—	3,390 (2.27)	—	8.9

Sources: CDC WONDER; CDC Web-based Injury Statistics Query and Reporting System (WISQARS); U.S. Census Bureau.
* Data for 2021 are provisional and as reported through August 7, 2022.
† Homicide rates are per 100,000 persons. Rates include all decedents with documented age. Rates are age-adjusted to the year 2000 U.S. standard population.
§ Suicide rates are per 100,000 persons aged ≥10 years. Rates are age-adjusted to the year 2000 U.S. standard population. Suicide statistics exclude data for persons aged <10 years because intent for self-harm can be difficult to ascertain in young children.
¶ Homicide percentages are based on all homicides with or without documented decedent age.
** Suicide percentages are based on all suicides with documented decedent age ≥10 years.

social connections or teach coping and problem-solving skills, therapeutic interventions (e.g., crisis intervention and treatment to address previous trauma), and policies (e.g., housing and economic) that address underlying risks and inequities.

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Notes from the Field

Coagulopathy Associated with Brodifacoum Poisoning — Florida, December 2021

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On December 4, 2021, the Florida Department of Health in Hillsborough County was notified by the Florida Poison Information Center Tampa about three patients with unexplained bleeding and a history of synthetic cannabinoid (SCB) use. These patients resembled those from the nationwide incident of coagulopathy associated with SCB use that occurred in 2018, which included five patients from Florida who displayed similar signs, symptoms, and high-risk behaviors (*1*). An epidemiologic investigation was conducted to establish exposure links and provide guidance to hospitals and health care providers. On December 7, 2021, epidemiology program managers at county health departments in the region including Pasco County, Pinellas County, and Polk County, and emergency department physicians as well as medical examiners at Advent Health, St. Joseph Hospital, and Tampa General Hospital were informed about these three patients and asked to report any suspected cases. A press release was issued to the public for awareness. Florida's syndromic surveillance database, Electronic Surveillance System for the Early Notification of Community-based Epidemics, was used to monitor Florida Poison Information Center, emergency department, and urgent care data for potential new cases. Case definitions were established based on the nationwide 2018 incident (*1*). Patients were interviewed, and medical records were reviewed to collect information on patient demographics; signs and symptoms; SCB, marijuana, or other drug use; product purchase locations; and exposure to prescription vitamin K oxidoreductase antagonists.

A total of 52 cases were identified; 43 (82.7%) were confirmed and nine (17.3%) probable. A total of 38 (73.1%) cases were distributed throughout north and east Tampa; the other cases occurred sporadically throughout Hillsborough County. One patient was identified in neighboring Pinellas County. All patients except one were admitted to hospitals in Hillsborough County. The mean patient age was 36 years (range = 16–63 years); 40 (76.9%) were male. A total of 47 (87.0%) reported using SCBs with similar purchase locations before symptom onset. Five patients had both elevated international normalized ratios (INRs) and positive brodifacoum tests but did not report SCB use.* Symptom onset occurred during November 24–December 19, 2021 (Figure). The most common symptoms were hematuria (36; 69.2%), abdominal pain (33; 63.5%), and hematemesis (16; 30.8%). INR measurements were elevated in all patients; the median INR was 12.8 (range = 3.9 to >15) (*2*). Four (7.7%) patients died; the mean age of deceased patients was 34 years.

None of the patients reported taking prescribed vitamin K oxidoreductase antagonists that could cause a substantial change in INR measurements. Five patients provided the SCB products they had smoked, of which four tested positive for brodifacoum, a long-acting vitamin K oxidoreductase antagonist.† All five products tested positive for the SCBs 4F-MDMB-BUTICA and ADB-BUTINACA.

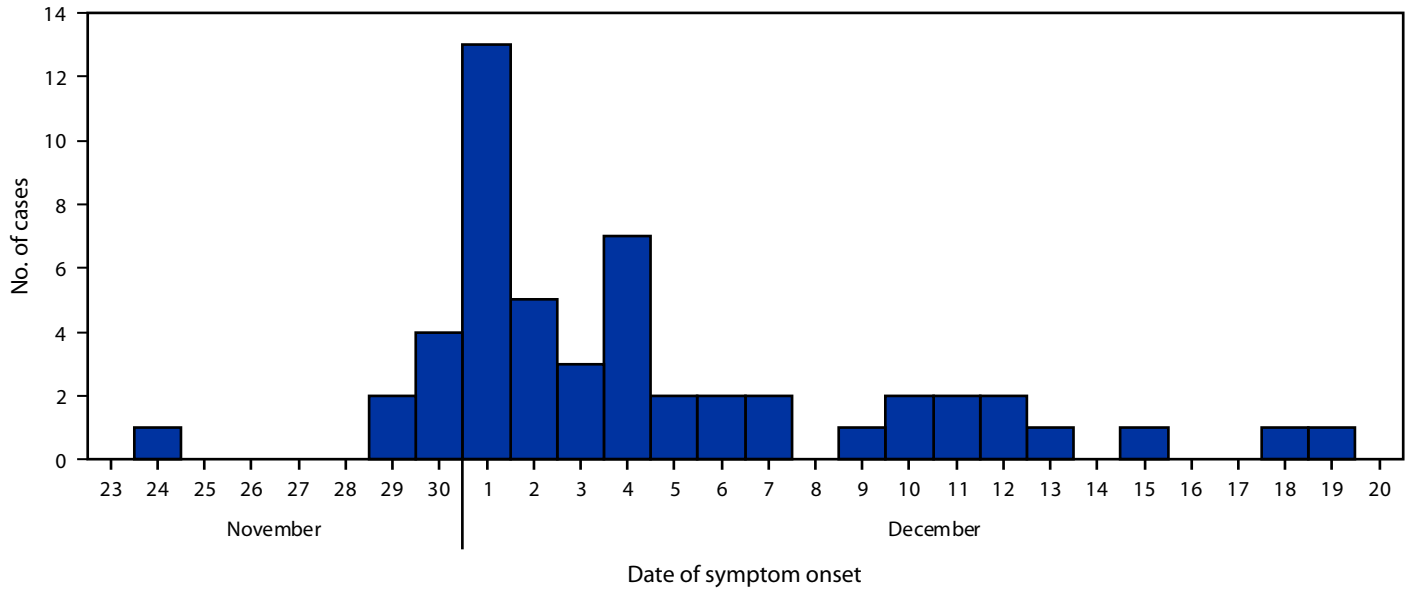
Vitamin K1 was used to treat vitamin K oxidoreductase antagonist coagulopathy; treatment was administered by both oral and intravenous routes. Patients began with intravenous vitamin K1 and transitioned to oral vitamin K1. Many patients needed high doses of oral vitamin K1 (i.e., 150 mg/day), which required taking 30 5-mg tablets daily during hospitalization and for 3–6 months after discharge, with treatment time varying for each patient based on their brodifacoum terminal elimination (*3*). Approximately two thirds of patients (34; 65.4%) were uninsured and unable to pay for inpatient and outpatient treatment; oral vitamin K1 treatment can cost ≥$65,000 per month. With assistance from Hillsborough County, 12 patients were enrolled in a local managed health care program for residents with limited income. A private pharmaceutical company donated enough vitamin K1 tablets to treat all 52 patients.

Three major challenges were identified during this incident response. First, diagnosis of a specific vitamin K oxidoreductase antagonist (i.e., brodifacoum) was challenging because diagnosis required testing against an anticoagulant panel that is expensive (i.e., >$750 per specimen), has long turnaround time, and is only offered by a single private laboratory. Initially, this laboratory performed only qualitative analysis while the testing to be able to perform quantitative brodifacoum testing was calibrated. Once the qualitative result was positive, the laboratory performed quantitative brodifacoum testing to aid in patient monitoring throughout the event. Through discussion with Florida Poison Information Center Tampa, the private laboratory was able to reduce the cost of quantitative brodifacoum testing and decrease turnaround time for patients involved in this event. Serial quantitative brodifacoum testing

* INR is a laboratory measurement of how long blood takes to form a clot. INR is used to determine the effects of oral anticoagulants on the clotting system.

† Brodifacoum is a vitamin K epoxide cycle antagonist with a long half-life resulting in prolonged symptoms and treatment. Clinical coagulopathy is caused by a depletion of functional (vitamin K-dependent) clotting factors as a result of vitamin K oxidoreductase inhibition caused by brodifacoum.

FIGURE. Cases* of coagulopathy associated with brodifacoum poisoning, by date of symptom onset — Florida, November–December 2021



* Total number of cases = 52.

was eventually performed to help determine when therapy could be discontinued (*3*). Second, treatment required high doses of vitamin K1 during an extended period of time, and local pharmacies only had a limited supply.[§] Before the private pharmaceutical company donated the vitamin K1 tablets, a contingency plan was developed to obtain them from other hospitals in the region in the event pharmacies were to run out of supply. Third, maintaining patient compliance and adherence to this treatment plan is challenging because of the high cost and cumbersome treatment regimen (*4*). These challenges reflect similar issues that arose during the 2018 incident; all stakeholders should discuss these issues and identify solutions for optimal patient care.

Communicating timely information to health care providers and the general public allowed for additional patient identification and was crucial to connecting with patients who needed medical care. Close collaboration among the health care community, Florida Department of Health, Florida Poison Information Center Tampa, laboratories, a private pharmaceutical company, and other stakeholders, such as local law enforcement and the Drug Enforcement Agency, was critical to identifying and characterizing the cluster and providing the necessary treatment to prevent additional morbidity and mortality. To help avert future distribution of brodifacoum-laced SCB products, local county law enforcement was informed of this incident and provided information regarding the locations where patients reported they had purchased SCB products.

[§] In addition to oral vitamin K1, treatment with cholestyramine was also considered. However, this treatment was not used because of concerns regarding patient compliance to take several medications timed appropriately and potential adverse events from long-term cholestyramine use. Cholestyramine can affect oral absorption of vitamin K1 if taken concurrently, which would reduce absorption of oral vitamin K1 for therapeutic purposes.

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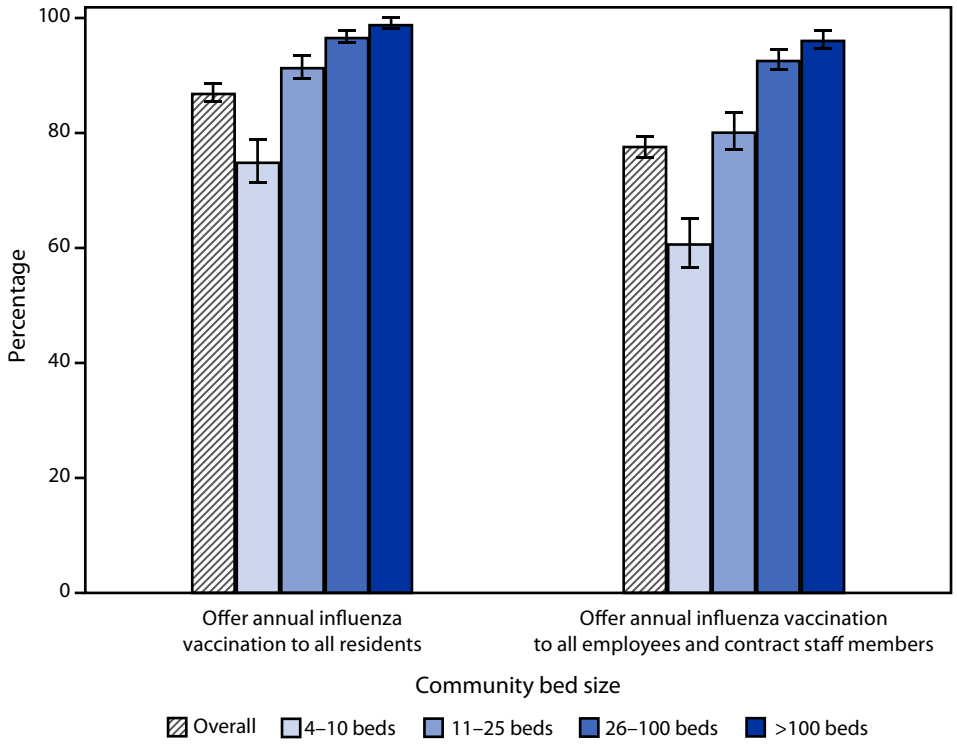
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Residential Care Communities† that Offer Annual Influenza Vaccination to Residents and to Employees and Contract Staff Members, by Community Bed Size — United States, 2020



* With 95% CIs indicated by error bars.

† Residential care communities are state-regulated, have four or more beds, provide room and board with at least two meals per day, and are staffed around the clock to provide supervision and assistance with personal care and health-related services to adults. Residential care communities licensed to exclusively serve persons who are mentally ill, intellectually disabled, or developmentally disabled were not included. Memory care units as a stand-alone community or part of a residential care community were included.

In 2020, 87.2% of residential care communities offered annual influenza vaccination to residents, and 77.8% offered annual influenza vaccination to all employees and contract staff members. The percentage of residential care communities offering annual influenza vaccination to residents and to all employees and contract staff members increased with increasing community bed size. The percentage of communities offering vaccination to residents ranged from 75.2% of communities with four to 10 beds to 91.7% with 11–25 beds, 97.0% with 26–100 beds, and 99.1% with more than 100 beds. Communities offering vaccination to all employees and contract staff members ranged from 60.9% of communities with four to 10 beds to 80.3% with 11–25 beds, 92.9% with 26–100 beds, and 96.4% with more than 100 beds.

Source: National Post-acute and Long-term Care Study, 2020 data. https://www.cdc.gov/nchs/npals/questionnaires.htm

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