Please note: An erratum has been published for this issue. To view the erratum, please click here.

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 68 / No. 27
July 12, 2019

Changes in HIV Preexposure Prophylaxis Awareness and Use Among Men Who Have Sex with Men — 20 Urban Areas, 2014 and 2017

Teresa Finlayson, PhD[1]; Susan Cha, PhD[1]; Ming Xia, MD[2]; Lindsay Trujillo, MPH[1,3]; Damian Denson, PhD[1]; Joseph Prejean, PhD[1]; Dafna Kanny, PhD[1]; Cyprian Wejnert, PhD[1]; National HIV Behavioral Surveillance Study Group

In February 2019, the U.S. Department of Health and Human Services proposed a strategic initiative to end the human immunodeficiency (HIV) epidemic in the United States by reducing new HIV infections by 90% during 2020–2030[*] (*1*). Phase 1 of the Ending the HIV Epidemic initiative focuses on Washington, DC; San Juan, Puerto Rico; and 48 counties where the majority of new diagnoses of HIV infection in 2016 and 2017 were concentrated and on seven states with a disproportionate occurrence of HIV in rural areas relative to other states.[†] One of the four pillars in the initiative is protecting persons at risk for HIV infection using proven, comprehensive prevention approaches and treatments, such as HIV preexposure prophylaxis (PrEP), which is the use of antiretroviral medications that have proven effective at preventing infection among persons at risk for acquiring HIV. In 2014, CDC released clinical PrEP guidelines to health care providers (*2*) and intensified efforts to raise awareness and increase the use of PrEP among persons at risk for infection, including gay, bisexual, and other men who have sex with men (MSM), a group that accounted for an estimated 68% of new HIV infections in 2016 (*3*). Data from CDC's National HIV Behavioral Surveillance (NHBS) were collected in 20 U.S. urban areas in 2014 and 2017, covering 26 of the geographic areas included in Phase I of the Ending the HIV Epidemic initiative, and were compared to assess changes in PrEP awareness and use among MSM. From 2014 to 2017, PrEP awareness increased by 50% overall, with >80% of MSM in 17 of the 20 urban areas reporting PrEP awareness in 2017. Among MSM with likely indications for PrEP (e.g., sexual risk behaviors or recent bacterial sexually transmitted infection [STI]), use of PrEP increased by approximately 500% from 6% to 35%, with significant increases observed in all urban areas and in almost all demographic subgroups. Despite this progress, PrEP use among MSM, especially among black and Hispanic MSM, remains low. Continued efforts to improve coverage are needed to reach the goal of 90% reduction in HIV incidence by 2030. In addition to developing new ways of connecting black and Hispanic MSM to health care providers through demonstration projects, CDC has developed resources and tools such as the Prescribe HIV Prevention program to enable health care providers to integrate PrEP into their clinical care.[§] By routinely testing their patients for HIV, assessing HIV-negative patients for risk behaviors, and prescribing PrEP as needed, health care providers can play a critical role in this effort.

NHBS staff members in 20 urban areas collected cross-sectional behavioral survey data and conducted HIV testing among MSM

---

[*] https://www.hiv.gov/federal-response/ending-the-hiv-epidemic/overview?s_cid=ht_endinghivinternet0002.

[†] https://aidsvu.org/ending-the-epidemic/.

[§] https://www.cdc.gov/actagainstaids/campaigns/prescribe-hiv-prevention/index.html.

INSIDE

604 Workplace Secondhand Tobacco Smoke Exposure Among U.S. Nonsmoking Workers, 2015
608 Vital Signs: Surveillance for Acute Flaccid Myelitis — United States, 2018
615 Notes from the Field: Conjunctivitis Caused by Toxigenic *Corynebacterium ulcerans* — Missouri, 2018
617 QuickStats

Continuing Education examination available at https://www.cdc.gov/mmwr/cme/conted_info.html#weekly.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

at recruitment events using venue-based sampling[¶] (*4*). Eligible participants[**] completed a standardized questionnaire administered in person by trained interviewers. All participants were offered anonymous HIV testing and incentives for the interview and HIV test.[††] Analysis was limited to eligible participants at risk for HIV infection who were likely to meet clinical indications for PrEP[§§] (*2*). Specifically, the analysis was limited to MSM who had a negative NHBS HIV test result, did not report a previous HIV-positive test result, had either one male sex partner who was HIV-positive or two or more male sex partners in the past 12 months, and reported either condomless anal sex or a bacterial STI (i.e., syphilis, gonorrhea, or chlamydia) in the past 12 months. PrEP awareness and use were measured differently in 2014 and in 2017. In 2014, participants were asked whether they had "ever heard of people who do not have HIV taking anti-HIV medicines, to keep from getting HIV" and whether, in the past 12 months, they had "taken anti-HIV medicines before sex because you thought it would keep you from getting HIV." In 2017, participants were informed that PrEP is an antiretroviral medicine taken for months or years by a person who is HIV-negative to reduce the risk for getting HIV and then asked whether they had ever heard of PrEP and whether, in the past 12 months they had taken PrEP to reduce the risk of getting HIV. Log-linked Poisson regression models with generalized estimating equations clustered on recruitment event were stratified by subgroup to estimate prevalence ratios and 95% confidence intervals (CIs) for PrEP awareness and use by year. Stratified models for each subgroup were adjusted for income, health insurance, and region. Analyses were conducted using SAS software (version 9.4; SAS Institute).

In 2014 and 2017, 18,610 sexually active MSM were interviewed (9,640 in 2014; 8,970 in 2017) in the 20 urban areas. Of those, this analysis is limited to 7,873 MSM (42%) who had a negative HIV test result but were at risk for HIV infection and likely met the clinical indications for PrEP (3,821 [40%] in 2014; 4,052 [45%] in 2017). From 2014 to 2017, awareness of PrEP among these MSM increased overall from 60% to 90% (adjusted prevalence

---

[¶] The number of U.S. urban areas collecting data differed in 2014 and 2017. The following 20 urban areas collected data both years: Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Detroit, Michigan; Houston, Texas; Los Angeles, California; Miami, Florida; Nassau and Suffolk counties, New York; New Orleans, Louisiana; New York City, New York; Newark, New Jersey; Philadelphia, Pennsylvania; San Diego, California; San Francisco, California; San Juan, Puerto Rico; Seattle, Washington; and Washington, DC. The following three urban areas that collected data in 2017 were not included in this analysis: Memphis, Tennessee; Norfolk, Virginia; and Portland, Oregon.

[**] Men who were born male and identified as male, reported having ever had oral or anal sex with another man, resided in the interview city, were aged ≥18 years, and could complete the interview in English or Spanish.

[††] The incentive format (cash or gift card) and amount varied by city according to formative assessment and local policy. A typical format included $25 for completing the interview and $25 for providing a specimen for HIV testing.

[§§] NHBS data do not correspond directly with the criteria for PrEP indication in the clinical guidelines. The guidelines recommend that men use PrEP if they are without acute or established HIV infection, have had sex with a nonmonogamous male partner who has not recently tested HIV-negative, and have had at least one of the following: any anal sex without a condom in the past 6 months or a bacterial STI (i.e., syphilis, gonorrhea, or chlamydia) diagnosed or reported in the past 6 months. NHBS data flag persons who are likely indicated for PrEP use because of behavior from a longer period (12 months versus 6 months) and use multiple sex partners as a proxy for a nonmonogamous partner.

The *MMWR* series of publications is published by the Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30329-4027.

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2019;68:[inclusive page numbers].

Centers for Disease Control and Prevention
Robert R. Redfield, MD, *Director*
Anne Schuchat, MD, *Principal Deputy Director*
Chesley L. Richards, MD, MPH, *Deputy Director for Public Health Science and Surveillance*
Rebecca Bunnell, PhD, MEd, *Director, Office of Science*
Barbara Ellis, PhD, MS, *Acting Director, Office of Science Quality, Office of Science*
Michael F. Iademarco, MD, MPH, *Director, Center for Surveillance, Epidemiology, and Laboratory Services*

***MMWR* Editorial and Production Staff (Weekly)**
Charlotte K. Kent, PhD, MPH, *Editor in Chief*
Jacqueline Gindler, MD, *Editor*
Mary Dott, MD, MPH, *Online Editor*
Terisa F. Rutledge, *Managing Editor*
Douglas W. Weatherwax, *Lead Technical Writer-Editor*
Glenn Damon, Soumya Dunworth, PhD, Teresa M. Hood, MS,
Technical Writer-Editors
Martha F. Boyd, *Lead Visual Information Specialist*
Maureen A. Leahy, Julia C. Martinroe,
Stephen R. Spriggs, Tong Yang,
Visual Information Specialists
Quang M. Doan, MBA, Phyllis H. King,
Terraye M. Starr, Moua Yang,
Information Technology Specialists

***MMWR* Editorial Board**
Timothy F. Jones, MD, *Chairman*
Matthew L. Boulton, MD, MPH
Virginia A. Caine, MD
Katherine Lyon Daniel, PhD
Jonathan E. Fielding, MD, MPH, MBA
David W. Fleming, MD
William E. Halperin, MD, DrPH, MPH
Robin Ikeda, MD, MPH
Phyllis Meadows, PhD, MSN, RN
Jewel Mullen, MD, MPH, MPA
Jeff Niederdeppe, PhD
Patricia Quinlisk, MD, MPH
Stephen C. Redd, MD
Patrick L. Remington, MD, MPH
Carlos Roig, MS, MA
William Schaffner, MD
Morgan Bobb Swanson, BS

ratio [aPR] = 1.45; 95% CI = 1.41–1.50) and increased in all urban areas and subgroups (Table 1). In 2017, >80% of MSM in 17 of 20 urban areas and in most demographic subgroups were aware of PrEP. From 2014 to 2017, use of PrEP among MSM increased overall from 6% to 35% (aPR = 5.66; 95% CI = 4.85–6.61) and increased in all urban areas and in almost all demographic subgroups (Table 2). Substantial increases in PrEP use occurred among black, Hispanic, and young (aged 18–29 years) MSM from 2014 to 2017. In 2017, the differences in PrEP use between Hispanic (30%) and white (42%) MSM (aPR = 0.91; 95% CI = 0.78–1.06) and between young (32%) and older (38%) MSM (aPR = 0.97; 95% CI = 0.89–1.05) were no longer significant after controlling for income, health insurance, and region. However, the difference in reported PrEP use between black (26%) and white (42%) MSM remained significant after controlling for these three factors (aPR = 0.78; 95% CI = 0.66–0.92). During 2017, PrEP use increased with education and income, and 39% of the MSM who saw a health care provider in the past 12 months reported PrEP use.

Discussion

From 2014 to 2017, PrEP awareness among MSM in this analysis increased by 50%. More importantly, in 2017, >80% of MSM in all racial and ethnic groups and in 17 of the 20 urban areas were aware of PrEP. This finding is encouraging and suggests that efforts designed to increase PrEP awareness among populations at risk for HIV infection are having a positive impact. These efforts have included media and social marketing campaigns (e.g., Act Against AIDS[¶¶]). In addition, national HIV prevention goals were updated in 2015 to expand efforts to prevent HIV infection using a combination of effective, evidence-based approaches among populations with the highest prevalences of HIV infection, including among black and Hispanic MSM (*5*). Thus, continued increases of awareness among MSM, especially among black and Hispanic MSM, are expected.

[¶¶] https://www.cdc.gov/actagainstaids/index.html.

TABLE 1. Number and percentage of men who have sex with men who are at risk for human immunodeficiency virus (HIV) infection[*] and reported awareness of HIV preexposure prophylaxis, by demographic characteristics — National HIV Behavioral Surveillance System, United States, 2014 and 2017

Characteristic	2014 No. (%)	2014 Total	2017 No. (%)	2017 Total	Adjusted prevalence ratio[†] (95% CI)
Overall	**2,286 (59.8)**	**3,821**	**3,664 (90.4)**	**4,052**	**1.45 (1.41–1.50)**
Age group (yrs)					
18–29	1,115 (57.5)	1,939	1,717 (91.2)	1,882	1.52 (1.45–1.59)
≥30	1,171 (62.2)	1,882	1,947 (89.7)	2,170	1.40 (1.34–1.46)
Racial/Ethnic group					
Black	376 (47.1)	798	729 (86.2)	846	1.76 (1.62–1.92)
Hispanic/Latino	529 (48.9)	1,081	1,032 (86.6)	1,191	1.66 (1.55–1.77)
White	1,152 (71.7)	1,607	1,555 (94.5)	1,645	1.30 (1.25–1.35)
Other[§]	216 (68.4)	316	322 (93.6)	344	1.36 (1.25–1.48)
Sexual identity					
Heterosexual	12 (38.7)	31	12 (60.0)	20	1.55 (0.87–2.76)
Homosexual or gay	2,038 (63.3)	3,222	3,126 (92.2)	3,389	1.41 (1.36–1.45)
Bisexual	227 (40.9)	555	513 (81.4)	630	1.90 (1.71–2.12)
Education					
High school degree or less	353 (38.8)	910	604 (80.5)	750	1.98 (1.79–2.17)
Some college or vocational school	695 (56.2)	1,237	1,184 (90.5)	1,309	1.56 (1.48–1.65)
College degree or graduate studies	1,237 (73.9)	1,673	1,875 (94.1)	1,992	1.26 (1.22–1.30)
Household income					
\$0–\$24,999	593 (45.5)	1,303	838 (82.2)	1,019	1.73 (1.61–1.85)
\$25,000–\$49,999	622 (61.5)	1,012	1,000 (91.0)	1,099	1.46 (1.38–1.55)
\$50,000–\$74,999	428 (66.9)	640	755 (93.8)	805	1.39 (1.31–1.48)
≥\$75,000	620 (75.7)	819	1,058 (95.3)	1,110	1.26 (1.20–1.31)
Currently have health insurance					
No	463 (51.1)	906	621 (85.5)	726	1.59 (1.48–1.72)
Yes	1,818 (62.6)	2,906	3,039 (91.6)	3,319	1.42 (1.37–1.47)
Visited a health care provider within the past 12 months					
No	332 (47.1)	705	409 (78.8)	519	1.60 (1.46–1.76)
Yes	1,953 (62.7)	3,114	3,254 (92.1)	3,532	1.42 (1.37–1.47)
Usual source of health care					
No usual place for health care	386 (46.3)	834	570 (83.3)	684	1.72 (1.58–1.87)
Clinic or health care center	599 (61.8)	970	1,053 (91.3)	1,153	1.43 (1.35–1.51)
Doctor's office or HMO	1,218 (64.8)	1,881	1,888 (92.6)	2,039	1.39 (1.34–1.44)
Other place for health care	57 (62.0)	92	115 (87.8)	131	1.42 (1.19–1.69)

See table footnotes on next page.

TABLE 1. (*Continued*) **Number and percentage of men who have sex with men who are at risk for human immunodeficiency virus (HIV) infection* and reported awareness of HIV preexposure prophylaxis, by demographic characteristics — National HIV Behavioral Surveillance System, United States, 2014 and 2017**

Characteristic	2014		2017		Adjusted prevalence ratio† (95% CI)
	No. (%)	Total	No. (%)	Total	
Participated in a behavioral Intervention within the past 12 months					
No	1,627 (57.2)	2,842	2,486 (88.9)	2,797	1.49 (1.43–1.55)
Yes	659 (67.3)	979	1,176 (93.9)	1,253	1.33 (1.27–1.40)
Tested for HIV within the past 12 months					
No	348 (41.5)	838	452 (75.1)	602	1.73 (1.57–1.91)
Yes	1,935 (65.0)	2,976	3,207 (93.1)	3,444	1.39 (1.35–1.43)
Region¶					
Midwest	216 (61.2)	353	289 (80.7)	358	1.29 (1.13–1.46)
Northeast	471 (59.4)	793	718 (90.4)	794	1.51 (1.40–1.62)
South	755 (55.9)	1,350	1,239 (89.6)	1,383	1.53 (1.44–1.62)
U.S. territories	63 (27.6)	228	82 (66.7)	123	2.25 (1.75–2.89)
West	781 (71.2)	1,097	1,336 (95.8)	1,394	1.34 (1.28–1.41)
Urban area					
Atlanta, GA	119 (62.0)	192	184 (92.5)	199	1.43 (1.25–1.64)
Baltimore, MD	87 (55.4)	157	89 (82.4)	108	1.52 (1.28–1.81)
Boston, MA	106 (73.1)	145	203 (96.7)	210	1.33 (1.18–1.49)
Chicago, IL	162 (82.2)	197	186 (94.4)	197	1.13 (1.05–1.22)
Dallas, TX	59 (33.1)	178	224 (89.2)	251	2.28 (1.76–2.97)
Denver, CO	122 (58.1)	210	270 (93.8)	288	1.61 (1.41–1.83)
Detroit, MI	54 (34.6)	156	103 (64.0)	161	1.80 (1.41–2.31)
Houston, TX	93 (49.7)	187	212 (86.5)	245	1.67 (1.38–2.01)
Los Angeles, CA	177 (68.3)	259	287 (97.3)	295	1.44 (1.31–1.57)
Miami, FL	98 (46.4)	211	134 (78.8)	170	1.67 (1.40–2.00)
Nassau and Suffolk counties, NY	73 (45.9)	159	68 (84.0)	81	1.83 (1.50–2.23)
New Orleans, LA	100 (55.2)	181	156 (94.5)	165	1.66 (1.42–1.94)
New York City, NY	125 (80.1)	156	236 (95.2)	248	1.17 (1.08–1.27)
Newark, NJ	22 (25.0)	88	48 (88.9)	54	3.73 (2.69–5.18)
Philadelphia, PA	145 (59.2)	245	163 (81.1)	201	1.36 (1.18–1.57)
San Diego, CA	139 (63.8)	218	277 (94.2)	294	1.47 (1.30–1.67)
San Francisco, CA	158 (90.8)	174	261 (97.4)	268	1.05 (1.00–1.12)
San Juan, PR	63 (27.6)	228	82 (66.7)	123	2.25 (1.75–2.89)
Seattle, WA	185 (78.4)	236	241 (96.8)	249	1.24 (1.16–1.33)
Washington, DC	199 (81.6)	244	240 (98.0)	245	1.19 (1.12–1.27)

Abbreviations: CI = confidence interval; HMO = health maintenance organization.

* Men who were at risk for HIV infection and likely to meet clinical indications for HIV preexposure prophylaxis. This was defined as men who had a negative HIV test result at the time of the interview, did not report a previous HIV-positive test result, had either one male sex partner who was HIV-positive or multiple male sex partners in the past 12 months, and reported either condomless anal sex or a sexually transmitted bacterial infection in the past 12 months.

† Models adjusted for income, health insurance, and region.

§ Includes American Indian, Alaskan Native, Asian, Native Hawaiian, Pacific Islander, or multiple races.

¶ *Midwest region* includes Chicago, IL and Detroit, MI. *Northeast region* includes Boston, MA; Nassau and Suffolk counties, NY; New York City, NY; Newark, NJ; and Philadelphia, PA. *South region* includes Atlanta, GA; Baltimore, MD; Dallas, TX; Houston, TX; Miami, FL; New Orleans, LA; and Washington, DC. *U.S. territories region* includes San Juan, PR. *West region* includes Denver, CO; Los Angeles, CA; San Diego, CA; San Francisco, CA; and Seattle, WA.

Although PrEP use by MSM in this analysis increased approximately 500% from 2014 to 2017, only approximately one in three men at risk for HIV infection reported using PrEP. Models examining the impact of PrEP use on incidence predict that the use of PrEP by 30%–40% of MSM with PrEP indications in a community could result in approximately one third of new HIV infections being averted over a 10-year period, with a greater predicted impact if coverage is increased (*6*). The reported increase in PrEP use among MSM is promising, but higher coverage is needed to reduce incidence of new infections by 90% within the 10 years of the Ending the HIV Epidemic initiative.

The overall impact and efficiency of PrEP at averting new infections is greater in communities with a high prevalence of HIV (*7*,*8*). Therefore, efforts focused on increasing PrEP use among black and Hispanic MSM, who have a higher prevalence of HIV infection (*3*), might substantially reduce the incidence of HIV infections. The large percentage increases in PrEP use among black and Hispanic MSM in this analysis are promising, but PrEP use in these groups remains low; continued efforts will be needed to meet the goals of the Ending the HIV Epidemic initiative. Because of the structural barriers associated with race that influence access to quality health care (*9*), demonstration projects for the Targeted Highly-Effective Interventions to Reverse the HIV Epidemic (THRIVE) program*** are underway in seven U.S. cities. These projects establish community

---

*** https://www.cdc.gov/hiv/research/thrive/about.html.

TABLE 2. Number and percentage of men who have sex with men who are at risk for human immunodeficiency virus (HIV) infection[*] and reported using HIV preexposure prophylaxis, by demographic characteristics — National HIV Behavioral Surveillance System, United States, 2014 and 2017

Characteristic	2014		2017		Adjusted prevalence ratio[†] (95% CI)
	No. (%)	Total	No. (%)	Total	
Overall	**216 (5.7)**	**3,821**	**1,425 (35.1)**	**4,052**	**5.66 (4.85–6.61)**
Age group (yrs)					
18–29	90 (4.6)	1,939	608 (32.3)	1,882	6.36 (5.05–8.02)
≥30	126 (6.7)	1,882	817 (37.6)	2,170	5.21 (4.30–6.32)
Racial/Ethnic group					
Black	30 (3.8)	798	222 (26.2)	846	6.44 (4.36–9.51)
Hispanic/Latino	41 (3.8)	1,081	357 (30.0)	1,191	6.92 (5.08–9.44)
White	133 (8.3)	1,607	697 (42.4)	1,645	4.83 (3.96–5.88)
Other[§]	12 (3.8)	316	137 (39.8)	344	9.53 (5.36–16.96)
Sexual identity					
Heterosexual	2 (6.5)	31	3 (15.0)	20	2.33 (0.42–12.78)
Homosexual or gay	196 (6.1)	3,222	1,273 (37.6)	3,389	5.65 (4.81–6.63)
Bisexual	18 (3.2)	555	144 (22.9)	630	6.43 (3.96–10.45)
Education					
High school degree or less	19 (2.1)	910	192 (25.6)	750	10.76 (6.69–17.33)
Some college or vocational school	55 (4.4)	1,237	390 (29.8)	1,309	6.77 (5.14–8.92)
College degree or graduate studies	142 (8.5)	1,673	842 (42.3)	1,992	4.80 (3.99–5.77)
Household income					
$0–$24,999	48 (3.7)	1,303	264 (25.9)	1,019	6.20 (4.51–8.52)
$25,000–$49,999	45 (4.4)	1,012	346 (31.5)	1,099	6.82 (5.00–9.32)
$50,000–$74,999	34 (5.3)	640	294 (36.5)	805	6.89 (4.89–9.71)
≥$75,000	88 (10.7)	819	521 (46.9)	1,110	4.29 (3.43–5.37)
Currently have health insurance					
No	23 (2.5)	906	134 (18.5)	726	6.63 (4.35–10.10)
Yes	192 (6.6)	2,906	1,290 (38.9)	3,319	5.53 (4.70–6.51)
Visited a health care provider within the past 12 months					
No	5 (0.7)	705	37 (7.1)	519	9.81 (3.87–24.85)
Yes	211 (6.8)	3,114	1,388 (39.3)	3,532	5.38 (4.60–6.28)
Usual source of health care					
No usual place for health care	18 (2.2)	834	111 (16.2)	684	7.08 (4.36–11.48)
Clinic or health care center	59 (6.1)	970	426 (37.0)	1,153	5.68 (4.36–7.38)
Doctor's office or HMO	136 (7.2)	1,881	850 (41.7)	2,039	5.34 (4.41–6.46)
Other place for health care	2 (2.2)	92	30 (22.9)	131	9.69 (2.38–39.38)

See table footnotes on next page.

collaboratives that provide comprehensive HIV prevention and care services for black and Hispanic MSM. Lessons learned from these efforts might help further inform how best to increase PrEP use among these populations.

Some health care providers might be missing opportunities to provide PrEP to patients who would benefit from its use. MSM included in this analysis reported behaviors that put them at substantial risk for HIV infection, yet only 39% of those who saw a health care provider in the past 12 months reported using PrEP. CDC's HIV PrEP clinical practice guideline offers comprehensive information to providers for prescribing and managing PrEP and recommends that health care providers take routine sexual histories of all their patients (*2*). However, some providers only take a sexual history if it is related to the patient's complaint and ask nonspecific questions about sex (*10*). To increase PrEP use, health care providers might need training and resources to ensure they know how to assess their patients for indications for PrEP and are confident discussing PrEP medication. As part of CDC's Act Against AIDS communication campaign, the Prescribe HIV Prevention program offers an online toolkit to help health care providers use PrEP to prevent new HIV infections among patients at high risk. This toolkit includes resources such as answers to frequently asked questions about PrEP medication and its related clinical care, campaign posters to help raise PrEP awareness, patient materials, a tool to aid health care providers in discussing sexual histories with their patients, and continuing medical education courses on PrEP. To fulfill their critical role in reducing new HIV infections in the United States, health care providers will need to routinely test patients for HIV, link those with HIV infection to care, and discuss HIV prevention options (e.g., condoms and PrEP) with those who are not infected.

The findings in this report are subject to at least six limitations. First, NHBS data do not correspond directly with the criteria for PrEP indication in the clinical guidelines. NHBS uses a 12-month period for assessing risk behaviors versus a 6-month period specified in the clinical guidelines. Second, this analysis used having two or

TABLE 2. (*Continued*) **Number and percentage of men who have sex with men who are at risk for human immunodeficiency virus (HIV) infection[*] and reported using HIV preexposure prophylaxis, by demographic characteristics — National HIV Behavioral Surveillance System, United States, 2014 and 2017**

Characteristic	2014 No. (%)	2014 Total	2017 No. (%)	2017 Total	Adjusted prevalence ratio[†] (95% CI)
Participated in a behavioral Intervention within the past 12 months					
No	118 (4.2)	2,842	858 (30.7)	2,797	6.64 (5.38–8.19)
Yes	98 (10.0)	979	565 (45.1)	1,253	4.03 (3.31–4.90)
Tested for HIV within the past 12 months					
No	3 (0.4)	838	19 (3.2)	602	8.33 (2.46–28.24)
Yes	213 (7.2)	2,976	1,406 (40.8)	3,444	5.26 (4.51–6.12)
Region[¶]					
Midwest	27 (7.6)	353	117 (32.7)	358	3.91 (2.35–6.52)
Northeast	46 (5.8)	793	293 (36.9)	794	5.78 (4.21–7.95)
South	69 (5.1)	1,350	409 (29.6)	1,383	5.44 (4.18–7.08)
U.S. territories	2 (0.9)	228	7 (5.7)	123	5.08 (1.19–21.74)
West	72 (6.6)	1,097	599 (43.0)	1,394	6.36 (4.87–8.30)
Urban area					
Atlanta, GA	12 (6.3)	192	56 (28.1)	199	4.29 (2.08–8.84)
Baltimore, MD	8 (5.1)	157	20 (18.5)	108	3.39 (1.53–7.55)
Boston, MA	11 (7.6)	145	105 (50.0)	210	6.33 (3.16–12.65)
Chicago, IL	23 (11.7)	197	93 (47.2)	197	3.79 (2.22–6.47)
Dallas, TX	4 (2.2)	178	63 (25.1)	251	11.12 (3.52–35.16)
Denver, CO	4 (1.9)	210	92 (31.9)	288	15.71 (5.97–41.30)
Detroit, MI	4 (2.6)	156	24 (14.9)	161	5.49 (2.05–14.66)
Houston, TX	9 (4.8)	187	60 (24.5)	245	4.66 (2.48–8.75)
Los Angeles, CA	11 (4.2)	259	109 (36.9)	295	9.13 (4.97–16.78)
Miami, FL	5 (2.4)	211	30 (17.6)	170	7.75 (3.26–18.41)
Nassau and Suffolk counties, NY	3 (1.9)	159	15 (18.5)	81	9.81 (3.03–31.79)
New Orleans, LA	5 (2.8)	181	65 (39.4)	165	12.99 (5.55–30.43)
New York City, NY	8 (5.1)	156	101 (40.7)	248	6.88 (3.61–13.10)
Newark, NJ	1 (1.1)	88	13 (24.1)	54	21.15 (2.97–150.41)
Philadelphia, PA	23 (9.4)	245	59 (29.4)	201	3.20 (2.03–5.04)
San Diego, CA	12 (5.5)	218	120 (40.8)	294	7.34 (4.11–13.13)
San Francisco, CA	26 (14.9)	174	164 (61.2)	268	3.93 (2.55–6.04)
San Juan, PR	2 (0.9)	228	7 (5.7)	123	5.08 (1.19–21.74)
Seattle, WA	19 (8.1)	236	114 (45.8)	249	5.44 (3.34–8.85)
Washington, DC	26 (10.7)	244	115 (46.9)	245	4.54 (3.08–6.70)

Abbreviations: CI = confidence interval; HMO = health maintenance organization.

[*] Men who were at risk for HIV infection and likely to meet clinical indications for HIV preexposure prophylaxis. This was defined as men who had a negative HIV test result at the time of the interview, did not report a previous HIV-positive test result, had either one male sex partner who was HIV-positive or multiple male sex partners in the past 12 months, and reported either condomless anal sex or a sexually transmitted bacterial infection in the past 12 months.

[†] Models adjusted for income, health insurance, and region.

[§] Includes American Indian, Alaskan Native, Asian, Native Hawaiian, Pacific Islander, or multiple races.

[¶] *Midwest region* includes Chicago, IL and Detroit, MI. *Northeast region* includes Boston, MA; Nassau and Suffolk counties, NY; New York City, NY; Newark, NJ; and Philadelphia, PA. *South region* includes Atlanta, GA; Baltimore, MD; Dallas, TX; Houston, TX; Miami, FL; New Orleans, LA; and Washington, DC. *U.S. territories region* includes San Juan, PR. *West region* includes Denver, CO; Los Angeles, CA; San Diego, CA; San Francisco, CA; and Seattle, WA.

more sex partners in the past year as a proxy for a nonmonogamous relationship, but these partnerships might not have overlapped in time. Thus, the analysis might include some men without indications for PrEP use. Their inclusion in the denominator might underestimate the percentage of men in NHBS using PrEP. Third, different questions were used to assess PrEP awareness and use in 2014 and 2017. The measure of PrEP use in 2017 was more specific than that in 2014, so estimates of PrEP use increases are potentially underestimated. Fourth, NHBS is not nationally representative and might not be generalizable to all cities, nonurban areas, or MSM. Fifth, because data were not weighted to account for the complex sampling methods used to recruit MSM, estimates might be biased by over- or underestimating subgroups of the population. Finally, data on self-reported behaviors might be subject to recall and social desirability biases. Although the impact of recall bias on the analysis is unknown, social desirability bias might lead to overreporting PrEP awareness and use.

HIV PrEP awareness and use is increasing in the United States among MSM who are at risk for acquiring HIV, but higher coverage is needed, especially among black and Hispanic MSM, to end the HIV epidemic in the United States by 2030. By routinely testing their patients for HIV, assessing HIV-negative patients for risk behaviors, and prescribing PrEP as needed, health care providers can play a critical role in this effort.

Summary

What is already known about this topic?

Men who have sex with men (MSM) can reduce their risk for human immunodeficiency virus (HIV) infection by using preexposure prophylaxis (PrEP) consistently. Increasing PrEP use is a principal strategy of the Ending the HIV Epidemic initiative.

What is added by this report?

From 2014 to 2017, PrEP awareness among MSM in 20 urban areas increased from 60% to 90%, and PrEP use increased from 6% to 35%. PrEP use increased in almost all demographic subgroups but remains lower among black and Hispanic MSM.

What are the implications for public health practice?

By routinely testing patients for HIV, assessing HIV-negative patients for risk behaviors, and prescribing PrEP as needed, health care providers can play a critical role in ending the HIV epidemic.

Acknowledgments

National HIV Behavioral Surveillance participants; CDC National HIV Behavioral Surveillance Team.

National HIV Behavioral Surveillance Study Group

Meaghan Abrego, Nassau and Suffolk counties, New York; Alia Al-Tayyib, Denver, Colorado; Bridget Anderson, Nassau and Suffolk counties, New York; Narquis Barak, New Orleans, Louisiana; Lissa Bayang, San Diego, California; Jeremy M. Beckford, New Orleans, Louisiana; Nanette Benbow, Chicago, Illinois; Barbara Bolden, Newark, New Jersey; Kathleen A. Brady, Philadelphia, Pennsylvania; Mary-Grace Brandt, Detroit, Michigan; Sarah Braunstein, New York City, New York; Richard Burt, Seattle, Washington; Rosalinda Cano, San Diego, California; Sidney Carrillo, New York City, New York; Jie Deng, Dallas, Texas; Rose Doherty, Boston, Massachusetts; Anna Flynn, San Diego, California; Colin Flynn, Baltimore, Maryland; David Forrest, Miami, Florida; Dawn Fukuda, Boston, Massachusetts; Danielle German, Baltimore, Maryland; Sara Glick, Seattle, Washington; Henry Godette, Newark, New Jersey; Vivian Griffin, Detroit, Michigan; Emily Higgins, Detroit, Michigan; Theresa Ick, San Francisco, California; Tom Jaenicke, Seattle, Washington; Antonio D. Jimenez, Chicago, Illinois; Salma Khuwaja, Houston, Texas; Monina Klevens, Boston, Massachusetts; Irene Kuo, Washington, D.C; Marlene LaLota, Miami, Florida; Zaida Lopez, Houston, Texas; Yingbo Ma, Los Angeles, California; Kathryn Macomber, Detroit, Michigan; Stephanie Masiello Schuette, Chicago, Illinois; Melanie Mattson, Denver, Colorado; David Melton, Atlanta, Georgia; Sandra Miranda De León, San Juan, Puerto Rico; Alan Neaigus, New York City, New York; Willie Nixon, Miami, Florida; Chrysanthus Nnumolu, Philadelphia, Pennsylvania; Alicia Novoa, Dallas, Texas; Conall O'Cleirigh, Boston, Massachusetts; Jenevieve Opoku, Washington, D.C; Paige Padgett, Houston, Texas; Jonathon Poe, Dallas, Texas; Nikhil Prachand, Chicago, Illinois; H. Fisher Raymond, San Francisco, California; Hafeez Rehman, Houston, Texas; Kathleen H. Reilly, New York City, New York; Alexis Rivera, New York City, New York; William T. Robinson, New Orleans, Louisiana; Yadira Rolón-Colón; San Juan, Puerto Rico; Kimi Sato, Atlanta, Georgia; John-Mark Schacht, Miami, Florida; Ekow Kwa Sey, Los Angeles, California; Shane Sheu, Dallas, Texas; Jennifer Shinefeld, Philadelphia, Pennsylvania; Mark Shpaner, Philadelphia, Pennsylvania; Amber Sinclair, Nassau and Suffolk counties, New York; Lou Smith, Nassau and Suffolk counties, New York; Emma Spencer, Miami, Florida; Ashley Tate, Nassau and Suffolk counties, New York; Hanne Thiede, Seattle, Washington; Jeff Todd, Atlanta, Georgia; Veronica Tovar-Moore, San Diego, California; Margaret Vaaler, Dallas, Texas; Chris Wittke, Boston, Massachusetts; Afework Wogayehu, Newark, New Jersey; Pascale Wortley, Atlanta, Georgia; Meagan C. Zarwell, New Orleans, Louisiana.

Corresponding author: Teresa Finlayson, TFinlayson@cdc.gov, 404-639-2083.

---

[1]Division of HIV/AIDS Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; [2]ICF International, Fairfax, Virginia; [3]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Fauci AS, Redfield RR, Sigounas G, Weahkee MD, Giroir BP. Ending the HIV epidemic: a plan for the United States. JAMA 2019;321:844–5. https://doi.org/10.1001/jama.2019.1343
2. CDC. Preexposure prophylaxis for the prevention of HIV infection in the United States—2017 update: a clinical practice guideline. Atlanta, GA: US Public Health Service, CDC; 2018. https://www.cdc.gov/hiv/pdf/risk/prep/cdc-hiv-prep-guidelines-2017.pdf
3. CDC. Estimated HIV incidence and prevalence in the United States, 2010–2016. HIV surveillance supplemental report. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-supplemental-report-vol-24-1.pdf
4. CDC. HIV infection risk, prevention, and testing behaviors among men who have sex with men—National HIV Behavioral Surveillance, 23 U.S. cities, 2017. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-special-report-number-22.pdf
5. Office of National AIDS Policy. National HIV/AIDS strategy for the United States: updated to 2020. Washington, DC: Office of National AIDS Policy; 2015. https://files.hiv.gov/s3fs-public/nhas-update.pdf
6. Jenness SM, Goodreau SM, Rosenberg E, et al. Impact of the Centers for Disease Control's HIV preexposure prophylaxis guidelines for men who have sex with men in the United States. J Infect Dis 2016;214:1800–7. https://doi.org/10.1093/infdis/jiw223
7. Jenness SM, Maloney KM, Smith DK, et al. Addressing gaps in HIV preexposure prophylaxis care to reduce racial disparities in HIV incidence in the United States. Am J Epidemiol 2018;188:743–52.
8. Grulich AE, Guy R, Amin J, et al.; Expanded PrEP Implementation in Communities New South Wales (EPIC-NSW) Research Group. Population-level effectiveness of rapid, targeted, high-coverage roll-out of HIV pre-exposure prophylaxis in men who have sex with men: the EPIC-NSW prospective cohort study. Lancet HIV 2018;5:e629–37. https://doi.org/10.1016/S2352-3018(18)30215-7
9. Millett GA, Peterson JL, Flores SA, et al. Comparisons of disparities and risks of HIV infection in black and other men who have sex with men in Canada, UK, and USA: a meta-analysis. Lancet 2012;380:341–8. https://doi.org/10.1016/S0140-6736(12)60899-X
10. Wimberly YH, Hogben M, Moore-Ruffin J, Moore SE, Fry-Johnson Y. Sexual history-taking among primary care physicians. J Natl Med Assoc 2006;98:1924–29.

Workplace Secondhand Tobacco Smoke Exposure Among U.S. Nonsmoking Workers, 2015

Chia-ping Su, MD[1,2]; Girija Syamlal, MBBS[3]; Sara Tamers, PhD[4]; Jia Li, MS[2]; Sara E. Luckhaupt, MD[2]

Secondhand tobacco smoke (SHS) exposure contributes to ill health and disease, including heart disease, lung cancer, and stroke (*1*). Although cigarette smoking has declined among U.S. workers, workplace exposure to SHS remains high, particularly among workers in certain industries, such as construction (*2*,*3*). Implementation of smoke-free laws has proven to be beneficial in reducing SHS exposure in general (*1*). CDC analyzed data from the 2015 National Health Interview Survey (NHIS) Occupational Health Supplement to assess the prevalence of self-reported workplace SHS exposure among nonsmoking workers by smoke-free policy status in the workers' states of residence and in detailed industry categories and subcategories. In 2015, 19.9% of nonsmoking workers reported any exposure to SHS at work during the 12 months preceding the interview, and 10.1% reported frequent exposure (twice a week or more). Nonsmoking workers who resided in states with comprehensive smoke-free laws in all three categories of venues (private worksites, bars, and restaurants) were least likely to report frequent exposure to workplace SHS. Nonsmoking workers employed in the commercial and industrial machinery and equipment repair and maintenance industry reported the highest prevalences of any workplace SHS exposure (65.1%), whereas the construction industry had the highest reported number of exposed workers (2.9 million); these industry categories/subcategories include outdoor workplaces and other settings that are unlikely to be protected by smoke-free laws. Identifying specific at-risk workplaces and implementing targeted intervention strategies could help reduce SHS exposure at work and protect workers' health.

NHIS is conducted annually by CDC to produce nationally representative information on the health of the U.S. civilian, noninstitutionalized population, using a multistage clustered sample design. In 2015, CDC's National Institute for Occupational Safety and Health (NIOSH) sponsored an Occupational Health Supplement to NHIS to collect information on the prevalence of several work-related conditions and exposures in the U.S. working population, including workplace SHS exposure. For this analysis, CDC included adults aged ≥18 years who were employed* during the week before the interview. Assessment of workplace SHS exposure was based on responses to the question "During the past 12 months, while at work, how often were you exposed to tobacco smoke from other people?" The response options were "never"; "less than twice a week"; "twice a week or more, but not every day"; and "every day." "Any exposure" to SHS was defined as any response other than never. "Frequent exposure" to SHS was defined as twice a week or more. Regarding state smoke-free policies, this report focuses on smoking restrictions in three categories of venues: private worksites, restaurants, and bars, because these venues are major sources of SHS exposure for nonsmoking workers (*4*). The workers' states of residence were classified, according to the 2015 smoke-free law status in the three categories of venues, into four categories: 1) no law or noncomprehensive law (e.g., law allowing smoking in designated areas or areas with separate ventilation); 2) 100% smoke-free in one venue category; 3) 100% smoke-free in two venue categories; and 4) 100% smoke-free in all three venue categories (comprehensive). These data were obtained from CDC's State Tobacco Activities Tracking and Evaluation System database.†

Free text responses regarding workers' current industry were coded to U.S. Census 4-digit industry codes by trained coders and recoded into 78 detailed industry recode categories. Exposure prevalence and 95% confidence intervals were calculated for workers in all industry recode categories and for U.S. Census industry codes that were within recode categories with high reported prevalence of SHS exposure (i.e., subcategories) that had adequate sample sizes. The number of exposed workers in each category was calculated by multiplying the prevalence by the weighted estimated population size. All analyses were weighted to be representative of U.S. civilian noninstitutionalized adults. Two-tailed tests of significance ($\alpha = 0.05$) were performed to compare the percentages of nonsmoking workers in different groups of states or industry categories reporting SHS exposure. For the industry comparisons, the simple recode category "Information Industries," which had an exposure prevalence similar to that among all workers, was used as the reference group to identify groups with significantly high prevalences. Most variables used for this study are included in the 2015 public-use data sets, but state of residence and U.S. Census 4-digit industry codes are restricted. The restricted variables were accessed through CDC's National Center for

---

* Employed workers were those who were working for pay at a job or business, had a job or business but were not working (i.e., on leave), or were working without pay at a family-owned business. Respondents who were employed in military-specific industries or occupations or with missing industry/occupation information were excluded from the study population.

† https://www.cdc.gov/statesystem.

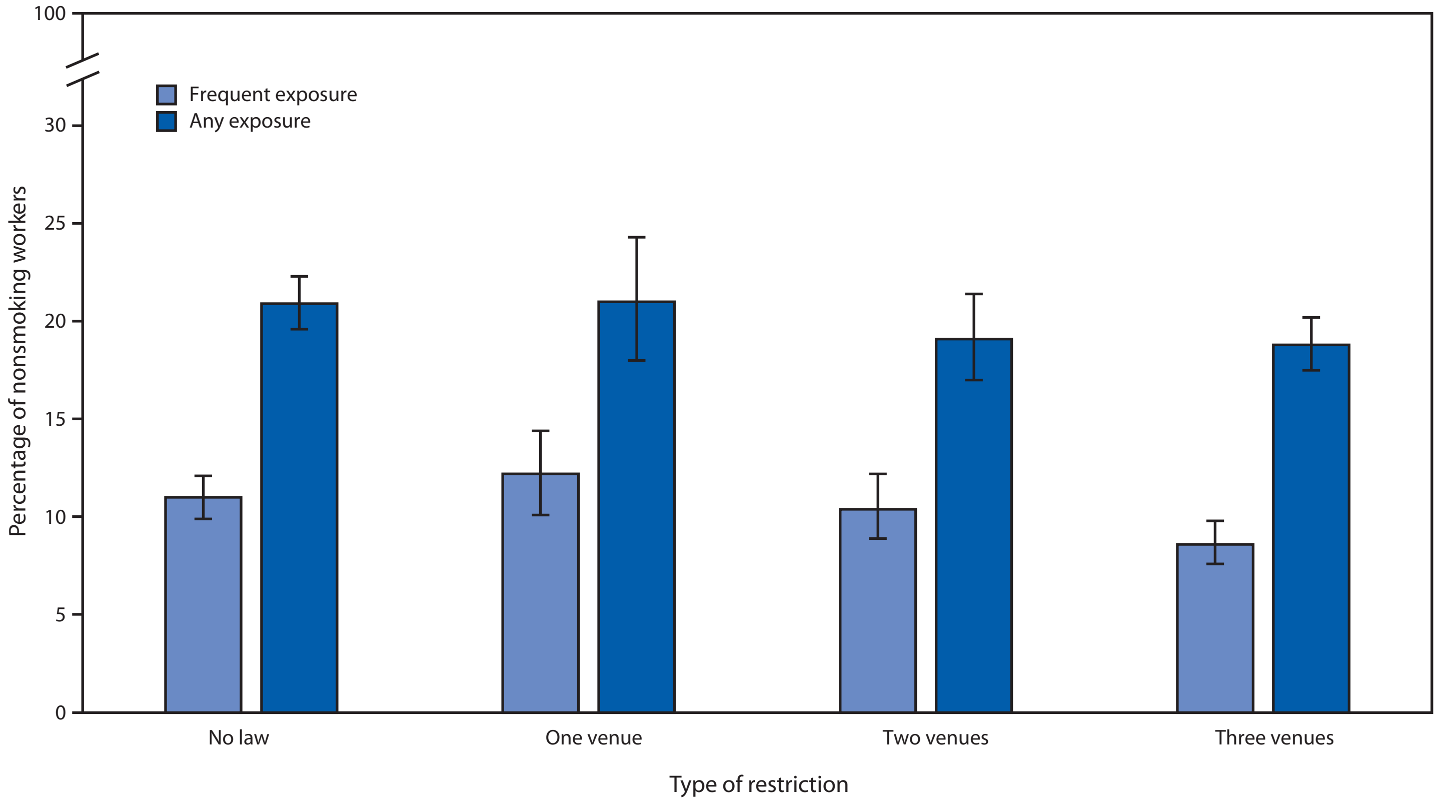
Health Statistics Research Data Center after the study proposal was approved by the Research Data Center. Data analyses were conducted using SAS-Callable SUDAAN (release 11.0.1; RTI International) within SAS (version 9.3; SAS Institute) to account for the complex sample.

In 2015, 19.9% of nonsmoking workers reported any exposure to workplace SHS during the 12 months before the interview; 10.1% reported frequent exposure. Across all industries, workers who resided in states with comprehensive smoke-free laws in all three categories of venues (private worksites, restaurants, and bars) reported significantly lower prevalences of frequent exposure to workplace SHS (8.6%) than did those residing in states with smoking restriction laws in one category of venue (12.2%) or no smoking restriction laws (11.0%) (Figure). None of the differences in any SHS exposure among workers in state smoking restriction categories was significant. Across all states, self-reported workplace SHS exposure varied by detailed industry categories and subcategories, with several industry groups reporting prevalences of exposure higher than that of the reference industry group (Table). Workers in the commercial and industrial machinery and equipment subcategory within the repair and maintenance industries category had the highest reported prevalence of any workplace SHS exposure (65.1%), followed by workers in the other transportation subcategory, which includes air, rail, pipeline, and scenic and sightseeing transportation (55.8%). The construction industry category had the highest number of nonsmoking workers reporting any SHS exposure (2.9 million).

Discussion

Nonsmoking workers residing in states with comprehensive smoke-free laws reported significantly lower prevalences of frequent exposure to workplace SHS. Moreover, SHS exposure among nonsmoking workers also significantly varied by

FIGURE. Percentage* of nonsmoking workers reporting any and frequent† workplace exposure to secondhand smoke, by type of restriction§,¶ of smoke-free indoor air legislation in state of residence — United States, 2015



* With 95% confidence intervals indicated with error bars.

† ≥2 times per week.

§ Type of restriction: *No law* = no law or noncomprehensive law (e.g., law allowing smoking in designated areas or areas with separate ventilation) (Alabama, Alaska, California, Connecticut, Georgia, Kentucky, Mississippi, Missouri, Oklahoma, South Carolina, Texas, and Virginia); *One venue* = 100% smoke-free in one venue category (Arkansas, Idaho, New Hampshire, Pennsylvania, and Tennessee); *Two venues* = 100% smoke-free in two venue categories (Florida, Indiana, Louisiana, Nevada, and North Carolina); *Three venues* = 100% smoke-free in three venue categories (Arizona, Colorado, Delaware, District of Columbia, Hawaii, Illinois, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Rhode Island, South Dakota, Utah, Vermont, Washington, and Wisconsin).

¶ Venue categories include private worksites, restaurants, and bars.

TABLE. Percentage of nonsmoking persons exposed to secondhand smoke at work, by industry categories and subcategories* with high prevalence† of any exposure and frequent§ exposure to secondhand smoke — United States, 2015

Industry category/Subcategory	Estimated population size (x 1,000)	% Exposed (95% CI) Any exposure	% Exposed (95% CI) Frequent exposure
Repair and maintenance	1,785	45.2 (36.2–54.5)	28.8 (21.5–37.4)
Commercial and industrial machinery and equipment repair and maintenance	279	65.1 (45.1–81.8)	38.4 (20.6–59.9)
Automotive repair and maintenance	1,105	47.3 (35.0–59.9)	29.6 (20.6–40.4)
Transportation	3,067	38.8 (33.0–44.8)	25.5 (20.1–31.9)
Other transportation¶	218	55.8 (30.2–79.3)	44.5 (21.7–69.8)
Services incidental to transportation	219	43.9 (30.3–58.2)	NS
Taxi and limousine service	232	43.6 (22.8–66.2)	NS
Truck transportation	1,272	41.4 (31.1–52.3)	29.1 (20.1–40.2)
Forestry and logging	88	52.9 (24.5–79.5)	NS
Beverage and tobacco product manufacturing	169	48.7 (26.6–71.3)	NS
Museums, historical sites, and similar institutions	290	47.6 (26.5–69.7)	NS
Construction	6,959	41.9 (37.9–46.1)	22.3 (18.9–26.1)
Accommodation	1,348	36.6 (27.1–47.2)	28.2 (19.6–38.8)
Performing arts, spectator sports, and related	760	36.5 (24.9–49.9)	NS
Motor vehicle and parts dealers	1,254	35.6 (25.2–47.6)	NS
Information (reference group)	2,995	20.4 (15.2–27.0)	10.3 (6.7–15.5)

Abbreviations: CI = confidence interval; NS = not significantly different from reference group.

* Not all subcategories within each category are shown.

† The estimates of prevalence in all categories/subcategories shown were significantly higher than that of the reference group (p<0.05).

§ ≥2 times per week.

¶ Includes air, rail, pipeline, and scenic and sightseeing transportation.

industry. During 2013–2014, one in four U.S. nonsmokers reported exposure to SHS (*5*), and an estimated 41,000 deaths among nonsmoking adults were associated with SHS exposure (*1*). Furthermore, workplace SHS exposure has been recognized as one of the top occupational hazards that contributes substantially to the prevalence of occupational cancer among nonsmokers (*6*). During 2000–2015, the number of states with smoke-free laws that prohibited smoking in indoor areas of worksites, restaurants, and bars increased from none to 27 (*4*). In this report, workers residing in states with smoke-free laws in all three venue categories were least likely to report frequent exposure to workplace SHS. Previous studies have revealed that the absence of a policy restricting or prohibiting smoking at the worksite put workers at higher risk for workplace SHS exposure (*7*). Despite the considerable progress in implementation of smoke-free laws over the past 2 decades, this analysis found that even in states with smoke-free laws in three categories of venues, 8.6% of nonsmoking workers reported frequent workplace SHS exposure. This finding suggests that certain workplaces might be outside the scope of most smoke-free laws.

Based on NHIS data for 2014–2016, 34.3% of workers in the construction, 30.4% of workers in the mining, and 30.2% of workers in the transportation industries used some form of tobacco (*8*). Higher smoking prevalences among workers employed in these industries might lead to exposure of their nonsmoking coworkers to SHS. Previous findings of higher tobacco use and SHS exposure among workers in the construction industry are consistent with current findings (*3*,*8*). The industry subcategories with the highest prevalences of reported SHS exposure in this study and the industry category with the highest number of exposed workers (construction) include outdoor workplaces and other settings that are unlikely to be protected by smoke-free laws. A recent study determined that indoor workers who reported working at a worksite having a 100% smoke-free policy had significantly lower odds of smoking combustible tobacco than did those reporting a partial or no smoke-free policy (*9*). Enhanced and sustained efforts to protect nonsmoking workers through comprehensive smoke-free laws and implementation of smoke-free workplace policies by employers can benefit public health.

The findings in this report are subject to at least five limitations. First, all information in NHIS, including work characteristics and SHS exposure, was self-reported at the time of interview and might be subject to reporting bias. Second, although NHIS records state of residence, some workers might work outside the states in which they reside or in multiple states where smoke-free laws might differ. Third, estimates for SHS exposure for some groups were unreliable because of small sample sizes and were therefore suppressed. Small sample sizes within individual industry groups also precluded analyses that combined the state and industry variables. Fourth, the study only accounted for statewide smoke-free policies, and considerable progress has been made in implementing local

Summary

What is already known about this topic?

Secondhand tobacco smoke (SHS) exposure contributes to diseases including heart disease, lung cancer, and stroke. Implementation of smoke-free laws has reduced SHS exposure.

What is added by this report?

Nonsmoking workers residing in states without comprehensive smoke-free laws and workers employed in certain industries were more likely to be frequently exposed to workplace SHS. Industry subcategories with the highest prevalences of SHS exposure, and the industry category with the highest number of exposed workers (construction), include outdoor workplaces and other settings unlikely to be protected by smoke-free laws.

What are the implications for public health practice?

Implementation of workplace smoke-free policies can help reduce SHS exposure among workers and protect workers' health.

level smoke-free policies in many states;[§] therefore, workers classified as being unprotected by statewide laws might have been protected by local level laws. Finally, variable distribution of industries by state might have led to some confounding.

Workplace SHS exposure is harmful for workers' health. In this study, nonsmoking workers residing in states without comprehensive smoke-free laws and those employed in certain industries were more likely to be frequently exposed to workplace SHS. NIOSH encourages employers, especially those in industries with high prevalences of SHS exposure, to implement workplace-specific smoke-free policies to complement state and local smoke-free laws to help reduce SHS exposure among workers and protect workers' health (*10*).

[§] https://www.cdc.gov/mmwr/volumes/65/wr/mm6524a4.htm.

Acknowledgment

Negasi Beyene, Research Data Center, National Center for Health Statistics, CDC.

Corresponding author: Sara E. Luckhaupt, SLuckhaupt@cdc.gov, 513-841-4123.

---

[1]Epidemic Intelligence Service, CDC; [2]Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, CDC; [3]Respiratory Health Division, National Institute for Occupational Safety and Health, CDC; [4]Division of Science Integration, National Institute for Occupational Safety and Health, CDC.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. US Department of Health and Human Services. The health consequences of smoking—50 years of progress. A report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. https://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.htm
2. Dai H, Hao J. The prevalence of exposure to workplace secondhand smoke in the United States: 2010 to 2015. Nicotine Tob Res 2017;19:1300–7.
3. Syamlal G, King BA, Mazurek JM. Tobacco product use among workers in the construction industry, United States, 2014–2016. Am J Ind Med 2018;61:939–51. https://doi.org/10.1002/ajim.22907
4. Tynan MA, Holmes CB, Promoff G, Hallett C, Hopkins M, Frick B. State and local comprehensive smoke-free laws for worksites, restaurants, and bars—United States, 2015. MMWR Morb Mortal Wkly Rep 2016;65:623–6. https://doi.org/10.15585/mmwr.mm6524a4
5. Tsai J, Homa DM, Gentzke AS, et al. Exposure to secondhand smoke among nonsmokers—United States, 1988–2014. MMWR Morb Mortal Wkly Rep 2018;67:1342–6. https://doi.org/10.15585/mmwr.mm6748a3
6. Hutchings SJ, Rushton L; British Occupational Cancer Burden Study Group. Occupational cancer in Britain. Industry sector results. Br J Cancer 2012;107(Suppl 1):S92–103. https://doi.org/10.1038/bjc.2012.123
7. Hammond SK, Sorensen G, Youngstrom R, Ockene JK. Occupational exposure to environmental tobacco smoke. JAMA 1995;274:956–60. https://doi.org/10.1001/jama.1995.03530120048040
8. Syamlal G, King BA, Mazurek JM. Tobacco use among working adults—United States, 2014–2016. MMWR Morb Mortal Wkly Rep 2017;66:1130–5. https://doi.org/10.15585/mmwr.mm6642a2
9. Syamlal G, King BA, Mazurek JM. Workplace smoke-free policies and cessation programs among U.S. working adults. Am J Prev Med 2019;56:548–62. https://doi.org/10.1016/j.amepre.2018.10.030
10. Castellan RM, Chosewood LC, Trout D, et al. Current intelligence bulletin 67: promoting health and preventing disease and injury through workplace tobacco policies. Morgantown, WV: US Department of Health and Human Services, CDC, National Institute for Occupational Safety and Health; 2015. https://www.cdc.gov/niosh/docs/2015-113/pdfs/FY15_CIB-67_2015-113_v3.pdf?id=10.26616/NIOSHPUB2015113

Please note: An erratum has been published for this issue. To view the erratum, please click here.

Vital Signs: Surveillance for Acute Flaccid Myelitis — United States, 2018

Adriana Lopez, MHS[1]; Adria Lee, MPH[1]; Angela Guo, MPH[1]; Jennifer L. Konopka-Anstadt, PhD[1]; Amie Nisler, MPH[1]; Shannon L. Rogers, MS[1]; Brian Emery[1]; W. Allan Nix[1]; Steven Oberste, PhD[1]; Janell Routh, MD[1]; Manisha Patel, MD[1]

On July 9, 2019, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Abstract

Background: Acute flaccid myelitis (AFM), a serious paralytic illness, was first recognized as a distinct condition in 2014, when cases were reported concurrent with a large U.S. outbreak of severe respiratory illness caused by enterovirus D-68 (EV-D68). Since 2014, nationwide outbreaks of AFM have occurred every 2 years in the United States; the cause for the recent change in the epidemiology of AFM in the United States, including the occurrence of outbreaks and a biennial periodicity since 2014, is under investigation. This report updates clinical, laboratory, and outcome data for cases reported to CDC during 2018.

Methods: Clinical data and specimens from persons in the United States who met the clinical criterion for AFM (acute onset of flaccid limb weakness) with onset in 2018 were submitted to CDC for classification of the illnesses as confirmed, probable, or non-AFM cases. Enterovirus/rhinovirus (EV/RV) testing was performed on available specimens from persons meeting the clinical criterion. Descriptive analyses, laboratory results, and indicators of early recognition and reporting are summarized.

Results: From January through December 2018, among 374 reported cases of AFM, 233 (62%) (from 41 states) were classified as confirmed, 26 (7%) as probable, and 115 (31%) as non-AFM cases. Median ages of patients with confirmed, probable, and non-AFM cases were 5.3, 2.9, and 8.8 years, respectively. Laboratory testing identified multiple EV/RV types, primarily in respiratory and stool specimens, in 44% of confirmed cases. Among confirmed cases, the interval from onset of limb weakness until specimen collection ranged from 2 to 7 days, depending on specimen type. Interval from onset of limb weakness until reporting to CDC during 2018 ranged from 18 to 36 days, with confirmed and probable cases reported earlier than non-AFM cases.

Conclusion: Identification of risk factors leading to outbreaks of AFM remains a public health priority. Prompt recognition of signs and symptoms, early specimen collection, and complete and rapid reporting will expedite public health investigations and research studies to elucidate the recent epidemiology of AFM and subsequently inform treatment and prevention recommendations.

Introduction

Acute flaccid myelitis (AFM) was initially defined as a distinct entity in 2014 following reports of the occurrence of acute limb weakness in previously healthy children across the United States during an outbreak of severe respiratory disease caused by enterovirus D-68 (EV-D68) (*1*,*2*). AFM is a rare but serious illness for which there are no known treatments or means of prevention. It is a recognized complication of infections caused by West Nile Virus, adenovirus, and enteroviruses (*3*,*4*); however, the more recent epidemiology of AFM, including the occurrence of outbreaks, its biennial periodicity since 2014, and the clustering of cases during the late summer and fall, has not been previously observed.

Neuroinvasive enteroviruses have been identified as causes of sporadic cases of AFM, including EV-D68 and EV-A71 (*5*–*8*). Extensive testing of AFM cases confirmed as part of national surveillance has detected multiple enteroviruses from sterile sites (i.e., cerebrospinal fluid [CSF] and serum) and nonsterile specimens (i.e., respiratory specimens and stool). Lack of a clear explanation for the emergence, in addition to the overall rarity of this condition, pose substantial challenges for identifying optimal treatment and prevention measures. Increased awareness of AFM by clinicians and timely reporting of persons with symptoms consistent with AFM to public health authorities are essential to identifying cases, improving patient management, and initiating public health investigations to further understand this condition.

This report summarizes and updates surveillance data for suspected cases of AFM reported to CDC (*9*), with onset of

Summary

What is already known about this topic?

Biennial U.S. outbreaks of acute flaccid myelitis (AFM) have been recognized since 2014. Most cases occur in children during late summer and early fall.

What is added by this report?

During 2018, 233 confirmed AFM cases were reported, the largest number since surveillance began in 2014. Upper limb involvement only was more prevalent in confirmed cases (42%), as was report of respiratory symptoms or fever (92%) within 4 weeks preceding limb weakness onset. Median intervals from onset of limb weakness to hospitalization, magnetic resonance imaging, and reporting to CDC were 1, 2, and 18 days, respectively.

What are the implications for public health practice?

Prompt recognition, early specimen collection, and rapid reporting will expedite public health investigations and help characterize AFM.

flaccid limb weakness from January 1 through December 31, 2018. Data from 2018 were also compared with the previous peak of AFM in 2016 to identify opportunities to improve recognition and reporting.

Methods

Health departments submitted reports of patients meeting the clinical criterion for AFM (acute onset of flaccid limb weakness) to CDC for case classification. For public health surveillance purposes, a confirmed case of AFM was defined as acute flaccid limb weakness in a person with magnetic resonance imaging (MRI) evidence of a spinal cord lesion largely restricted to gray matter and spanning ≥1 spinal segments. Patients with probable AFM met the clinical criterion and had CSF pleocytosis (>5 white blood cells per cubic mm) (*10*). Patients without documented flaccid limb weakness, with MRI findings that were inconsistent with AFM, or who had alternative diagnoses (e.g., transverse myelitis, acute disseminated encephalomyelitis, Guillain-Barré syndrome, other myelopathy, or spinal stroke) were classified as non-AFM cases.

Health departments and clinicians submitted CSF, respiratory, serum, and/or stool specimens, when available, from patients with suspected AFM to CDC for testing (https://www.cdc.gov/acute-flaccid-myelitis/hcp/instructions.html). In accordance with current clinical, laboratory, and epidemiologic evidence, CDC laboratory protocols included testing of these specimens for enteroviruses, rhinoviruses, and parechoviruses. All specimens were tested for EV/RV using a 5’ nontranslated region qualitative real-time reverse transcription–polymerase chain reaction (real-time RT-PCR) pan-enterovirus assay (*11*) and a pan-enterovirus typing assay by viral protein 1 RT–semi-nested PCR and Sanger sequencing of the resultant amplicon (*12*). All specimens were also tested for parechoviruses using a pan-parechovirus real-time RT-PCR assay (*13*). Stool specimens were tested for poliovirus by virus isolation in cell culture as part of national poliovirus surveillance. A subset of 31 specimens was also tested at CDC for arboviruses. Results from non-CDC laboratories are not included in this update.

Descriptive analyses of confirmed, probable, and non-AFM cases in patients with onset of limb weakness in 2018 were performed using SAS (version 9.4; SAS Institute). To ascertain early recognition of AFM by clinicians, the number of days from onset of limb weakness to hospitalization and receipt of MRI were compiled. Data from cases confirmed in 2016 and 2018 were compared to evaluate time to hospitalization, collection of specimens, and reporting to CDC. Categorical variables were compared using Chi-squared tests, and medians were compared using the Wilcoxon rank sum test. P-values of <0.05 were considered statistically significant.

Results

Since surveillance for AFM began following the 2014 outbreak, nationwide outbreaks have occurred in 2016 and 2018 (Figure 1). From January 1 through December 31, 2018, a total of 374 persons meeting the clinical criterion for AFM were reported to CDC; 233 (62%), from 41 states, were classified as confirmed, 26 (7%) as probable, and 115 (31%) as non-AFM cases (Figure 2). The median age of patients with confirmed AFM, 5.3 years (range = 6 months–81.8 years), was significantly older than that of patients with probable AFM (2.9 years [range = 4 months–55.3 years]; p = 0.04). Patients with illnesses classified as non-AFM were significantly older than were patients with confirmed AFM (median = 8.6 years [range = 1 month–78.1 years]; p<0.001) (Table 1). Sex and race did not differ among patients with confirmed AFM, probable AFM, and non-AFM. Involvement of upper limbs only was significantly more prevalent in patients with confirmed AFM (42%) than in those with non-AFM (10%) (p<0.001). Patients with confirmed and probable AFM more frequently had respiratory symptoms (e.g., cough, rhinorrhea, and congestion) or fever (e.g., temperature ≥100.4°F) (92%) within the 4 weeks preceding limb weakness onset than did patients with non-AFM (62%; p<0.001). Among all patients with confirmed, probable, and non-AFM, 227 (98%), 26 (100%), and 113(98%), respectively, were hospitalized, including 127 (60%), 12 (57%), and 54 (50%), respectively, admitted to an intensive care unit; 27% (62) of those with confirmed AFM required respiratory support, 87% of whom (53/61) required mechanical ventilation. No deaths were reported during the acute illness of patients with confirmed AFM who had limb weakness onset in 2018; however, there were two reports of patients confirmed with AFM in 2018 who had died months after limb weakness onset.

FIGURE 1. Confirmed cases of acute flaccid myelitis reported to CDC (N = 559) — United States, August 1, 2014–December 31, 2018

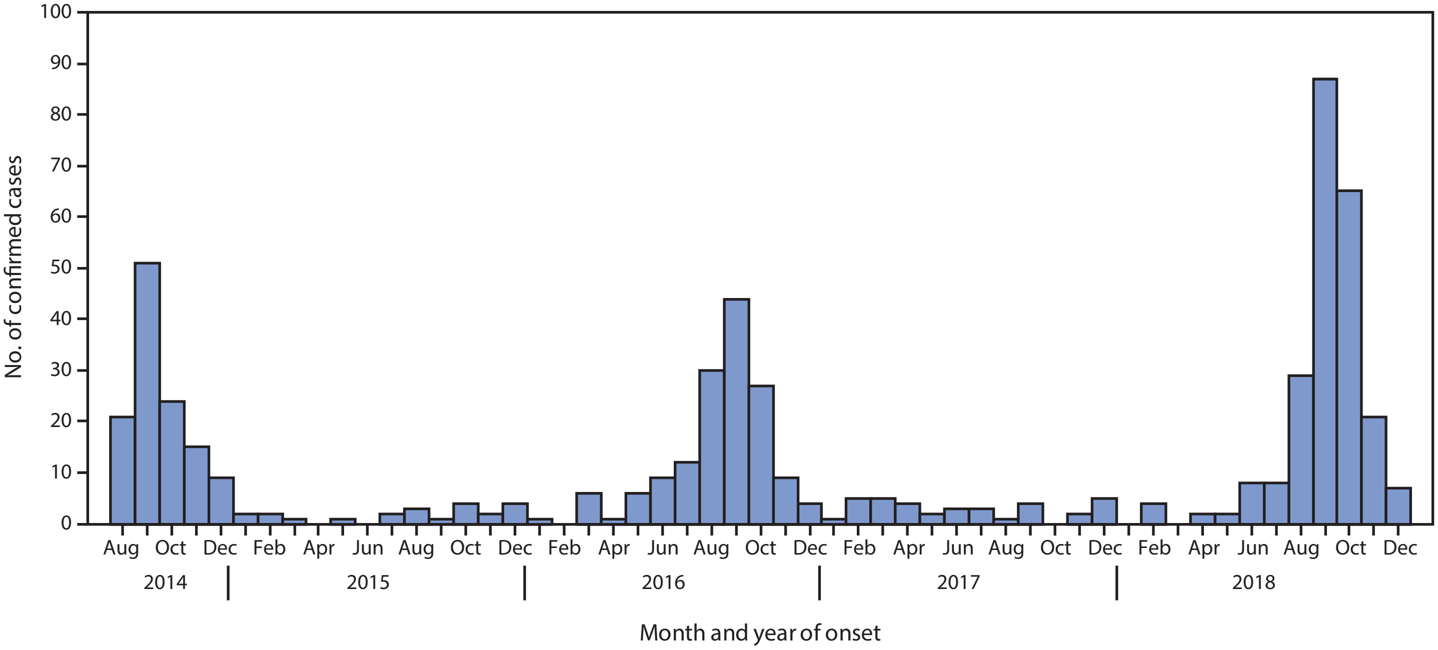
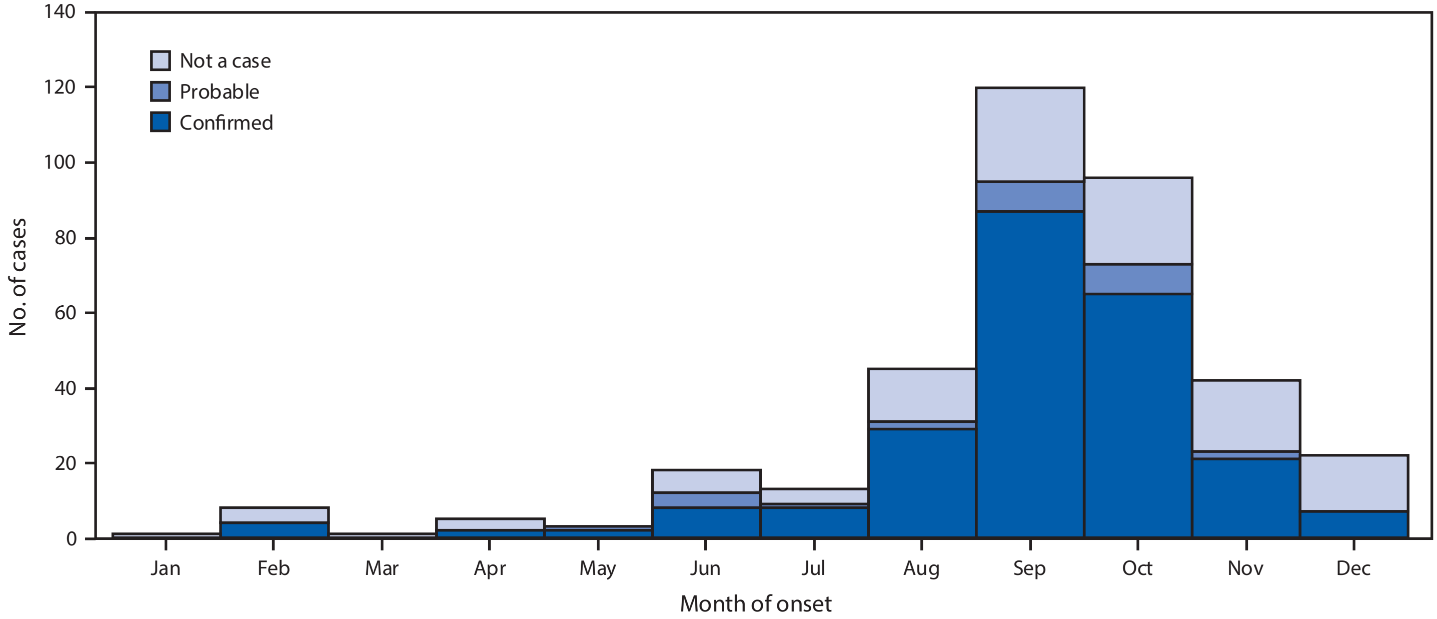


FIGURE 2. Cases of acute flaccid myelitis reported to CDC, by case classification status — United States, 2018



Among patients with confirmed AFM, the interval between limb weakness onset to hospitalization (1 day) and to MRI (2 days) suggests early recognition by clinicians. Among patients with probable AFM, the interval from onset of limb weakness to hospitalization (3 days) and MRI (4 days) was significantly longer than that among those with confirmed AFM. Compared with patients with confirmed AFM, the interval from onset of limb weakness to hospitalization among patients with non-AFM (1 day) was similar, but the interval to MRI (3 days) was significantly longer (p = 0.002). Among patients with confirmed AFM, the median interval from onset of limb weakness to specimen collection ranged from 2–7 days, depending on specimen type. The median interval from onset of limb weakness until reporting to CDC ranged from 18–36 days, with confirmed and probable cases reported earlier than non-AFM cases (Table 1).

TABLE 1. Demographic and clinical characteristics of patients with confirmed and probable cases of acute flaccid myelitis (AFM) and non-AFM cases, and timing to medical care and reporting to public health — United States, 2018

	No. (%)			No. (%)	
Characteristic	**Confirmed (N = 233)**	**Probable (N = 26)**	**P-value***	**Noncase (N = 115)**	**P-value†**
Demographics					
Median age, yrs (range, IQR)	5.3 (0.5–81.8, 3.3–8.2)	2.9 (0.3–55.3, 1.0–10.1)	0.04	8.8 (0.1–78.1, 3.9–19.7)	<0.001
Male sex	136/233 (58)	14/25 (56)	0.83	67/111 (60)	0.81
Race					
Asian	9/233 (4)	1/26 (4)	0.87	8/115 (7)	0.40
Black or African American	22/233 (9)	4/26 (15)		17/115 (15)	
Native Hawaiian/Pacific Islander	1/233 (0)	0/26 (0)		0/115 (0)	
White	147/233 (63)	14/26 (54)		69/115 (60)	
Multiracial	4/233 (2)	1/26 (4)		1/115 (1)	
Unknown	50/233 (21)	6/26 (23)		20/115 (17)	
Laboratory finding					
Lumbar puncture	219/229 (96)	26/26 (100)	0.60	102/111 (92)	0.21
Pleocytosis	180/207 (87)	26/26 (100)	0.05	46/88 (52)	<0.001
Median§, cells/mm^3 (range, IQR)	92 (6–814, 42–158)	42 (7–730, 16–128)	0.01	53 (7–920, 27–146)	0.19
Spine MRI performed	231/232 (99)	25/26 (96)	0.19	109/114 (96)	0.02
Clinical illness					
Upper limbs only	98/233 (42)	6/26 (23)	0.09	12/115 (10)	<0.001
Lower limbs only	31/233 (13)	8/26 (31)	0.04	30/115 (26)	0.004
In the 4 weeks before onset of limb weakness					
Any illness	219/229 (96)	25/26 (96)	1.00	85/108 (79)	<0.001
Any respiratory illness	184/222 (83)	18/26 (69)	0.11	54/109 (50)	<0.001
Any fever	170/217 (78)	19/24 (79)	1.00	46/101 (46)	<0.001
Any respiratory illness or fever	214/233 (92)	24/26 (92)	1.00	71/115 (62)	<0.001
Any gastrointestinal illness	80/225 (36)	9/26 (35)	1.00	42/108 (39)	0.63
Hospitalized	227/231 (98)	26/26 (100)	1.00	113/115 (98)	1.00
ICU	127/210 (60)	12/21 (57)	0.82	54/107 (50)	0.09
Timing of preceding illness to onset of limb weakness, median days (range, IQR)					
Any illness	5 (0–27, 2–8)	4 (0–19, 2–10)	0.84	5 (0–28, 2–10)	0.78
Any respiratory illness	5 (0–27, 3–8)	4 (0–19, 3–11)	0.67	6.5 (0–28, 3–11.5)	0.63
Any fever	3 (0–21, 1–5)	3 (0–19, 1.5–8.5)	0.25	4 (0–28, 1–7)	0.12
Any respiratory illness or fever	5 (0–27, 2–7)	3 (0–19, 2–11)	0.77	5 (0–28, 2–10)	0.40
Any gastrointestinal illness	2.5 (0–23, 1–7)	4 (0–17, 2–5)	0.61	4 (0–19, 1–6.5)	0.22
Timing from onset of limb weakness to medical care, specimen collection, and reporting to public health, median days (range, IQR)					
Hospitalization	1 (0–54, 0–2)	3 (0–8, 1–4)	0.03	1 (0–62, 0–3)	0.48
Lumbar puncture	2 (0–31, 1–3)	4 (0–30, 1–7)	0.03	2 (0–140, 1–5)	0.05
MRI	2 (0–164, 1–3)	4 (0–12, 2–7)	0.02	3 (0–113, 1–8)	0.002
Specimen collection					
CSF	2 (0–31, 1–4)	7 (2–19, 6–11)	0.01	5 (0–63, 2–9)	0.09
Respiratory	3 (0–35, 2–6)	13 (2–65, 6–21)	0.004	6 (1–66, 3–11)	0.03
Serum	4 (0–31, 2–7)	9 (3–65, 6–19)	0.007	8.5 (1–64, 5–14)	<0.001
Stool	7 (0–44, 4–11)	13 (2–65, 6–17)	0.13	8 (0–65, 6–14)	0.33
Completion of patient summary form	8.5 (1–175, 4–25)	14 (4–105, 8–21)	0.10	20 (0–277, 9–56)	<0.001
CDC notified	18 (0–208, 7–35)	18.5 (4–111, 12–26)	0.75	36 (1–282, 14–70)	0.003

Abbreviations: CSF = cerebrospinal fluid; ICU = intensive care unit; IQR = interquartile range; MRI = magnetic resonance imaging.

* P-value represents comparison of confirmed and probable cases of AFM.

† P-value represents comparison of confirmed and non-AFM cases.

§ Median includes only those cases with pleocytosis (>5 white blood cells per cubic mm).

Among all 233 patients with confirmed AFM, CSF, respiratory specimens, and stool specimens were tested from 74 (32%), 123 (53%), and 100 (43%) patients, respectively (Table 2). The highest positive yield (44%) was from respiratory specimens, of which EV-D68 was most commonly detected; only two (3%) CSF specimens tested positive (one each for EV-D68 and EV-A71). Testing of specimens from probable and non-AFM cases also identified multiple EV/RV types. Stool specimens from all patients with available specimens tested negative for poliovirus. Among specimens sent from 31 patients (17 confirmed, three probable, and 11 noncases) for arboviral testing, all were negative.

Among patients with confirmed AFM in 2018, the median interval between antecedent illness (e.g., febrile, respiratory, and/or gastrointestinal) during the preceding 4 weeks and onset of limb weakness (5 days), between limb weakness and hospitalization (1 day) and CSF collection (2 days) was similar to that in the 2016 outbreak, (5 days, 1 day, and 3 days, respectively) (Supplementary table, https://stacks.cdc.gov/view/cdc/79271).

TABLE 2. Laboratory results from cerebrospinal fluid (CSF), respiratory, and stool specimens collected from patients with confirmed acute flaccid myelitis (N = 233) — United States, 2018

Specimen source	No. with specimens available (% of 233)	No. (%) positive	Positive test results (No.)
CSF	74 (32)	2/74 (3)	EV-A71 (1) EV-D68 (1)
Respiratory	123 (53)	54/123 (44)	EV-D68 (30) EV-A71 (10) Other/Untyped EV/RV (14)
Stool	100 (43)	13/100 (13)	EV-D68 (1) EV-A71 (2) Echovirus 11 (1) Coxsackievirus (3) Parechovirus (4) Other/Untyped EV/RV (2)

Abbreviations: EV = enterovirus; RV = rhinovirus.

However, the median interval from onset of limb weakness to MRI, respiratory specimen collection, and stool collection was shorter in 2018 than in 2016 (2 days versus 3 days, 3 days versus 4.5 days, and 7 days versus 7.5 days, respectively). Reporting to CDC occurred at a median of 18 days (range = 0–208 days) in 2018 versus 15 days (range = 0–344 days) in 2016 for patients with confirmed AFM.

Discussion

National AFM surveillance using a standardized case definition was established following the first recognized outbreak in 2014. Subsequently, two nationwide outbreaks occurred, one in 2016 with 149 confirmed cases (https://www.cdc.gov/acute-flaccid-myelitis/afm-surveillance.html),* and the largest in 2018, which accounted for 42% of the 559 cases reported from August 2014 through December 2018. As in previous years, most AFM cases occurred in children, during the late summer and early fall. Findings such as presence of fever or respiratory symptoms before the onset of limb weakness, predominance of upper limb involvement, and detection of viruses in respiratory specimens in approximately 50% of patients with specimens submitted were also consistent with those in previous outbreak years. The accumulation of national surveillance data since 2014 has been pivotal to refining the AFM case definition, allowing for better differentiation of epidemiologic, clinical, and laboratory features and risk factors of confirmed cases from those of probable and non-AFM cases. In addition, the shorter interval between limb weakness and diagnostic evaluations in 2018 compared with that in 2016, suggests that support to health departments for strengthened surveillance and increased provider outreach activities has improved awareness of AFM among providers, particularly during outbreak years. Prompt recognition, early specimen collection, and reporting of all suspected cases to public health are important goals for AFM national surveillance.

Early recognition and specimen collection from suspected AFM patients are essential to optimizing pathogen detection and determining whether single or multiple etiologies are responsible for the recent outbreaks. Data from the 2014 and 2016 outbreaks suggested that early specimen collection resulted in higher pathogen yield (*1*) (CDC unpublished data, 2019), and the median interval from onset of limb weakness to CSF collection was short in 2016 (3 days) and again in 2018 (2 days). However, only 3% of CSF specimens yielded a pathogen in 2018, similar to data from previous outbreak years. These data suggest that routine EV/RV PCR testing of CSF is unlikely to confirm the cause of these outbreaks (*1*,*8*,*14*). This could represent the absence of viral shedding into the CSF or might reflect limitations in the timing of specimen collection from viremia, because CSF is collected only after onset of neurologic symptoms and not during the febrile or respiratory illness.

Although 44% of confirmed AFM cases in 2018 had an enterovirus or rhinovirus identified in respiratory specimens, approximately half were negative. Timing of respiratory specimen collection improved in 2018 compared with that in 2016, but still occurred a median of approximately 3 days after the onset of limb weakness and 5 days after the onset of any respiratory illness. Shedding of viruses in the respiratory tract can be transient, so delays in specimen collection could contribute to negative findings. Because conventional testing has not been successful in identifying pathogens in the majority of AFM cases, testing strategies have been expanded to include approaches to identifying immune responses directed toward viruses implicated in AFM, such as measuring pathogen-specific antibody responses to infection. Timely specimen collection can optimize both conventional and novel testing approaches.

---

* Numbers for 2018 include patients under investigation that have not yet been classified.

Surveillance data from 2018 indicate that most patients received recommended medical care (*13*), with evidence of prompt hospitalization, and lumbar puncture and/or MRI shortly after the onset of limb weakness, indicating heightened clinical awareness and successful public health outreach since surveillance for AFM was implemented in 2014. Improved understanding of the different characteristics of confirmed and non-AFM cases, including a history of febrile or respiratory symptoms preceding onset of limb weakness and a predominance of upper limb involvement has helped to differentiate AFM from other forms of acute limb weakness (*15*).

AFM can progress rapidly and might require respiratory support (*14–17*); patients evaluated with signs and symptoms consistent with AFM should be hospitalized for close monitoring. In the absence of a confirmatory diagnostic test for AFM, management decisions for individual patients in the acute setting should be informed by careful review of the patient's signs and symptoms, laboratory testing, MRI results, and other test results, including electromyography, and in close consultation with infectious disease specialists and neurologists. To help with clinical management, the Acute Flaccid Myelitis Workgroup and the Transverse Myelitis Association (https://myelitis.org/living-with-myelitis/resources/afm-physician-support-portal/) offer a 24-hour clinical consultation service with physicians at the University of Texas Southwestern's Transverse Myelitis Center or Johns Hopkins University Transverse Myelitis Center, established in 2019, for providers with questions about patients suspected to have AFM. Although studies on treatment have not been systematically evaluated for effectiveness, CDC, in collaboration with experts in multiple disciplines, developed interim considerations for the management of AFM patients (https://www.cdc.gov/acute-flaccid-myelitis/hcp/clinical-management.html), which do not indicate a preference for or against any of the commonly employed treatments for AFM, including intravenous immunoglobulin, steroids, and plasmapheresis. Physical rehabilitation might also improve long-term outcomes if implemented during the acute phase of illness (*14*); thus, early recognition of AFM is important so that clinicians might implement targeted clinical management with the potential to improve patient outcomes.

Because AFM is uncommon, ensuring that all suspected cases are reported to public health is vital to collecting clinical information and specimens from each patient. There continues to be a notable delay in reporting suspected cases of AFM by clinicians to public health authorities. Delays might impede important provider outreach activities to increase awareness and the early collection of specimens for pathogen detection, particularly when there is an increase in cases.

To provide additional specificity for reporting of patients with suspected AFM to health departments, the Council of State and Territorial Epidemiologists modified the clinical criteria for reporting of patients suspected of AFM in June 2019 to include MRI evidence of spinal lesions with at least some gray matter involvement, in addition to acute flaccid limb weakness.[†] These changes to the case definition more clearly reflect the cumulative clinical and epidemiologic surveillance data collected for AFM over the past 5 years. It is important to note that the clinical diagnosis of AFM by a physician might differ from case definitions used for public health surveillance. Whereas an AFM diagnosis is based on a physician's comprehensive assessment of the affected patient, public health surveillance requires standardized criteria to evaluate overall morbidity, mortality, and seasonal trends and provide consistency in measurements from year to year.

The findings in this report are subject to at least three limitations. First, national AFM surveillance relies on passive reporting and clinician awareness, which can result in underreporting. Second, misclassification might occur since a confirmatory test for AFM is not available. Lack of submission of all requested specimen types from each patient suspected to have AFM limits the ability to fully characterize the laboratory profile of all AFM cases. Finally, although national data on long-term outcomes are not yet available, CDC and state and local health departments are investigating long-term outcomes of AFM patients and other risk factors that might affect the development of AFM.

Improving the understanding of AFM is a public health priority. The overall rarity of this condition and absence of a confirmatory test highlight the need for increased vigilance among providers seeing pediatric patients with acute onset of flaccid limb weakness in the late summer and fall. Ongoing national AFM surveillance will provide an important bridge between research and public health response and will be critical for the development of optimal treatment and prevention recommendations.

[†] https://www.cste.org/page/PositionStatements.

Acknowledgments

Vaccine Preventable Diseases Surveillance coordinators at local and state health departments; Carolyn Gould, Erin Staples, Amanda Panella, Emily McDonald, Marc Fischer, National Center for Emerging and Zoonotic Infectious Diseases Arbovirus Laboratory, CDC; AFM Task Force members; Sarah Hopkins, Children's Hospital of Philadelphia; Daniel Pastula, National Center for Emerging and Zoonotic Infectious Diseases, CDC; Catherine Otten, Seattle Children's Hospital; CDC AFM Outbreak Response Team.

Corresponding author: Adriana Lopez, alopez@cdc.gov, 404-639-8369.

---

[1] Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, CDC.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Sejvar JJ, Lopez AS, Cortese MM, et al. Acute flaccid myelitis in the United States, August–December 2014: results of nationwide surveillance. Clin Infect Dis 2016;63:737–45. https://doi.org/10.1093/cid/ciw372
2. Midgley CM, Watson JT, Nix WA, et al.; EV-D68 Working Group. Severe respiratory illness associated with a nationwide outbreak of enterovirus D68 in the USA (2014): a descriptive epidemiological investigation. Lancet Respir Med 2015;3:879–87. https://doi.org/10.1016/S2213-2600(15)00335-5
3. Sejvar JJ, Bode AV, Marfin AA, et al. West Nile virus-associated flaccid paralysis. Emerg Infect Dis 2005;11:1021–7. https://doi.org/10.3201/eid1107.040991
4. Ooi MH, Wong SC, Clear D, et al. Adenovirus type 21-associated acute flaccid paralysis during an outbreak of hand-foot-and-mouth disease in Sarawak, Malaysia. Clin Infect Dis 2003;36:550–9. https://doi.org/10.1086/367648
5. Bitnun A, Yeh EA. Acute flaccid paralysis and enteroviral infections. Curr Infect Dis Rep 2018;20:34. https://doi.org/10.1007/s11908-018-0641-x
6. Aliabadi N, Messacar K, Pastula DM, et al. Enterovirus D68 infection in children with acute flaccid myelitis, Colorado, USA, 2014. Emerg Infect Dis 2016;22:1387–94. https://doi.org/10.3201/eid2208.151949
7. Knoester M, Helfferich J, Poelman R, Van Leer-Buter C, Brouwer OF, Niesters HGM; 2016 EV-D68 AFM Working Group. Twenty-nine cases of enterovirus-d68-associated acute flaccid myelitis in Europe 2016: a case series and epidemiologic overview. Pediatr Infect Dis J 2019;38:16–21. https://doi.org/10.1097/INF.0000000000002188
8. Ruggieri V, Paz MI, Peretti MG, et al. Enterovirus D68 infection in a cluster of children with acute flaccid myelitis, Buenos Aires, Argentina, 2016. Eur J Paediatr Neurol 2017;21:884–90. https://doi.org/10.1016/j.ejpn.2017.07.008
9. McKay SL, Lee AD, Lopez AS, et al. Increase in acute flaccid myelitis—United States, 2018. MMWR Morb Mortal Wkly Rep 2018;67:1273–5. https://doi.org/10.15585/mmwr.mm6745e1
10. Council of State and Territorial Epidemiologists. Revision to the standardized surveillance and case definition for acute flaccid myelitis. Atlanta, GA: Council of State and Territorial Epidemiologists; 2017. https://cdn.ymaws.com/www.cste.org/resource/resmgr/2017PS/2017PSFinal/17-ID-01.pdf
11. Kilpatrick DR, Yang CF, Ching K, et al. Rapid group-, serotype-, and vaccine strain-specific identification of poliovirus isolates by real-time reverse transcription-PCR using degenerate primers and probes containing deoxyinosine residues. J Clin Microbiol 2009;47:1939–41. https://doi.org/10.1128/JCM.00702-09
12. Nix WA, Oberste MS, Pallansch MA. Sensitive, seminested PCR amplification of VP1 sequences for direct identification of all enterovirus serotypes from original clinical specimens. J Clin Microbiol 2006;44:2698–704. https://doi.org/10.1128/JCM.00542-06
13. Nix WA, Maher K, Johansson ES, et al. Detection of all known parechoviruses by real-time PCR. J Clin Microbiol 2008;46:2519–24. https://doi.org/10.1128/JCM.00277-08
14. Van Haren K, Ayscue P, Waubant E, et al. Acute flaccid myelitis of unknown etiology in California, 2012–2015. JAMA 2015;314:2663–71. https://doi.org/10.1001/jama.2015.17275
15. Hopkins SE. Acute flaccid myelitis: etiologic challenges, diagnostic and management considerations. Curr Treat Options Neurol 2017;19:48. https://doi.org/10.1007/s11940-017-0480-3
16. Nelson GR, Bonkowsky JL, Doll E, et al. Recognition and management of acute flaccid myelitis in children. Pediatr Neurol 2016;55:17–21. https://doi.org/10.1016/j.pediatrneurol.2015.10.007
17. Cramer N, Munjal N, Ware D, et al. New cluster of acute flaccid myelitis in Western Pennsylvania. Ann Emerg Med 2019;19:30051-4. https://doi.org/10.1016/j.annemergmed.2019.01.024

Notes from the Field

Conjunctivitis Caused by Toxigenic *Corynebacterium ulcerans* — Missouri, 2018

Lauren M. Weil, PhD[1,2]; Cindy Butler[3]; Karla R. Howell[4]; Sarah Sharr[5]; Grace L. Paley, MD, PhD[6]; Andrew J. W. Huang, MD[6]; Robi N. Maamari, MD[6]; Lucia C. Pawloski, PhD[2]; Pamela K. Cassiday, MS[2]; Anna M. Acosta, MD[2]; Susan Hariri, PhD[2]; Tejpratap S. P. Tiwari, MD[2]

On December 12, 2018, an immunocompromised man with non-Hodgkin's lymphoma, aged 73 years, was evaluated by an ophthalmologist for left eyelid redness, swelling, and eye discharge and received a diagnosis of ligneous (pseudomembranous) conjunctivitis. The pseudomembrane was debrided and sent for culture, and the patient was prescribed oral amoxicillin clavulanate and moxifloxacin eye drops, with topical loteprednol and cyclosporine to decrease the robust inflammatory response. *Corynebacterium ulcerans*, one of three species of Corynebacterium (in addition to *C. diphtheriae* and *C. psuedotuberculosis*) that can harbor the diphtheria toxin–producing gene was initially identified by matrix-assisted laser desorption ionization time-of-flight mass spectrometry performed on an isolate obtained from culture of the pseudomembrane at a Missouri hospital on December 13. The Missouri Department of Health and Senior Services (MDHSS) laboratory-confirmed *C. ulcerans* by culture and forwarded the isolate to CDC for toxin testing. On December 28, CDC confirmed toxin-producing *C. ulcerans*. The patient had no systemic symptoms, was not hospitalized, and did not receive diphtheria antitoxin. On January 11, 2019, following multiple membrane removals and no residual membrane; cultures of conjunctival swabs tested by the hospital were negative for *C. ulcerans*. The patient was not up-to-date for tetanus-diphtheria (Td) vaccine and had postponed vaccination because of his ongoing cancer treatment.

Case investigation by MDHSS and the St. Louis County Department of Public Health identified one household contact. Paired nasal and throat swabs collected from the patient (posttreatment) and the household contact to assess carriage were negative by culture for *C. ulcerans*. The household contact was not offered antibiotic postexposure prophylaxis (PEP) and declined a Td booster. Ophthalmology staff members who had direct contact with the patient reported wearing recommended personal protective equipment and declined PEP. No identified contacts developed disease. The patient lived with two dogs; neither was reported to be ill or examined by a veterinarian, and the patient declined to have the dogs tested for *C. ulcerans*.

Toxigenic strains of *Corynebacterium diphtheriae* are transmitted person-to-person and cause respiratory and cutaneous diphtheria; infections of other mucous membranes, such as the eye, have been reported (*1*). This is the first reported case of conjunctivitis caused by a toxigenic strain of *C. ulcerans*, which, along with *C. pseudotuberculosis*, is a zoonotic species. Toxigenic *C. ulcerans* has been isolated from a variety of animal species. Infected livestock and pets such as dogs and cats are recognized sources of occasional *C. ulcerans* infection in humans, particularly in older adults who are either unvaccinated with diphtheria toxoid–containing vaccines or have not received recommended booster doses. Since the late 1980s, *C. ulcerans* has been increasingly reported as a cause of respiratory and cutaneous diphtheria-like illness. Although it is possible, secondary person-to-person transmission of *C. ulcerans* has not been verified.

Because diphtheria toxoid–containing vaccines target diphtheria toxin, vaccination with these vaccines most likely prevents toxin-mediated disease caused by all toxigenic strains of Corynebacterium. Because there are common exposures among household contacts and person-to-person transmission might be possible, vaccination status of household and other close contacts (e.g., medical providers) should be assessed, and contacts who are not up-to-date should be offered vaccination (*2*,*3*).

Antibiotic treatment of illnesses caused by toxin-producing *C. ulcerans* should follow treatment guidelines for patients infected with *C. diphtheriae* (*1*). Diphtheria antitoxin is recommended for respiratory infections caused by toxigenic *C. diphtheriae* or *C. ulcerans* (*4*). Health care providers should be aware that *C. ulcerans* infection can be acquired from pets, particularly by elderly or immunocompromised persons (*3*,*5*). Both *C. diphtheriae* and *C. ulcerans* can become toxigenic through lysogeny by beta-corynebacteriophages harboring the diphtheria toxin gene. Circulation of toxigenic *C. ulcerans* in animals highlights an animal reservoir for corynebacteriophages. This poses programmatic challenges to eradicating diphtheria caused by toxigenic *C. diphtheriae* and emphasizes the need to maintain high human population immunity through diphtheria vaccination, including recommended decennial booster doses (*6*).

Corresponding author: Lauren M. Weil, lweil@cdc.gov, 404-718-6830.

---

[1] Epidemic Intelligence Service, CDC; [2] Division of Bacterial Diseases, National Center for Immunization and Respiratory Diseases, CDC; [3] Missouri Department of Health and Senior Services, Jefferson City, Missouri; [4] St. Louis County Department of Public Health, St. Louis, Missouri; [5] Missouri State Public Health Laboratory, Jefferson City, Missouri; [6] Department of Ophthalmology and Visual Sciences, Washington University School of Medicine, St. Louis, Missouri.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

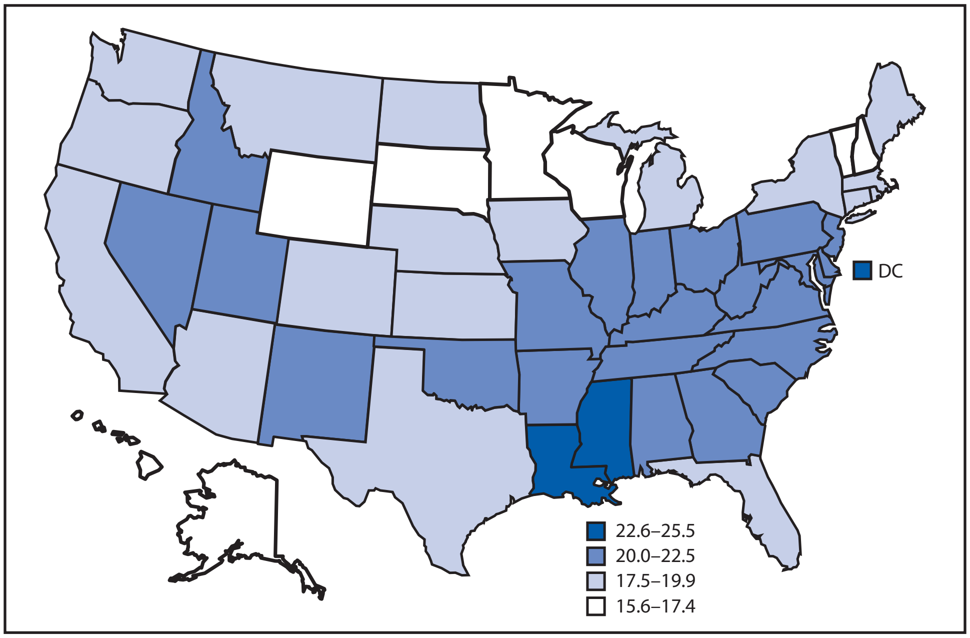
References

1. American Academy of Pediatrics. Committee on Infectious Diseases. Diphtheria. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, eds. Red book: 2018 report of the Committee on Infectious Diseases. Itasca, IL: American Academy of Pediatrics; 2018:320–3.
2. Hacker E, Antunes CA, Mattos-Guaraldi AL, Burkovski A, Tauch A. *Corynebacterium ulcerans*, an emerging human pathogen. Future Microbiol 2016;11:1191–208. https://doi.org/10.2217/fmb-2016-0085
3. Lartigue MF, Monnet X, Le Flèche A, et al. *Corynebacterium ulcerans* in an immunocompromised patient with diphtheria and her dog. J Clin Microbiol 2005;43:999–1001. https://doi.org/10.1128/JCM.43.2.999-1001.2005
4. CDC. Use of diphtheria antitoxin (DAT) for suspected diphtheria cases. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/diphtheria/downloads/protocol.pdf
5. Otsuji K, Fukuda K, Endo T, et al. The first fatal case of *Corynebacterium ulcerans* infection in Japan. JMM Case Rep 2017;4:e005106. https://doi.org/10.1099/jmmcr.0.005106
6. Liang JL, Tiwari T, Moro P, et al. Prevention of pertussis, tetanus, and diphtheria with vaccines in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2018;67(No. RR-2). https://doi.org/10.15585/mmwr.rr6702a1

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Death Rates* from Female Breast Cancer,† by State — National Vital Statistics System, United States,§ 2017



Abbreviation: DC = District of Columbia.

* Data were age-adjusted to the 2000 U.S. standard population.

† Breast cancer deaths were those with *International Classification of Diseases, Tenth Revision* underlying cause of death code C50.

§ The U.S. death rate for female breast cancer was 19.9 per 100,000 population in 2017.

In 2017, the overall age-adjusted death rate for female breast cancer was 19.9 per 100,000 population. The highest death rates were in Mississippi (25.5), DC (24.3), and Louisiana (23.6). The lowest death rates were in Hawaii (15.6), Alaska (16.3), New Hampshire (16.3), Wyoming (16.5), Rhode Island (16.6), Minnesota (16.7), South Dakota (17.3), Wisconsin (17.4), and Vermont (17.4).

Source: National Center for Health Statistics, National Vital Statistics System, mortality file. https://www.cdc.gov/nchs/nvss/deaths.htm.

Reported by: Sibeso N. Joyner, MPH, sjoyner@cdc.gov, 301-458-4254; Deepthi Kandi, MS.

The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format. To receive an electronic copy each week, visit *MMWR* at *https://www.cdc.gov/mmwr/index.html*.

Readers who have difficulty accessing this PDF file may access the HTML file at *https://www.cdc.gov/mmwr/index2019.html*. Address all inquiries about the *MMWR* Series, including material to be considered for publication, to Executive Editor, *MMWR* Series, Mailstop E-90, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30329-4027 or to mmwrq@cdc.gov.

All material in the *MMWR* Series is in the public domain and may be used and reprinted without permission; citation as to source, however, is appreciated.

MMWR and *Morbidity and Mortality Weekly Report* are service marks of the U.S. Department of Health and Human Services.

Use of trade names and commercial sources is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services.

References to non-CDC sites on the Internet are provided as a service to *MMWR* readers and do not constitute or imply endorsement of these organizations or their programs by CDC or the U.S. Department of Health and Human Services. CDC is not responsible for the content of these sites. URL addresses listed in *MMWR* were current as of the date of publication.

ISSN: 0149-2195 (Print)