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West Nile Virus and Other Nationally Notifiable Arboviral Diseases — United States, 2017

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Arthropodborne viruses (arboviruses) are transmitted to humans primarily through the bites of infected mosquitoes or ticks. West Nile virus (WNV) is the leading cause of domestically acquired arboviral disease in the continental United States (*1*). Other arboviruses, including Jamestown Canyon, La Crosse, Powassan, St. Louis encephalitis, and eastern equine encephalitis viruses, cause sporadic cases of disease and occasional outbreaks. This report summarizes surveillance data reported to CDC from U.S. states in 2017 for nationally notifiable arboviruses. It excludes dengue, chikungunya, and Zika viruses because, in the continental United States, these viruses are acquired primarily through travel. In 2017, 48 states and the District of Columbia (DC) reported 2,291 cases of domestic arboviral disease, including 2,097 (92%) WNV disease cases. Among the WNV disease cases, 1,425 (68%) were classified as neuroinvasive disease (e.g., meningitis, encephalitis, or acute flaccid paralysis), for a national rate of 0.44 cases per 100,000 population. More Jamestown Canyon and Powassan virus disease cases were reported in 2017 than in any previous year. Because arboviral diseases continue to cause serious illness, maintaining surveillance is important to direct and promote prevention activities.

Arboviruses are maintained in transmission cycles between arthropods and vertebrate hosts, including humans and other animals (*2*). Humans primarily become infected when bitten by an infected tick or mosquito. Most human infections are asymptomatic; symptomatic infections commonly manifest as a systemic febrile illness and less commonly as neuroinvasive disease.

Most endemic arboviral diseases are nationally notifiable and are reported by state health departments to CDC through ArboNET using standard surveillance case definitions that include clinical and laboratory criteria (*3*). Confirmed and probable cases are included in this analysis. Cases reported as meningitis, encephalitis, acute flaccid paralysis, or other neurologic illnesses are classified as neuroinvasive disease; the remainder are considered non-neuroinvasive disease. Incidence was calculated using neuroinvasive disease cases and the 2017 U.S. Census mid-year population estimates.

In 2017, 2,291 cases of domestic arboviral disease were reported to CDC; 1,596 (70%) were neuroinvasive. Cases were caused by the following viruses: WNV (2,097 cases; 92%), Jamestown Canyon (75), La Crosse (63), Powassan (34), St. Louis encephalitis (11), unspecified California serogroup (six), and eastern equine encephalitis (five). No cases were reported from Alaska or Hawaii. Among the 3,007 counties

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in the contiguous United States, 722 (24%) reported one or more arboviral disease cases.

Overall, 2,097 WNV disease cases were reported from 641 counties in 47 states and DC. Among these cases, 1,425 (68%) were neuroinvasive, and 1,814 (87%) patients had illness onset during July–September (Table 1). The median patient age was 59 years (interquartile range [IQR] = 46–69); 1,301 (62%) were male. A total of 1,545 (74%) patients were hospitalized, and 146 (7%) died. The median age of patients who died was 77 years (IQR = 68–84).

Among the 1,425 WNV neuroinvasive disease cases, 714 (50%) were reported as encephalitis, 530 (37%) as meningitis, 89 (6%) as acute flaccid paralysis, and 92 (6%) as other neurologic illness. Among the 89 patients with acute flaccid paralysis, 34 (38%) also had encephalitis or meningitis. Among patients with neuroinvasive disease, 1,346 (94%) were hospitalized, and 146 (10%) died. The rate of neuroinvasive disease in the United States was 0.44 per 100,000 population (Table 2). The highest rates were in South Dakota (3.10 per 100,000), North Dakota (2.65), Mississippi (1.54), Arizona (1.40), and Utah (1.26) (Figure). The largest numbers of neuroinvasive disease cases were reported from California (401), Arizona (98), Texas (87), and Illinois (72), and together accounted for 46% of neuroinvasive disease cases. The rate of WNV neuroinvasive disease increased with patient age, from 0.02 per 100,000 in children aged <10 years to 1.28 in adults aged ≥70 years. The rate was higher among males (0.57 per 100,000) than among females (0.31).

Seventy-five Jamestown Canyon virus disease cases were reported from eight states, primarily in the Northeast and upper Midwest (Table 2). In 2017, Jamestown Canyon virus disease was reported for the first time from Louisiana, Maine, and North Carolina. The median patient age was 58 years (IQR = 41–68), and 46 (61%) were male (Table 1). Illness onset ranged from January to November, with 45 (60%) patients reporting onset during July–September. Fifty-eight (77%) cases were neuroinvasive, 46 (61%) patients were hospitalized, and two (3%) died; both deaths were among patients aged ≥58 years with neuroinvasive disease. The rate of Jamestown Canyon virus neuroinvasive disease was highest in Wisconsin (0.62 per 100,000).

Sixty-three La Crosse virus disease cases were reported from 10 states, all in the Southeast and Midwest (Table 2). The median age of patients was 8 years (IQR = 5–12), and 54 (86%) were aged <18 years (Table 1). Illness onset dates ranged from March to October, with 53 (84%) reporting onset during July–September. All 63 cases were neuroinvasive and the patients were hospitalized; none died.

Thirty-four Powassan virus disease cases were reported from 10 states, primarily in the Northeast and Midwest (Table 2). The median patient age was 63 years (IQR = 48–74) and 28 (82%) were male (Table 1). Illness onset dates ranged from April to December, with 21 (62%) reporting onset during April–June. Powassan virus disease was reported for the first time from North Dakota in 2017, but the patient had history of travel to a state with previously documented transmission.

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TABLE 1. Number and percentage of reported cases of West Nile virus and other arboviral diseases, by virus type and selected patient characteristics — United States, 2017

Characteristic	Virus no. (%)					
	West Nile* (N = 2,097)	Jamestown Canyon (N = 75)	La Crosse (N = 63)	Powassan (N = 34)	St. Louis encephalitis* (N = 11)	Eastern equine encephalitis (N = 5)
Age group (yrs)						
<18	50 (2)	4 (5)	54 (86)	5 (15)	0 (0)	0 (0)
18–59	1,020 (49)	36 (48)	6 (10)	10 (29)	5 (45)	5 (100)
≥60	1,027 (49)	35 (47)	3 (5)	19 (56)	6 (55)	0 (0)
Sex						
Male	1,301 (62)	46 (61)	34 (54)	28 (82)	8 (73)	2 (40)
Female	796 (38)	29 (39)	29 (46)	6 (18)	3 (27)	3 (60)
Period of illness onset						
January–March	7 (<1)	1 (1)	1 (2)	0 (0)	1 (9)	0 (0)
April–June	87 (4)	25 (33)	4 (6)	21 (62)	0 (0)	0 (0)
July–September	1,814 (87)	45 (60)	53 (84)	7 (21)	8 (73)	1 (20)
October–December	185 (9)	4 (5)	5 (8)	6 (18)	1 (9)	4 (80)
Clinical syndrome						
Nonneuroinvasive	672 (32)	17 (23)	0 (0)	1 (3)	5 (45)	0 (0)
Neuroinvasive						
Encephalitis	714 (34)	29 (39)	53 (84)	22 (65)	2 (18)	3 (60)
Meningitis	530 (25)	5 (7)	10 (16)	7 (21)	3 (27)	0 (0)
AFP	89 (4)	4 (5)	0 (0)	2 (6)	1 (9)	0 (0)
Other	92 (4)	20 (27)	0 (0)	2 (6)	0 (0)	2 (40)
Outcome						
Hospitalization	1,545 (74)	46 (61)	63 (100)	33 (97)	6 (55)	5 (100)
Death	146 (7)	2 (3)	0 (0)	2 (6)	0 (0)	2 (40)

Abbreviation: AFP = acute flaccid paralysis.
* Date of illness onset missing for four cases of West Nile virus and one case of St. Louis encephalitis virus.

Thirty-three (97%) cases were neuroinvasive, 33 (97%) patients were hospitalized (32 with neuroinvasive disease and one with non-neuroinvasive disease), and two (6%) patients died.

Eleven cases of St. Louis encephalitis virus disease were reported from three states (Alabama, Arizona, and California) (Table 2). The median patient age was 60 years (IQR = 48–63), and eight were male (Table 1). Illness onset dates ranged from January to October, with eight patients reporting onset during July–September. Six cases were neuroinvasive; all patients with neuroinvasive disease were hospitalized. No patients died.

Five cases of eastern equine encephalitis virus disease were reported from four states (Florida, Georgia, Maryland, and Wisconsin) (Table 2); however, infection occurred in three of the cases through organ transplantation. The median patient age was 42 years (IQR = 27–42), and two were male. All cases occurred in September and October. All cases were neuroinvasive, and the patients were hospitalized; two (40%) patients died.

Discussion

As in previous years, WNV was the most common cause of neuroinvasive arboviral disease in the United States, accounting for 89% of reported neuroinvasive disease cases. The rate of WNV neuroinvasive disease in 2017 (0.44 per 100,000) was comparable to the median rate during 2007–2016 (0.41) (*4*). La Crosse virus continued to be the most common cause of neuroinvasive arboviral disease in children (*5*).

In 2017, eastern equine encephalitis virus transmission via organ transplantation was reported for the first time (*6*). More cases of Jamestown Canyon and Powassan virus disease were reported in 2017 than in any previous year: 75 Jamestown Canyon virus disease cases were reported in 2017 compared with a previous high of 16 cases in 2013, and 34 Powassan virus disease cases were reported in 2017 compared with a previous high of 22 cases in 2016 (*7*,*8*). These recent increases are likely caused by an increase in awareness and testing, but increased activity of these viruses cannot be ruled out. Deaths possibly associated with Jamestown Canyon virus infection are rare; however, two deaths were reported in 2017.

Arboviruses continue to cause substantial morbidity in the United States although reported numbers of cases vary annually. Cases occur sporadically, and the epidemiology varies by virus and geographic area. Consistent with previous years, in 2017, approximately 90% of arboviral disease cases occurred during April–September. Weather, zoonotic host and vector abundance, and human behavior are all factors that can influence when and where outbreaks occur. These factors make it difficult to predict future locations and timing of cases and emphasize the importance of surveillance to identify outbreaks and inform public health prevention efforts.

TABLE 2. Number and rate* of reported cases of arboviral neuroinvasive disease, by virus type, U.S. Census division, and state — United States, 2017

	Virus											
	West Nile		Jamestown Canyon		La Crosse		Powassan		St. Louis encephalitis		Eastern equine encephalitis	
U.S. Census Division/State	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
United States	**1,425**	**0.44**	**58**	**0.02**	**63**	**0.02**	**33**	**0.01**	**6**	**<0.01**	**5**	**<0.01**
New England	**10**	**0.07**	**5**	**0.03**	—†	**—**	**9**	**0.06**	**—**	**—**	**—**	**—**
Connecticut	2	0.06	—	—	—	—	—	—	—	—	—	—
Maine	—	—	1	0.07	—	—	3	0.22	—	—	—	—
Massachusetts	5	0.07	2	0.03	—	—	3	0.04	—	—	—	—
New Hampshire	—	—	2	0.15	—	—	1	0.07	—	—	—	—
Rhode Island	1	0.09	—	—	—	—	2	0.19	—	—	—	—
Vermont	2	0.32	—	—	—	—	—	—	—	—	—	—
Middle Atlantic	**66**	**0.16**	**—**	**—**	**—**	**—**	**13**	**0.03**	**—**	**—**	**—**	**—**
New Jersey	6	0.07	—	—	—	—	4	0.04	—	—	—	—
New York	45	0.23	—	—	—	—	5	0.03	—	—	—	—
Pennsylvania	15	0.12	—	—	—	—	4	0.03	—	—	—	—
East North Central	**192**	**0.41**	**37**	**0.08**	**16**	**0.03**	**3**	**0.01**	**—**	**—**	**1**	**<0.01**
Illinois	72	0.56	—	—	1	0.01	—	—	—	—	—	—
Indiana	18	0.27	—	—	—	—	—	—	—	—	—	—
Michigan	32	0.32	—	—	—	—	—	—	—	—	—	—
Ohio	23	0.20	1	0.01	13	0.11	—	—	—	—	—	—
Wisconsin	47	0.81	36	0.62	2	0.03	3	0.05	—	—	1	0.02
West North Central	**118**	**0.55**	**14**	**0.07**	**2**	**0.01**	**8**	**0.04**	**—**	**—**	**—**	**—**
Iowa	10	0.32	—	—	1	0.03	—	—	—	—	—	—
Kansas	12	0.41	—	—	—	—	—	—	—	—	—	—
Minnesota	13	0.23	14	0.25	1	0.02	7	0.13	—	—	—	—
Missouri	17	0.28	—	—	—	—	—	—	—	—	—	—
Nebraska	19	0.99	—	—	—	—	—	—	—	—	—	—
North Dakota	20	2.65	—	—	—	—	1§	0.13	—	—	—	—
South Dakota	27	3.10	—	—	—	—	—	—	—	—	—	—
South Atlantic	**91**	**0.14**	**1**	**<0.01**	**28**	**0.04**	**—**	**—**	**—**	**—**	**4**	**0.01**
Delaware	—	—	—	—	—	—	—	—	—	—	—	—
District of Columbia	1	0.14	—	—	—	—	—	—	—	—	—	—
Florida	4	0.02	—	—	—	—	—	—	—	—	1	<0.01
Georgia	44	0.42	—	—	2	0.02	—	—	—	—	2	0.02
Maryland	5	0.08	—	—	1	0.02	—	—	—	—	1	0.02
North Carolina	8	0.08	1	0.01	21	0.20	—	—	—	—	—	—
South Carolina	16	0.32	—	—	—	—	—	—	—	—	—	—
Virginia	12	0.14	—	—	—	—	—	—	—	—	—	—
West Virginia	1	0.06	—	—	4	0.22	—	—	—	—	—	—

See table footnotes on next page.

The findings in this report are subject to at least two limitations. First, because ArboNET does not require information about clinical signs and symptoms or laboratory findings, cases might be misclassified. Second, ArboNET is a passive surveillance system that only collects cases that are diagnosed and reported, resulting in underestimation of the actual incidence of disease. Detection and reporting of neuroinvasive disease are thought to be more consistent and more complete than they are for non-neuroinvasive disease. Previous studies have estimated that between 30 and 70 non-neuroinvasive disease cases occur for every reported case of WNV neuroinvasive disease (*9*). Based on the number of neuroinvasive disease cases reported in 2017, between 42,750 and 99,750 non-neuroinvasive disease cases of WNV would have been expected to occur; however, only 672 (1%–2%) were reported.

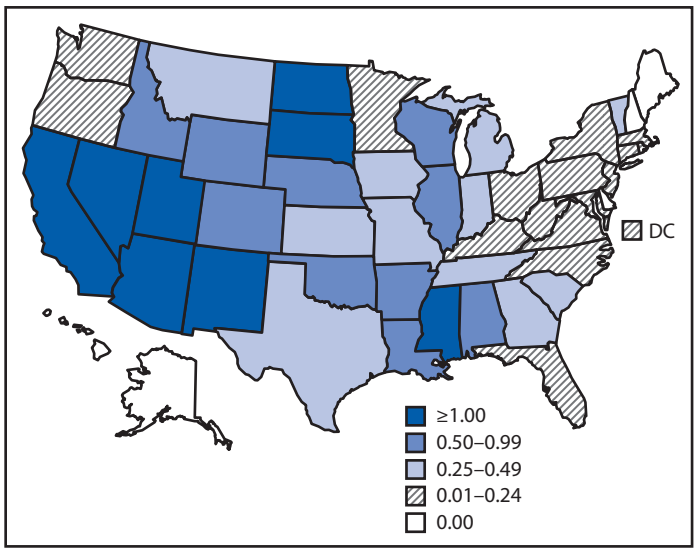
Health care providers need to consider arboviral infections in the differential diagnosis of aseptic meningitis and encephalitis, obtain appropriate specimens for laboratory testing, and promptly report cases to public health authorities (*2*,*3*). Understanding the epidemiology, seasonality, and geographic distribution of these viruses will assist with clinical recognition and differentiation from other neurologic infections. Because human vaccines against domestic arboviruses are not available, prevention depends on community and household efforts to reduce vector populations (e.g., applying insecticides and reducing breeding sites), personal protective measures to decrease exposure to mosquitoes and ticks (e.g., use of repellents and wearing protective clothing), and blood donor screening.

TABLE 2. (*Continued*) Number and rate* of reported cases of arboviral neuroinvasive disease, by virus type, U.S. Census division, and state — United States, 2017

	Virus											
	West Nile		Jamestown Canyon		La Crosse		Powassan		St. Louis encephalitis		Eastern equine encephalitis	
U.S. Census Division/State	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
East South Central	**117**	**0.61**	—	—	**17**	**0.09**	—	—	**1**	**0.01**	—	—
Alabama	40	0.82	—	—	—	—	—	—	1	0.02	—	—
Kentucky	9	0.20	—	—	—	—	—	—	—	—	—	—
Mississippi	46	1.54	—	—	—	—	—	—	—	—	—	—
Tennessee	22	0.33	—	—	17	0.25	—	—	—	—	—	—
West South Central	**174**	**0.44**	**1**	**<0.01**	—	—	—	—	—	—	—	—
Arkansas	15	0.50	—	—	—	—	—	—	—	—	—	—
Louisiana	38	0.81	1	0.02	—	—	—	—	—	—	—	—
Oklahoma	34	0.86	—	—	—	—	—	—	—	—	—	—
Texas	87	0.31	—	—	—	—	—	—	—	—	—	—
Mountain	**243**	**1.01**	—	—	—	—	—	—	**3**	**0.01**	—	—
Arizona	98	1.40	—	—	—	—	—	—	3	0.04	—	—
Colorado	29	0.52	—	—	—	—	—	—	—	—	—	—
Idaho	16	0.93	—	—	—	—	—	—	—	—	—	—
Montana	3	0.29	—	—	—	—	—	—	—	—	—	—
Nevada	31	1.03	—	—	—	—	—	—	—	—	—	—
New Mexico	23	1.10	—	—	—	—	—	—	—	—	—	—
Utah	39	1.26	—	—	—	—	—	—	—	—	—	—
Wyoming	4	0.69	—	—	—	—	—	—	—	—	—	—
Pacific	**414**	**0.78**	—	—	—	—	—	—	**2**	**<0.01**	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
California	401	1.01	—	—	—	—	—	—	2	0.01	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Oregon	3	0.07	—	—	—	—	—	—	—	—	—	—
Washington	10	0.14	—	—	—	—	—	—	—	—	—	—

* Per 100,000 population, based on July 1, 2017, U.S. Census population estimates.
† Dashes indicate none reported.
§ Patient reported travel to a state with a history of the virus.

FIGURE. Rate* of reported cases of West Nile virus neuroinvasive disease — United States, 2017



* Per 100,000 population.

Summary

What is already known about this topic?

West Nile virus (WNV) is the leading cause of arboviral disease in the continental United States, but several other arboviruses cause sporadic cases and outbreaks of neuroinvasive disease.

What is added by this report?

In 2017, eastern equine encephalitis virus transmission via organ transplantation was reported for the first time. More cases of Jamestown Canyon and Powassan virus neuroinvasive disease were reported in 2017 than in any previous year.

What are the implications for public health practice?

Health care providers need to consider arboviral infections in the differential diagnosis of aseptic meningitis and encephalitis, obtain appropriate specimens for laboratory testing, and promptly report cases to public health authorities.

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Mumps Outbreak in a Marshallese Community — Denver Metropolitan Area, Colorado, 2016–2017

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In January 2017, the Colorado Department of Public Health and Environment (CDPHE) identified four epidemiologically linked cases of mumps among persons from a Marshallese community who were members of the same church in the Denver metropolitan area. During 2016–2017, sizable outbreaks of mumps reported in Arkansas, Hawaii, and Washington also affected the Marshallese population (*1*). CDPHE, the Tri-County Health Department (TCHD), and Denver Public Health collaborated to conduct an outbreak investigation during January–March 2017 using active and passive surveillance that identified 17 confirmed and 30 probable cases. Public health actions included conducting measles-mumps-rubella (MMR) vaccination clinics at local Marshallese churches; these resulted in the vaccination of 126 persons with ≥1 doses of MMR vaccine. Implementation of active surveillance and support from local Marshallese church leaders in promoting vaccination programs likely contributed to interruption of the outbreak.

Investigation and Results

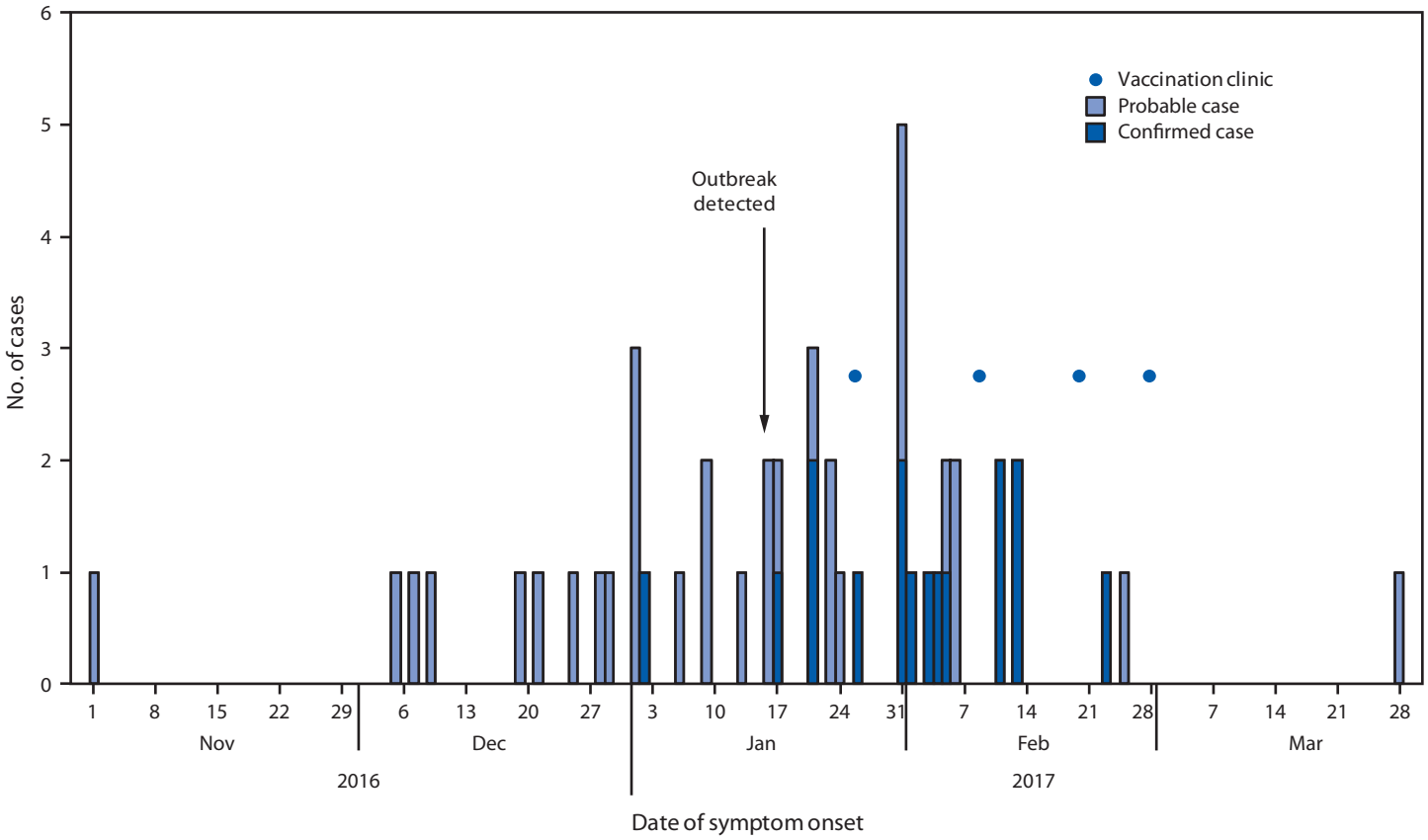
On January 19, 2017, CDPHE identified a cluster of four mumps cases through routine surveillance in the Denver metropolitan area; the cluster was epidemiologically linked to one local Marshallese church (church A). Initial patient interviews indicated that additional church members had recent symptoms of facial swelling suggestive of mumps. During January 20–22, TCHD staff members met with church A leaders to initiate rapid case ascertainment through active surveillance, and leaders agreed to provide a list of church A member households. Local and state public health staff members attempted to contact each household up to three times by telephone and collected information for each household member, including demographics, reported MMR vaccination history, occurrence and timing of mumps symptoms, travel history, household visitors, and church attendance since November 1, 2016. Cases also were identified through passive surveillance, either from laboratory reports of positive mumps test results in the Colorado Electronic Disease Reporting System or from health care provider reports. A Health Alert Network broadcast was issued to health care providers, and targeted outreach to local hospitals encouraged mumps testing and reporting.

Case definitions were derived from the 2012 Council of State and Territorial Epidemiologists case classification (*2*). A probable outbreak-associated mumps case was defined as the occurrence of mumps-compatible symptoms on or after November 1, 2016, and an epidemiologic link to the Marshallese community in the Denver metropolitan area. A confirmed case was defined as identification of mumps virus by reverse transcription–polymerase chain reaction (RT-PCR) or culture in a person with a probable case. Clinical samples from confirmed cases were sent to CDC for genotyping.

From the contact list of 21 member names provided by church A, 17 members were located, representing 15 unique households (defined as all persons residing at a single address) comprising 117 persons. Interviews were conducted with each head of household on behalf of all household occupants. Information was collected for 76 (65%) household occupants. Median reported household size was six persons (range = 4–18 persons). At least one person from every household included in the interviews attended church A. Among the 76 persons for whom information was collected, 22 (29%) reported attending at least one other Marshallese church gathering since November 1, 2016, in addition to attending church A. Three households reported visitors from Arkansas, the site of a large concurrent mumps outbreak in the Marshallese population (*1*), since November 1, 2016. One visitor from Arkansas reportedly had a "swollen jaw" at the time of the visit in late November 2016.

In total, 47 outbreak cases (17 confirmed and 30 probable) were identified, representing two counties in the Denver metropolitan area. Illness onset dates ranged from November 1, 2016, to March 28, 2017 (Figure 1). Among persons with mumps, 24 (51%) were male; median age was 20 years (range = 4 months–44 years; interquartile range = 12–27 years). Forty-six cases (98%) occurred in Marshallese persons. All persons with mumps experienced parotitis; 22 (47%) reported bilateral swelling. Other symptoms included jaw pain (74%), malaise (62%), fever (57%), and submandibular swelling (47%). One pregnant woman, aged 20 years, was hospitalized; no deaths or serious mumps complications (e.g., orchitis, meningitis, or deafness) were reported. Patients were identified from 21 unique households; 15 (71%) households had two or more patients (range two–four). Cases were also tightly clustered geographically; 46 of 47 (98%) patients resided within a 7.5-mile radius (Figure 2). All 17 patients with confirmed cases tested positive for mumps virus by RT-PCR. Samples from 12 patients with

FIGURE 1. Probable and confirmed cases of mumps (N = 47), by date of symptom onset and measles-mumps-rubella vaccination outbreak response clinics — Colorado, 2016–2017



confirmed cases were submitted to CDC for genotyping, and all were mumps virus genotype G, the most common genotype currently circulating in the United States (*3*).

Determining accurate MMR vaccination status in this population was challenging. None of the mumps patients was able to provide personal vaccination records, nor were records from outside Colorado available. Thirty-four (72%) of the 47 patients had no confirmed doses of MMR vaccine recorded in the Colorado Immunization Information System, which collects information only on vaccinations administered in Colorado (*4*). One case occurred in an infant aged <12 months who was too young for routine MMR vaccination.

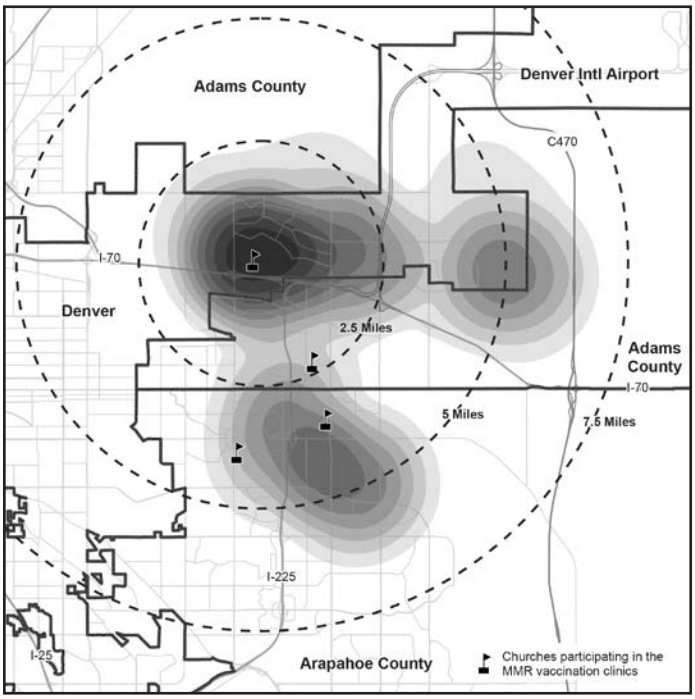
Public Health Response

After the first cluster of cases was identified, TCHD staff members met with Marshallese community leaders from church A to disseminate information about mumps illness and explore the possibility of hosting MMR vaccination clinics to prevent further transmission. In this Marshallese community, church pastors and their wives served as important spokespersons. After multiple in-person visits with church leaders, TCHD staff members organized four vaccination clinics at four different Marshallese church locations (including church A), during the 5 weeks after the outbreak was recognized; the first clinic was held at Church A, 9 days after identification of the outbreak (Figure 1). The goal of the immunization clinics was to offer all eligible persons from the Marshallese community up to 2 MMR doses; vaccine eligibility was determined by age and documented vaccination history, according to Advisory Committee on Immunization Practices (ACIP) recommendations at the time of the response (*4*). For children aged 12 months—4 years, an accelerated second MMR dose was given if the child previously received only 1 documented dose at least 28 days earlier.

In total, 164 MMR vaccine doses were administered to 126 church attendees; 38 (30%) persons received 2 doses, administered at least 28 days apart per ACIP guidelines, during clinics. Median age of church attendees who were vaccinated at the clinics was 20 years (range = 1–55 years).

In addition to vaccination clinics, local public health agencies disseminated culturally sensitive messages regarding mumps disease and prevention through Marshallese church leaders, radio, and social media; and CDPHE issued two press releases to alert the public about mumps. Local public health staff

FIGURE 2. Geographic density* of outbreak mumps cases (n = 46),† by geocoded residential address§ and location of measles-mumps-rubella vaccination clinics held during the public health response — Colorado, 2016–2017



* Gradient indicates the relative number of cases; darkest shading indicates highest density.
† One outbreak case occurred in a patient who was geographically isolated from all other cases and was suppressed from the calculation of the density surface to protect patient privacy.
§ Density surface is calculated by a kernel density function using the geocoded residential addresses of confirmed mumps cases.

members contacted affected school districts in the Denver metropolitan area and provided a letter for parents urging them to have children without 2 documented doses of MMR vaccine receive catch-up vaccination, according to ACIP guidelines. The outbreak was declared over on May 17, 2017, 50 days (two incubation periods) after the last reported case.

Discussion

This mumps outbreak occurred in a Denver metropolitan area Marshallese community characterized by a strong cultural and social network with frequent community gatherings. Regular socializing and large households likely contributed to mumps transmission throughout Marshallese households and churches. Although mumps importation from another state could not be confirmed, it is likely that mumps was introduced into this community from out-of-state Marshallese persons, given frequent travel to and from areas with concurrent mumps outbreaks in other Marshallese communities. The outbreak did not spread widely outside the Marshallese community in the Denver metropolitan area. Only one case in a non-Marshallese person was identified at a school attended by multiple Marshallese patients.

Summary

What is already known about this topic?

Mumps outbreaks typically occur among persons in close contact, such as in schools and athletic teams. Measles-mumps-rubella (MMR) vaccine can prevent mumps.

What is added by this report?

An outbreak of 47 mumps cases occurred in the Denver metropolitan area, mostly among members of a Marshallese community. Public health response included early active surveillance, public education, and prompt implementation of MMR vaccination clinics.

What are the implications for public health practice?

All eligible children should receive MMR vaccine at age 12–15 months and 4–6 years. During a mumps outbreak, eligible persons should receive prompt MMR vaccinations according to Advisory Committee on Immunization Practices guidelines, including use of a third dose when appropriate.

Public health staff members used active surveillance after identification of the initial mumps cluster to identify additional cases and to assess potential contributing factors for transmission, including household size and travel history. Early and close communication between TCHD staff members and church leaders helped to inform the affected population about the risks for mumps. As a result, a substantial number of Marshallese persons in the Denver area received MMR vaccine. The willingness of the community to receive MMR vaccine with support from church leaders highlights the importance of these community partnerships.

The vaccination clinics held in response to this outbreak focused on vaccinating persons who did not have 2 previously documented doses of MMR. At the time of this outbreak, ACIP did not recommend a third MMR dose in an outbreak setting for previous 2-dose recipients (*4*,*5*). In addition, the effectiveness of a third dose for an outbreak in a population with undocumented vaccination history, such as this one, was unclear; use of a third dose had been described primarily among populations with high documented 2-dose MMR coverage, such as college students (*6*–*8*). However, since this outbreak, ACIP guidelines were updated to recommend a third dose of mumps virus–containing vaccine for persons previously vaccinated with 2 doses and who are identified by public health authorities as being part of a group or population at increased risk for acquiring mumps because of an outbreak (*5*).

The findings in this report are subject to at least three limitations. First, vaccination status was determined primarily through Colorado's immunization registry, which likely did not record all previously received vaccines in this highly mobile

community. Persons previously vaccinated in the Republic of the Marshall Islands or another state might have been misclassified as being unvaccinated, which highlights the need for interoperable state registries. Second, language and cultural barriers might have led to errors in collecting information, especially during telephone interviews, despite use of interpreters and translated materials. Finally, uncertainty regarding household living arrangements made accurate identification of household members a challenge and might have resulted in an underestimation of household sizes and response rate.

Response to this mumps outbreak in a Colorado Marshallese community was facilitated by building relationships with church leaders, leading to early active surveillance, public education, and MMR vaccination clinics. These interventions might have contributed to the rapid interruption of transmission and limited spread of mumps to other local communities.

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HIV Preexposure Prophylaxis, by Race and Ethnicity — United States, 2014–2016

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Preexposure prophylaxis (PrEP) with a daily, oral pill containing antiretroviral drugs is highly effective in preventing acquisition of human immunodeficiency virus (HIV) infection (*1*–*4*). The combination of tenofovir disoproxil fumarate (TDF) and emtricitabine (FTC) is the only medication approved by the Food and Drug Administration (FDA) for PrEP. PrEP is indicated for men and women with sexual or injection drug use behaviors that increase their risk for acquiring HIV (*5*). CDC analyzed 2014–2016 data from the IQVIA Real World Data — Longitudinal Prescriptions (IQVIA database) to estimate the number of persons prescribed PrEP (users) in the United States and to describe their demographic characteristics, including sex and race/ethnicity. From 2014 to 2016, the annual number of PrEP users aged ≥16 years increased by 470%, from 13,748 to 78,360. In 2016, among 32,853 (41.9%) PrEP users for whom race/ethnicity data were available, 68.7% were white, 11.2% were African American or black (black), 13.1% were Hispanic, and 4.5% were Asian. Approximately 7% of the estimated 1.1 million persons who had indications for PrEP were prescribed PrEP in 2016, including 2.1% of women with PrEP indications (*6*). Although black men and women accounted for approximately 40% of persons with PrEP indications (*6*), this study found that nearly six times as many white men and women were prescribed PrEP as were black men and women. The findings of this study highlight gaps in effective PrEP implementation efforts in the United States.

In 2012, FDA approved TDF/FTC for use as PrEP (*7*), and CDC published clinical practice guidelines for use of PrEP (*5*). A previous study estimated PrEP uptake among U.S. commercially insured populations and found that PrEP use increased among men during 2010–2014, but was very low among women (*8*). It is important to monitor PrEP uptake both among persons with private and public insurance. Because racial and ethnic disparities in HIV diagnoses exist in the United States (*9*), it is also important to better understand PrEP use by race/ethnicity. Monitoring trends in PrEP use can inform the development of interventions to ensure that PrEP is provided for persons who need it most to reduce racial and ethnic disparities in PrEP use and new HIV infections.

Data on antiretroviral drug prescriptions dispensed during 2014–2016 were extracted from the IQVIA database,* which captured prescriptions from all payers and represented approximately 92% of all prescriptions dispensed from retail pharmacies and 60%–86% dispensed from mail order outlets in the United States. The database included antiretroviral drugs dispensed, demographic variables of persons to whom the drugs were dispensed, and medical claims for these persons. IQVIA acquired medical claims and race/ethnicity data from various sources, including ambulatory, hospital, and consumer databases, and linked these data to persons in the prescription database. Among persons with any antiretroviral drug prescription (1,418,621), approximately 69% had medical claims data available, and race/ethnicity information was available for about 32%. CDC estimated the annual number of PrEP users based on a previously developed algorithm that discerns whether TDF/FTC was prescribed for PrEP or for HIV treatment, hepatitis B treatment, or HIV postexposure prophylaxis (*8*). For each year of the study, records of persons aged ≥16 years who had at least one TDF/FTC prescription were selected. Persons were then excluded if they had any diagnostic codes for HIV or hepatitis B infection that preceded their initial TDF/FTC prescription. In addition, persons prescribed TDF/FTC for ≤30 days were defined as postexposure prophylaxis users and excluded; the remaining persons with TDF/FTC prescribed for >30 days were considered PrEP users. Postexposure prophylaxis is recommended for 28 days; however, it is often prescribed for 30 days. The 30-day definition of postexposure prophylaxis was chosen to produce conservative estimates of TDF/FTC for PrEP. PrEP use among persons prescribed TDF/FTC for >28 days was also estimated, to assess the impact of different duration of drug use on the estimates. PrEP use estimates were reported by age group, sex, geographic region, payer type, and race/ethnicity. Payer type was estimated for each person prescribed PrEP using a payer hierarchy of Medicaid, Medicare, commercial insurance, cash, and other payers. The number of PrEP users who received medication assistance program benefits from the manufacturer of PrEP also was estimated.

The annual number of PrEP users aged ≥16 years increased by 470%, from 13,748 in 2014 to 78,360 in 2016 (Table 1). In 2016, 65.0% of PrEP users were aged 25–44 years, and 0.1% were aged 16–17 years. Males accounted for 95.3% of all PrEP users. The percentage of PrEP users was highest in the Western U.S. Census Region (29.7%), followed by the Southern (27.2%) and Northeastern Regions (26.7%) and was lowest in

* https://www.iqvia.com/locations/united-states/commercial-operations/essential-information/prescription-information.

TABLE 1. Annual number of persons aged ≥16 years prescribed HIV preexposure prophylaxis, by selected characteristics — IQVIA* Longitudinal Prescription Database, United States, 2014–2016

Characteristic	Year no (%) 2014	2015	2016
Total	**13,748 (100)**	**38,879 (100)**	**78,360 (100)**
Sex			
Male	12,624 (91.8)	36,845 (94.8)	74,639 (95.3)
Female	1,110 (8.1)	2,012 (5.2)	3,678 (4.7)
Unknown/Missing	14 (0.1)	22 (0.1)	43 (0.1)
Age group (yrs)			
16–17	22 (0.2)	29 (0.1)	64 (0.1)
18–24	953 (6.9)	3,223 (8.3)	7,382 (9.4)
25–34	4,687 (34.1)	14,766 (38.0)	30,959 (39.5)
35–44	3,825 (27.8)	10,156 (26.1)	19,989 (25.5)
45–54	2,845 (20.7)	7,564 (19.5)	13,913 (17.8)
55–64	1,080 (7.9)	2,543 (6.5)	5,046 (6.4)
≥65	336 (2.4)	598 (1.5)	1,007 (1.3)
Census region			
Northeast	3,411 (24.8)	10,110 (26.0)	20,909 (26.7)
Midwest	2,330 (17.0)	6,350 (16.3)	12,748 (16.3)
South	3,562 (25.9)	10,223 (26.3)	21,335 (27.2)
West	4,420 (32.2)	12,169 (31.3)	23,306 (29.7)
Other†	22 (0.2)	22 (0.1)	55 (0.1)
Unknown/Missing	3 (0.0)	5 (0.0)	7 (0.0)
Payer type§			
Medicaid/CHIP	1,430 (10.4)	4,547 (11.7)	9,542 (12.2)
Medicare	488 (3.6)	968 (2.5)	1,832 (2.3)
Commercial	9,980 (72.6)	31,993 (82.3)	63,430 (81.0)
Cash	163 (1.2)	262 (0.7)	732 (0.9)
Other¶	356 (2.6)	1,080 (2.8)	2,705 (3.5)
Unknown/Missing	1,331 (9.7)	29 (0.1)	119 (0.2)

Abbreviation: CHIP = Children's Health Insurance Program.
* https://www.iqvia.com/.
† Other region included U.S. territories.
§ Payer type is a calculated hierarchical variable, thus numbers of each category are mutually exclusive. Before 2014, payer type information was not available for some of the specialty mail order suppliers.
¶ Other payer types included coupon/voucher programs, discount card programs, and federal or state assistance programs.

TABLE 2. Number of persons aged ≥16 years prescribed HIV preexposure prophylaxis based on different durations of drug use, by selected characteristics — IQVIA Longitudinal Prescription Database, United States, 2016

Characteristic	Length of drug use no. (%) >30 days	>28 days
Total	**78,360 (100)**	**98,599 (100)**
Sex		
Male	74,639 (95.3)	92,042 (93.4)
Female	3,678 (4.7)	6,468 (6.6)
Unknown/Missing	43 (0.1)	89 (0.1)
Age group (yrs)		
16–17	64 (0.1)	175 (0.2)
18–24	7,382 (9.4)	10,984 (11.1)
25–34	30,959 (39.5)	39,243 (39.8)
35–44	19,989 (25.5)	24,177 (24.5)
45–54	13,913 (17.8)	16,646 (16.9)
55–64	5,046 (6.4)	6,067 (6.2)
≥65	1,007 (1.3)	1,307 (1.3)
Race/Ethnicity*		
White	22,574 (68.7)	26,832 (67.7)
Black	3,687 (11.2)	4,693 (11.8)
Hispanic	4,317 (13.1)	5,409 (13.6)
Asian	1,486 (4.5)	1,779 (4.5)
Unspecified	789 (2.4)	941 (2.4)
Census region		
Northeast	20,909 (26.7)	26,460 (26.8)
Midwest	12,748 (16.3)	15,704 (15.9)
South	21,335 (27.2)	27,119 (27.5)
West	23,306 (29.8)	29,217 (29.6)
Other	55 (0.1)	87 (0.1)
Unknown/Missing	7 (0.0)	12 (0.0)
Payer type†		
Medicaid/CHIP	9,542 (12.2)	12,732 (12.9)
Medicare	1,832 (2.3)	2,355 (2.4)
Commercial	63,430 (81.0)	76,767 (77.9)
Cash	732 (0.9)	2,332 (2.4)
Other§	2,705 (3.5)	4,206 (4.3)
Unknown/Missing	119 (0.2)	207 (0.2)

Abbreviation: CHIP = Children's Health Insurance Program.
* Percentages calculated among 32,853 (41.9%) >30-day users and 39,654 (40.2%) >28-day users with information on race/ethnicity available.
† Payer type is a calculated hierarchical variable, thus numbers of each category are mutually exclusive. Persons who identified their race as white, black, Asian, or unspecified were all non-Hispanic. Persons who identified as Hispanic might be of any race.
§ Other payer type included coupon and voucher programs, discount card programs, and federal or state assistance programs.

the Midwestern Region (16.3%). Commercial health insurance was the payer for 81.0% of PrEP users' medications and Medicaid for 12.2%. The number of PrEP users who received medication assistance program benefits from the manufacturer increased significantly, from 435 in 2014 to 5,437 in 2016.

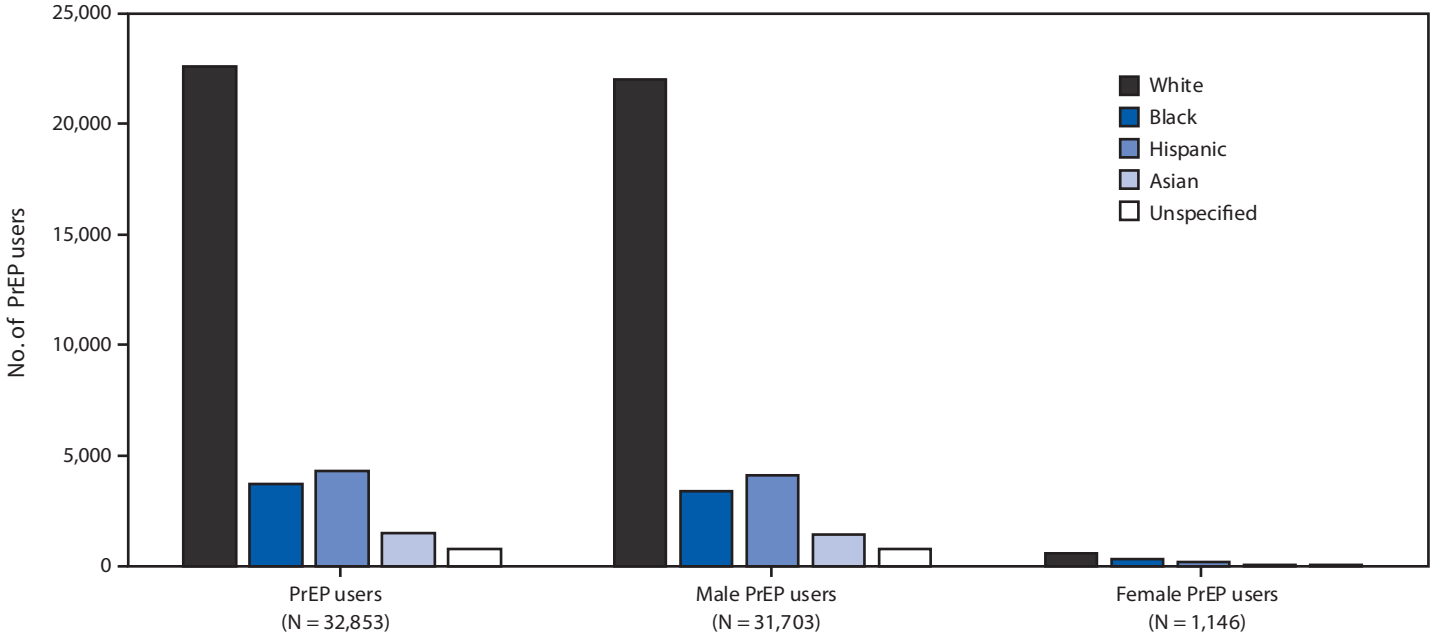
When length of TDF/FTC prescription drug use for PrEP was defined as >28 days rather than >30 days, the total number of PrEP users in 2016 increased 26%, from 78,360 to 98,599. Demographic and payer type distributions were similar using both algorithms (Table 2).

Among the 78,360 PrEP users identified in 2016, information on race/ethnicity was available for 32,853 (41.9%), including 22,574 (68.7%) who were white, 3,687 (11.2%) who were black, 4,317 (13.1%) who were Hispanic, and 1,486 (4.5%) who were Asian. When stratified by sex, among the 1,146 female PrEP users with race/ethnicity data, 554 (48.3%) were white, 297 (25.9%) were black, and 201 (17.5%) were Hispanic (Figure).

Discussion

Compared with recently published estimates based on an analysis of the MarketScan database with commercial health insurance billing claims, the estimated number of PrEP users was higher using this IQVIA database (*8*). This is because the IQVIA database contains all third party payers, including Medicaid, and prescriptions claims paid by medication assistance programs. The number of PrEP users with commercial

FIGURE. Number of PrEP users by sex and race/ethnicity*— IQVIA Longitudinal Prescription Database, United States, 2016



Abbreviation: PrEP = preexposure prophylaxis.
* Among 32,853 (42%) persons with race/ethnicity data available, among all 78,360 PrEP users identified in 2016; information on sex was missing/unknown for four of these 32,853 persons.

insurance was similar in both analyses. In 2014, a total of 7,792 PrEP users with commercial insurance were identified in the MarketScan database, compared with 9,980 users with commercial insurance in the IQVIA database (*8*); in 2015, a total of 33,273 PrEP users with commercial insurance were identified in MarketScan,† compared with 31,993 users with commercial insurance in IQVIA. The algorithm used in this study and in the MarketScan analysis defined postexposure prophylaxis as a TDF/FTC prescription for ≤30 days, resulting in a conservative estimate of PrEP use that might underestimate the number of PrEP users because persons might have been prescribed a 30-day supply of TDF/FTC for PrEP or postexposure prophylaxis. Persons prescribed TFD/FTC for ≤30 days might also have been using on-demand PrEP that is not taken daily. When a definition of postexposure prophylaxis as a TDF/FTC prescription for ≤28 days was used, the estimated number of PrEP users was higher. The true estimate of PrEP use likely falls between the estimate that defines PrEP use as a TDF/FTC prescription for >30 days and the one that defines it as >28 days. A validation study that compares estimates of PrEP use based on various algorithm definitions with a review of medical records will be helpful for future research.

† MarketScan data came from Table 11, Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 dependent areas, 2015. HIV Surveillance Supplemental Report 2017; vol. 22, no. 2. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-supplemental-report-vol-22-2.pdf.

Women accounted for 3,678 (4.7%) of the 78,360 PrEP users and 2.1% of the estimated 176,670 heterosexual women for whom PrEP is indicated (*6*). Among the estimated 1.1 million adults for whom PrEP is indicated, 303,230 (26.3%) were white, 500,340 (43.7%) were black, and 282,260 (24.7%) were Hispanic (*6*). However, among PrEP users with available race/ethnicity data in this study, 68.7% were white, 11.2% were black, and 13.1% were Hispanic. The large gap between the numbers of persons with indications for PrEP and those who were prescribed PrEP, and the low proportions of women and racial/ethnic minorities prescribed PrEP, suggests that more equitable implementation of PrEP recommendations for women and persons in racial/ethnic minority populations is needed. In addition, whereas men and women in the South had 52% of HIV diagnoses in the United States in 2016 (*8*), this study found that only 27% of the PrEP users were in the South.

The findings in this report are subject to at least four limitations. First, 58% of PrEP users identified in the IQVIA database did not have race/ethnicity information available. Race/ethnicity data were obtained from a convenience sample of a consumer database, in which persons who were older and had a credit history were more likely to be included. Although race/ethnicity data were not available for many PrEP users, this study suggests a substantial unmet prevention need for black and Hispanic populations who might benefit from PrEP. Second, PrEP users were identified using an algorithm that

might be subject to misclassification bias. However, a similar algorithm was validated based on a review of electronic medical records (*10*). Third, the estimates were based on prescriptions dispensed rather than actual use. Finally, the IQVIA database did not include diagnosis data for 31% of persons, which might result in an overestimate of PrEP users by including persons potentially using TDF/FTC for treatment of HIV or hepatitis B infection. However, most persons (99%) with HIV in the IQVIA database had other antiretroviral medications in addition to TDF/FTC and were excluded.

Barriers to the provision of PrEP for persons in populations with the highest rates of annual HIV diagnoses, such as black and Hispanic men and women, need to be better understood to help guide the development of interventions to increase access to and utilization of PrEP. Focused public health efforts to support increasing PrEP prescriptions for persons in populations who might benefit from its use could increase the impact of PrEP on HIV incidence in the United States.

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Summary

What is already known about this topic?

In 2015, approximately 1.1 million adults were at risk for acquiring human immunodeficiency virus infection and had indications for preexposure prophylaxis (PrEP); 26.3%, 43.7%, and 24.7% were white, black, and Hispanic, respectively.

What is added by this report?

In 2016, among 78,360 persons who filled prescriptions for PrEP in the United States, women accounted for only 4.7%. Among PrEP users with available race/ethnicity data, 68.7%, 11.2%, 13.1%, and 4.5% were white, black, Hispanic, and Asian, respectively.

What are the implications for public health practice?

The gap between numbers of persons with PrEP indications and those prescribed PrEP was substantial, especially among persons in female, black, and Hispanic populations. Focused efforts are needed to increase the impact of PrEP in the United States.

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Use of Personal Hearing Protection Devices at Loud Athletic or Entertainment Events Among Adults — United States, 2018

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Tens of millions of U.S. residents have a range of adverse health outcomes caused by noise exposure (*1*). During 2011–2012, 21 million U.S. adults who reported no exposure to loud or very loud noise at work exhibited hearing damage suggestive of noise-induced hearing loss (*2*). In addition to the known risk for hearing damage, nonauditory adverse health outcomes and health risks from excessive environmental sound exposure can include effects on the cardiovascular system, metabolism, blood pressure, body weight, cognition, sleep, mental health, quality of life, and overall well-being (*1*,*3*,*4*). CDC analyzed a representative sample of the U.S. adult population (aged ≥18 years) from a 2018 national marketing survey (50 states and the District of Columbia) that included questions about use of hearing protection devices (HPDs) (e.g., ear plugs or ear muffs) during recreational exposure to loud athletic and entertainment events; approximately 8% of respondents reported consistent use of an HPD at these types of events. Among those adults more likely to wear an HPD, 63.8% had at least some college education, and 49.1% had higher income levels. Women and older adults were significantly less likely to use HPDs. These findings suggest a need to strengthen a public health focus on the adverse health effects of excessive noise exposure at home and in recreational settings as well as a need for continued efforts to raise public awareness about the protective value of HPDs.

Sound intensity at recreational events can reach hazardous levels and might remain high for the duration of the event, thereby increasing the risk for hearing damage. To protect the public health and welfare, in 1974 the Environmental Protection Agency determined that a 24-hour exposure limit level of 70 decibels (dB) would produce minimal hearing loss in 96% of the population.* In 1999, the World Health Organization Guidelines for Community Noise concluded that a 24-hour equivalent sound level of ≤70 dB would avoid hearing impairment in 95% of persons, even over a lifetime of exposure.†

In an assessment of noise exposure at college basketball games, attendees wearing dosimeters at a midsized arena were exposed to average sound levels over 98 dB, with peak levels ranging from 127.5 to 138.3 dB (*5*). Other investigators reported sound level measurements at arenas hosting hockey games ranging from 81 to 96 dB, with peak sound levels from 105 to 124 dB (*6*). In another investigation, recorded instantaneous peak sound levels of up to 140 dB during college football games were reported (*7*). As recommended by the National Hearing Conservation Association, persons exposed to high levels of sounds can limit their risk by using a personal HPD, increasing distance from the source, and by taking quiet breaks to reduce their overall sound exposure (*8*).

CDC analyzed data from the 2018 SpringStyles, a cross-sectional, national online marketing survey conducted by Porter Novelli via the KnowledgePanel of the market research firm Growth for Knowledge.§ Panel members were randomly recruited by mail using probability-based sampling by address to reach respondents regardless of whether they had landline telephones or Internet access. If needed, households were provided with a laptop or tablet computer and Internet access. During March 21–April 11, 2018, a random sample of 10,904 panelists received an initial SpringStyles survey covering a wide range of personal health-related conditions, knowledge, and attitudes. Panelists who did not answer at least half of the questions or who completed the survey in ≤5 minutes were removed, resulting in a response rate of 58.9%. Panelists who completed the survey received a cash-equivalent reward worth approximately $5. To match U.S. population proportions, participant responses were weighted to March 2017 U.S. Census estimates on eight selected demographic variables: age, census region, education, sex, household income, household size, metro status, and race/ethnicity.

The 2018 SpringStyles survey included the following question related to the use of an HPD during recreational exposure to loud sounds: "In the past 12 months, how often did you wear hearing protection devices (ear plugs, ear muffs) when attending a loud athletic or entertainment event?" Participants were asked to indicate their responses on a 5-point Likert scale (never or seldom, some of the time, about half the time, most of the time, or always).

Independent variables included sex, age, race/ethnicity, education, household income, metropolitan statistical area of residence status, presence of hearing impairment in a household member, and frequent sporting event attendance. A total of 6,357 adults answered the question concerning HPD use during a loud athletic or entertainment event. Researchers combined participant answers into three categories: never or seldom, some or about half the time, and most of the time or

* https://nepis.epa.gov/Exe/ZyPDF.cgi/2000L3LN.PDF?Dockey=2000L3LN.PDF.
† http://www.who.int/iris/handle/10665/66217.

§ https://www.gfk.com/fileadmin/user_upload/dyna_content/US/documents/KnowledgePanel_-_A_Methodological_Overview.pdf.

always; they then applied adjusted multinomial logistic regression to examine how the likelihood of wearing an HPD varied by sociodemographic factors.

Overall, 81.8% of U.S. adults aged ≥18 years reported never or seldom wearing an HPD when attending a loud athletic or entertainment event (Table 1). The majority of adults who never or seldom wore HPDs at these types of events were women (54.4%), white (65.1%), or lived in a metropolitan area (86.5%). Adults who were more likely to wear an HPD (most of the time or always) at loud athletic or entertainment events had at least some college education (63.8%) or had household incomes of ≥$75,000 (49.1%).

Compared with adults who had a bachelor's degree or other higher education, those with a high school education or less (odds ratio [OR] = 1.7) and those with some college education (OR = 1.6) were significantly more likely to not wear HPDs (Table 2). Adults aged ≥35 years were significantly more likely to not wear HPDs than were young adults aged 18–24 years. Among adults who frequently enjoy attending sporting events as a leisure-time activity, women were twice as likely (OR = 2.0) as men to seldom or never wear HPDs. Adults with hearing impairment or with a deaf or hard-of-hearing household member were significantly more likely to wear HPDs than were those without hearing impairment in a household member or themselves.

Discussion

In this analysis, approximately 8% of participants reported consistent use of an HPD at loud athletic or entertainment events. Approximately two thirds of adults who were more likely to wear an HPD had at least some college education, and approximately half had higher income levels. Women and older adults were significantly less likely to wear an HPD.

Persons with auditory damage caused by excessive loud sound exposure often do not recognize it. An analysis of 2011–2012 data from the National Health and Nutrition Examination Survey found that one in four U.S. adults who reported excellent or good hearing had damage to their hearing suggestive of excessive exposure to loud sounds (*2*). During a given 24-hour period, persons are exposed to a wide range of loud sounds, including not only those at work, but also at home, school, and places of recreation, thereby complicating the determination of an exposure level that would provide an adequate level of safety to protect hearing.

It has been reported that despite an apparent understanding of the effects of noise exposure from loud activities, much of the public appears unconcerned about the use of HPDs during recreational activities (*9*). As part of a health belief model, a construct to describe factors that affect participation in a health behavior and personal experience of noise injury symptoms, as well as awareness of the benefits of ear plugs and the long-term implications of hearing damage are key motivators for using HPDs (*10*).

Summary

What is already known about this topic?

Noise-induced hearing loss is a substantial, often unrecognized, health problem.

What is added by this report?

Among surveyed U.S. adults, approximately 8% reported consistent use of a hearing protection device (HPD) at loud athletic or entertainment events; women and older adults were less likely to use an HPD, whereas adults with hearing impairment, or who had a hearing-impaired household member, or some college education were significantly more likely to use an HPD.

What are the implications for public health practice?

Increasing awareness about the adverse health effects of excessive noise exposure and the simple preventive measures to reduce risk are needed. Health care providers can help their patients prevent or reduce the risks for noise-induced hearing loss.

The findings in this report are subject to at least two limitations. First, the data obtained in this survey were self-reported and relied on respondents' perceptions of loudness, recall of attendance at events, and their HPD use. Second, although a subgroup of panelists reported frequently enjoying sporting events, that frequency was not defined, and frequency of attending was interpreted by the respondent.

The reported infrequent use of HPDs at loud athletic and entertainment events suggests the need for an increased public health focus on recreational noise exposure, including efforts to raise awareness about the adverse health effects of excessive noise exposure at home and in recreational settings, as well as the protective value of HPDs. Discussions between patients and health care providers regarding the consequences of excessive sound exposure and the potential benefits to health from the use of hearing protection might provide opportunities to prevent or reduce harmful effects.¶

¶ https://www.nap.edu/catalog/23446/hearing-health-care-for-adults-priorities-for-improving-access-and.

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TABLE 1. Selected characteristics regarding the use of personal hearing protection devices (HPDs) when attending a loud athletic or entertainment event in the past 12 months among adults aged ≥18 years — Porter Novelli SpringStyles panelists, United States, 2018

Characteristic	Unweighted no.	Weighted no.	All respondents Weighted % (95% CI)	Never or seldom Weighted % (95% CI)	Some or about half the time Weighted % (95% CI)	Most of the time or always Weighted % (95% CI)
HPD use*						
Never or seldom	5,247	5,197	81.84 (80.64–83.03)	—	—	—
Some or about half the time	591	6,410	10.08 (9.12–11.03)	—	—	—
Most of the time or always	519	514	8.08 (7.25–8.91)	—	—	—
All respondents	6,357	6,351	—	81.84 (80.64–83.03)	10.08 (9.12–11.03)	8.08 (7.25–8.91)
Sex						
Men	2,874	3,066	48.28 (46.78–49.79)	45.63 (43.99–47.27)	60.22 (55.37–65.08)	60.25 (55.03–65.47)
Women	3,483	3,284	51.72 (50.21–53.22)	54.37 (52.73–56.01)	39.78 (34.92–44.63)	39.75 (34.53–44.97)
Age group (yrs)						
18–24	236	697	10.97 (9.65–12.30)	10.14 (8.73–11.56)	16.28 (11.45–21.10)	12.77 (7.76–17.78)
25–34	800	1,149	18.09 (16.84–19.33)	17.47 (16.12–18.82)	21.57 (17.20–25.93)	20.06 (15.45–24.67)
35–44	1,247	1,044	16.44 (15.38-–17.49)	16.00 (14.87–17.14)	20.29 (16.43–24.15)	16.04 (12.20–19.89)
45–54	1,515	1,100	17.32 (16.30–18.34)	17.76 (16.62–18.91)	13.72 (10.86–16.58)	17.35 (13.87–20.83)
55–64	1,318	1,078	16.97 (16.00–17.95)	17.32 (16.23–18.40)	14.70 (11.78–17.61)	16.34 (13.07–19.62)
65–74	863	901	14.19 (13.23–15.14)	14.68 (13.61–15.74)	10.84 (8.04–13.64)	13.42 (10.19–16.66)
≥75	378	382	6.02 (5.39–6.64)	6.63 (5.90–7.36)	2.61 (1.31–3.91)	4.01 (2.25–5.78)
Race/Ethnicity†						
White	4,719	4,100	64.55 (63.01–66.10)	65.12 (63.43–66.80)	55.99 (50.81–61.17)	69.51 (64.05–74.98)
Black	537	741	11.66 (10.60–12.73)	11.52 (10.38–12.66)	14.41 (10.37 -18.44)	9.68 (5.82–13.55)
Hispanic	576	851	13.39 (12.20–14.59)	12.72 (11.44–14.00)	18.76 (14.18–23.35)	13.52 (9.24–17.79)
Asian	214	340	5.35 (4.56 –6.14)	5.73 (4.82–6.64)	4.41 (2.30–6.52)	2.66 (0.71–4.61)
Other, multiracial	311	320	5.04 (4.31–5.77)	4.91 (4.11–5.71)	6.43 (3.79–9.07)	4.63 (2.30–6.96)
Education						
High school or less	1,755	2,496	39.30 (37.76–40.85)	39.67 (37.99–41.36)	38.83 (33.62–44.04)	36.16 (30.51–41.81)
Some college or associate degree	1,967	1,827	28.78 (27.46–30.10)	28.99 (27.54–30.44)	29.59 (25.08–34.11)	25.62 (21.24–30.00)
Bachelor's degree or higher	2,635	2,027	31.92 (30.63–33.21)	31.34 (29.93–32.75)	31.57 (27.38–35.77)	38.22 (33.31–43.14)
Income						
<$40,000	1,522	1,712	26.96 (25.58–28.35)	26.48 (24.99–27.96)	31.57 (26.61–36.53)	26.15 (20.90–31.39)
$40,000–$74,999	1,627	1,626	25.61 (24.30–26.92)	26.33 (24.88–27.79)	20.40 (16.47–24.33)	24.79 (20.15–29.43)
$75,000–$124,999	1,828	1,715	27.00 (25.69–28.31)	26.82 (25.37–28.26)	25.35 (21.12–29.57)	30.94 (26.20–35.67)
≥$125,000	1,380	1,297	20.42 (19.26–21.59)	20.37 (19.09–21.66)	22.68 (18.64–26.73)	18.13 (14.39–21.86)
U.S. Census region of residence§						
Northeast	1,137	1,132	17.82 (16.68–18.95)	18.53 (17.26–19.79)	15.41 (11.86–18.96)	13.60 (9.96–17.24)
Midwest	1,573	1,335	21.02 (19.86–22.18)	21.41 (20.12–22.70)	20.25 (16.46–24.04)	18.03 (14.33–21.74)
South	2,224	2,380	37.47 (36.00–38.94)	36.99 (35.39–38.59)	38.53 (33.58–43.48)	41.00 (35.62–46.38)
West	1,423	1,505	23.69 (22.39–25.00)	23.07 (21.65–24.49)	25.81 (21.27–30.34)	27.36 (22.57–32.16)
Metropolitan statistical area status						
Nonmetropolitan	898	885	13.93 (12.92–14.95)	13.54 (12.46–14.63)	14.31 (10.88–17.75)	17.39 (13.18–21.60)
Metropolitan	5,459	5,466	86.07 (85.05–87.08)	86.46 (85.37–87.54)	85.69 (82.25–89.12)	82.61 (78.40–86.82)
Household hearing impairment¶						
Self	643	626	10.11 (9.25–10.97)	9.49 (8.59–10.39)	13.12 (9.67–16.56)	12.64 (9.23–16.05)
Other household member	480	504	8.12 (7.29–8.96)	8.15 (7.23–9.08)	6.85 (4.27–9.44)	9.41 (6.28–12.44)
No	5,089	5,067	81.77 (80.63–82.91)	82.36 (81.13–83.59)	80.03 (75.95–84.12)	77.96 (73.64–82.27)
Frequently enjoy attending sporting events**						
No	4,939	5,058	79.64 (78.45–80.83)	79.93 (78.65–81.22)	74.74 (70.37–79.11)	82.76 (78.69–86.83)
Yes	1,418	1,293	20.36 (19.17–21.55)	20.07 (18.78–21.35)	25.26 (20.89–29.63)	17.24 (13.17–21.31)

Abbreviations: CI = confidence interval.

* Panelists were asked: "In the past 12 months, how often did you wear hearing protection devices (ear plugs, ear muffs) when attending a loud athletic or entertainment event?"

† Persons who identified as white, black, Asian, or other or multiracial were all non-Hispanic. Persons who identified as Hispanic might be of any race.

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

¶ Panelists were asked: "Do you, or does anyone in your household have deafness or hard of hearing in either ear?"

** Panelists were asked: "Which of the following leisure-time activities do you frequently enjoy doing?" Responses included "Attending sporting events."

TABLE 2. Adjusted multinomial logistic regression comparing frequencies of use of personal hearing protection devices (HPDs) when attending a loud athletic or entertainment event in the past 12 months among adults aged ≥18 years — Porter Novelli SpringStyles panelists, United States, 2018

	Comparison of less frequent and more frequent use of personal HPDs*			
	All respondents	All respondents	Frequently attending sporting event†	
	Never/ Seldom versus Most/ Always	Some/Half versus Most/ Always	Never/ Seldom versus Most/ Always	Some/Half versus Most/ Always
Characteristic	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Sex				
Men	Referent	Referent	Referent	Referent
Women	1.85§ (1.54–2.24)	1.05 (0.83–1.33)	2.04§ (1.25–3.31)	1.25 (0.71–2.22)
Age group (yrs)				
18–24	Referent	Referent	Referent	Referent
25–34	1.26 (0.90–1.77)	0.99 (0.65–1.49)	0.52 (0.22–1.24)	0.46 (0.17–1.23)
35–44	1.46§ (1.03–2.08)	1.17 (0.76–1.79)	0.65 (0.27–1.60)	0.56 (0.20–1.55)
45–54	1.48§ (1.05–2.10)	0.75 (0.48–1.17)	1.31 (0.48–3.57)	0.45 (0.14–1.47)
55–64	1.48§ (1.04–2.10)	0.83 (0.54–1.28)	0.63 (0.25–1.59)	0.50 (0.18–1.42)
65–74	1.57§ (1.09–2.26)	0.80 (0.50–1.28)	0.78 (0.28–2.13)	0.54 (0.17–1.74)
≥75	2.59§ (1.53–4.37)	0.71 (0.35–1.47)	1.52 (0.27–8.68)	1.10 (0.15–7.93)
Race/Ethnicity¶				
White	Referent	Referent	Referent	Referent
Black	1.25 (0.91–1.73)	1.75§ (1.19–2.58)	2.24 (0.87–5.77)	1.80 (0.61–5.29)
Hispanic	1.07 (0.81–1.42)	1.69§ (1.19–2.39)	0.46§ (0.25–0.85)	1.00 (0.48–2.08)
Asian	2.93§ (1.66–5.16)	2.22§ (1.13–4.37)	5.75 (0.47–71.08)	7.23 (0.53–99.32)
Other, multiracial	1.23 (0.79–1.91)	1.69 (0.99–2.89)	9.27 (0.44–197.17)	28.00 (1.28–613.33)
Education				
Bachelor's degree or higher	Referent	Referent	Referent	Referent
High school or less	1.69§ (1.32–2.16)	1.41§ (1.02–1.95)	0.95 (0.52–1.74)	0.89 (0.42–1.85)
Some college or associate degree	1.61§ (1.26–2.06)	1.52§ (1.11–2.09)	1.62 (0.86–3.05)	1.93 (0.93–4.01)
Income				
<$40,000	Referent	Referent	Referent	Referent
$40,000–$74,999	1.10 (0.85–1.43)	0.74 (0.53–1.03)	1.14 (0.58–2.25)	1.14 (0.49–2.63)
$75,000–$124,999	0.95 (0.73–1.24)	0.75 (0.54–1.05)	2.56§ (1.25–5.21)	2.16 (0.94–4.99)
≥$125,000	1.34 (0.98–1.84)	1.26 (0.85–1.86)	1.85 (0.86–3.98)	2.09 (0.85–5.18)
U.S. Census region of residence**				
Northeast	Referent	Referent	Referent	Referent
Midwest	0.94 (0.67–1.30)	1.05 (0.69–1.58)	0.72 (0.32–1.62)	0.69 (0.26–1.78)
South	0.69§ (0.52–0.91)	0.79 (0.55 – 1.14)	0.47 (0.22–1.00)	0.78 (0.33–1.86)
West	0.61§ (0.45–0.83)	0.76 (0.52–1.13)	0.58 (0.25–1.34)	0.44 (0.16–1.17)
Metropolitan statistical area status				
Nonmetropolitan	Referent	Referent	Referent	Referent
Metropolitan	1.38§ (1.07–1.78)	1.14 (0.82–1.59)	1.77 (0.92–3.39)	1.22 (0.56–2.67)
Household hearing impairment††				
No	Referent	Referent	Referent	Referent
Yes	0.66§ (0.49–0.90)	1.24 (0.85–1.82)	0.35§ (0.17–0.71)	0.56 (0.24–1.32)
Other household member	0.70§ (0.50–0.97)	0.73 (0.47–1.13)	0.52 (0.24–1.11)	0.53 (0.21–1.35)
Frequently enjoy attending sporting events†				
No	Referent	Referent	—	—
Yes	1.40§ (1.09–1.79)	1.68§ (1.24–2.27)	—	—

Abbreviations: CI = confidence interval; OR = odds ratio.

* Panelists were asked: "In the past 12 months, how often did you wear hearing protection devices (ear plugs, ear muffs) when attending a loud athletic or entertainment event?"

† Panelists were asked: "Which of the following leisure-time activities do you frequently enjoy doing?" Responses included "Attending sporting events."

§ Statistical difference at $p<0.05$ compared with the referent group.

¶ Persons who identified as white, black, Asian, or other or multiracial were all non-Hispanic. Persons who identified as Hispanic might be of any race.

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

†† Panelists were asked: "Do you, or does anyone in your household have deafness or hard of hearing in either ear?"

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CDC Grand Rounds: New Frontiers in Workplace Health

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Overview of Current U.S. Workplace Health Promotion Programs

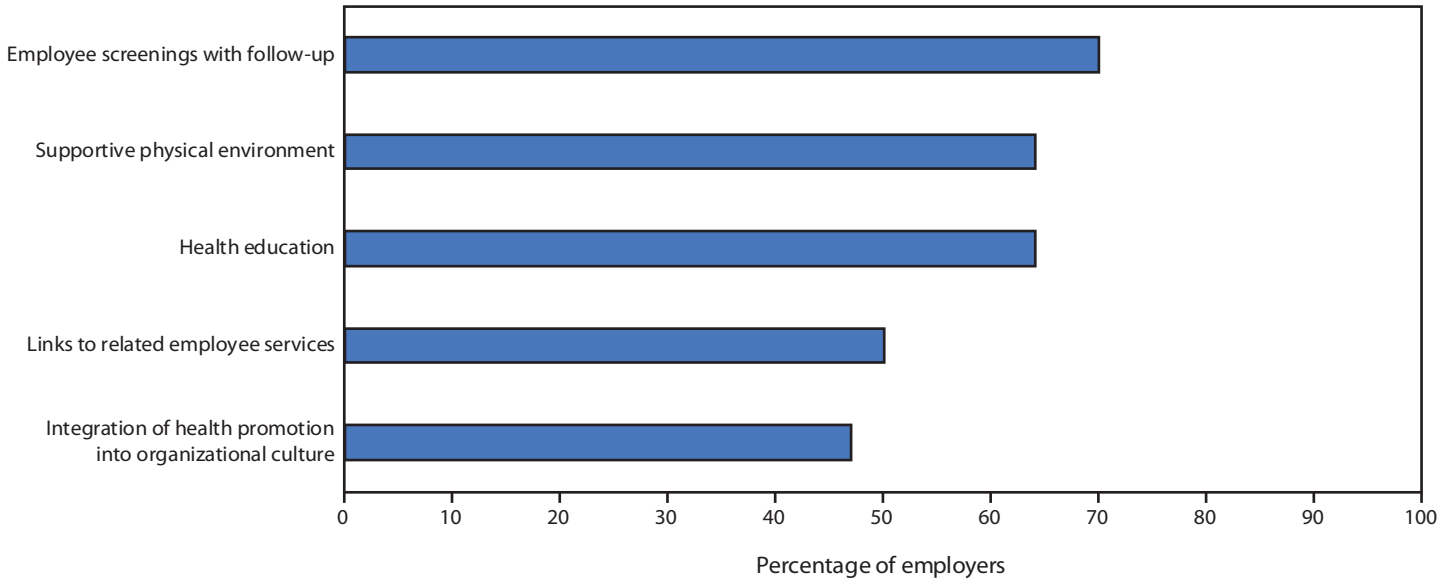
Approximately 150 million Americans go to work each day, and where and how they work are closely linked to health and disease. Thus, workplace health promotion programs provide an opportunity to affect the health of the nation. Workplace health promotion programs traditionally rooted in occupational safety and health focus on preventing injury and illness resulting from the workplace environment. As gains have been made in reducing workplace hazards, and the prevalence of disease has shifted toward chronic diseases, employers have encountered rising health care costs. In the United States, chronic diseases are responsible for approximately seven in 10 deaths and account for 86% of health care costs (*1*,*2*). Approximately 20% of employer health care spending is associated with 10 modifiable health risks in the U.S. workforce: depression, high blood glucose, high blood pressure, obesity, tobacco use, physical inactivity, high stress, high cholesterol, poor nutrition and eating habits, and high alcohol consumption (*3*). Many employers have sought to establish workplace health promotion programs to improve employee health and lower health care costs; results of these efforts have been mixed. For example, some employers, especially smaller firms with limited resources, report barriers to implementing workplace health promotion programs, including lack of knowledge of program design, difficulty identifying credible information, and lack of awareness of program benefits (*4*,*5*). Evaluation and research continue to increase knowledge about workplace health promotion program design and identify ways to overcome the challenges of establishing effective programs. State health departments can provide assistance to employers and employees. In 2017, the CDC Workplace Health Resource Center was launched as a source for reliable evidence and best practices to improve worker health and productivity, address research gaps, and potentially reduce health care costs.

This is another in a series of occasional MMWR *reports titled CDC Grand Rounds. These reports are based on grand rounds presentations at CDC on high-profile issues in public health science, practice, and policy. Information about CDC Grand Rounds is available at https://www.cdc.gov/grand-rounds.*

Workplace health promotion programs are popular with both employers and employees, although programs offered by employers vary considerably. *Healthy People 2010* established five elements for a comprehensive workplace health promotion program, including 1) health education; 2) supportive social and physical environments; 3) integration of the worksite program into the organization's culture; 4) links between health promotion and related programs like employee assistance; and 5) screenings with follow-up (*6*). A 2017 study based on two independent, nationally representative surveys of U.S. employers and employees (*7*) found that 81% of 705 surveyed employers offered some type of workplace health promotion program (Figure). The most frequently offered program elements were screenings with follow-up (70.4%), health education (64.3%), a supportive environment for health improvement (63.7%), and links to other employee services (50.4%). Using these same five elements, the 2015 Harris Poll Nielson survey found that a minority of employers (13.3%) offered comprehensive workplace health promotion programs (*7*).

The existence of a workplace health promotion program, however, guarantees neither its use nor any resulting health and economic benefits. Among 1,833 employees surveyed by the 2015 Harris Poll Neilson survey, fewer than half (45%) reported being offered some form of workplace health promotion program, and 55% of those who were offered such a program reported participating (*7*). This gap between what employers offer and what employees perceive or use might reflect the variability in what program elements employers offer, or more likely, improperly designed programs that are not based on best or promising practices, or are underresourced or poorly implemented or both. Workplace health promotion programs that do not follow best practices, including assessing needs, often have low employee participation (*7*,*8*). However, accumulating evidence in the workplace health promotion program literature suggests that when these programs are well executed they benefit both employees and employers (*5*,*9*,*10*). In the 2015 Harris Poll Neilson survey, approximately three quarters of employers with a workplace health promotion program in place reported positive impacts from their wellness programs, including improved workers' health (83.6%); performance and productivity (83.3%); and reduced health care costs (73.6%) (*7*). Survey results did not shed light on what made particular programs successful. A meta-analysis found that for every $1.00 spent on wellness programs, $3.27 was

FIGURE. Percentage of employers offering the five elements included in workplace health promotion programs, by element — United States, 2017*



* Figure adapted with permission from McCleary K, Goetzel RZ, Roemer EC, et al. Employer and employee opinions about workplace health promotion (wellness) programs: results of the 2015 Harris Poll Nielsen Survey. J Occup Environ Med 2017;59:256–63.

returned in reduced medical costs and $2.73 in absenteeism reductions (*11*). Research also has found reduced medical costs and absenteeism as well as fewer claims for short-term disability and safety/workers' compensation (*12–14*).

Workplace Health Promotion Program Evidence and Best Practices

Although employers have implemented programs and health departments have assisted through direct services to employers, gaps in understanding of workplace health promotion program best practices and evidence remain. In 2008 and 2013, reports sponsored by Partnership for Prevention and the Bipartisan Policy Center synthesized the evidence base from the field, described the need for and benefits of workplace health promotion programs, and provided actionable policy recommendations (*4*,*5*). These recommendations included improving employer education about benefits of workplace health promotion programs; providing technical assistance on the design, implementation, and evaluation of programs; developing and improving tools and resources to support these programs; and creating a comprehensive health promotion resource center.

Through its external workplace health promotion program, managed out of the National Center for Chronic Disease Prevention and Health Promotion, CDC was involved in several of the recommended activities, such as providing technical assistance and developing or improving tools and resources. However, no centralized resource for workplace health promotion existed.

New CDC Workplace Health Resource Center

To fill this gap, and based on Partnership for Prevention and Bipartisan Policy Center recommendations, the CDC Workplace Health Resource Center (https://nccd.cdc.gov/WHRC/) was launched in August 2017, with the aim of serving as a comprehensive website with reliable information, tools, and resources to help employers find credible, public domain, fact-based resources from organizations already in the workplace health marketplace. All resources on the website are vetted by a steering committee comprising subject matter experts from state health departments, public and private sectors, and academia.

Structurally, the highest level of content is organized according to the CDC Workplace Health Model (assessment, planning and governance, implementation, and evaluation). Website users can search for resources within each of the model components. One notable feature of the Workplace Health Resource Center is the CDC Worksite ScoreCard (https://www.cdc.gov/workplacehealthpromotion/initiatives/healthscorecard/index.html), a comprehensive tool that employers can use to assess which health promotion activities are currently in place within an organization, plan strategies and interventions that could be implemented as part of a workplace health promotion program, and evaluate and monitor progress in primary health topic and programmatic areas.

Other search options on the website's navigation bar include Workplace Organizational Factors (benefit plan design, creating a culture of health, etc.); Individual and Family Wellness (tobacco-free policies, healthy vending, and access to fitness facilities, etc.); Prevention Resources (clinical preventive services and vaccinations, etc.); and Health Conditions (disease management programs and lifestyle counseling to address chronic diseases, etc.) (Box). Users also can search for specific types of resources, including case studies; how-to manuals; peer-reviewed articles; and online, interactive training. Small businesses (those with fewer than 200 employees) might have difficulties offering a workplace health promotion program: whereas 55% of small businesses offer health insurance coverage, fewer than half offer wellness programs that address major lifestyle risks such as tobacco use and overweight/obesity (*15*). The website places a special emphasis on unique challenges and opportunities for small businesses, but can be used by all employers to tailor workplace health promotion programs to their organizations' needs.

State Health Departments' Support of Workplace Health Promotion Programs

Within state health departments, occupational safety and health and workplace health promotion departments support and assist employers in implementing workplace health promotion programs. A 2017 national survey of Workplace Health Promotion and Occupational Safety and Health within health departments found that surveillance and implementation support were the activities most commonly reported by occupational safety and health and workplace health promotion program respondents, respectively (L Linnan, University of North Carolina, unpublished data, 2018). Implementation support might include providing technical assistance, training programs, educational materials/tools, and quality assurance/improvement. Fifty-one percent of survey respondents reported that their health department was involved in direct service to workers; occupational safety and health and workplace health promotion program respondents were equally likely (61%) to report this activity. Importantly, occupational safety and health programs in 26 health departments receive funding from CDC's National Institute for Occupational Safety and Health to conduct occupational safety and health surveillance. However, many state health departments also reported that capacity to support occupational safety and health and workplace health promotion program activities is limited because of low funding and staffing levels: 19% of occupational safety and health and 30% of workplace health promotion program respondents indicated they had no funding designated for these efforts.

BOX. Organization of the Workplace Health Resource Center*

Organizational or employer factors
- Creating a culture of health
- Employee engagement
- Strategic communication
- Benefit plan design
- Legal and regulatory environment
- Wellness and health promotion technology

Individual or employee factors
- Physical activity and fitness
- Nutrition
- Mental and emotional health
- Financial health
- Work-life balance
- Social connectedness

* https://nccd.cdc.gov/WHRC/

The Role of Public Health in a 21st Century Workplace for a 21st Century Workforce

Chronic disease prevention and health promotion represent major challenges for employers in the 21st century. In aggregate, workplace health promotion programs can affect population health outcomes while improving individual quality of life and productivity. Evidence-based and best practice literature exists for the design, implementation, and evaluation of workplace health promotion programs. Dissemination to employers and health department programs that support employers in promoting occupational safety and health and workplace health promotion can encourage maximum effectiveness of workplace health promotion programs. Small and mid-size employers, particularly those without experience in workplace health, could benefit from information that is credible and useful. Support from CDC, state health departments, and professional organizations can facilitate acceptance of science-based strategies for workplace health promotion program development, implementation, and evaluation. Together, public health and employers can implement employer-based workplace health promotion programs to address modifiable health risks, lower the prevalence of chronic conditions, and improve the health and well-being of workers.

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Notes from the Field

Reference Laboratory Investigation of Patients with Clinically Diagnosed Lyme Disease and Babesiosis — Indiana, 2016

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In the midwestern United States, the principal vector for Lyme disease (*Borrelia burgdorferi*) and babesiosis (*Babesia microti*) is the *Ixodes scapularis* tick, which has been documented in 77 of 92 Indiana counties (Indiana State Department of Health [ISDH], unpublished data, 2018) (*1*). The average annual Lyme disease incidence in Indiana is low (1.3 cases per 100,000 population during 2011–2015) (*2*); however, rates in some northwestern counties are higher (*3*). A two-tiered serologic testing algorithm is recommended for diagnosing Lyme disease (*4*). Babesiosis is rare in Indiana, with no confirmed cases and one probable case reported during 2011–2015. Blood smear examination or polymerase chain reaction (PCR) analysis are typically recommended for the diagnosis of acute babesiosis (*5*). In June 2016, a physician in northwestern Indiana informed ISDH of a high prevalence of clinically diagnosed Lyme disease among his patients. He further reported that eight patients evaluated during 2015–2016 had tested positive for *B. microti* immunoglobulin G (IgG) or immunoglobulin M (IgM) antibodies by enzyme immunoassay (EIA) at a commercial laboratory. To further evaluate these findings, ISDH and CDC conducted a laboratory investigation using specimens from some of the patients.

The physician in northwestern Indiana was asked to select clinically representative patients for further investigation; 14 were chosen, including five of the eight who had positive *B. microti* EIA results (Table). Whole blood and serum specimens were collected and tested at CDC for evidence of *Borrelia* and *Babesia* infection. ISDH did not conduct patient interviews or chart reviews; demographic and clinical data were obtained from the CDC specimen submission form. Clinical manifestations reported in an unstructured memo field were compared with national surveillance case definition clinical criteria for Lyme disease and babesiosis (*6*). CDC tested for Lyme disease by whole cell sonicate and C6 peptide EIAs followed by IgM and IgG immunoblots for all patients and for *Babesia* infection by examination of Giemsa-stained blood smears, PCR, and indirect fluorescent antibody (IFA) for total immunoglobulin to *B. microti*.

The 14 patients lived in seven northwestern Indiana counties. The median age was 46 years (range = 10–76 years); nine were female (Table). The only reported objective clinical manifestations potentially consistent with Lyme disease were unspecified rashes in three patients (B, K, and N). Objective manifestations consistent with babesiosis included anemia (patient E) and fever (patient F). A median of three prescribed antimicrobial agents (range = 1–6) were reported per patient, without mention of indications. Exposure and travel histories were not provided.

Patient specimens were collected a median of 172 days (range = 22–348 days) after reported illness onset dates; the interval was ≥3 months for all but two patients (D and G). One patient (M) had positive C6 peptide EIA results; no patient had positive whole cell sonicate EIA or immunoblot results (Table). All patient serologies were therefore interpreted to be negative for Lyme disease (*4*). Two patients (F and G) had *B. microti* IFA titers of 1:64; they reportedly became symptomatic in July 2015 and June 2016, respectively. The results of all other *Babesia* testing were negative.

This laboratory-based investigation does not suggest a cluster of Lyme disease or babesiosis cases among these patients. None had serologic evidence of Lyme disease or parasitologic or molecular evidence of *Babesia* infection, and only two had serologic evidence of *B. microti* infection. A *B. microti* IFA titer of 1:64 is insufficient laboratory evidence to fulfill the national surveillance case definition for non–transfusion-associated babesiosis (*6*) and could reflect early, chronic, or resolved infection or nonspecific reactivity.

Lyme disease and babesiosis should be considered in the differential diagnosis for patients with clinically compatible illness and potential exposure to *I. scapularis* ticks in areas where the pathogens are present. Physicians in low-prevalence states can increase the positive predictive value of laboratory testing by carefully selecting patients for testing, following established diagnostic recommendations, and using certified or accredited laboratories (*5*,*7*).

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TABLE. Demographic data, illness onset dates, selected clinical manifestations, and selected laboratory results for 14 patients with clinically diagnosed Lyme disease and babesiosis — Indiana, 2016

Patient	Age (yrs)	Sex	Onset date	Clinical manifestation		*Babesia microti* serology (commercial laboratory EIA)		CDC results			
								Lyme disease serology			Total Ig titer to B. microti (IFA)*
				Objective	Subjective	IgG	IgM	WCS EIA	C6 peptide EIA	IgM/IgG immunoblot	
A	57	F	09/2015	None	Sweats, headache, myalgia	pos	neg	neg	neg	neg	<1:8
B	50	F	09/2015	Rash†	Sweats, headache, myalgia	pos	neg	neg	neg	neg	<1:8
C	31	F	11/2015	None	Headache, myalgia	pos	neg	neg	neg	neg	<1:8
D	46	M	06/2016	None	Sweats	pos	neg	neg	neg	neg	<1:8
E	68	F	08/2015	Anemia†	Sweats, headache, myalgia	neg	pos	neg	neg	neg	<1:8
F	51	F	07/2015	Fever†	Headache, myalgia, arthralgia	—§	—§	neg	neg	neg	1:64
G	50	M	06/2016	None	Sweats, myalgia, arthralgia	—	—	neg	neg	neg	1:64
H	76	F	07/2015	None	Sweats, myalgia, arthralgia	—	—	neg	neg	neg	<1:8
I	31	M	01/2016	None	Sweats, myalgia, arthralgia	—	—	neg	neg	neg	<1:8
J	40	F	01/2016	None	Myalgia, arthralgia	—	—	neg	neg	neg	<1:8
K	43	F	01/2016	Rash†	Headache, myalgia, arthralgia	—	—	neg	neg	neg	<1:8
L	30	F	01/2016	NP	NP	—	—	neg	neg	neg	<1:8
M	45	M	03/2016	None	Sweats, myalgia	—	—	neg	pos	neg	<1:8
N	10	M	04/2016	Rash†	Myalgia	—	—	neg	neg	neg	<1:8

Abbreviations: EIA = enzyme immunoassay; F = female; IFA = indirect fluorescent antibody; Ig = immunoglobulin; IgG = immunoglobulin G; IgM = immunoglobulin M; M = male; neg = negative; NP = not provided; pos = positive; WCS = whole cell sonicate.

* For patients A–E, the specimens tested by IFA were collected a median of 282 days (range = 30–323 days) after the specimens tested by EIA.

† Details not specified.

§ Not done.

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Notes from the Field

Contact Tracing Investigation after First Case of Andes Virus in the United States — Delaware, February 2018

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In January 2018, a woman admitted to a Delaware hospital tested positive for New World hantavirus immunoglobulin M (IgM) and immunoglobulin G (IgG) by enzyme-linked immunosorbent assay (ELISA). Subsequent testing by CDC's Viral Special Pathogens Branch detected New World hantavirus by nested reverse transcription–polymerase chain reaction (RT-PCR) and Andes virus by nucleic acid sequencing. This case represents the first confirmed importation of Andes virus infection into the United States; two imported cases have also been reported in Switzerland (*1*). Before her illness, the patient had traveled to the Andes region of Argentina and Chile from December 20, 2017, to January 3, 2018. She stayed in cabins and youth hostels in reportedly poor condition. No rodent exposures were reported. After returning to the United States on January 10, she developed fever, malaise, and myalgias on January 14. On January 17, while ill, she traveled on two commercial domestic flights. She was hospitalized during January 20–25 in Delaware and discharged to her home after clinical recovery.

Andes virus, a species of New World hantavirus, is transmitted to humans primarily through contact with long-tailed rice rats (*Oligoryzomys longicaudatus*), which are endemic to much of Argentina and Chile. Clinical symptoms are similar to those of other New World hantaviruses, and the case fatality rate is approximately 36% (*2*). Unlike all other hantavirus species, Andes virus can be transmitted from person to person; however, transmission is typically limited to close contacts of ill persons (*2–4*). Because of this risk, a contact tracing investigation was initiated by CDC as well as state and county health departments.

A suspected case was defined as the occurrence of one or more of the following signs or symptoms in a person with close contact with the patient within 42 days (the maximum incubation period) after last contact: new onset anorexia, chest pain, cough, diarrhea, fever, headache, muscle pain, nausea, or vomiting. A high-risk contact was defined as a person with exposure to the traveler's body fluids. A low-risk contact was defined as a person who, in the absence of exposure to body fluids, provided medical care or in-flight service to, or was seated near, the traveler for at least 1 hour.

Among 53 contacts identified in six states, 51 were successfully contacted (Table). Of these, 28 were health care personnel, 15 were airline contacts (flight crew who served the traveler and passengers seated within one seat of the traveler), and eight were other contacts of the traveler (including acquaintances and a hospital roommate). All contacts were advised to self-monitor their temperature daily for 42 days from last contact and to seek medical evaluation for any of the specified symptoms. Contacts who developed symptoms were tested for hantavirus by RT-PCR and serology by CDC's Viral Special Pathogens Branch.

Two high-risk contacts were identified: a health care worker with exposure to the traveler's sweat and a family member with exposure to the traveler's clothes and bedding. Both high-risk contacts remained asymptomatic. Six low-risk contacts, all flight attendants, reported influenza-like illness, diarrhea, or mild rhinitis during the incubation period; all tested negative for hantavirus by RT-PCR and serology. The remaining low-risk contacts remained asymptomatic, and the investigation concluded on March 8.

Hospitalized patients with Andes virus should be managed with standard contact and droplet precautions. Although the risk for person-to-person Andes virus transmission is low, contact tracing should be considered to identify potential cases and limit additional exposures. Health care personnel should consider Andes virus in returning travelers with nonspecific febrile illness or acute respiratory disease whose travel history includes the Andes region of Argentina or Chile in the preceding 6 weeks.

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TABLE. Number and types of contacts traced during Andes virus investigation, by state — United States, 2018

State	Airline contacts	Health care contacts	Other contacts	Total contacts (no. contacted)	High-risk contacts	Specimens sent to CDC for testing
Delaware	0	28	9	37 (35)	1	0
California	7	0	1	8 (8)	1	5
Pennsylvania	2	0	0	2 (2)	0	0
Illinois	1	0	0	1 (1)	0	0
Arizona	3	0	0	3 (3)	0	1
Maryland	2	0	0	2 (2)	0	0
Total	**15**	**28**	**10**	**53 (51)**	**2**	**6**

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Erratum

Vol. 67, No. 33

In the report "National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13–17 Years — United States, 2017," on page 914, in Table 2, the entry for the column "Difference" and row "≥3 Hepatitis B doses" should have read -2.6 (-4.8 to **-0.3**). The entry for the column "MSA principal city" and row "Tdap ≥1 dose" should have read "88.8 (87.2 **to** 90.1). Entries for the column "Difference between non-MSA and MSA principal city" and row "MenACWY, ≥1 dose" should have read -7.4 (-10.0 to **-4.7**), row "MenACWY, ≥2 dose" should have read -12.0 (-19.5 to **-4.6**), row "HPV, ≥1dose" should have read -10.8 (-14.0 to **-7.6**), and row "HPV UTD" should have read -10.0 (-13.3 to **-6.6**). Entries for the column "Difference between MSA nonprincipal city and principal city" and row "MenACWY, ≥1 dose" should have read 0.1 (**-2.0 to 2.2**), row "HPV, ≥1dose" should have read -7.0 (9.6 to **-4.4**), and row "HPV UTD" should have read -5.5 (-8.3 to **-2.6**).

Erratum

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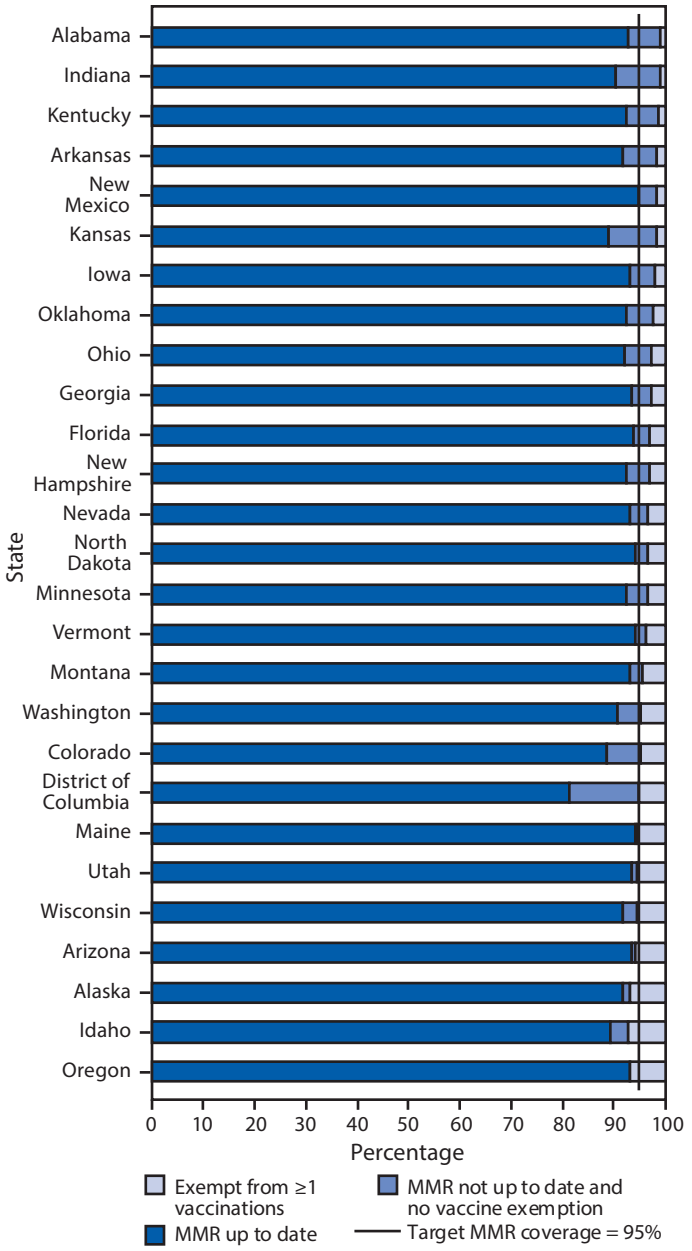
In the report "Vaccination Coverage for Selected Vaccines and Exemption Rates Among Children in Kindergarten — United States, 2017–18 School Year," on page 1121, an incorrect figure was published. The corrected figure follows.

FIGURE. Estimated percentage of kindergartners with documented up-to-date vaccination for measles, mumps, and rubella vaccine (MMR)*; exempt from one or more vaccines†,§; and not up to date with MMR and not exempt,¶ — selected states and District of Columbia, 2017–18 school year**



* Estimates are based on completed vaccine series and are not MMR-specific for Alabama, Florida, Georgia, Iowa, and New Hampshire. Up-to-date coverage reported here is the lower bound of possible MMR coverage.

† Most states report the number of kindergartners with an exemption from one or more vaccines. Estimates reported here might include exemptions from vaccines other than MMR, except in Colorado and Minnesota where MMR-specific exemptions are reported.

§ Coverage estimates are based on a sample of kindergartners, and exemption estimates are based on a census for Alaska, Kansas, and Wisconsin.

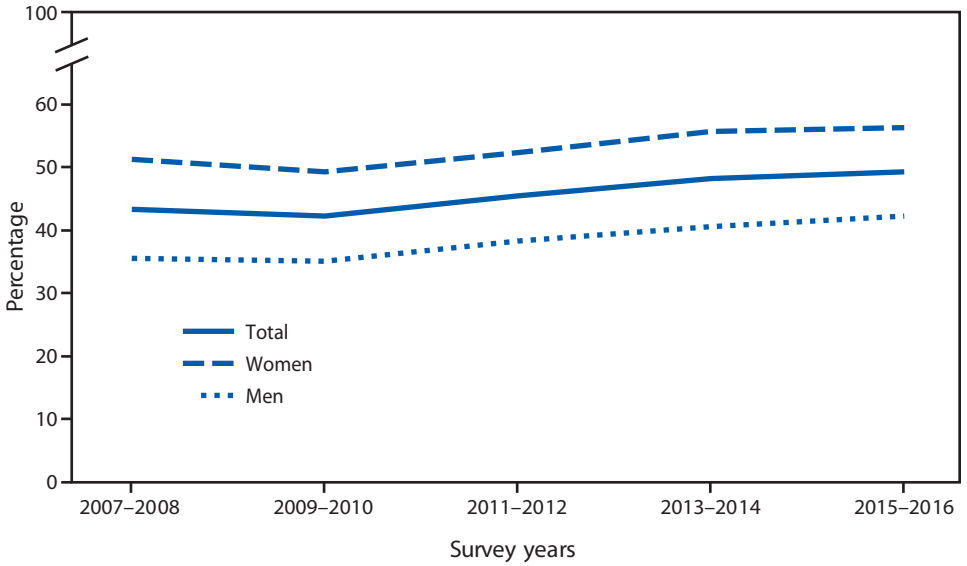
¶ Includes nonexempt students provisionally enrolled, in a grace period, or otherwise without documentation of complete MMR vaccination.

** Figure includes all states with reported MMR coverage for the 2017–18 school year of <95%, the *Healthy People 2020* target for MMR vaccination coverage among kindergartners. http://www.healthypeople.gov.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentage of Adults Aged ≥20 Years Who Tried to Lose Weight During the Past 12 Months,* by Sex — National Health and Nutrition Examination Survey, 2007–2008 to 2015–2016



* Based on self-reported intentional ≥10-pound weight loss compared with 1 year ago or self-report of trying to lose weight during the past 12 months. Pregnant women were excluded.

From 2007–2008 to 2015–2016, the age-adjusted percentage of adults who tried to lose weight during the past 12 months increased from 43.3% to 49.3%. This increase was seen among both men (35.5% to 42.2%) and women (51.2% to 56.3%). The percentage of women who tried to lose weight in the past year was higher than that for men for each survey year from 2007–2008 to 2015–2016.

Source: National Center for Health Statistics data brief no. 313. https://www.cdc.gov/nchs/data/databriefs/db313.pdf; National Center for Health Statistics, National Health and Nutrition Examination Survey Data, 2007–2008 to 2015–2016. https://www.cdc.gov/nchs/nhanes.htm.

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