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Behavioral and Clinical Characteristics of American Indian/Alaska Native Adults in HIV Care — Medical Monitoring Project, United States, 2011–2015

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The rate of diagnosis of human immunodeficiency virus (HIV) infection among American Indians and Alaska Natives (AI/ANs) in 2016 (10.2 per 100,000 population) was the fourth highest among seven racial/ethnic groups in the United States (*1*); the number of diagnoses of HIV infection among AI/AN persons increased by 70%, from 143 in 2011 to 243 in 2016 (*1*). However, little has been published about the sociodemographic, behavioral, and clinical characteristics of AI/AN patients with HIV infection in care because small sample sizes have led to infrequent analysis of AI/AN-specific estimates (*2*) and because of underestimation of AI/AN race/ethnicity in surveillance and other data sources (*3*). CDC analyzed data from the Medical Monitoring Project (MMP), a surveillance system that collects information about the experiences and needs of persons with diagnosed HIV infection, collected during 2011–2015 among AI/AN adults receiving HIV medical care. The results indicated that 64% of AI/AN patients with HIV infection in care achieved sustained viral suppression, and 76% achieved viral suppression at their most recent viral load test within the past 12 months, which is below the national HIV prevention goal of 80%, but comparable to or better than some other racial/ethnic groups (*4*). Based on self-report, 51% of AI/AN patients with HIV infection had incomes at or below the U.S. Department of Health and Human Services' (HHS) annual poverty limit, 27% had symptoms of depression, 78% reported internalized HIV-related stigma, and 20% reported binge drinking in the past 30 days. To improve the health of AI/AN patients with HIV infection, it is important that health care providers, tribal organizations, and state and local health departments consider the sociodemographic and behavioral barriers to AI/AN patients with HIV infection achieving viral suppression and design care plans that seek to eliminate those barriers.

MMP used a three-stage sample design (states and territories, facilities, patients). Response rates were 100% (states and territories), 83%–85% (range across cycles for facilities), and 49%–55% (patients). Data were collected using face-to-face or telephone interviews and medical record abstraction during June 2011–May 2015. Data were weighted for unequal selection probabilities and nonresponse (*5*). Weighted prevalence estimates describing the sociodemographic, behavioral, and clinical characteristics of AI/AN patients with HIV infection in care were calculated with accompanying 95% confidence intervals (CIs). Based on mental health results found in this descriptive analysis, mental health and peer group support services received and needed were also described.

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AI/AN classification was determined by self-identified AI/AN race, regardless of ethnicity or other racial group identity (*2*). Poverty was defined as income at or below the HHS annual poverty guidelines.* Depression was defined as self-reported symptoms consistent with a diagnosis of major/other depression in the past 2 weeks based on the Patient Health Questionnaire-8 (PHQ-8) scale with major/other depression defined as a PHQ-8 score ≥2. Binge drinking was defined as consumption of four or more (females) or five or more (males) alcoholic drinks in one sitting in the past 30 days. Antiretroviral therapy (ART) adherence was defined as taking all prescribed HIV medicines in the past 3 days. Sustained viral suppression was defined as <200 copies of viral RNA/mL in all viral load tests during the past 12 months. Need for support services was defined as needing, but not receiving, mental health or HIV peer group support services during the past 12 months.

AI/AN patients (666) accounted for 3.6% (95% CI = 3.1–4.1) of the MMP population. Among AI/AN patients with HIV infection, 65% identified as being part of more than one racial group, and 29% identified as Hispanic/Latino ethnicity (Table 1). Fifty-one percent had household incomes at or below the HHS poverty guidelines, 12% experienced homelessness in the past 12 months, and 6% had been incarcerated in the past 12 months. Internalized HIV-related stigma† was reported by 78% of patients, and 37% experienced health care discrimination since testing positive for HIV.§

Among AI/AN patients with HIV infection in care, 27% had symptoms consistent with major/other depression in the past 2 weeks, 12% were dissatisfied with their social support, 20% reported binge drinking, 32% used noninjection drugs in the past 12 months, 5% injected drugs in the past 12 months, and 46% currently smoked cigarettes (Table 2). Eight percent of AI/AN patients with HIV infection had condomless sex with a partner who had a negative or unknown HIV status while the patient was not sustainably virally suppressed during the past 12 months. In terms of clinical characteristics, 86% of AI/AN patients on ART were adherent, 64% had achieved sustained viral suppression, and 76% had achieved viral suppression as of their most recent viral load test in the past 12 months.

Peer support group services were received by 17% of AI/AN patients, whereas 11% needed but did not receive these

* Poverty guidelines as defined by the U.S. Department of Health and Human Services. https://aspe.hhs.gov/poverty/faq.cfm.

† Any internalized HIV-related stigma was defined as agreeing with any of the following statements from the Internalized AIDS-Related Stigma Scale: it is difficult to tell people about my HIV infection, being HIV-positive makes me feel dirty, I feel guilty that I am HIV-positive, I am ashamed that I am HIV-positive, I sometimes feel worthless because I am HIV-positive, and I hide my HIV status from others.

§ Health care discrimination was defined as a health care worker exhibiting hostility or lack of respect, giving the patient less attention than other patients, or refusing the patient service since the patient tested positive for HIV.

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TABLE 1. Sociodemographic characteristics of American Indian/Alaska Native (AI/AN)* adults living with human immunodeficiency virus (HIV) infection receiving medical care (N = 666) — Medical Monitoring Project, United States, 2011–2015

Characteristic	Total	%† (95% CI§)
Race		
Single-race AI/AN	**249**	36 (31–40)
Multiple-race AI/AN	**417**	65 (60–69)
Ethnicity		
AI/AN, non-Hispanic/Latino	**455**	71 (65–77)
AI/AN, Hispanic/Latino	**211**	29 (23–35)
Gender		
Male	**491**	74 (69–78)
Female	**157**	23 (20–27)
Transgender¶	**18**	3 (2–5)
Age group (yrs)		
18–29	**45**	7 (5–9)
30–39	**106**	16 (14–19)
40–49	**230**	34 (30–37)
≥50	**285**	43 (40–47)
Sexual identity		
Homosexual	**279**	43 (39–48)
Heterosexual	**306**	46 (41–52)
Bisexual	**67**	10 (8–13)
Education		
<High school	**172**	25 (22–29)
High school/General educational development certificate	**163**	23 (20–26)
>High school	**331**	51 (47–56)
Household income at/below poverty in past 12 months**		
Yes	**334**	51 (46–55)
No	**308**	50 (45–54)
Homeless in past 12 months††		
Yes	**78**	12 (9–14)
No	**588**	88 (86–91)
Jail in past 12 months		
Yes	**40**	6 (4–8)
No	**626**	94 (92–96)
Health insurance in past 12 months		
Private only	**141**	22 (19–26)
Any public	**445**	65 (61–70)
Only Ryan White coverage or uninsured	**76**	12 (9–16)
Any HIV-related stigma§§		
Yes	**519**	78 (74–81)
No	**140**	22 (19–26)
Any health care discrimination¶¶		
Yes	**241**	37 (32–42)
No	**417**	63 (58–68)

Abbreviation: CI = confidence interval.
* Self-identified AI/AN race, regardless of ethnicity or other racial groups.
† Percentages are weighted percentages and might not sum to 100% because of rounding.
§ 95% CIs incorporate weighted percentages
¶ Patients were classified as transgender if sex at birth and gender reported by patient were different, or if patient's gender identity was transgender.
** Poverty guidelines as defined by the U.S. Department of Health and Human Services. https://aspe.hhs.gov/poverty/faq.cfm.
†† Living on the street, in a shelter, in a single-room-occupancy hotel, or in a car.
§§ Agreed with any of the following statements: it is difficult to tell people about my HIV infection, being HIV-positive makes me feel dirty, I feel guilty that I am HIV positive, I am ashamed that I am HIV-positive, I sometimes feel worthless because I am HIV-positive, and I hide my HIV status from others.
¶¶ Health care discrimination was defined as a health care worker exhibiting hostility or lack of respect, giving the patient less attention than others, or refusing the patient service since the patient tested positive for HIV.

TABLE 2. Behavioral and clinical characteristics of American Indian/Alaska Native (AI/AN)* adults living with human immunodeficiency virus (HIV) infection receiving medical care (N = 666) — Medical Monitoring Project, United States, 2011–2015

Characteristic	Total	%† (95% CI§)
Depression in past 2 weeks		
Major/Other depression	169	27 (23–30)
None	484	73 (70–77)
Satisfied with social support		
Very dissatisfied	42	6 (5–8)
Somewhat dissatisfied	39	6 (4–8)
Somewhat satisfied	141	24 (20–28)
Very satisfied	382	64 (60–67)
Binge drinking in past 30 days¶		
Yes	132	20 (17–23)
No	524	80 (77–83)
Any noninjection drugs in past 12 months		
Yes	216	32 (27–35)
No	445	68 (64–73)
Injected drugs in past 12 months		
Yes	35	5 (3–7)
No	625	95 (93–97)
Currently smokes cigarettes		
Yes	302	46 (42–50)
No	359	55 (50–58)
Sex without a condom with partner with HIV-negative or unknown status in past 12 months		
Yes	87	14 (11–17)
No	540	86 (83–89)
Sex without a condom with HIV-negative or unknown status partners while not sustainably virally suppressed in past 12 months		
Yes	49	8 (5–10)
No	578	92 (90–95)
ART adherence**		
100% adherent	519	86 (83–90)
Not 100% adherent	87	14 (11–17)
Sustained viral suppression in past 12 months		
Yes	432	64 (60–68)
No	234	36 (32–41)
Most recent viral load suppressed in past 12 months		
Yes	512	76 (73–80)
No	154	24 (20–27)

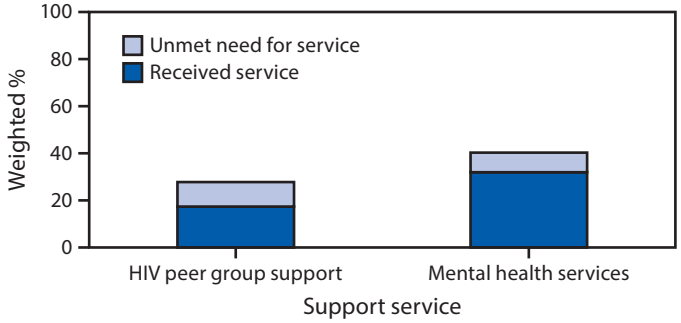
Abbreviations: ART = antiretroviral therapy; CI = confidence interval.
* Self-identified AI/AN race, regardless of ethnicity or other racial groups.
† Percentages are weighted percentages and might not sum to 100% because of rounding.
§ 95% CIs incorporate weighted percentages.
¶ Consumption of four or more (females) or five or more (males) alcoholic drinks in one sitting in the past 30 days.
** Taking all prescribed HIV medicines in the past 3 days.

services (Figure). Approximately one third of AI/AN patients received mental health services, and 8% needed but did not receive mental health services.

Discussion

In this analysis, levels of viral suppression among AI/AN patients with HIV infection in care were suboptimal. Moreover, compared with other racial/ethnic groups, AI/AN patients have a higher rate of poverty, which is associated with poor physical and mental health outcomes (*1*). The prevalence of

FIGURE. Mental health and peer group support service needs* among American Indian/Alaska Native (AI/AN)† adults receiving human immunodeficiency virus (HIV) care (N = 666) — Medical Monitoring Project, United States, 2011–2015



* Need was defined as needing, but not receiving mental health or HIV peer group support services during the past 12 months.
† Self-identified AI/AN race, regardless of ethnicity or other racial groups.

Summary

What is already known about this topic?

In 2016, American Indians/Alaska Natives (AI/ANs) had the fourth highest human immunodeficiency virus (HIV) infection diagnosis rate among all racial/ethnic groups. During 2011–2016, diagnoses of HIV infection among AI/AN patients increased by 70%. Little has been published about characteristics of AI/AN patients with HIV infection.

What is added by this report?

Among adults receiving HIV care from 2011 to 2015, AI/AN patients had high poverty levels (51%), depression (27%), HIV stigma (78%), and suboptimal sustained HIV viral suppression (64%).

What are the implications for public health practice?

Providers serving AI/AN patients should offer screening and referrals for mental health and peer support services to improve the health of this population and help them achieve viral suppression.

major/other depression (27%) among AI/AN patients in HIV care was similar to that among all adult patients in HIV care (25%) (*6*). The prevalence of stigma (78%) among AI/AN patients in HIV care, although high, was also similar to stigma among all adult patients in HIV care (79%) (*7*). The high prevalence of poverty, depression, stigma, and alcohol use in this population might be caused in part by racial and historical inequities and is not intrinsic to AI/AN cultures (*2*). Receiving culturally appropriate mental health and peer group support services could reduce symptoms of depression and increase social support (*8*); in this analysis, some AI/AN patients with HIV infection needed but did not receive these services.

Despite factors such as poverty and depression, which are often associated with suboptimal achievement of viral suppression, the prevalence of viral suppression among AI/AN patients in HIV care was similar to or higher than that among other racial/ethnic groups. AI/AN patients had prevalences of sustained viral suppression that were similar to those among white patients (66%) and higher than those among black (49%) and Hispanic/Latino (59%) patients in HIV care (*9*). However, the prevalence of viral suppression among AI/AN patients was lower than the national prevention goal of 80% for persons with diagnosed HIV infection.

The findings in this report are subject to at least three limitations. First, analysts pooled multiple years of data and could not analyze trends over time because of the small sample size of AI/AN patients in each MMP cycle year. Second, although the MMP sampling design was intended to represent all adult patients with HIV infection in outpatient settings in the United States, it did not include Indian Health Services (IHS) facilities, tribal lands, or some areas with a high concentration of AI/AN persons; however, the majority of AI/AN persons do not live on tribal lands (*10*). Finally, interview data were obtained by self-report, which might be susceptible to recall or social desirability biases.

From 2011 to 2016, diagnoses of HIV infection among AI/AN patients increased by 70% (*1*). CDC is currently working with IHS and tribal leaders to implement effective, scalable prevention approaches to support AI/AN patients. In light of the fact that almost 80% of AI/AN patients with HIV infection reported experiencing stigma related to their HIV status, and that more than a third reported experiencing discrimination in health care settings, it is evident that culturally appropriate HIV education, interventions, and care remain priorities (*2*). CDC provides culturally competent capacity-building assistance to IHS prevention programs, such as the Project Red Talon,¶ which works to achieve a more coordinated national and Northwest tribal response to HIV. Community-based interventions, such as CDC's Let's Stop HIV Together** media campaign might also help to reduce HIV-related stigma (*7*).

Because of historical factors affecting AI/AN populations, AI/AN patients receiving HIV care face unique circumstances that might interfere with their ability to achieve sustained viral suppression, including a high prevalence of poverty, depression, stigma, and substance use. It is important that HIV providers and clinics screen for these issues and offer referrals to mental health services and HIV peer group support as appropriate. Many community-based and tribal organizations are positioned to help AI/AN populations access culturally appropriate HIV and ancillary services to improve their health outcomes and reduce HIV-related health disparities.

¶ https://npin.cdc.gov/featured-partner/project-red-talon.
** https://www.cdc.gov/actagainstaids/campaigns/lsht/.

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Human Rabies — Virginia, 2017

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On May 9, 2017, the Virginia Department of Health was notified regarding a patient with suspected rabies. The patient had sustained a dog bite 6 weeks before symptom onset while traveling in India. On May 11, CDC confirmed that the patient was infected with a rabies virus that circulates in dogs in India. Despite aggressive treatment, the patient died, becoming the ninth person exposed to rabies abroad who has died from rabies in the United States since 2008. A total of 250 health care workers were assessed for exposure to the patient, 72 (29%) of whom were advised to initiate postexposure prophylaxis (PEP). The total pharmaceutical cost for PEP (rabies immunoglobulin and rabies vaccine) was approximately $235,000. International travelers should consider a pretravel consultation with travel health specialists; rabies preexposure prophylaxis is warranted for travelers who will be in rabies endemic countries for long durations, in remote areas, or who plan activities that might put them at risk for a rabies exposures.

Case Report

On May 3, 2017, a woman aged 65 years with no preexisting health conditions began experiencing pain and paresthesia in her right arm while gardening. On May 6, the patient sought care at an urgent care facility for the arm pain. She received a diagnosis of carpal tunnel syndrome and was prescribed a nonsteroidal anti-inflammatory drug and hydrocodone. On May 7, she was evaluated at hospital A with shortness of breath, anxiety, insomnia, and difficulty swallowing water. The patient expressed concern about exposure to a toxic substance. Diagnostic test results including complete blood count, serum chemistry, D-dimer (to rule out thromboembolism), troponin, magnesium, electrocardiogram, and chest radiographs were unremarkable. She was given 0.75 mg of lorazepam for a presumed panic attack and discharged. Upon entering the car, she experienced claustrophobia and shortness of breath and immediately returned to hospital A's emergency department (ED), where she received an additional 0.25 mg of lorazepam and was again discharged.

On May 8, she was transported from her residence by ambulance to the ED of hospital B with chest discomfort, shortness of breath, progressive paresthesia involving the right shoulder and arm, and increased anxiety. On examination, she was agitated, tachycardic, and intermittently tachypneic. Her neurologic exam was notable for dysmetria (a type of ataxia). Laboratory results were notable for elevated cardiac enzymes, a serum troponin I level of 1.05 ng/mL (normal <0.02 ng/mL), and a serum lactate level of 8.8 mmol/L (normal, 0.7–2.1 mmol/L). Electrocardiogram results* suggested acute cardiac ischemia with atypical chest pain. The patient underwent emergency cardiac catheterization, which indicated normal coronary arteries.

On the evening of May 8, the patient became progressively agitated and combative and was noted to be gasping for air when attempting to drink water. Hospital staff members questioned family about animal exposures, and the patient's husband reported that she had been bitten on the right hand by a puppy approximately 6 weeks before symptom onset while touring in India. According to the husband, the patient cleaned the wound with the help of the tour operator but did not seek further medical treatment. The patient had no record of a pretravel health screening, did not receive rabies preexposure vaccination before the trip, nor had she ever been vaccinated against rabies.

On the morning of May 9, the patient required endotracheal intubation and mechanical ventilation for increasing somnolence, oral secretions, and oxygen desaturation; peak axillary temperature was 100.6°F (38.1°C). Electroencephalography demonstrated low-amplitude unreactive delta activity suggestive of severe encephalopathy. In light of the concern for human rabies, the patient was sedated with ketamine and midazolam, and the Virginia Department of Health was notified; because rabies PEP is ineffective for treatment of rabies and not indicated after the onset of symptoms, PEP was not administered. A lumbar puncture was performed. Cerebrospinal fluid (CSF) lactate was elevated (2.6 mmol/L; normal = 0.5–2.2 mmol/L), and CSF white blood cell count was 1 cell/μL (normal = 0–5 cells/μL) with 19% polymorphonuclear leukocytes and 81% mononuclear leukocytes, consistent with encephalitis. CSF, serum, saliva, and nuchal skin biopsy specimens were collected on May 9 and submitted to CDC for rabies testing on May 10.

On May 11, rabies was confirmed by the detection of rabies virus RNA by real-time reverse transcription polymerase–chain reaction (real-time RT-PCR) in saliva and skin biopsy specimens, and rabies virus antigen by direct fluorescent antibody testing of the skin biopsy (Table 1). No antirabies virus antibodies were

* The results showed 1 mm of ST segment elevation in leads AVR, V1 and V2, and 1 mm of ST segment depression in lead II, avF, and V3–V6.

TABLE 1. Antemortem diagnostic testing* of specimens in a case of human rabies transmitted by a dog bite received in India — Virginia, 2017

Specimen type	Testing method	Date specimen collected							
		May 9	May 12	May 14	May 15	May 16	May 17	May 18	May 19
CSF	IFA IgG	Neg	—	Neg	—	—	Neg	Neg	—
	IFA IgM	Neg	—	Neg	—	—	Neg	Neg	—
	RFFIT	Neg	—	Neg	—	—	Neg	Neg	—
Serum	IFA IgG	Neg	Neg	—	Neg	Neg	Neg	—	—
	IFA IgM	Neg	Neg	—	Neg	Neg	Neg	—	—
	RFFIT	Neg	Neg	—	Neg	Neg	Neg	—	—
Saliva	Isolation in MNA	Neg	—	—	—	Pos	Pos	Pos	Pos
	real-time RT-PCR†	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos
Skin biopsy	DFA	Pos	—	—	—	—	—	—	—
	real-time RT-PCR†	Pos	—	—	—	—	—	—	—

Abbreviations: CSF = cerebrospinal fluid; DFA = direct fluorescent antibody; IFA = indirect fluorescent antibody; IgG = immunoglobulin G; IgM = immunoglobulin M; MNA = mouse neuroblastoma cell culture; Neg = negative; Pos = positive; RFFIT = rapid fluorescent foci inhibition test; RT-PCR = reverse transcription–polymerase chain reaction.

* Positive result indicates detection of rabies virus antigen; negative result indicates no detection of antibody to rabies virus.

† RT-PCR conducted in triplicate.

detected in serum or CSF. Sequencing of the virus identified a canine rabies virus variant associated with dogs in India.

On May 13, the full Milwaukee protocol (an experimental protocol for persons with rabies that has demonstrated inconsistent, rare success) (*1*) was implemented with the addition of favipiravir (*2*). On May 15, the patient developed profuse oral secretions. On May 17, aggressive titering of ketamine and midazolam was initiated to address increased agitation, and dexmedetomidine was started to limit sympathetic responses during weaning. On May 18, repeat CSF studies continued to demonstrate no white blood cells, normal protein level of 36.0 mg/dL, and a normalized lactate level of 2.2 mmol/L. Interferon beta was started May 18 in the hope of stimulating an immune response; however, repeat CSF analysis demonstrated no evidence of antirabies virus antibodies (Table 1). Rabies virus nucleic acid was again detected in saliva by real-time RT-PCR on May 19. On May 21, the family decided to withdraw advanced medical support, and the patient died shortly thereafter. Rabies virus was isolated from brain tissue postmortem.

Public Health Investigation

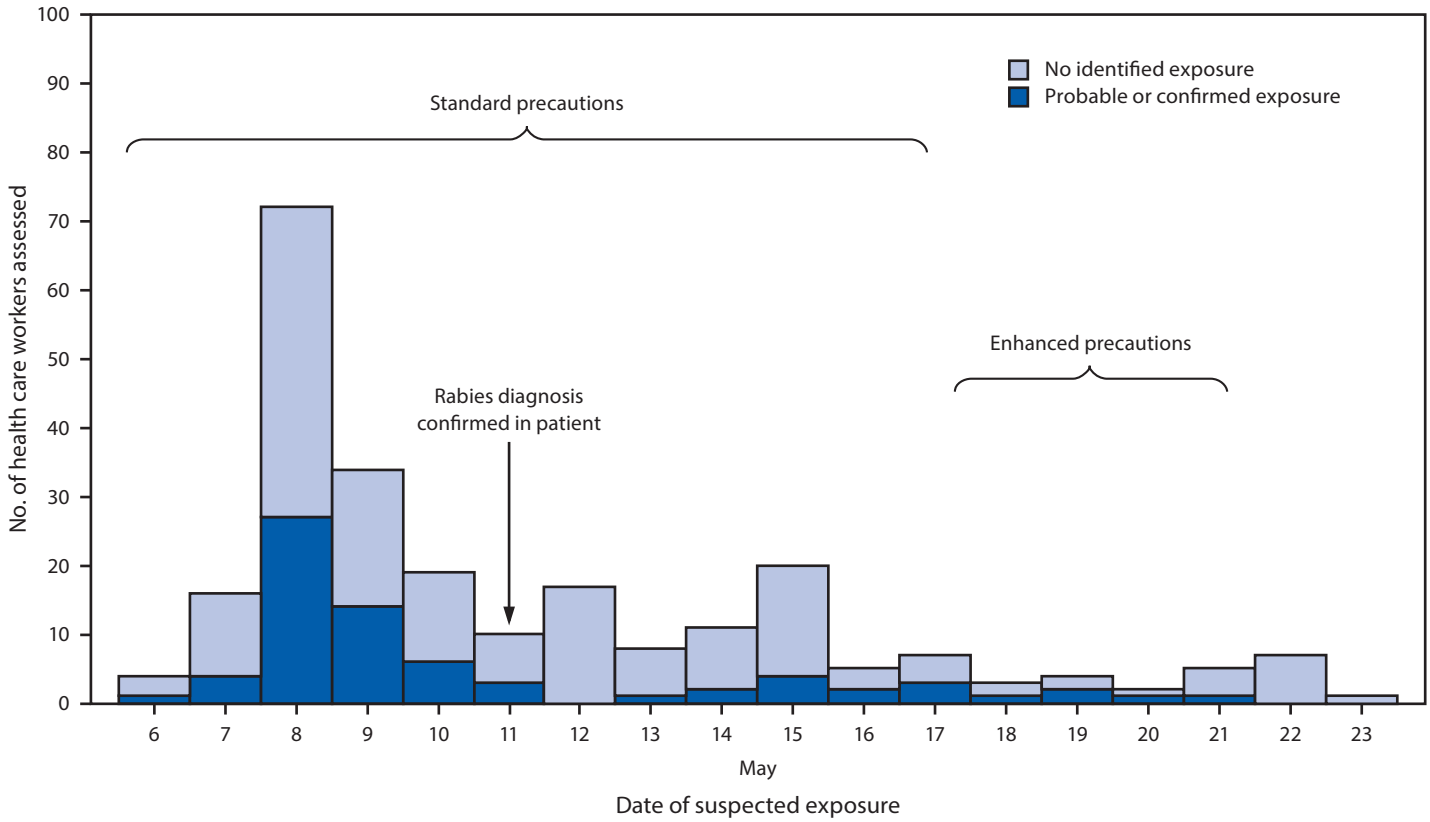
On May 9, 2017, the Thomas Jefferson Health District (TJHD) (the health district local to hospitals A and B and the urgent care center visited by the patient) initiated a local public health investigation. The district used an existing survey tool to assess exposure risk and assisted in implementing the Advisory Committee on Immunization Practices (ACIP) recommendations for PEP based on exposure risk (*3*). Hospital A infection-prevention staff members identified 18 employees who had cared for the patient, two of whom did not respond to a request for an interview. TJHD identified 240 health care providers from the urgent care center (four), emergency medical services providers (five), hospital B (223), the funeral home (seven), and the Office of the Chief Medical Examiner (one). Six employees of hospital B did not respond to interview requests. Among the 258 employees identified by TJHD and hospital A for rabies exposure risk assessments, 250 were located and assessed; rabies PEP was recommended for 72 (29%) (Figure).

In accordance with ACIP recommendations, during May 8–10 (before the confirmed rabies diagnosis), staff members at hospital B had been recommended to follow standard infection prevention precautions (*3*). PEP was recommended for 47 health care staff members who cared for the patient during this time because of likely exposure to saliva (15.7 exposures per day) (Table 2). PEP was recommended for 15 health care workers who cared for the patient after rabies was diagnosed on May 11, but before additional precautions were implemented on May 18 (2.1 exposures per day). Implementation of enhanced contact precaution (droplet and contact precautions) during May 18–May 21 after the patient developed an antibiotic-resistant urinary tract infection presented an opportunity to assess the impact of enhanced precautions on reported exposures; PEP was recommended for five additional health care workers who cared for the patient during this period (1.3 confirmed exposures per day). The rate of daily PEP recommendations decreased significantly after the diagnosis of rabies was made (95% confidence interval [CI] = 4.2–13.5, p<0.001) but did not significantly change after enhanced precautions were implemented (rate ratio = 1.7, 95% CI = 0.6–5.3) (Figure).

Rabies PEP was offered to all 72 health care providers who met the ACIP definition of an exposure (*3*); eight persons declined PEP. The total pharmaceutical cost for PEP (rabies immunoglobulin and rabies vaccine) was approximately $235,000, with the cost borne by both hospitals and the local health department.

The patient's communicability period was presumed to have begun 2 weeks before symptom onset, on April 19. The patient was a resident of a communal living facility. The Piedmont

FIGURE. Suspected and probable or confirmed rabies virus exposures among health care workers and type of precautions implemented — Virginia, 2017*



* Guidelines for precautions are available online (https://www.cdc.gov/infectioncontrol/guidelines/isolation/appendix/standard-precautions.html). Enhanced precautions were implemented in response to the patient's urinary tract infection.

TABLE 2. Health care worker (HCW) exposures to rabies virus while caring for a patient with rabies during three safety precaution recommendation periods — Virginia, 2017

Period	Rabies diagnosis status	Health care precautions	No. of HCW assessed	Average no. of HCW assessed per day (95% CI*)	No. (%) of HCW exposed	Average no. of HCW exposed per day (95% CI*)
May 8–10	Suspected	Standard	125	41.7 (34.8–49.5)	47 (38)	15.7 (11.6–20.7)
May 11–17	Confirmed	Standard	78	11.1 (8.9–13.8)	15 (19)	2.1 (1.2–3.5)
May 18–21	Confirmed	Enhanced†	14	3.5 (2.0–5.7)	5 (36)	1.3 (0.5–2.8)

Abbreviation: CI = confidence interval.

* Confidence intervals calculated using the Mid-P exact test with Miettinen's (1974d) modification (Rothman KJ, Boice JD. Epidemiologic analysis with a programmable calculator. Bethesda, MD: National Institutes of Health 1979).

† Enhanced precautions included both droplet and contact precautions and were implemented after the patient developed an antibiotic resistant urinary tract infection.

Health District interviewed 13 residents of the commune who reported close contact with the patient, four of whom met the exposure criteria: three persons had direct contact with the patient's saliva, and one person was bitten by the patient. All four were advised to initiate PEP.

The patient had participated in a lengthy organized yoga retreat tour of India during January 28–April 5, 2017. Seventeen tour members (including the patient) from five states (California, Illinois, Maryland, North Carolina, and Virginia) and two countries (United States and Spain) and six staff members from two countries (United States and India) participated in the tour. Tour members confirmed that the patient was bitten by a puppy outside her hotel in Rishikesh, India, and that the wound was washed with water, but no further treatment was administered. Three tour members in addition to the patient reported direct contact with the same puppy; two were determined not to have been exposed to infectious materials. One, a North Carolina resident, reported having been bitten on the leg; TJHD recommended PEP for this person. A tour manual was provided to all members before

travel that recommended consulting with a physician regarding any pretravel health concerns, but did not list specific health risks or pretravel vaccination recommendations. The World Health Organization International Health Regulations focal point with the Indian Ministry of Health was notified of the case, and local health authorities conducted an investigation (*4*). One rabid dog was reported from the area within the preceding 6 months, but no additional information regarding the puppy or its owner was available.

Discussion

The canine rabies virus variant was eliminated from the United States in 2004, but remains endemic in 122 countries and is the leading global cause of human deaths secondary to zoonotic pathogens (estimated at 59,000 per year) (*5*,*6*). Recognizing that the reduced burden of human rabies deaths in the United States might result in a lack of awareness of risk when traveling abroad, CDC publishes pretravel vaccination recommendations (https://wwwnc.cdc.gov/travel). Travelers to India, which has the world's largest incidence of dog-mediated human rabies deaths, are recommended to receive pretravel rabies vaccination if they will be involved in outdoor activities (such as camping, hiking, biking, adventure travel, and caving) that put them at risk for animal bites. In the case of the yoga retreat tour, given the extended length of the tour and the rural and community activities involved, pretravel rabies vaccination should have been considered. In the event of a suspected rabies exposure, PEP is recommended as soon as possible and has been shown to be highly effective at preventing rabies if administered prior to symptom onset (typically 3 weeks to 3 months after exposure). Persons with a history of vaccination should receive a 2-dose booster vaccination series if exposed, whereas persons with no history of vaccination require a 4-dose vaccination series with rabies immune globulin administered at the site of exposure.

CDC recommends using standard precautions when providing care to persons suspected of having clinical rabies, including wearing gowns, goggles, masks, and gloves, particularly during procedures that might result in splashes or sprays from body fluids. Enhanced precautions such as droplet and contact precautions are not considered necessary for prevention of health care–associated rabies virus exposures (https://www.cdc.gov/infectioncontrol/guidelines/isolation/appendix/standard-precautions.html) (*3*). In the case described, implementation of enhanced precautions after the patient developed a urinary tract infection did not significantly reduce the daily rate of health care worker exposures, which supports ACIP guidance that standard precautions, when applied appropriately, are adequate to minimize health care–associated rabies virus exposures. Health care–associated rabies virus exposures declined significantly after a diagnosis of rabies was confirmed, suggesting that early consideration of rabies virus infection coupled with timely diagnosis might result in improved adherence to standard infection control precautions and a reduction in exposures and related PEP costs.

This was the ninth death in the United States from rabies infection acquired while traveling or working abroad since 2008 (*7*–*10*). These events underscore the importance of obtaining a thorough pretravel health consultation, particularly when visiting countries with high incidence of emerging or zoonotic pathogens, to ensure awareness of health risks and appropriate pretravel and postexposure health care actions.

Summary

What is already known about this topic?

Canine rabies was eliminated from the United States in 2004, but remains endemic in 122 countries. Since 2008, nine persons have died from rabies in the United States following a rabies exposure abroad.

What is added by this report?

A U.S. citizen was bitten by a puppy while in India; rabies postexposure prophylaxis was not sought. The traveler developed rabies upon return to the United States and died during hospitalization. Seventy-two health care providers were exposed to infectious materials. Treatment for exposures cost approximately $235,000.

What are the implications for public health practice?

This case highlights the importance of prompt rabies diagnosis to minimize health care–associated exposures. Persons traveling internationally should seek pretravel guidance, including recommended vaccination and prophylactic measures.

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Wound Botulism Outbreak Among Persons Who Use Black Tar Heroin — San Diego County, California, 2017–2018

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During September 29–October 6, 2017, the County of San Diego Public Health Services (COSD) was notified of two patients with suspected wound botulism and a history of using black tar heroin. On October 9, COSD, which had reported an average of one wound botulism case per year during 2001–2016, sent a health alert through the California Health Alert Network, notifying Southern California providers of these two patients, including their signs and symptoms and black tar heroin exposure. In collaboration with the California Department of Public Health, COSD conducted an investigation to identify additional cases, determine risk factors for illness, estimate cost of medical care, and develop recommendations to prevent further illness. By April 18, 2018, nine (eight confirmed and one probable) patients with wound botulism were identified, all of whom were hospitalized; one of the nine died. All nine were persons who inject drugs; seven specifically reported using black tar heroin and six practiced subcutaneous injection known as skin popping. Clinically compatible signs and symptoms included muscle weakness, difficulty swallowing, blurred vision, drooping eyelids, slurred speech, difficulty breathing, loss of facial expression, or descending paralysis. All patients were treated with heptavalent botulism antitoxin (BAT). Wound botulism is likely underrecognized because of its rarity and the overlapping signs and symptoms with opioid intoxication, overdose, and other neurologic syndromes including Guillain-Barré syndrome, the Miller Fisher variant of Guillain-Barré syndrome, and myasthenia gravis. Prompt diagnosis, administration of BAT, and provision of supportive care can help stop the progression of paralysis and be lifesaving.

Investigation and Results

A confirmed case was defined as illness in a resident of San Diego County who had 1) clinically compatible signs or symptoms of botulism during September 2017–May 2018; 2) laboratory detection of botulinum neurotoxin (BoNT) in serum; 3) a history of injection drug use during the 2 weeks before illness onset; and 4) no suspected exposure to a contaminated food. A probable case was defined similarly, but without laboratory confirmation. All wound botulism patients reported to COSD were asked by investigators about potential exposures using a standardized questionnaire. Self-reported history of injection drug use was recorded for each patient, with drug use corroborated by toxicology results when possible. Serum collected from each patient was tested for BoNT by mouse bioassay at the California Department of Public Health's Microbial Diseases Laboratory; serum specimens with indeterminate results were tested by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry at CDC. Direct hospital charges for the outbreak-associated patients were estimated based on hospital charges for wound botulism cases reported to COSD during 2005–2016 from the California Office of Statewide Health Planning and Development database.*

Among nine total cases, eight patients were men; median age was 40 years (range = 25–67 years). Symptom onset dates ranged from September 26, 2017, (epidemiologic week 39) to April 12, 2018 (epidemiologic week 15) (Figure). The most frequently reported symptoms were muscle weakness, difficulty swallowing, and blurred vision (Table 1). Abscesses were observed for five patients. Symptoms of wound botulism were initially attributed to drug intoxication for four patients. One patient was admitted for 7 days before receiving BAT and died 9 days later at a long-term care facility. One patient had received the opioid overdose reversal medication naloxone without improvement in symptoms, and one patient had received 2 doses of naloxone upon admission after at least one previous emergency department visit associated with wound botulism. A fourth patient, who was evaluated for symptoms of wound botulism and a history of close contact with a person known to have wound botulism, was discharged from the hospital before later being readmitted. All nine patients required admission to the intensive care unit; six required endotracheal intubation and mechanical ventilation, one of whom died. Median duration of hospitalization was 15 days (range = 9–67 days) until discharge to long-term care facilities (eight, including the patient who died) or departure against medical advice (one). All patients reported history of injecting heroin; seven reported using black tar heroin, six injected heroin by skin popping, and one patient did not report injection method. Toxicology tests performed for six patients were all positive for opioids. Two patients reported close contact with each other that included sharing drugs and needles.

* Search included *International Classification of Diseases, Ninth Revision* codes 040.4, 040.41, 040.42, and 005.1 and *International Classification of Diseases, Tenth Revision* codes A48.5, A48.51, A48.52, and A05.1.

FIGURE. Confirmed and probable wound botulism cases, by epidemiologic week of symptom onset — San Diego County, California, September 2017–April 2018

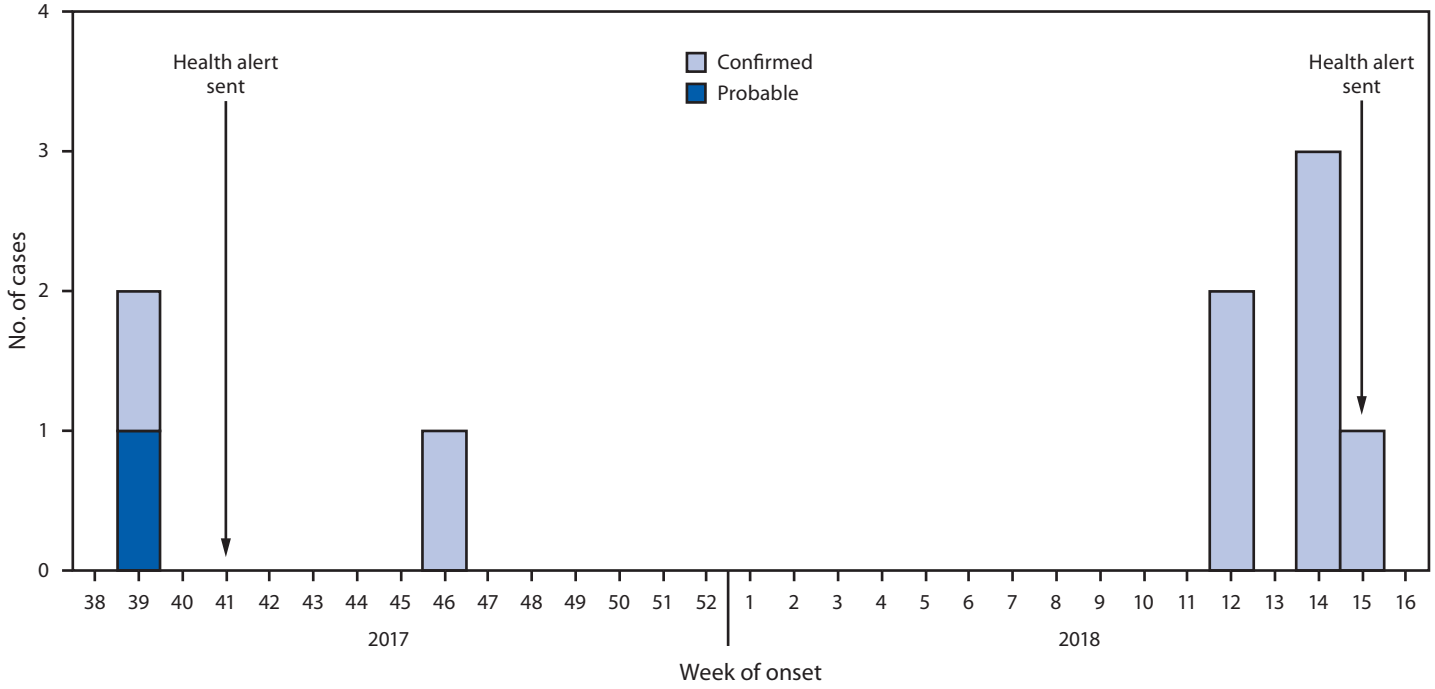

TABLE 1. Characteristics of wound botulism cases (N = 9) — San Diego County, California, 2017–2018

Characteristic	No. (%) of patients
Sign/Symptom	
Subjective muscle weakness	9 (100)
Difficulty swallowing	8 (89)
Blurred vision	8 (89)
Drooping eyelids	7 (78)
Slurred speech	7 (78)
Difficulty breathing	5 (56)
Double vision	5 (56)
Descending paralysis	5 (56)
Abscess	5 (56)
Complication	
Hospitalization	9 (100)
Endotracheal intubation/Mechanical ventilation	6 (67)
Death	1 (11)
Self-reported illicit drug use	
Heroin	9 (100)
Intravenous injection	9 (100)
Black tar heroin	7 (78)
Subcutaneous injection (skin popping)	6 (67)

TABLE 2. Timing of events among patients with wound botulism (N = 9) — San Diego County, California, 2017–2018

Event timing	Median no. of days (range)
Illness onset to hospital admission	2.0 (0.1–6.0)
Hospital admission to BAT request	2.5 (0.1–9.1)
BAT request to BAT administration	0.2 (0.2–0.4)
Illness onset to BAT administration	6.5 (2.7–10.5)
Duration of hospitalization	15 (9.0–67.0)

Abbreviation: BAT = botulism antitoxin.

In coordination with COSD, the California Department of Public Health authorized BAT, which was released for nine patients by CDC quarantine stations in Los Angeles (eight) and San Francisco (one). Median interval from symptom onset to BAT administration was 6.5 days (range = 2.7–10.5 days) (Table 2). Pre-BAT serum specimens from nine patients were collected for testing; BoNT type A was confirmed for six patients by mouse bioassay and two patients by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. BoNT was not detected for one patient; however, that serum sample was frozen and hemolyzed and therefore not in optimal condition for confirmatory testing.

During the 2017–2018 outbreak, all nine patients were enrolled in public health care programs, including Medi-Cal[†] (seven), Medicare (one), and the Veterans Health Administration (one). The total direct hospital costs for this outbreak was estimated at $2.3 million, for 203 total in-patient days charged at the historical median daily rate of $11,506 per day, based on data available for nine patients hospitalized with wound botulism in San Diego County during 2005–2016 (COSD, unpublished data; 2018).

[†] A program that offers low-cost or free health coverage to eligible California residents with limited income.

Public Health Response

Health alerts issued by COSD on October 9, 2017, and April 10, 2018, reminded health care providers to educate persons who inject drugs about the risks and symptoms of wound botulism, thoroughly search for wounds, consider a wound botulism diagnosis for patients with injection drug use history and cranial nerve abnormalities or descending paralysis, and consult promptly with local health departments to request BAT (*1*,*2*). Within 1 day of the April 2018 health alert, local clinicians reported suspected clinical wound botulism for two currently hospitalized patients. Additional public health communications included presentations to the local infectious diseases medical society, the local chapter of the American College of Surgeons, and the local anti-opioid misuse coalition, and distribution of informational flyers at substance abuse, needle exchange, and methadone clinics. The California Department of Public Health issued a communicable disease brief to local health departments throughout California.

Summary

What is already known about this topic?

Wound botulism is a rare but serious illness associated with black tar heroin use, especially by subcutaneous injection (skin popping).

What is added by this report?

During September 2017–April 2018, nine cases of wound botulism were reported in San Diego County, California; all patients reported injecting heroin, and seven used black tar heroin, including subcutaneous injection in six patients. Symptoms were first attributed to drug intoxication for four patients; two received the opioid overdose reversal medication naloxone without improvement in symptoms. One patient died.

What are the implications for public health practice?

Increasing use of black tar heroin during the opioid crisis might lead to additional cases of wound botulism. Heightened awareness of the disease might improve timely diagnosis and treatment. Prompt diagnosis and administration of botulism antitoxin can be lifesaving.

Discussion

Botulism, a nationally notifiable condition, is a rare but serious illness of descending paralysis most commonly caused by the neurotoxin produced by the anaerobic, gram-positive bacteria *Clostridium botulinum;* wound botulism in particular results from germination of *C. botulinum* spores in a wound or other necrotic tissue (*3*,*4*). The 2017–2018 outbreak of wound botulism among persons who inject drugs in San Diego County was associated with black tar heroin use, possibly through contamination of one or more batches. Black tar heroin use poses a heightened risk for wound botulism attributable to its production, preparation, and practice. Black tar heroin is a dark, gummy drug primarily produced in Mexico and often contains adulterants to increase bulk or contaminants introduced during illicit transport to the United States, such as inside car tires or other unsanitary locations where the drug might be exposed to soil containing *C. botulinum* spores (*3*). Preparation of black tar heroin for injection through cooking does not destroy *C. botulinum* spores, which can survive high heat and later germinate to produce BoNT (*5*). Skin popping can create an anaerobic environment of necrotic tissue in which BoNT can be readily formed and released (*6*).

With recent increases in opioid misuse nationwide (*7*) there is a growing need for awareness of the risks and symptoms of wound botulism among persons who inject drugs. During 2001–2016, in the United States, 353 wound botulism cases were reported to CDC (*8*); 291 (82%) were from California, including 15 from San Diego County. Although rarely reported outside California, wound botulism likely is underdiagnosed in the United States (*5*). Diagnosing wound botulism can be challenging because of the complex testing required and symptoms that can overlap with other neurologic syndromes or opioid intoxication and overdose (*5*,*6*). In addition, law enforcement authorities throughout the western United States and increasingly in the northeast have confiscated black tar heroin (*9*), providing evidence of potential exposure to this primary risk factor for wound botulism (*3*).

Prompt BAT administration can help stop progression of paralysis (*10*). The median interval between symptom onset and BAT administration in this outbreak (6.5 days) primarily comprised the time from symptom onset to hospital admission (2.0 days) and a suspicion of botulism that prompted a BAT request (2.5 days). Consistent with a previous report (*5*), costs of inpatient medical care were high and paid at public or hospital expense because the patients lacked private medical insurance. Efforts to improve botulism prevention, identification, and prompt treatment can improve morbidity and mortality outcomes as well as likely lower the monetary burden to the public and health care system (*5*).

Persons who have symptoms of wound botulism should promptly seek medical care and communicate their specific drug practices to aid diagnosis and accelerate BAT administration. Persons who inject drugs should be aware that, although safe injection practices can reduce the risk for some bloodborne infections (e.g., human immunodeficiency virus and hepatitis), wound botulism remains a risk when injecting or skin popping black tar heroin.[§] Clinicians caring for persons who inject drugs or persons who fail to respond to naloxone need to perform thorough searches for wounds, be alert for wound botulism, and inform patients of this potentially lethal

[§] https://www.cdc.gov/botulism/wound-botulism.html.

consequence of injection drug use. Health departments can deliver these health messages and emphasize the importance of opioid overdose education, referral of persons who inject drugs to medication-assisted treatment for opioid use disorder, and implement timely surveillance and notification of injection drug users when wound botulism clusters are detected.

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Drug and Opioid-Involved Overdose Deaths — United States, 2013–2017

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On December 21, 2018, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

The 63,632 drug overdose deaths in the United States in 2016 represented a 21.4% increase from 2015; two thirds of these deaths involved an opioid (*1*). From 2015 to 2016, drug overdose deaths increased in all drug categories examined; the largest increase occurred among deaths involving synthetic opioids other than methadone (synthetic opioids), which includes illicitly manufactured fentanyl (IMF) (*1*). Since 2013, driven largely by IMF, including fentanyl analogs (*2–4*), the current wave of the opioid overdose epidemic has been marked by increases in deaths involving synthetic opioids. IMF has contributed to increases in overdose deaths, with geographic differences reported (*1*). CDC examined state-level changes in death rates involving all drug overdoses in 50 states and the District of Columbia (DC) and those involving synthetic opioids in 20 states, during 2013–2017. In addition, changes in death rates from 2016 to 2017 involving all opioids and opioid subcategories,* were examined by demographics, county urbanization levels, and by 34 states and DC. Among 70,237 drug overdose deaths in 2017, 47,600 (67.8%) involved an opioid.† From 2013 to 2017, drug overdose death rates increased in 35 of 50 states and DC, and significant increases in death rates involving synthetic opioids occurred in 15 of 20 states, likely driven by IMF (*2,3*). From 2016 to 2017, overdose deaths involving all opioids and synthetic opioids increased, but deaths involving prescription opioids and heroin remained stable. The opioid overdose epidemic continues to worsen and evolve because of the continuing increase in deaths involving synthetic opioids. Provisional data from 2018 indicate potential improvements in some drug overdose indicators;§ however, analysis of final data from 2018 is necessary for confirmation. More timely and comprehensive surveillance data are essential to inform efforts to prevent and respond to opioid overdoses; intensified prevention and response measures are urgently needed to curb deaths involving prescription and illicit opioids, specifically IMF.

Drug overdose deaths were identified in the National Vital Statistics System multiple cause-of-death mortality files,¶ with death certificate data coded using the *International Classification of Diseases, Tenth Revision* (ICD-10) codes X40–44 (unintentional), X60–64 (suicide), X85 (homicide), or Y10–Y14 (undetermined intent). Among deaths with drug overdose as the underlying cause, the type of drug or drug category is indicated by the following ICD-10 multiple cause-of-death codes: opioids (T40.0, T40.1, T40.2, T40.3, T40.4, or T40.6)**; natural/semisynthetic opioids (T40.2); methadone (T40.3); heroin (T40.1); synthetic opioids other than methadone (T40.4); cocaine (T40.5); and psychostimulants with abuse potential (T43.6).†† Some deaths involved more than one type of drug, and these were included in rates for each drug category; thus, categories are not mutually exclusive.§§

Annual percent change with statistically significant trends in age-adjusted drug overdose death rates¶¶ for all 50 states and DC from 2013 to 2017 and in age-adjusted death rates involving synthetic opioids for 20 states that met drug specificity criteria*** were analyzed using Joinpoint regression.††† Age-adjusted overdose death rates were examined from 2016 to 2017 for all opioids, prescription opioids (*5*), heroin, and synthetic opioids. Death rates were stratified by age, sex, racial/ethnic group, urbanization level,§§§ and state. State-level analyses included DC and 34 states with adequate drug

* Natural opioids include morphine and codeine, and semisynthetic opioids include drugs such as oxycodone, hydrocodone, hydromorphone, and oxymorphone. Methadone is a synthetic opioid. Prescription opioids include methadone, natural, and semisynthetic opioids. Synthetic opioids, other than methadone, include drugs such as tramadol and fentanyl. Heroin is an illicit opioid synthesized from morphine that can be a white or brown powder or a black, sticky substance.

† https://www.cdc.gov/nchs/products/databriefs/db329.htm.

§ https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm.

¶ https://www.cdc.gov/nchs/nvss/mortality_public_use_data.htm.

** T40.0 (opium) and T40.6 (other and unspecified narcotics).

†† Psychostimulants with abuse potential include drugs such as methamphetamine and 3,4-methylenedioxy-methamphetamine (MDMA).

§§ For example, a death involving both a synthetic opioid other than methadone and heroin would be included in both the synthetic opioid other than methadone and heroin death rates.

¶¶ Age-adjusted death rates were calculated by applying age-specific death rates to the 2000 U.S. Census standard population age distribution https://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_04.pdf.

*** State-level analyses for synthetic opioid-involved overdose deaths, comparing death rates from 2013 to 2017, included 20 states that met the following criteria: 1) >80% of drug overdose death certificates named at least one specific drug in 2013–2017; 2) change from 2013 to 2017 in the percentage of death certificates reporting at least one specific drug was <10 percentage points; and 3) ≥20 deaths involving synthetic opioids other than methadone occurred during 2013 and 2017. States whose reporting of any specific drug or drugs involved in an overdose changed by ≥10 percentage points from 2013 to 2017 were excluded because drug-specific overdose numbers and rates might have changed substantially from 2013 to 2017 as a result of changes in reporting.

††† For all analyses, a p-value of <0.05 was considered to be statistically significant. https://surveillance.cancer.gov/joinpoint/.

§§§ Categories of 2013 NCHS Urban-Rural Classification Scheme for Counties (https://www.cdc.gov/nchs/data_access/urban_rural.htm). Large central metro: Counties in metropolitan statistical areas (MSAs) of ≥1 million population that 1) contain the entire population of largest principal city of the MSA, or 2) have their entire population contained in the largest principal city of the MSA, or 3) contain at least 250,000 inhabitants of any principal city of the MSA; Large fringe metro: Counties in MSAs of ≥1 million population that did not qualify as large central metro counties; Medium metro: Counties in MSAs of populations of 250,000–999,999; Small metro: Counties in MSAs of populations <250,000; Micropolitan (nonmetropolitan counties): counties in micropolitan statistical areas; Noncore (nonmetropolitan counties): nonmetropolitan counties that did not qualify as micropolitan.

specificity data for 2016 and 2017.¶¶¶ Analyses comparing changes in death rates from 2016 to 2017 used z-tests when the number of deaths was ≥100 and nonoverlapping confidence intervals based on a gamma distribution when the number was <100.****

Drug overdoses resulted in 70,237 deaths during 2017; among these, 47,600 (67.8%) involved opioids (14.9 per 100,000 population), representing a 12.0% rate increase from 2016 (Table 1). Synthetic opioids were involved in 59.8% of all opioid-involved overdose deaths; the rate increased by 45.2% from 2016 to 2017 (Table 2). From 2013 through 2017, overdose death rates increased significantly in 35 states and DC; 15 of 20 states that met drug specificity criteria had significant increases in overdose death rates involving synthetic opioids (Figure). From 2016 to 2017, death rates involving cocaine and psychostimulants increased 34.4% (from 3.2 to 4.3 per 100,000) and 33.3% (from 2.4 to 3.2 per 100,000), respectively, likely contributing to increases in drug overdose deaths; however, rates remained stable for deaths involving prescription opioids (5.2 per 100,000) (Table 1) and heroin (4.9) (Table 2).

From 2016 to 2017, opioid-involved overdose deaths increased among males and females and among persons aged ≥25 years, non-Hispanic whites (whites), non-Hispanic blacks (blacks), and Hispanics (Table 1). The largest relative change occurred among blacks (25.2%), and the largest absolute rate increase was among males aged 25–44 years (an increase of 4.6 per 100,000). The largest relative change among age groups was for persons aged ≥65 years (17.2%). Counties in medium metro

¶¶¶ State-level analyses comparing death rates from 2016 to 2017 included 34 states and DC that met the following criteria: 1) >80% of drug overdose death certificates named at least one specific drug in 2016 and 2017; 2) change from 2016 to 2017 in the percentage of death certificates reporting at least one specific drug was <10 percentage points; and 3) ≥20 deaths occurred during 2016 and 2017 in at least two opioid subcategories examined. States whose reporting of any specific drug or drugs involved in an overdose changed by ≥10 percentage points from 2016 to 2017 were excluded because drug-specific overdose numbers and rates might have changed substantially from 2016 to 2017 as a result of changes in reporting.

**** Z-tests were used if the number of deaths was ≥100, and a p-value of <0.05 was considered to be statistically significant. Nonoverlapping confidence intervals based on the gamma method were used if the number of deaths was <100 in 2015 or 2016. Note that the method of comparing confidence intervals is a conservative method for statistical significance; caution should be observed when interpreting a nonsignificant difference when the lower and upper limits being compared overlap only slightly.

TABLE 1. Annual number and age-adjusted rate of drug overdose deaths* involving all opioids† and prescription opioids,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2016 and 2017**

	All opioids						Prescription opioids					
	2016		2017		Change from 2016 to 2017¶¶		2016		2017		Change from 2016 to 2017¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
All	**42,249**	**13.3**	**47,600**	**14.9**	**1.6*** **	**12.0*** **	**17,087**	**5.2**	**17,029**	**5.2**	**0.0**	**0.0**
Sex												
Male	28,498	18.1	32,337	20.4	2.3***	12.7***	9,978	6.2	9,873	6.1	-0.1	-1.6
Female	13,751	8.5	15,263	9.4	0.9***	10.6***	7,109	4.3	7,156	4.2	-0.1	-2.3
Age group (yrs)												
0–14	83	0.1	79	0.1	0.0	0.0	60	0.1	50	0.1	0.0	0.0
15–24	4,027	9.3	4,094	9.5	0.2	2.2	1,146	2.6	1,050	2.4	-0.2	-7.7
25–34	11,552	25.9	13,181	29.1	3.2***	12.4***	3,442	7.7	3,408	7.5	-0.2	-2.6
35–44	9,747	24.1	11,149	27.3	3.2***	13.3***	3,727	9.2	3,714	9.1	-0.1	-1.1
45–54	9,074	21.2	10,207	24.1	2.9***	13.7***	4,307	10.1	4,238	10.0	-0.1	-1.0
55–64	6,321	15.2	7,153	17.0	1.8***	11.8***	3,489	8.4	3,509	8.4	0.0	0.0
≥65	1,441	2.9	1,724	3.4	0.5***	17.2***	915	1.9	1,055	2.1	0.2***	10.5***
Sex and age group (yrs)												
Male 15–24	2,986	13.4	2,885	13.0	-0.4	-3.0	852	3.8	728	3.3	-0.5***	-13.2***
Male 25–44	15,137	35.4	17,352	40.0	4.6***	13.0***	4,527	10.6	4,516	10.4	-0.2	-1.9
Male 45–64	9,519	23.2	11,061	26.9	3.7***	15.9***	4,124	10.0	4,089	9.9	-0.1	-1.0
Female 15–24	1,041	4.9	1,209	5.7	0.8***	16.3***	294	1.4	322	1.5	0.1	7.1
Female 25–44	6,162	14.5	6,978	16.3	1.8***	12.4***	2,642	6.2	2,606	6.1	-0.1	-1.6
Female 45–64	5,876	13.6	6,299	14.6	1.0***	7.4***	3,672	8.5	3,658	8.5	0.0	0.0
Race and Hispanic origin**												
White, non-Hispanic	33,450	17.5	37,113	19.4	1.9***	10.9***	14,167	7.0	13,900	6.9	-0.1	-1.4
Black, non-Hispanic	4,374	10.3	5,513	12.9	2.6***	25.2***	1,392	3.3	1,508	3.5	0.2	6.1
Hispanic	3,440	6.1	3,932	6.8	0.7***	11.5***	1,133	2.1	1,211	2.2	0.1	4.8
American Indian/Alaska Native, non-Hispanic	369	13.9	408	15.7	1.8	12.9	173	6.5	187	7.2	0.7	10.8
Asian/Pacific Islander, non-Hispanic	323	1.5	348	1.6	0.1	6.7	131	0.7	130	0.6	-0.1	-14.3
County urbanization level††												
Large central metro	12,903	12.5	14,518	13.9	1.4***	11.2***	4,930	4.7	4,945	4.7	0.0	0.0
Large fringe metro	11,993	15.4	13,594	17.2	1.8***	11.7***	4,209	5.2	4,273	5.2	0.0	0.0
Medium metro	9,264	14.3	10,561	16.2	1.9***	13.3***	3,988	6.0	3,951	5.9	-0.1	-1.7
Small metro	3,224	11.7	3,560	12.9	1.2***	10.3***	1,471	5.2	1,479	5.2	0.0	0.0

See table footnotes on next page.

TABLE 1. (*Continued*) Annual number and age-adjusted rate of drug overdose deaths* involving all opioids† and prescription opioids,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2016 and 2017**

	All opioids						Prescription opioids					
	2016		2017		Change from 2016 to 2017¶¶		2016		2017		Change from 2016 to 2017¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
Micropolitan (nonmetro)	3,068	12.1	3,462	13.9	1.8***	14.9***	1,475	5.7	1,440	5.6	-0.1	-1.8
Noncore (nonmetro)	1,797	10.5	1,905	11.2	0.7	6.7	1,014	5.7	941	5.3	-0.4	-7.0
Selected states§§												
States with very good to excellent reporting (n = 27)												
Alaska	94	12.5	102	13.9	1.4	11.2	51	6.8	51	7.0	0.2	2.9
Connecticut	855	24.5	955	27.7	3.2***	13.1***	264	7.2	273	7.7	0.5	6.9
District of Columbia	209	30.0	244	34.7	4.7	15.7	66	9.3	58	8.4	-0.9	-9.7
Georgia	918	8.8	1,014	9.7	0.9***	10.2***	536	5.1	568	5.4	0.3	5.9
Hawaii	77	5.2	53	3.4	-1.8	-34.6	55	3.6	40	2.5	-1.1	-30.6
Illinois	1,947	15.3	2,202	17.2	1.9***	12.4***	479	3.7	623	4.8	1.1***	29.7***
Iowa	183	6.2	206	6.9	0.7	11.3	92	3.1	104	3.4	0.3	9.7
Maine	301	25.2	360	29.9	4.7***	18.7***	154	12.5	100	7.6	-4.9***	-39.2***
Maryland	1,821	29.7	1,985	32.2	2.5***	8.4***	812	13.1	711	11.5	-1.6***	-12.2***
Massachusetts	1,990	29.7	1,913	28.2	-1.5	-5.1	351	4.9	321	4.6	-0.3	-6.1
Nevada	408	13.3	412	13.3	0.0	0.0	275	8.9	276	8.7	-0.2	-2.2
New Hampshire	437	35.8	424	34.0	-1.8	-5.0	89	6.5	62	4.8	-1.7	-26.2
New Mexico	349	17.5	332	16.7	-0.8	-4.6	186	9.2	171	8.5	-0.7	-7.6
New York	3,009	15.1	3,224	16.1	1.0***	6.6***	1,100	5.4	1,044	5.1	-0.3	-5.6
North Carolina	1,506	15.4	1,953	19.8	4.4***	28.6***	695	6.9	659	6.5	-0.4	-5.8
Ohio	3,613	32.9	4,293	39.2	6.3***	19.1***	867	7.7	947	8.4	0.7	9.1
Oklahoma	444	11.6	388	10.2	-1.4	-12.1	322	8.4	251	6.7	-1.7***	-20.2***
Oregon	312	7.6	344	8.1	0.5	6.6	165	3.9	154	3.5	-0.4	-10.3
Rhode Island	279	26.7	277	26.9	0.2	0.7	114	10.5	99	8.8	-1.7	-16.2
South Carolina	628	13.1	749	15.5	2.4***	18.3***	381	7.8	345	7.1	-0.7	-9.0
Tennessee	1,186	18.1	1,269	19.3	1.2	6.6	739	11.1	644	9.6	-1.5***	-13.5***
Utah	466	16.4	456	15.5	-0.9	-5.5	349	12.5	315	10.8	-1.7	-13.6
Vermont	101	18.4	114	20.0	1.6	8.7	35	5.9	40	6.3	0.4	6.8
Virginia	1,130	13.5	1,241	14.8	1.3***	9.6***	400	4.7	404	4.7	0.0	0.0
Washington	709	9.4	742	9.6	0.2	2.1	388	5.0	343	4.3	-0.7***	-14.0***
West Virginia	733	43.4	833	49.6	6.2***	14.3***	340	19.7	304	17.2	-2.5	-12.7
Wisconsin	866	15.8	926	16.9	1.1	7.0	382	6.7	362	6.4	-0.3	-4.5
States with good reporting (n = 8)												
Arizona	769	11.4	928	13.5	2.1***	18.4***	380	5.6	414	5.9	0.3	5.4
California	2,012	4.9	2,199	5.3	0.4***	8.2***	1,172	2.8	1,169	2.8	0.0	0.0
Colorado	536	9.5	578	10.0	0.5	5.3	258	4.5	300	5.1	0.6	13.3
Kentucky	989	23.6	1,160	27.9	4.3***	18.2***	429	10.0	433	10.2	0.2	2.0
Michigan	1,762	18.5	2,033	21.2	2.7***	14.6***	678	7.0	633	6.5	-0.5	-7.1
Minnesota	396	7.4	422	7.8	0.4	5.4	195	3.6	195	3.6	0.0	0.0
Missouri	914	15.9	952	16.5	0.6	3.8	268	4.5	253	4.1	-0.4	-8.9
Texas	1,375	4.9	1,458	5.1	0.2	4.1	617	2.2	646	2.3	0.1	4.5

Source: National Vital Statistics System, Mortality file.

* Deaths are classified using the *International Classification of Diseases, Tenth Revision* (ICD–10). Drug overdose deaths are identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Rates are age-adjusted using the direct method and the 2000 U.S. standard population, except for age-specific crude rates. All rates are per 100,000 population.

† Drug overdose deaths, as defined, that have opium (T40.0), heroin (T40.1), natural and semisynthetic opioids (T40.2), methadone (T40.3), synthetic opioids other than methadone (T40.4), or other and unspecified narcotics (T40.6) as a contributing cause.

§ Drug overdose deaths, as defined, that have natural and semisynthetic opioids (T40.2) or methadone (T40.3) as a contributing cause.

¶ Categories of deaths are not exclusive because deaths might involve more than one drug. Summing of categories will result in more than the total number of deaths in a year.

** Data for Hispanic origin should be interpreted with caution; studies comparing Hispanic origin on death certificates and on census surveys have shown inconsistent reporting on Hispanic ethnicity. Potential race misclassification might lead to underestimates for certain categories, primarily American Indian/Alaska Native non-Hispanic and Asian/Pacific Islander non-Hispanic decedents. https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf.

†† By 2013 urbanization classification (https://www.cdc.gov/nchs/data_access/urban_rural.htm).

§§ Analyses were limited to states meeting the following criteria. For states with very good to excellent reporting, ≥90% of drug overdose deaths mention at least one specific drug in 2016, with the change in drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2016 to 2017. States with good reporting had 80% to <90% of drug overdose deaths mention at least one specific drug in 2016, with the change in the percentage of drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2016 to 2017. States included also were required to have stable rate estimates, based on ≥20 deaths, in at least two drug categories (i.e., opioids, prescription opioids, synthetic opioids other than methadone, and heroin).

¶¶ Absolute rate change is the difference between 2016 and 2017 rates. Percent change is the absolute rate change divided by the 2016 rate, multiplied by 100. Nonoverlapping confidence intervals based on the gamma method were used if the number of deaths was <100 in 2016 or 2017, and z-tests were used if the number of deaths was ≥100 in both 2016 and 2017.

*** Statistically significant (P-value <0.05).

TABLE 2. Annual number and age-adjusted rate of drug overdose deaths* involving heroin† and synthetic opioids other than methadone,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2016 and 2017**

	Heroin						Synthetic opioids other than methadone					
	2016		2017		Change from 2016 to 2017¶¶		2016		2017		Change from 2016 to 2017¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
All	**15,469**	**4.9**	**15,482**	**4.9**	**0.0**	**0.0**	**19,413**	**6.2**	**28,466**	**9.0**	**2.8*****	**45.2*****
Sex												
Male	11,752	7.5	11,596	7.3	-0.2***	-2.7***	13,835	8.9	20,524	13.0	4.1***	46.1***
Female	3,717	2.4	3,886	2.5	0.1	4.2	5,578	3.5	7,942	5.0	1.5***	42.9***
Age group (yrs)												
0–14	—†††	—†††	—†††	—†††	—†††	—†††	18	—†††	33	0.1	—†††	—†††
15–24	1,728	4.0	1,454	3.4	-0.6***	-15.0***	1,958	4.5	2,655	6.1	1.6***	35.6***
25–34	5,051	11.3	4,890	10.8	-0.5***	-4.4***	6,094	13.6	8,825	19.5	5.9***	43.4***
35–44	3,625	9.0	3,713	9.1	0.1	1.1	4,825	11.9	7,084	17.3	5.4***	45.4***
45–54	3,009	7.0	3,043	7.2	0.2	2.9	3,872	9.1	5,762	13.6	4.5***	49.5***
55–64	1,777	4.3	2,005	4.8	0.5***	11.6***	2,238	5.4	3,481	8.3	2.9***	53.7***
≥65	275	0.6	368	0.7	0.1***	16.7***	405	0.8	620	1.2	0.4***	50.0***
Sex and age group (yrs)												
Male 15–24	1,275	5.7	1,031	4.7	-1.0***	-17.5***	1,434	6.4	1,877	8.5	2.1***	32.8***
Male 25–44	6,643	15.5	6,428	14.8	-0.7***	-4.5***	8,029	18.8	11,693	27.0	8.2***	43.6***
Male 45–64	3,599	8.8	3,830	9.3	0.5***	5.7***	4,116	10.0	6,524	15.8	5.8***	58.0***
Female 15–24	453	2.1	423	2.0	-0.1	-4.8	524	2.5	778	3.7	1.2***	48.0***
Female 25–44	2,033	4.8	2,175	5.1	0.3***	6.3***	2,890	6.8	4,216	9.8	3.0***	44.1***
Female 45–64	1,187	2.8	1,218	2.8	0.0	0.0	1,994	4.6	2,719	6.3	1.7***	37.0***
Race and Hispanic origin**												
White, non-Hispanic	11,631	6.3	11,293	6.1	-0.2***	-3.2***	15,143	8.2	21,956	11.9	3.7***	45.1***
Black, non-Hispanic	1,899	4.5	2,140	4.9	0.4***	8.9***	2,391	5.6	3,832	9.0	3.4***	60.7***
Hispanic	1,555	2.8	1,669	2.9	0.1	3.6	1,505	2.7	2,152	3.7	1.0***	37.0***
American Indian/Alaska Native, non-Hispanic	131	5.0	136	5.2	0.2	4.0	113	4.1	171	6.5	2.4***	58.5***
Asian/Pacific Islander, non-Hispanic	102	0.5	119	0.5	0.0	0.0	134	0.6	189	0.8	0.2***	33.3***
County urbanization level††												
Large central metro	5,507	5.3	5,820	5.6	0.3***	5.7***	6,009	5.8	8,511	8.2	2.4***	41.4***
Large fringe metro	4,623	6.1	4,526	5.8	-0.3***	-4.9***	6,264	8.2	8,991	11.6	3.4***	41.5***
Medium metro	3,077	4.9	2,973	4.6	-0.3***	-6.1***	3,978	6.3	6,254	9.8	3.5***	55.6***
Small metro	990	3.7	972	3.6	-0.1	-2.7	1,270	4.7	1,878	7.0	2.3***	48.9***
Micropolitan (nonmetro)	860	3.6	801	3.3	-0.3	-8.3	1,228	5.0	1,860	7.7	2.7***	54.0***
Noncore (nonmetro)	412	2.6	390	2.4	-0.2	-7.7	664	4.1	972	6.0	1.9***	46.3***
Selected states§§												
States with very good to excellent reporting (n = 27)												
Alaska	49	6.5	36	4.9	-1.6	-24.6	—†††	—†††	37	4.9	—†††	—†††
Connecticut	450	13.1	425	12.4	-0.7	-5.3	500	14.8	686	20.3	5.5***	37.2***
District of Columbia	122	17.3	127	18.0	0.7	4.0	129	19.2	182	25.7	6.5***	33.9***
Georgia	226	2.2	263	2.6	0.4	18.2	277	2.7	419	4.1	1.4***	51.9***
Hawaii	20	1.4	10	—†††	—†††	—†††	—†††	—†††	—†††	—†††	—†††	—†††
Illinois	1,040	8.2	1,187	9.2	1.0***	12.2***	907	7.2	1,251	9.8	2.6***	36.1***
Iowa	47	1.7	61	2.1	0.4	23.5	58	2.0	92	3.2	1.2¶¶	60.0¶¶
Maine	55	4.7	76	6.2	1.5	31.9	199	17.3	278	23.5	6.2***	35.8***
Maryland	650	10.7	522	8.6	-2.1***	-19.6***	1,091	17.8	1,542	25.2	7.4***	41.6***
Massachusetts	630	9.5	466	7.0	-2.5***	-26.3***	1,550	23.5	1,649	24.5	1.0	4.3

See table footnotes on next page.

TABLE 2. (*Continued*) Annual number and age-adjusted rate of drug overdose deaths* involving heroin† and synthetic opioids other than methadone,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2016 and 2017**

	Heroin						Synthetic opioids other than methadone					
	2016		2017		Change from 2016 to 2017¶¶		2016		2017		Change from 2016 to 2017¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
Nevada	86	2.9	94	3.1	0.2	6.9	53	1.7	66	2.2	0.5	29.4
New Hampshire	34	2.8	28	2.4	-0.4	-14.3	363	30.3	374	30.4	0.1	0.3
New Mexico	161	8.2	144	7.4	-0.8	-9.8	78	4.0	75	3.7	-0.3	-7.5
New York	1,307	6.5	1,356	6.8	0.3	4.6	1,641	8.3	2,238	11.3	3.0***	36.1***
North Carolina	544	5.7	537	5.6	-0.1	-1.8	601	6.2	1,285	13.2	7.0***	112.9***
Ohio	1,478	13.5	1,000	9.2	-4.3***	-31.9***	2,296	21.1	3,523	32.4	11.3***	53.6***
Oklahoma	53	1.4	61	1.6	0.2	14.3	98	2.5	102	2.6	0.1	4.0
Oregon	114	2.9	124	3.0	0.1	3.4	43	1.1	85	2.1	1.0***	90.9***
Rhode Island	25	2.5	14	—†††	—†††	—†††	182	17.8	201	20.1	2.3	12.9
South Carolina	115	2.5	153	3.2	0.7	28.0	237	5.0	404	8.5	3.5***	70.0***
Tennessee	260	4.1	311	4.8	0.7	17.1	395	6.2	590	9.3	3.1***	50.0***
Utah	166	5.6	147	4.8	-0.8	-14.3	72	2.5	92	3.1	0.6	24.0
Vermont	45	8.7	41	7.3	-1.4	-16.1	53	10.1	77	13.8	3.7	36.6
Virginia	450	5.5	556	6.7	1.2***	21.8***	648	7.9	829	10.0	2.1***	26.6***
Washington	283	3.9	306	4.0	0.1	2.6	93	1.3	143	1.9	0.6***	46.2***
West Virginia	235	14.9	244	14.9	0.0	0.0	435	26.3	618	37.4	11.1***	42.2***
Wisconsin	389	7.3	414	7.8	0.5	6.8	288	5.3	466	8.6	3.3***	62.3***
States with good reporting (n = 8)												
Arizona	299	4.5	334	5.0	0.5	11.1	123	1.8	267	4.0	2.2***	122.2***
California	587	1.4	715	1.7	0.3***	21.4***	355	0.9	536	1.3	0.4***	44.4***
Colorado	234	4.2	224	3.9	-0.3	-7.1	72	1.3	112	2.0	0.7***	53.8***
Kentucky	311	7.6	269	6.6	-1.0	-13.2	465	11.5	780	19.1	7.6***	66.1***
Michigan	727	7.6	783	8.2	0.6	7.9	921	9.8	1,368	14.4	4.6***	46.9***
Minnesota	149	2.8	111	2.0	-0.8***	-28.6***	99	1.9	184	3.5	1.6***	84.2***
Missouri	380	6.7	299	5.3	-1.4***	-20.9***	441	7.8	618	10.9	3.1***	39.7***
Texas	530	1.9	569	2.0	0.1	5.3	250	0.9	348	1.2	0.3***	33.3***

Source: National Vital Statistics System, Mortality file.

* Deaths are classified using the *International Classification of Diseases, Tenth Revision* (ICD–10). Drug overdose deaths are identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Rates are age-adjusted using the direct method and the 2000 U.S. standard population, except for age-specific crude rates. All rates are per 100,000 population.

† Drug overdose deaths, as defined, that have heroin (T40.1) as a contributing cause.

§ Drug overdose deaths, as defined, that have semisynthetic opioids other than methadone (T40.4) as a contributing cause.

¶ Categories of deaths are not exclusive as deaths might involve more than one drug. Summing of categories will result in more than the total number of deaths in a year.

** Data on Hispanic origin should be interpreted with caution; studies comparing Hispanic origin on death certificates and on census surveys have shown inconsistent reporting on Hispanic ethnicity. Potential race misclassification might lead to underestimates for certain categories, primarily American Indian/Alaska Native non-Hispanic and Asian/Pacific Islander non-Hispanic decedents. https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf.

†† By 2013 urbanization classification (https://www.cdc.gov/nchs/data_access/urban_rural.htm).

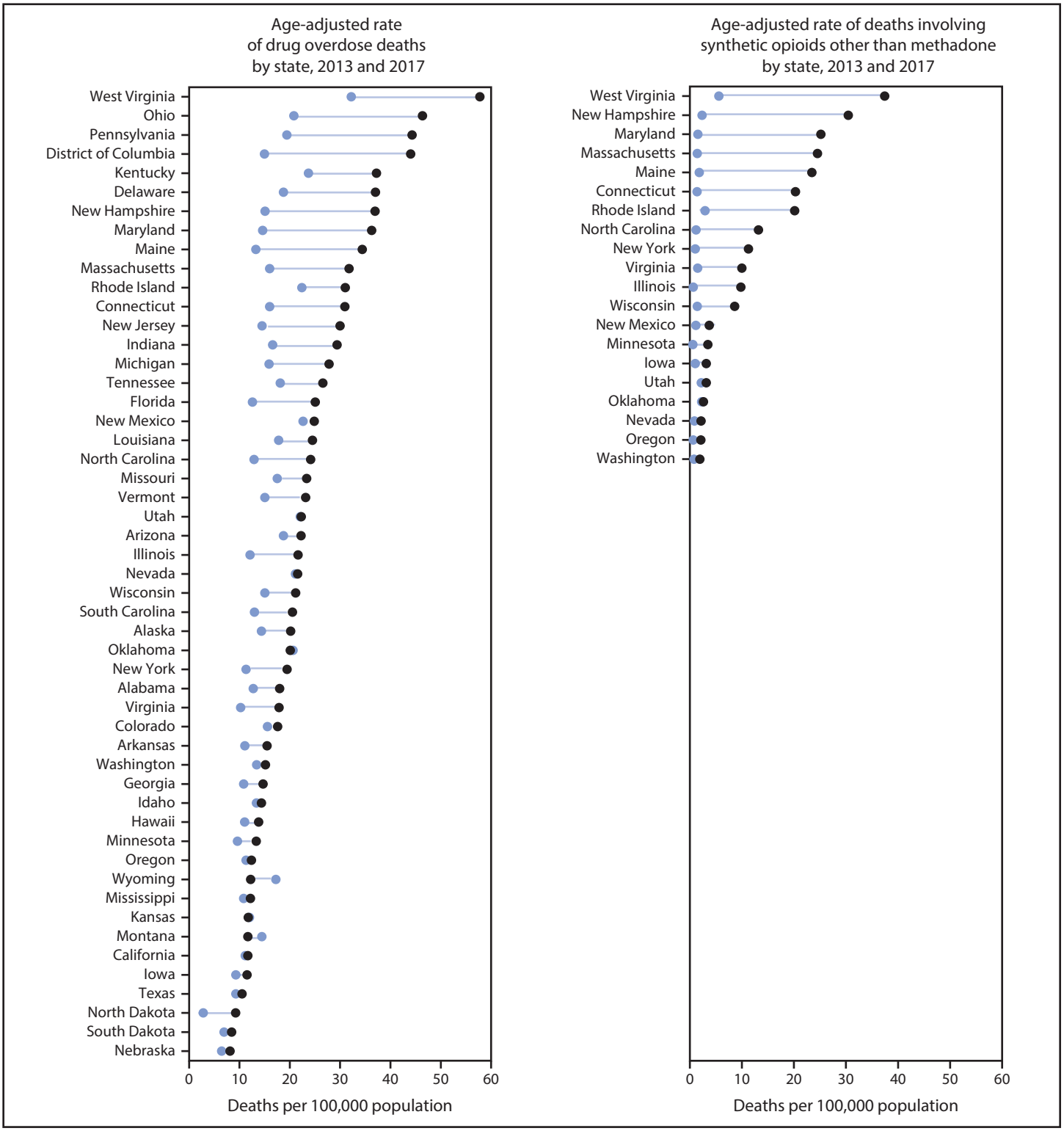
§§ Analyses were limited to states meeting the following criteria. For states with very good to excellent reporting, ≥90% of drug overdose deaths mention at least one specific drug in 2016, with the change in drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2016 to 2017. States with good reporting had 80% to <90% of drug overdose deaths mention at least one specific drug in 2016, with the change in the percentage of drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2016 to 2017. States included also were required to have stable rate estimates, based on ≥20 deaths, in at least two drug categories (i.e., opioids, prescription opioids, synthetic opioids other than methadone, and heroin).

¶¶ Absolute rate change is the difference between 2016 and 2017 rates. Percent change is the absolute rate change divided by the 2016 rate, multiplied by 100. Nonoverlapping confidence intervals based on the gamma method were used if the number of deaths was <100 in 2016 or 2017, and z-tests were used if the number of deaths was ≥100 in both 2016 and 2017. Note that the method of comparing confidence intervals is a conservative method for statistical significance; caution should be observed when interpreting a nonsignificant difference when the lower and upper limits being compared overlap only slightly. Confidence intervals of 2016 and 2017 rates of synthetic opioid-involved deaths in Iowa overlapped only slightly: (1.40, 2.39), (2.36, 3.59).

*** Statistically significant (P-value <0.05).

††† Cells with ≤9 deaths are not reported. Rates based on <20 deaths are not considered reliable and are not reported.

FIGURE. Age-adjusted rates* of drug overdose deaths and deaths involving synthetic opioids other than methadone,† by state§ — United States, 2013 and 2017¶



See footnotes on next page.

FIGURE. (*Continued*) Age-adjusted rates* of drug overdose deaths and deaths involving synthetic opioids other than methadone,† by state,§ 2013 and 2017¶

* Rates shown are the number of deaths per 100,000 population. Age-adjusted death rates were calculated by applying age-specific death rates to the 2000 U.S standard population age distribution.

† Deaths are classified using the *International Classification of Diseases, Tenth Revision* (ICD–10). Left panel includes drug overdose deaths identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Right panel includes drug overdose deaths, as defined, that have synthetic opioids other than methadone (T40.4) as a contributing cause.

§ State-level analyses of overdose rates for deaths involving synthetic opioids other than methadone included 20 states that met the following criteria: 1) >80% of drug overdose death certificates named at least one specific drug in 2013–2017; 2) change from 2013 to 2017 in the percentage of death certificates reporting at least one specific drug was <10 percentage points; and 3) ≥20 deaths involving synthetic opioids other than methadone occurred each year during 2013–2017. States whose reporting of any specific drug or drugs involved in an overdose changed by ≥10 percentage points from 2013 to 2017 were excluded because drug-specific overdose numbers and rates might have changed substantially from 2013 to 2017 as a result of changes in reporting.

¶ *Left panel*: Joinpoint regression examining changes in trends from 2013 to 2017 indicated that 35 states and the District of Columbia had significant increases in drug overdose death rates from 2013 to 2017 (Alabama, Alaska, Arizona, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, Washington, West Virginia, and Wisconsin). All remaining states had nonsignificant trends during this period. *Right panel*: Joinpoint regression examining changes in trends from 2013 to 2017 indicated that 15 states had significant increases in death rates for overdoses involving synthetic opioids other than methadone from 2013 to 2017 (Connecticut, Illinois, Iowa, Maine, Maryland, Minnesota, Nevada, New York, North Carolina, Oregon, Rhode Island, Virginia, Washington, West Virginia, and Wisconsin). The five remaining states analyzed had nonsignificant trends during this period. Significant increases in trends were not detected in some states with large absolute increases in death rates from 2013 to 2017 because of limited power to detect significant effects.

areas experienced the largest absolute rate increase (an increase of 1.9 per 100,000), and the largest relative rate increase occurred in micropolitan counties (14.9%). Death rates increased significantly in 15 states, with the largest relative changes in North Carolina (28.6%), Ohio (19.1%), and Maine (18.7%).

From 2016 to 2017, the prescription opioid-involved death rate decreased 13.2% among males aged 15–24 years but increased 10.5% among persons aged ≥65 years (Table 1). These death rates remained stable from 2016 to 2017 across all racial groups and urbanization levels and in most states, although five states (Maine, Maryland, Oklahoma, Tennessee, and Washington) experienced significant decreases, and one (Illinois) had a significant increase. The largest relative changes included a 29.7% increase in Illinois and a 39.2% decrease in Maine. The highest prescription opioid-involved death rates in 2017 were in West Virginia (17.2 per 100,000), Maryland (11.5), and Utah (10.8).

Heroin-involved overdose death rates declined among many groups in 2017 compared with those in 2016 (Table 2). The largest declines occurred among persons aged 15–24 years (15.0%), particularly males (17.5%), as well as in medium metro counties (6.1%). Rates declined 3.2% among whites. However, heroin-involved overdose death rates did increase among some groups; the largest relative rate increase occurred among persons aged ≥65 years (16.7%) and 55–64 years (11.6%) and among blacks (8.9%). Rates remained stable in most states, with significant decreases in five states (Maryland, Massachusetts, Minnesota, Missouri, and Ohio), and increases in three (California, Illinois, and Virginia). The largest relative decrease (31.9%) was in Ohio, and the largest relative increase (21.8%) was in Virginia. The highest heroin-involved overdose death rates in 2017 were in DC (18.0 per 100,000), West Virginia (14.9), and Connecticut (12.4).

Deaths involving synthetic opioids propelled increases from 2016 to 2017 across all demographic categories (Table 2). The highest death rate was in males aged 25–44 years (27.0 per 100,000), and the largest relative increases occurred among blacks (60.7%) and American Indian/Alaska Natives (58.5%). Deaths increased across all urbanization levels from 2016 to 2017. Twenty-three states and DC experienced significant increases in synthetic opioid-involved overdose death rates, including eight states west of the Mississippi River. The largest relative rate increase occurred in Arizona (122.2%), followed by North Carolina (112.9%) and Oregon (90.9%). The highest synthetic opioid-involved overdose death rates in 2017 were in West Virginia (37.4 per 100,000), Ohio (32.4), and New Hampshire (30.4).

Discussion

In the United States, drug overdoses resulted in 702,568 deaths during 1999–2017, with 399,230 (56.8%) involving opioids.†††† From 2016 to 2017, death rates from all opioids increased, with increases driven by synthetic opioids. Deaths involving IMF have been seen primarily east of the Mississippi River;§§§§ however, recent increases occurred in eight states west of the Mississippi River, including Arizona, California, Colorado, Minnesota, Missouri, Oregon, Texas, and Washington.

Drug overdose death rates from 2013 to 2017 increased in most states; the influence of synthetic opioids on these rate increases was seen in approximately one quarter of all states during this same 5-year period. Overdose deaths involving cocaine and psychostimulants also have increased in recent years (*1,6*). Overall, the overdose epidemic continues to worsen, and it has grown increasingly complex by co-involvement of prescription and illicit drugs (*7,8*).¶¶¶¶ For example, in 2016, synthetic opioids

†††† https://wonder.cdc.gov.

§§§§ https://emergency.cdc.gov/han/han00413.asp.

¶¶¶¶ https://www.cdc.gov/nchs/data/nvsr/nvsr67/nvsr67_09-508.pdf.

Summary

What is already known about this topic?

The U.S. opioid overdose epidemic continues to evolve. In 2016, 66.4% of the 63,632 drug overdose deaths involved an opioid.

What is added by this report?

In 2017, among 70,237 drug overdose deaths, 47,600 (67.8%) involved opioids, with increases across age groups, racial/ethnic groups, county urbanization levels, and in multiple states. From 2013 to 2017, synthetic opioids contributed to increases in drug overdose death rates in several states. From 2016 to 2017, synthetic opioid-involved overdose death rates increased 45.2%.

What are the implications for public health practice?

Continued federal, state, and local surveillance efforts to inform evidence-based prevention, response, and treatment strategies and to strengthen public health and public safety partnerships are urgently needed.

(primarily IMF) were involved in 23.7% of deaths involving prescription opioids, 37.4% involving heroin, and 40.3% involving cocaine (*9*). In addition, death rates are increasing across multiple demographic groups. For example, although death rates involving opioids remained highest among whites, relatively large increases across several drug categories were observed among blacks.

The findings in this report are subject to at least five limitations. First, at autopsy, substances tested for vary by time and jurisdiction, and improvements in toxicologic testing might account for some reported increases. Second, the specific types of drugs involved were not included on 15% of drug overdose death certificates in 2016 and 12% in 2017, and the percentage of death certificates with at least one drug specified ranged among states from 54.7%–99.3% in 2017, limiting rate comparisons between states. Third, because heroin and morphine are metabolized similarly (*10*), some heroin deaths might have been misclassified as morphine deaths, resulting in underreporting of heroin deaths. Fourth, potential race misclassification might have led to underestimates for certain categories, primarily for American Indian/Alaska Natives and Asian/Pacific Islanders.***** Finally, most state-specific analyses were restricted to DC and a subset of states with adequate drug specificity, limiting generalizability.

Through 2017, the drug overdose epidemic continues to worsen and evolve, and the involvement of many types of drugs (e.g., opioids, cocaine, and methamphetamine) underscores the urgency to obtain more timely and local data to inform public health and public safety action. Although prescription opioid- and heroin-involved death rates were stable from 2016 to 2017, they remained high. Some preliminary indicators in 2018 point to possible improvements based on provisional data;††††† however, confirmation will depend on results of pending medical investigations and analysis of final data. Overall, deaths involving synthetic opioids continue to drive increases in overdose deaths. CDC funds 32 states and DC to collect more timely and comprehensive drug overdose data, including improved toxicologic testing in opioid-involved fatal overdoses.§§§§§ CDC is funding prevention activities in 42 states and DC.¶¶¶¶¶ CDC also is leveraging emergency funding to support 49 states, DC, and four territories to broaden their surveillance and response capabilities and enable comprehensive community-level responses with implementation of novel, evidence-based interventions.****** Continued efforts to ensure safe prescribing practices by following the CDC Guideline for Prescribing Opioids for Chronic Pain†††††† are enhanced by access to nonopioid and nonpharmacologic treatments for pain. Other important activities include increasing naloxone availability, expanding access to medication-assisted treatment, enhancing public health and public safety partnerships, and maximizing the ability of health systems to link persons to treatment and harm-reduction services.

***** https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf.
††††† https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm.
§§§§§ https://www.cdc.gov/drugoverdose/foa/state-opioid-mm.html.
¶¶¶¶¶ https://www.cdc.gov/drugoverdose/states/state_prevention.html. https://www.cdc.gov/drugoverdose/foa/ddpi.html.
****** https://www.cdc.gov/cpr/readiness/funding-opioid.htm.
†††††† https://www.cdc.gov/drugoverdose/prescribing/guideline.html.

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Notes from the Field

Mycobacteria chimaera Infections Associated with Heater-Cooler Unit Use During Cardiopulmonary Bypass Surgery — Los Angeles County, 2012–2016

M. Claire Jarashow, PhD[1,2]; Dawn Terashita, MD[1]; Sharon Balter, MD[1]; Benjamin Schwartz, MD[1]

In December 2016, hospital A in Los Angeles County, California, reported two *Mycobacterium avium* complex infections, later identified as *Mycobacterium chimaera*, in patients with a recent history (<5 years) of cardiopulmonary bypass surgery. Both surgical procedures used the Sorin Stöckert 3T (Sorin Group, Munich, Germany) heater-cooler unit brand (currently LivaNova PLC, London, United Kingdom) to heat and cool blood. These heater-cooler units have been linked to outbreaks of *M. chimaera* infections among patients with similar surgical histories in Europe and the United States (*1*,*2*). Sorin Stöckert 3T heater-cooler units contaminated during manufacturing before September 2014 were identified as the source of infection through emission of bioaerosols containing *M. chimaera* during surgery (*3*); these units have been removed and replaced by hospital A.

M. chimaera is a nontuberculous mycobacterium first described in 2004 (*4*). *M. chimaera* infection diagnosis is challenging because clinical manifestations can take months or years to develop and are often nonspecific. Infections have been diagnosed up to 6 years after initial surgical exposure (*5*). Acid-fast bacillus cultures might not be ordered, or results might be negative given the slow-growing nature of *M. chimaera* (*5*,*6*). In hospitals with confirmed *M. chimaera* infections, reported incidence rates among heater-cooler unit–exposed patients ranged from one per 100 persons to one per 1,000 persons (*2*,*5*), and the case-fatality rate was approximately 50% (*6*,*7*). Infections were reported most frequently among patients who had valve replacement or other implants during surgery (*8*).

CDC released a health alert in October 2016 recommending that hospitals that used Sorin Stöckert 3T heater-cooler units notify patients who were potentially exposed during 2012–2016. Because hospital A used implicated heater-cooler units, an investigation was initiated by the Los Angeles County Department of Public Health in December 2016, to enhance case findings and implement control measures. During the investigation, approximately 4,000 patients were sent letters per CDC guidance, describing the potential exposure and instructing them to seek care if they experienced signs or symptoms consistent with *M. chimaera* infection, such as fatigue, unexplained fever, night sweats, weight loss, or wound infection. A nurse call center was established to answer patient questions and refer to care when necessary. All relevant clinical staff members were notified, and an alert was inserted into electronic health records of potentially exposed patients. Hospital A was advised to report all *M. chimaera* cases to the Food and Drug Administration via MedWatch.

By May 2017, 20 confirmed cases of *M. chimaera* infection had been identified, defined as isolation of culture-positive nontuberculous mycobacterium from an invasive nonpulmonary specimen, with *M. chimaera* species identification by DNA sequencing of 16S rRNA, in a patient with a history of cardiopulmonary bypass during 2013–2016. Fifteen (75%) cases were identified by clinicians during patient hospitalization, follow-up care, or subsequent surgical procedures at hospital A or affiliated facilities. Five (25%) patients sought care because they received a patient notification letter and subsequently received a diagnosis of *M. chimaera* infection. All five patients identified through patient notification letters had valve replacements or implants inserted during surgery, and all five remain alive. Thirteen of the 15 patients identified during hospitalization, follow-up care, or subsequent surgery had valve replacements or implants, and eight of these 15 patients were alive at the time this report was produced.

Informing and reminding exposed persons to seek care for *M. chimaera*–associated nonspecific symptoms can be important for diagnosis, particularly because subsequent care might not occur at the exposure hospital, limiting the likelihood of complete exposures being known. Because of *M. chimaera's* long incubation time, hospitals that used implicated heater-cooler units could consider additional proactive steps toward early detection of infection, such as annual patient renotification and implementation of clinician alerts in electronic medical records.

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Notes from the Field

Environmental Investigation of a Multistate Salmonellosis Outbreak Linked to Live Backyard Poultry from a Mail-Order Hatchery — Michigan, 2018

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In the United States, contact with live poultry has been linked to 70 *Salmonella* outbreaks resulting in 4,794 clinical cases since 2000 (*1*). Environmental sampling to confirm the outbreak strain at poultry hatcheries that supply backyard flocks is conducted infrequently during investigations; therefore, the source of the outbreak is rarely identified. On June 12, 2018, the Michigan Department of Health and Human Services requested assistance from CDC to investigate risk factors for *Salmonella* infection linked to live backyard poultry originating at a mail-order hatchery in Michigan (hatchery A). This hatchery supplies young poultry (poults) to backyard flocks through direct sale to flock owners and via feed stores. At the start of the investigation, traceback had linked 24 clinical cases of *Salmonella enterica* serotype Enteritidis to exposure to live poultry from hatchery A. Whole genome sequencing analysis of the clinical isolates revealed that they were closely related (within 0–15 alleles) by whole genome multilocus sequence typing to environmental isolates sampled from shipping containers originating from hatchery A at retail outlets in several states.

Environmental sampling for *Salmonella* was conducted at hatchery A on June 19. Collectors were briefed on priorities and techniques on the day of sampling to ensure consistency. The four sampled areas were prioritized to ensure that the majority of samples were collected from the following areas: 1) hatching environment (liners inside egg hatchers and incubators and inside and outside surfaces of egg hatchers and incubators); 2) preshipping area (swabbing of work surfaces); 3) resident breeding stock environment (laying boxes, bedding, and food or water containers); and 4) trucks used for live poultry and egg transportation onsite and offsite. Shoe covers worn by the sampling team inside hatchery buildings also were tested to sample the environment.

Using best practices for biosecurity (*2*), two sample collectors and two data recorders conducted environmental sampling. Published procedures for environmental collection were reviewed (*3*), and hatchery A was sampled using three swab types: sterile polyurethane culture swabs in liquid Amies agar gel, sterile wooden swabs, and sterile gauze squares. Samples were collected from chick box liners and bedding and placed in sterile whirl pack bags and sterile collection cups, respectively. Samples were transported and delivered at ambient temperature to Michigan Department of Health and Human Services within 6 hours. Samples were cultured and characterized through polymerase chain reaction, followed by pulsed-field gel electrophoresis and whole genome sequencing of isolates.

Among 45 samples collected, *Salmonella* was identified in four (9%) (Table). Three isolates collected from the same building were identified as *Salmonella enterica* serotype Typhimurium, and one isolate from poults in the preshipping area was closely related to the outbreak strain (differing by 1–3 alleles by whole genome multilocus sequence typing. Epidemiologic and laboratory investigations are ongoing.

The investigation confirmed the presence of the outbreak strain at hatchery A. Environmental sampling at poultry hatcheries should be considered as part of an outbreak response. This investigation supported the use of identified priority areas for systematic sampling for *Salmonella* at poultry hatcheries.

* These authors contributed equally.

TABLE. Results of environmental sampling for *Salmonella* by priority sample area — hatchery A, Michigan, June 2018

Priority sample area*,†	No. of samples	Culture results		
		S. Typhimurium,§ no. (%)	*S.* Enteritidis,¶ no. (%)	Negative, no. (%)
Hatching environment	11	0 (—)	0 (—)	11 (100)
Preshipping area	20	0 (—)	1 (5)	19 (95)
Breeding stock	12	3 (25)	0 (—)	9 (75)
Trucks	2	0 (—)	0 (—)	2 (100)
Total	**45**	**3 (7)**	**1 (2)**	**41 (91)**

* Hatching environment = liners inside egg hatchers and incubators, and inside and outside surfaces of egg hatchers and incubators; preshipping area = swabs of work surfaces; resident breeding stock environment = laying boxes, bedding, and food or water containers; trucks = vehicles used for live poultry and egg transportation onsite and offsite.
† Shoe covers worn by the sampling team inside hatchery buildings were also tested to sample the environment.
§ Positive samples collected in the same building from chick box liners, shoe covers worn inside the building, and bedding where chicks were housed.
¶ Collected from male Cornish Rock poults in the preshipping area; this isolate was found to be closely related to the outbreak strain by whole genome sequencing analysis.

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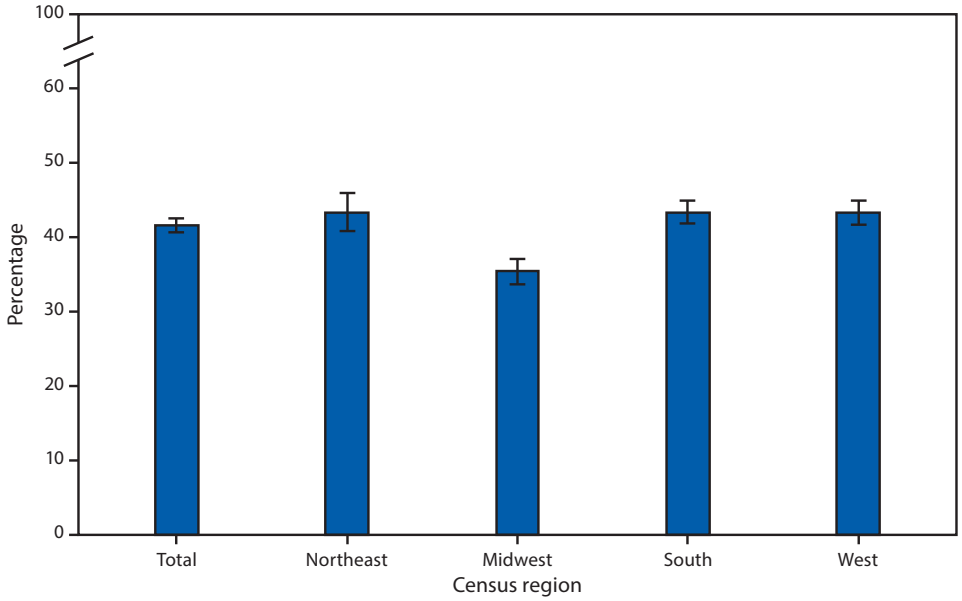
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentage* of Adults Aged ≥18 Years Who Were Ever Tested for Human Immunodeficiency Virus (HIV)† Infection, by U.S. Census Region§ — National Health Interview Survey, 2017¶



* With 95% confidence intervals indicated with error bars.
† Based on responses to a survey question that asked "Except for tests you may have had as part of blood donations, have you ever been tested for HIV?" The weighted percentage of unknown responses was 5.3%; these respondents were not included in the analysis.
§ *Northeast*: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. *Midwest*: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. *West*: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
¶ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population; are shown for sampled adults aged ≥18 years; and are age-adjusted using the projected 2000 U.S. population as the standard population and using four age groups: 18–44, 45–64, 65–74, and ≥75 years.

In 2017, 41.7% of adults aged ≥18 years had ever been tested for HIV. Adults living in the Midwest (35.5%) were less likely to have ever been tested for HIV than adults in the Northeast (43.5%), South (43.5%), and West (43.4%).

Source: Tables of Summary Health Statistics, 2017. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/NHIS/SHS/2017_SHS_Table_A-20.pdf.

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