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Overdose Deaths Involving Opioids, Cocaine, and Psychostimulants — United States, 2015–2016

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During 1999–2015, 568,699 persons died from drug overdoses in the United States.* Drug overdose deaths in the United States increased 11.4% from 2014 to 2015 resulting in 52,404 deaths in 2015, including 33,091 (63.1%) that involved an opioid. The largest rate increases from 2014 to 2015 occurred among deaths involving synthetic opioids other than methadone (synthetic opioids) (72.2%) (*1*). Because of demographic and geographic variations in overdose deaths involving different drugs (*2*,*3*),† CDC examined age-adjusted death rates for overdoses involving all opioids, opioid subcategories (i.e., prescription opioids, heroin, and synthetic opioids),§ cocaine, and psychostimulants with abuse potential (psychostimulants) by demographics, urbanization levels, and in 31 states and the District of Columbia (DC). There were 63,632 drug overdose deaths in 2016; 42,249 (66.4%) involved an opioid.¶ From 2015 to 2016, deaths increased across all drug categories examined. The largest overall rate increases occurred among deaths involving cocaine (52.4%) and synthetic opioids (100%), likely driven by illicitly manufactured fentanyl (IMF) (*2*,*3*). Increases were observed across demographics, urbanization levels, and states and DC. The opioid overdose epidemic in the United States continues to worsen. A multifaceted approach, with faster and more comprehensive surveillance, is needed to track emerging threats to prevent and respond to the overdose epidemic through naloxone availability, safe prescribing practices, harm-reduction services, linkage into treatment, and more collaboration between public health and public safety agencies.

Drug overdose deaths were identified in the National Vital Statistics System multiple cause-of-death mortality files,** using the *International Classification of Diseases, Tenth Revision* (ICD-10), based on ICD-10 underlying cause-of-death 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,

* https://wonder.cdc.gov.

† https://www.cdc.gov/drugoverdose/pdf/pubs/2017-cdc-drug-surveillance-report.pdf.

§ Natural opioids include morphine and codeine, and semisynthetic opioids include drugs such as oxycodone, hydrocodone, hydromorphone, and oxymorphone. Methadone is a synthetic opioid. 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/db294.htm.

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

INSIDE

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

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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; these deaths were included in the rates for each drug category. Therefore, categories are not mutually exclusive.[§§]

Age-adjusted overdose death rates[¶¶] were examined for 2015 and 2016 for all opioids, opioid subcategories (prescription opioids [i.e., natural/semisynthetic opioids and methadone] (*4*), heroin, and synthetic opioids), cocaine, and psychostimulants in the United States and by age, sex, racial/ethnic group, urbanization level,[***] and state. State-level analyses included 31 states and DC that met the following criteria: 1) ≥80% of drug overdose death certificates named at least one specific drug in 2015 and 2016; 2) change from 2015 to 2016 in the percentage of death certificates reporting at least one specific drug was <10 percentage points[†††]; and 3) ≥20 deaths occurred during 2015 and 2016 in at least two drug categories examined. These inclusion criteria were selected to ensure accurate examination of death rates and increases. Relative change in age-adjusted rates and absolute change were calculated. Significance was assessed using z-tests when the number of deaths was ≥100 ($p<0.05$) and nonoverlapping confidence intervals based on a gamma distribution when the number of deaths was <100.[§§§]

In the United States, 63,632 drug overdose deaths occurred in 2016; the age-adjusted rate of overdose deaths increased significantly (21.5%) from 16.3 in 2015 to 19.8 in 2016. Opioids were involved in 42,249 (66.4%) drug overdose deaths (13.3 per 100,000 population) in 2016, representing a 27.9% rate increase from 2015 (Table 1). These increases primarily

[††] T40.0 (opium) and T40.6 (other and unspecified narcotics).

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

[***] 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.

[†††] States whose reporting of any specific drug or drugs involved in an overdose changed by ≥10 percentage points from 2015 to 2016 were excluded because drug-specific overdose numbers and rates might have changed substantially from 2015 to 2016 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.

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were driven by deaths involving synthetic opioids, for which the rate doubled from 2015 to 2016 (Table 2). Rates of overdose deaths involving prescription opioids and heroin increased by 10.6% and 19.5%, respectively (Table 1) (Table 2), and rates of overdose deaths involving cocaine and psychostimulants increased by 52.4% and 33.3%, respectively (Table 3).

From 2015 to 2016, opioid-involved deaths increased in males and females and among persons aged ≥15 years, whites, blacks, Hispanics, and Asian/Pacific Islanders. The largest relative rate change occurred among blacks (56.1%) (Table 1). The largest absolute rate increases of opioid-involved deaths and deaths involving synthetic opioids occurred among males aged 25–44 years and persons aged 25–34 years. However, deaths involving synthetic opioids increased in every subgroup examined (Table 2). Rates involving prescription opioids, heroin, cocaine, and psychostimulants increased for both sexes, whites, blacks, and most age groups (Table 1) (Table 2) (Table 3). Counties in large central and fringe metro areas experienced the largest absolute increases in deaths involving prescription and synthetic opioids, heroin, and cocaine; micropolitan areas experienced the largest increase in rates involving psychostimulants (Table 1) (Table 2) (Table 3).

Opioid death rates differed across the 31 states and DC, with synthetic opioids driving increases in many states.¶¶¶ Although several states experienced increases across drug categories, in many, the changes from 2015 to 2016 were not significant. Rates of deaths involving synthetic opioids ranged from 0.9 to 30.3 per 100,000, with the largest rates and increases concentrated in eastern states. New Hampshire (30.3 per 100,000), West Virginia (26.3), and Massachusetts (23.5) had the highest synthetic opioid death rates. Twenty states and DC experienced increases in overdose death rates involving synthetic opioids, with 10 experiencing increases by ≥100%; the largest such increase (392.3%) occurred in DC, followed by Illinois (227.3%) and Maryland (206.9%) (Table 2). Many states with large increases in synthetic opioid death rates also had large increases in rates involving other drug categories (e.g., Maryland, Virginia, and DC), including any opioid, prescription opioids (Table 1), heroin (Table 2), and cocaine (Table 3).

Thirteen states and DC experienced significant increases in heroin-involved death rates, whereas a significant decrease (56.9%) occurred in New Hampshire (Table 2). In 2016, the highest rates were in DC (17.3 per 100,000), West Virginia (14.9), and Ohio (13.5). The rates of prescription opioid–involved overdose deaths significantly increased in seven states and DC, with the highest rates in West Virginia (19.7), Maryland (13.1), Maine (12.5), and Utah (12.5) (Table 1). The highest cocaine-involved overdose death rates occurred in DC (13.5), Rhode Island (10.7), and Ohio (10.1), with 15 states and DC experiencing a significant increase from 2015 (Table 3). Significant increases in overdose death rates from heroin, prescription opioids, and cocaine occurred primarily in states in the eastern part of the country. Fourteen states experienced significant increases in psychostimulant-involved overdose death rates. The highest rates were in midwestern and western states: Nevada (7.5), New Mexico (7.1), and Oklahoma (7.1) (Table 3).

Discussion

Drug overdoses resulted in 632,331 deaths from 1999 to 2016 in the United States, with 351,630 being opioid overdose deaths.**** The epidemic has continued to worsen, with deaths increasing from 2015 to 2016 across all drug categories examined. Opioid-involved overdoses accounted for two thirds of drug overdose deaths, with increases across age and racial/ethnic groups, urbanization levels, and in numerous states. The findings highlight wide state and regional variations. Some states (e.g., New Hampshire, Ohio, and West Virginia,) experienced the highest overdose death rates across multiple drug categories, and others (primarily in the Midwest and West) recorded the highest rates of psychostimulant-involved overdose deaths. In New Hampshire, although heroin-involved death rates declined from 2015 to 2016, deaths involving synthetic opioids increased, as they did in most states. In addition, in some states (e.g., Maryland, Rhode Island, and West Virginia), 2016 rates of prescription opioid–involved deaths were higher than were those involving heroin. These data highlight the persistent and multifaceted nature of overdoses.

The first wave of opioid overdose deaths began in the 1990s and included prescription opioid deaths.†††† A second wave, which began in 2010, was characterized by heroin deaths (*5*). A third wave started in 2013, with deaths involving highly potent synthetic opioids, particularly IMF and fentanyl analogs (*2*,*3*,*6*).§§§§ Synthetic opioid-involved deaths in 2016 accounted for 30.5% of all drug overdose deaths and 45.9% of all opioid-involved deaths, with a 100% increase in the rate of these deaths compared with 2015. Synthetic opioids propelled increases with 19,413 deaths (more than any drug examined), and previous findings underscore the contribution of IMF. In addition, IMF is now being mixed into counterfeit

¶¶¶ Maps and figures providing significant changes in drug overdose and opioid-involved overdose death rates by state are available on CDC's Drug Overdose website: https://www.cdc.gov/drugoverdose/data.

**** https://www.cdc.gov/nchs/data/databriefs/db294_table.pdf.

†††† https://www.cdc.gov/nchs/products/databriefs/db81.htm.

§§§§ 2017 National Drug Threat Assessment: https://www.dea.gov/docs/DIR-040-17_2017-NDTA.pdf; https://emergency.cdc.gov/han/han00384.asp; https://emergency.cdc.gov/han/han00395.asp.

TABLE 1. Annual number and age-adjusted rate of drug overdose deaths* involving any opioid† and prescription opioids,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2015 and 2016**

	Opioids						Prescription opioids					
	2015		2016		Change from 2015 to 2016¶¶		2015		2016		Change from 2015 to 2016¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
All	**33,091**	**10.4**	**42,249**	**13.3**	**2.9*** **	**27.9*** **	**15,281**	**4.7**	**17,087**	**5.2**	**0.5*** **	**10.6*** **
Sex												
Male	21,671	13.7	28,498	18.1	4.4***	32.1***	8,617	5.4	9,978	6.2	0.8***	14.8***
Female	11,420	7.1	13,751	8.5	1.4***	19.7***	6,664	4.0	7,109	4.3	0.3***	7.5***
Age group (yrs)												
0–14	83	0.1	83	0.1	0.0	0.0	61	0.1	60	0.1	0.0	0.0
15–24	3,082	7.0	4,027	9.3	2.3***	32.9***	886	2.0	1,146	2.6	0.6***	30.0***
25–34	8,568	19.4	11,552	25.9	6.5***	33.5***	2,906	6.6	3,442	7.7	1.1***	16.7***
35–44	7,484	18.4	9,747	24.1	5.7***	31.0***	3,390	8.4	3,727	9.2	0.8***	9.5***
45–54	7,595	17.6	9,074	21.2	3.6***	20.5***	4,100	9.5	4,307	10.1	0.6***	6.3***
55–64	5,089	12.4	6,321	15.2	2.8***	22.6***	3,101	7.6	3,489	8.4	0.8***	10.5***
≥65	1,188	2.5	1,441	2.9	0.4***	16.0***	835	1.7	915	1.9	0.2***	11.8***
Sex and age group (yrs)												
Male												
15–24	2,211	9.8	2,986	13.4	3.6***	36.7***	619	2.8	852	3.8	1.0***	35.7***
25–44	11,228	26.4	15,137	35.4	9.0***	34.1***	3,862	9.1	4,527	10.6	1.5***	16.5***
45–64	7,537	18.4	9,519	23.2	4.8***	26.1***	3,676	9.0	4124	10.0	1.0***	11.1***
Female												
15–24	871	4.1	1,041	4.9	0.8***	19.5***	267	1.2	294	1.4	0.2	16.7
25–44	4,824	11.4	6,162	14.5	3.1***	27.2***	2,434	5.8	2,642	6.2	0.4***	6.9***
45–64	5,147	12.0	5,876	13.6	1.6***	13.3***	3,525	8.2	3,672	8.5	0.3	3.7
Race and Hispanic origin**												
White, non-Hispanic	27,056	13.9	33,450	17.5	3.6***	25.9***	12,894	6.4	14,167	7.0	0.6***	9.4***
Black, non-Hispanic	2,741	6.6	4,374	10.3	3.7***	56.1***	1,060	2.6	1,392	3.3	0.7***	26.9***
Hispanic	2,507	4.6	3,440	6.1	1.5***	32.6***	961	1.8	1,133	2.1	0.3***	16.7***
AI/AN, non-Hispanic	315	12.1	369	13.9	1.8	14.9	181	7.0	173	6.5	-0.5	-7.1
A/PI, non-Hispanic	220	1.1	323	1.5	0.4***	36.4***	89	0.5	131	0.7	0.2	40
County urbanization level††												
Large central metro	9,679	9.4	12,903	12.5	3.1***	33.0***	4,276	4.1	4,930	4.7	0.6***	14.6***
Large fringe metro	8,683	11.2	11,993	15.4	4.2***	37.5***	3,444	4.2	4,209	5.2	1.0***	23.8***
Medium metro	7,618	11.8	9,264	14.3	2.5***	21.2***	3,664	5.6	3,988	6.0	0.4***	7.1***
Small metro	2,729	9.9	3,224	11.7	1.8***	18.2***	1,404	5.0	1,471	5.2	0.2	4.0
Micropolitan (nonmetro)	2,730	10.8	3,068	12.1	1.3***	12.0***	1,457	5.6	1,475	5.7	0.1	1.8
Noncore (nonmetro)	1,652	9.6	1,797	10.5	0.9***	9.4***	1,036	5.9	1,014	5.7	-0.2	-3.4
Selected states§§												
States with very good to excellent reporting (n = 25)												
Alaska	86	11.0	94	12.5	1.5	13.6	57	7.4	51	6.8	-0.6	-8.1
Connecticut	685	19.2	855	24.5	5.3***	27.6***	243	6.3	264	7.2	0.9	14.3
District of Columbia	98	14.5	209	30.0	15.5***	106.9***	26	3.7	66	9.3	5.6***	151.4***
Georgia	858	8.4	918	8.8	0.4	4.8	519	5.0	536	5.1	0.1	2.0
Illinois	1,381	10.7	1,947	15.3	4.6***	43.0***	351	2.7	479	3.7	1.0***	37.0***
Iowa	170	5.8	183	6.2	0.4	6.9	92	3.1	92	3.1	0.0	0.0
Maine	238	19.3	301	25.2	5.9***	30.6***	124	9.6	154	12.5	2.9***	30.2***
Maryland	1,087	17.7	1,821	29.7	12.0***	67.8***	534	8.7	812	13.1	4.4***	50.6***
Massachusetts	1,550	23.3	1,990	29.7	6.4***	27.5***	298	4.3	351	4.9	0.6	14.0
Nevada	419	13.8	408	13.3	-0.5	-3.6	298	9.8	275	8.9	-0.9	-9.2
New Hampshire	380	31.3	437	35.8	4.5	14.4	80	5.7	89	6.5	0.8	14.0

See table footnotes on the next page.

opioid and benzodiazepine pills, heroin, and cocaine, likely contributing to increases in overdose death rates involving other substances (*3*,*7*,*8*).

The findings in this report are subject to at least five limitations. First, at autopsy, substances tested for, and circumstances under which tests are performed to determine which drugs are present, vary by time and jurisdiction, and improvements in toxicologic testing might account for some reported increases. Second, 17% (2015) and 15% (2016) of drug overdose death certificates did not include the specific types of drugs involved,

TABLE 1. (*Continued*) Annual number and age-adjusted rate of drug overdose deaths* involving any opioid† and prescription opioids,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2015 and 2016**

	Opioids						Prescription opioids					
	2015		2016		Change from 2015 to 2016¶¶		2015		2016		Change from 2015 to 2016¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
New Mexico	351	17.9	349	17.5	-0.4	-2.2	189	9.6	186	9.2	-0.4	-4.2
New York	2,166	10.8	3,009	15.1	4.3***	39.8***	895	4.4	1,100	5.4	1.0***	22.7***
North Carolina	1,171	11.9	1,506	15.4	3.5***	29.4***	635	6.4	695	6.9	0.5	7.8
Ohio	2,698	24.7	3,613	32.9	8.2***	33.2***	780	6.9	867	7.7	0.8***	11.6***
Oklahoma	427	11.2	444	11.6	0.4	3.6	328	8.6	322	8.4	-0.2	-2.3
Oregon	331	7.9	312	7.6	-0.3	-3.8	198	4.7	165	3.9	-0.8	-17.0
Rhode Island	254	23.5	279	26.7	3.2	13.6	122	10.6	114	10.5	-0.1	-0.9
South Carolina	554	11.4	628	13.1	1.7***	14.9***	361	7.3	381	7.8	0.5	6.8
Tennessee	1,038	16.0	1,186	18.1	2.1***	13.1***	693	10.5	739	11.1	0.6	5.7
Utah	448	15.9	466	16.4	0.5	3.1	385	13.7	349	12.5	-1.2	-8.8
Vermont	79	13.4	101	18.4	5.0	37.3	32	5.3	35	5.9	0.6	11.3
Virginia	820	9.9	1,130	13.5	3.6***	36.4***	322	3.8	400	4.7	0.9***	23.7***
Washington	692	9.3	709	9.4	0.1	1.1	355	4.7	388	5.0	0.3	6.4
West Virginia	629	36.0	733	43.4	7.4***	20.6***	380	21.2	340	19.7	-1.5	-7.1
States with good reporting (n = 7)												
Arizona	671	10.2	769	11.4	1.2***	11.8***	362	5.5	380	5.6	0.1	1.8
Colorado	495	8.7	536	9.5	0.8	9.2	288	5.1	258	4.5	-0.6	-11.8
Hawaii	62	4.1	77	5.2	1.1	26.8	42	2.8	55	3.6	0.8	28.6
Minnesota	338	6.2	396	7.4	1.2***	19.4***	177	3.2	195	3.6	0.4	12.5
Missouri	692	11.7	914	15.9	4.2***	35.9***	289	4.8	268	4.5	-0.3	-6.3
Texas	1,287	4.7	1,375	4.9	0.2	4.3	590	2.1	617	2.2	0.1	4.8
Wisconsin	622	11.2	866	15.8	4.6***	41.1***	300	5.2	382	6.7	1.5***	28.8***

Source: National Vital Statistics System, Mortality file.

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

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

† 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 may involve more than one drug. Summing of categories will result in greater 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 AI/AN non-Hispanic and A/PI 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 2015, with the change in drug overdose deaths mentioning at least one specific drug differing by no more than 10 percentage points from 2015 to 2016. States with good reporting had 80% to <90% of drug overdose deaths mention of at least one specific drug in 2015, with the change in the percentage of drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2015 to 2016. 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, heroin, cocaine, and psychostimulants with abuse potential). South Dakota was the only state with good or excellent reporting in both years, but with an improvement >10 percentage points in drug specificity.

¶¶ Absolute rate change is the difference between 2015 and 2016 rates. Percent change is the absolute rate change divided by the 2015 rate, multiplied by 100. Nonoverlapping confidence intervals based on the gamma method were used if the number of deaths was <100 in 2015 or 2016, and z-tests were used if the number of deaths was ≥100 in both 2015 and 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. Confidence intervals of 2015 and 2016 rates of prescription opioid deaths for Asian/Pacific Islanders overlapped only slightly: (0.37, 0.57), (0.56, 0.80).

*** Statistically significant at 0.05 level.

and the percentage of drug overdose death certificates with at least one drug specified varied widely by state, ranging from 52.5% to 99.3% in 2016. This variation limits rate comparisons between states. Third, because heroin and morphine are metabolized similarly (*9*), some heroin deaths might have been misclassified as morphine deaths, resulting in underreporting of heroin deaths. Fourth, potential race misclassification might lead to underestimates for certain categories, primarily for American Indian/Alaska Natives and Asian/Pacific Islanders.¶¶¶¶ Finally, state-specific analyses are restricted to 31 states and DC, limiting generalizability.

¶¶¶¶ https://www.cdc.gov/nchs/data/series/sr_02/sr02_172.pdf.

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, 2015 and 2016**

	Heroin						Synthetic opioids other than methadone					
	2015		2016		Change from 2015 to 2016¶¶		2015		2016		Change from 2015 to 2016¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
All	**12,989**	**4.1**	**15,469**	**4.9**	**0.8*** **	**19.5*** **	**9,580**	**3.1**	**19,413**	**6.2**	**3.1*** **	**100.0*** **
Sex												
Male	9,881	6.3	11,752	7.5	1.2***	19.0***	6,560	4.2	13,835	8.9	4.7***	111.9***
Female	3,108	2.0	3,717	2.4	0.4***	20.0***	3,020	1.9	5,578	3.5	1.6***	84.2***
Age group (yrs)												
0–14	—†††	—†††	—†††	—†††	—†††	—†††	14	—†††	18	—†††	—†††	—†††
15–24	1,649	3.8	1,728	4.0	0.2	5.3	999	2.3	1,958	4.5	2.2***	95.7***
25–34	4,292	9.7	5,051	11.3	1.6***	16.5***	2,896	6.6	6,094	13.6	7.0***	106.1***
35–44	3,012	7.4	3,625	9.0	1.6***	21.6***	2,289	5.6	4,825	11.9	6.3***	112.5***
45–54	2,439	5.6	3,009	7.0	1.4***	25.0***	1,982	4.6	3,872	9.1	4.5***	97.8***
55–64	1,407	3.4	1,777	4.3	0.9***	26.5***	1,167	2.9	2,238	5.4	2.5***	86.2***
≥65	184	0.4	275	0.6	0.2***	50.0***	232	0.5	405	0.8	0.3***	60.0***
Sex and age group (yrs)												
Male												
15–24	1,172	5.2	1,275	5.7	0.5***	9.6***	718	3.2	1,434	6.4	3.2***	100.0***
25–44	5,602	13.2	6,643	15.5	2.3***	17.4***	3,764	8.9	8,029	18.8	9.9***	111.2***
45–64	2,953	7.2	3,599	8.8	1.6***	22.2***	1,948	4.8	4,116	10.0	5.2***	108.3***
Female												
15–24	477	2.2	453	2.1	-0.1	-4.5	281	1.3	524	2.5	1.2***	92.3***
25–44	1,702	4.0	2,033	4.8	0.8***	20.0***	1,421	3.4	2,890	6.8	3.4***	100.0***
45–64	893	2.1	1,187	2.8	0.7***	33.3***	1,201	2.8	1,994	4.6	1.8***	64.3***
Race and Hispanic origin**												
White, non-Hispanic	10,050	5.4	11,631	6.3	0.9***	16.7***	7,995	4.2	15,143	8.2	4.0***	95.2***
Black, non-Hispanic	1,310	3.1	1,899	4.5	1.4***	45.2***	883	2.1	2,391	5.6	3.5***	166.7***
Hispanic	1,299	2.3	1,555	2.8	0.5***	21.7***	524	0.9	1,505	2.7	1.8***	200.0***
AI/AN, non-Hispanic	117	4.4	131	5.0	0.6	13.6	51	2.0	113	4.1	2.1***	105.0***
A/PI, non-Hispanic	98	0.5	102	0.5	0.0	0.0	51	0.2	134	0.6	0.4***	200.0***
County urbanization level††												
Large central metro	4,496	4.4	5,507	5.3	0.9***	20.5***	2,509	2.4	6,009	5.8	3.4***	141.7***
Large fringe metro	3,778	5.0	4,623	6.1	1.1***	22.0***	2,947	3.9	6,264	8.2	4.3***	110.3***
Medium metro	2,736	4.3	3,077	4.9	0.6***	14.0***	2,255	3.5	3,978	6.3	2.8***	80.0***
Small metro	868	3.2	990	3.7	0.5***	15.6***	686	2.5	1,270	4.7	2.2***	88.0***
Micropolitan (nonmetro)	778	3.2	860	3.6	0.4***	12.5***	753	3.0	1,228	5.0	2.0***	66.7***
Noncore (nonmetro)	333	2.1	412	2.6	0.5***	23.8***	430	2.6	664	4.1	1.5***	57.7***
Selected states§§												
States with very good to excellent reporting (n = 25)												
Alaska	37	4.7	49	6.5	1.8	38.3	14	—†††	—†††	—†††	—†††	—†††
Connecticut	390	11.3	450	13.1	1.8***	15.9***	211	6.1	500	14.8	8.7***	142.6***
District of Columbia	67	9.9	122	17.3	7.4***	74.7***	26	3.9	129	19.2	15.3***	392.3***
Georgia	222	2.2	226	2.2	0.0	0.0	284	2.8	277	2.7	-0.1	-3.6
Illinois	844	6.7	1,040	8.2	1.5***	22.4***	278	2.2	907	7.2	5.0***	227.3***
Iowa	45	1.6	47	1.7	0.1	6.2	44	1.5	58	2.0	0.5	33.3
Maine	52	4.5	55	4.7	0.2	4.4	116	9.9	199	17.3	7.4***	74.7***
Maryland	405	6.6	650	10.7	4.1***	62.1***	357	5.8	1,091	17.8	12.0***	206.9***
Massachusetts	634	9.6	630	9.5	-0.1	-1.0	949	14.4	1,550	23.5	9.1***	63.2***
Nevada	82	2.7	86	2.9	0.2	7.4	32	1.1	53	1.7	0.6	54.5
New Hampshire	78	6.5	34	2.8	-3.7***	-56.9***	285	24.1	363	30.3	6.2***	25.7***

See table footnotes on the next page.

The ongoing and worsening drug overdose epidemic requires immediate attention and action. Faster access to data collected is needed to understand emerging threats in local communities and to tailor response activities. CDC's Enhanced State Opioid Overdose Surveillance program funds 32 states and DC for more timely and comprehensive nonfatal and fatal overdose data, including funding for improved comprehensive toxicologic testing to identify emerging drug threats in opioid-involved fatal overdoses.***** Syndromic surveillance

***** https://www.cdc.gov/drugoverdose/foa/state-opioid-mm.html.

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, 2015 and 2016**

	Heroin						Synthetic opioids other than methadone					
	2015		2016		Change from 2015 to 2016¶¶		2015		2016		Change from 2015 to 2016¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
New Mexico	156	8.1	161	8.2	0.1	1.2	42	2.1	78	4.0	1.9***	90.5***
New York	1,058	5.4	1,307	6.5	1.1***	20.4***	668	3.3	1,641	8.3	5.0***	151.5***
North Carolina	393	4.1	544	5.7	1.6***	39.0***	300	3.1	601	6.2	3.1***	100.0***
Ohio	1,444	13.3	1,478	13.5	0.2	1.5	1,234	11.4	2,296	21.1	9.7***	85.1***
Oklahoma	36	1.0	53	1.4	0.4	40.0	93	2.4	98	2.5	0.1	4.2
Oregon	102	2.5	114	2.9	0.4	16.0	34	0.9	43	1.1	0.2	22.2
Rhode Island	45	4.3	25	2.5	-1.8	-41.9	137	13.2	182	17.8	4.6***	34.8***
South Carolina	100	2.2	115	2.5	0.3	13.6	161	3.3	237	5.0	1.7***	51.5***
Tennessee	205	3.3	260	4.1	0.8***	24.2***	251	4.0	395	6.2	2.2***	55.0***
Utah	127	4.3	166	5.6	1.3***	30.2***	62	2.3	72	2.5	0.2	8.7
Vermont	33	5.8	45	8.7	2.9	50.0	33	5.6	53	10.1	4.5	80.4
Virginia	353	4.3	450	5.5	1.2***	27.9***	270	3.3	648	7.9	4.6***	139.4***
Washington	303	4.2	283	3.9	-0.3	-7.1	65	0.9	93	1.3	0.4	44.4
West Virginia	194	11.8	235	14.9	3.1***	26.3***	217	12.7	435	26.3	13.6***	107.1***
States with good reporting (n = 7)												
Arizona	247	3.8	299	4.5	0.7***	18.4***	72	1.1	123	1.8	0.7***	63.6***
Colorado	159	2.8	234	4.2	1.4***	50.0***	64	1.2	72	1.3	0.1	8.3
Hawaii	15	—†††	20	1.4	—†††	—†††	13	—†††	—†††	—†††	—†††	—†††
Minnesota	115	2.2	149	2.8	0.6	27.3	55	1.0	99	1.9	0.9***	90.0***
Missouri	303	5.3	380	6.7	1.4***	26.4***	183	3.1	441	7.8	4.7***	151.6***
Texas	523	1.9	530	1.9	0.0	0.0	186	0.7	250	0.9	0.2***	28.6***
Wisconsin	287	5.3	389	7.3	2.0***	37.7***	112	2.1	288	5.3	3.2***	152.4***

Source: National Vital Statistics System, Mortality file.
Abbreviations: A/PI = Asian/Pacific Islander; AI/AN = American Indian/Alaska Native.
* 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 synthetic opioids other than methadone (T40.4) as a contributing cause.
¶ Categories of deaths are not exclusive because deaths may involve more than one drug. Summing of categories will result in greater 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 AI/AN non-Hispanic and A/PI 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 2015, with the change in drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2015 to 2016. States with good reporting had 80% to <90% of drug overdose deaths mention of at least one specific drug in 2015, with the change in the percentage of drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2015 to 2016. 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, heroin, cocaine, and psychostimulants with abuse potential). South Dakota was the only state with good or excellent reporting in both years, but with an improvement >10 percentage points in drug specificity.
¶¶ Absolute rate change is the difference between 2015 and 2016 rates. Percent change is the absolute rate change divided by the 2015 rate, multiplied by 100. Nonoverlapping confidence intervals based on the gamma method were used if the number of deaths was <100 in 2015 or 2016, and z-tests were used if the number of deaths was ≥100 in both 2015 and 2016.
*** Statistically significant at 0.05 level.
††† Cells with ≤9 deaths are not reported. Rates based on <20 deaths are not considered reliable and not reported.

data allow communities to identify overdoses quickly (*10*). The State Unintentional Drug Overdose Reporting System provides improved collection of toxicology data to identify specific drugs involved (*6*), information gathered from death scene investigations, and risk factors associated with fatal overdoses. Given the continuing threat from prescription opioids and the evolving threat from illicit opioids and other substances, a multifaceted prevention approach is required. Efforts to ensure safe prescribing practices†††† are enhanced by access to nonopioid and nonpharmacologic treatments for pain. Other important efforts include increasing naloxone availability, expanding access to medication-assisted treatment, and maximizing the ability of health systems to link persons to treatment and harm reduction services (*10*). CDC supports

†††† https://www.cdc.gov/drugoverdose/prescribing/guideline.html.

TABLE 3. Annual number and age-adjusted rate of drug overdose deaths* involving cocaine† and psychostimulants with abuse potential,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2015 and 2016**

	Cocaine						Psychostimulants with abuse potential					
	2015		2016		Change from 2015 to 2016¶¶		2015		2016		Change from 2015 to 2016¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
All	**6,784**	**2.1**	**10,375**	**3.2**	**1.1*** **	**52.4*** **	**5,716**	**1.8**	**7,542**	**2.4**	**0.6*** **	**33.3*** **
Sex												
Male	4,885	3.1	7,493	4.7	1.6***	51.6***	3,971	2.5	5,348	3.4	0.9***	36.0***
Female	1,899	1.2	2,882	1.8	0.6***	50.0***	1,745	1.1	2,194	1.4	0.3***	27.3***
Age group (yrs)												
0–14	—†††	—†††	—†††	—†††	—†††	—†††	11	—†††	11	—†††	—†††	—†††
15–24	442	1.0	757	1.7	0.7***	70.0***	416	0.9	571	1.3	0.4***	44.4***
25–34	1,571	3.6	2,525	5.7	2.1***	58.3***	1,307	3.0	1,762	3.9	0.9***	30.0***
35–44	1,549	3.8	2,431	6.0	2.2***	57.9***	1,357	3.3	1,831	4.5	1.2***	36.4***
45–54	1,861	4.3	2,629	6.1	1.8***	41.9***	1,513	3.5	1,914	4.5	1.0***	28.6***
55–64	1,166	2.9	1,721	4.2	1.3***	44.8***	946	2.3	1,244	3.0	0.7***	30.4***
≥65	194	0.4	303	0.6	0.2***	50.0***	164	0.3	206	0.4	0.1***	33.3***
Sex and age group (yrs)												
Male												
15–24	303	1.3	553	2.5	1.2***	92.3***	259	1.2	388	1.7	0.5***	41.7***
25–44	2,238	5.3	3,569	8.3	3.0***	56.6***	1,853	4.4	2,536	5.9	1.5***	34.1***
45–64	2,181	5.3	3,108	7.6	2.3***	43.4***	1,714	4.2	2,251	5.5	1.3***	31.0***
Female												
15–24	139	0.7	204	1.0	0.3***	42.9***	157	0.7	183	0.9	0.2***	28.6***
25–44	882	2.1	1,387	3.3	1.2***	57.1***	811	1.9	1,057	2.5	0.6***	31.6***
45–64	846	2.0	1,242	2.9	0.9***	45.0***	745	1.7	907	2.1	0.4***	23.5***
Race and Hispanic origin**												
White, non-Hispanic	4,225	2.2	6,443	3.4	1.2***	54.5***	4,324	2.2	5,777	3.0	0.8***	36.4***
Black, non-Hispanic	1,690	4.0	2,599	6.1	2.1***	52.5***	316	0.8	477	1.2	0.4***	50.0***
Hispanic	697	1.3	1,097	2.0	0.7***	53.8***	725	1.4	846	1.5	0.1	7.1
AI/AN, non-Hispanic	43	1.6	56	2.1	0.5	31.3	142	5.4	181	6.9	1.5***	27.8***
A/PI, non-Hispanic	61	0.3	85	0.4	0.1	33.3	149	0.7	171	0.8	0.1	14.3
County urbanization level††												
Large central metro	2,786	2.7	4,301	4.2	1.5***	55.6***	2,003	2.0	2,561	2.5	0.5***	25.0***
Large fringe metro	1,617	2.1	2,734	3.5	1.4***	66.7***	909	1.2	1,235	1.6	0.4***	33.3***
Medium metro	1,462	2.3	2,082	3.2	0.9***	39.1***	1,378	2.1	1,821	2.8	0.7***	33.3***
Small metro	419	1.5	569	2.1	0.6***	40.0***	533	2.0	698	2.6	0.6***	30.0***
Micropolitan (nonmetro)	360	1.4	474	1.9	0.5***	35.7***	517	2.0	745	3.0	1.0***	50.0***
Noncore (nonmetro)	140	0.9	215	1.3	0.4***	44.4***	376	2.3	482	2.9	0.6***	26.1***
Selected states§§												
States with very good to excellent reporting (n = 25)												
Alaska	—†††	—†††	15	—†††	—†††	—†††	27	3.5	49	6.3	2.8	80.0
Connecticut	166	4.7	237	6.9	2.2***	46.8***	22	0.6	25	0.7	0.1	16.7
District of Columbia	33	4.9	89	13.5	8.6***	175.5***	—†††	—†††	—†††	—†††	—†††	—†††
Georgia	159	1.5	209	2.0	0.5***	33.3***	220	2.2	243	2.4	0.2	9.1
Illinois	332	2.5	507	4.0	1.5***	60.0***	60	0.5	112	0.9	0.4***	80.0***
Iowa	17	—†††	15	—†††	—†††	—†††	63	2.2	80	2.7	0.5	22.7
Maine	32	2.8	61	5.0	2.2***	78.6***	21	1.7	28	2.3	0.6	35.3
Maryland	143	2.3	314	5.0	2.7***	117.4***	26	0.4	43	0.8	0.4	100.0
Massachusetts	402	6.1	567	8.5	2.4***	39.3***	43	0.6	45	0.7	0.1	16.7
Nevada	40	1.3	37	1.2	-0.1	-7.7	172	5.7	228	7.5	1.8***	31.6***
New Hampshire	47	4.1	61	5.0	0.9	22.0	—†††	—†††	13	—†††	—†††	—†††

See table footnotes on the next page.

many of these efforts through the Prevention for States and Data-Driven Prevention Initiatives,§§§§§ which together support opioid overdose prevention efforts in 42 states and DC. Collaboration with law enforcement, first responders, and harm reduction partners is also important to understanding local variations in drug supply and lethality and to implementing a multisectoral prevention approach.

§§§§§ https://www.cdc.gov/drugoverdose/states/state_prevention.html; https://www.cdc.gov/drugoverdose/foa/ddpi.html.

TABLE 3. (*Continued*) Annual number and age-adjusted rate of drug overdose deaths* involving cocaine† and psychostimulants with abuse potential,§,¶ by sex, age, race and Hispanic origin, urbanization level,†† and selected states§§ — United States, 2015 and 2016**

	Cocaine						Psychostimulants with abuse potential					
	2015		2016		Change from 2015 to 2016¶¶		2015		2016		Change from 2015 to 2016¶¶	
Decedent characteristic	No.	Rate	No.	Rate	Absolute rate change	% Change in rate	No.	Rate	No.	Rate	Absolute rate change	% Change in rate
New Mexico	51	2.6	58	3.0	0.4	15.4	119	6.1	135	7.1	1.0	16.4
New York	634	3.1	991	4.9	1.8***	58.1***	80	0.4	150	0.8	0.4***	100.0***
North Carolina	314	3.2	500	5.1	1.9***	59.4***	67	0.7	115	1.2	0.5***	71.4***
Ohio	698	6.3	1,124	10.1	3.8***	60.3***	105	1.0	243	2.3	1.3***	130.0***
Oklahoma	29	0.7	31	0.8	0.1	14.3	199	5.3	263	7.1	1.8***	34.0***
Oregon	22	0.6	26	0.7	0.1	16.7	124	3.1	150	3.6	0.5	16.1
Rhode Island	87	8.3	112	10.7	2.4	28.9	11	—†††	10	—†††	—†††	—†††
South Carolina	116	2.4	143	3.0	0.6	25.0	87	1.9	125	2.7	0.8	42.1
Tennessee	202	3.0	249	3.8	0.8***	26.7***	113	1.8	186	2.9	1.1***	61.1***
Utah	44	1.5	48	1.7	0.2	13.3	147	5.2	143	5.1	-0.1	-1.9
Vermont	14	—†††	21	4.0	—†††	—†††	—†††	—†††	—†††	—†††	—†††	—†††
Virginia	168	2.0	254	3.0	1.0***	50.0***	55	0.7	76	0.9	0.2	28.6
Washington	85	1.1	90	1.2	0.1	9.1	304	4.2	326	4.4	0.2	4.8
West Virginia	94	5.6	143	8.5	2.9***	51.8***	65	3.9	117	7.0	3.1***	79.5***
States with good reporting (n = 7)												
Arizona	62	0.9	82	1.2	0.3	33.3	333	5.1	454	6.7	1.6***	31.4***
Colorado	60	1.0	106	1.9	0.9***	90.0***	140	2.6	200	3.6	1.0***	38.5***
Hawaii	—†††	—†††	—†††	—†††	—†††	—†††	87	5.9	102	6.8	0.9	15.3
Minnesota	42	0.7	43	0.8	0.1	14.3	82	1.5	140	2.6	1.1***	73.3***
Missouri	77	1.3	103	1.8	0.5	38.5	133	2.4	185	3.3	0.9***	37.5***
Texas	470	1.7	584	2.1	0.4***	23.5***	454	1.7	577	2.1	0.4***	23.5***
Wisconsin	115	2.0	147	2.6	0.6***	30.0***	38	0.7	76	1.4	0.7***	100.0***

Source: National Vital Statistics System, Mortality file.

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

* 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 cocaine (T40.5) as a contributing cause.

§ Drug overdose deaths, as defined, that have psychostimulants with abuse potential (T43.6) as a contributing cause.

¶ Categories of deaths are not exclusive because deaths may involve more than one drug. Summing of categories will result in greater 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 AI/AN non-Hispanic and A/PI 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 2015, with the change in drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2015 to 2016. States with good reporting had 80% to <90% of drug overdose deaths mention of at least one specific drug in 2015, with the change in the percentage of drug overdose deaths mentioning at least one specific drug differing by <10 percentage points from 2015 to 2016. 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, heroin, cocaine, and psychostimulants with abuse potential). South Dakota was the only state with good or excellent reporting in both years, but with an improvement >10 percentage points in drug specificity.

¶¶ Absolute rate change is the difference between 2015 and 2016 rates. Percent change is the absolute rate change divided by the 2015 rate, multiplied by 100. Nonoverlapping confidence intervals based on the gamma method were used if the number of deaths was <100 in 2015 or 2016, and z-tests were used if the number of deaths was ≥100 in both 2015 and 2016.

*** Statistically significant at 0.05 level.

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

Conflict of Interest

No conflicts of interest were reported.

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Summary

What is already known about this topic?

From 1999 to 2015, the drug overdose epidemic resulted in approximately 568,699 deaths. In 2015, 52,404 drug overdose deaths occurred; 63.1% (33,091) involved an opioid. From 2014 to 2015, the age-adjusted opioid-involved death rate increased by 15.6%; the rapid increase in deaths was driven in large part by synthetic opioids other than methadone (e.g., fentanyl).

What is added by this report?

In 2016, there were 63,632 drug overdose deaths in the United States. Opioids accounted for 66.4% (42,249) of deaths, with increases across age groups, racial/ethnic groups, urbanization levels, and multiple states. Age-adjusted death rates for overdoses involving synthetic opioids other than methadone doubled from 2015 to 2016, and death rates from prescription opioids, heroin, cocaine, and psychostimulants also increased.

What are the implications for public health practice?

There is an urgent need to implement a multifaceted, collaborative public health and public safety approach. Building on existing resources, more rapidly available and comprehensive surveillance data are needed to track emerging drug threats to guide public action to prevent and respond to the epidemic through increased naloxone availability, harm reduction services, linkage into treatment (including medication-assisted treatment), safe prescribing practices, and supporting law enforcement strategies to reduce the illicit drug supply.

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Prevalence of Diagnosed Diabetes in Adults by Diabetes Type — United States, 2016

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Currently 23 million U.S. adults have been diagnosed with diabetes (*1*). The two most common forms of diabetes are type 1 and type 2. Type 1 diabetes results from the autoimmune destruction of the pancreas's beta cells, which produce insulin. Persons with type 1 diabetes require insulin for survival; insulin may be given as a daily shot or continuously with an insulin pump (*2*). Type 2 diabetes is mainly caused by a combination of insulin resistance and relative insulin deficiency (*3*). A small proportion of diabetes cases might be types other than type 1 or type 2, such as maturity-onset diabetes of the young or latent autoimmune diabetes in adults (*3*). Although the majority of prevalent cases of type 1 and type 2 diabetes are in adults, national data on the prevalence of type 1 and type 2 in the U.S. adult population are sparse, in part because of the previous difficulty in classifying diabetes by type in surveys (*2*,*4*,*5*). In 2016, supplemental questions to help distinguish diabetes type were added to the National Health Interview Survey (NHIS) (*6*). This study used NHIS data from 2016 to estimate the prevalence of diagnosed diabetes among adults by primary type. Overall, based on self-reported type and current insulin use, 0.55% of U.S. adults had diagnosed type 1 diabetes, representing 1.3 million adults; 8.6% had diagnosed type 2 diabetes, representing 21.0 million adults. Of all diagnosed cases, 5.8% were type 1 diabetes, and 90.9% were type 2 diabetes; the remaining 3.3% of cases were other types of diabetes. Understanding the prevalence of diagnosed diabetes by type is important for monitoring trends, planning public health responses, assessing the burden of disease for education and management programs, and prioritizing national plans for future type-specific health services.

NHIS is an annual, cross-sectional household interview survey conducted by CDC that gathers health-related data in a nationally representative sample of the civilian, noninstitutionalized U.S. population (*6*). The 2016 NHIS Sample Adult Core consisted of 33,028 adults aged ≥18 years, with a final response rate of 54.3%. Each respondent was randomly selected among all adults aged ≥18 years in each household. During face-to-face interviews, respondents were asked whether a doctor or health care professional had ever told them that they had diabetes, other than during pregnancy. Among those who said they had diabetes, questions were asked regarding age at diagnosis and insulin and oral hypoglycemic medication use. In 2016, respondents were also asked to report whether they had type 1, type 2, or another type of diabetes. Virtually all patients with type 1 diabetes require insulin to survive, and very few persons who use insulin do not report using it (*5*). Previous studies have found that self-reported diabetes type alone is not a valid method for classifying diabetes type in surveys because some patients are not aware of their diabetes type (*5*,*7*). Therefore, for this analysis, type 1 diabetes was defined as current insulin use and self-report of type 1 diabetes. Adults who reported having type 1 diabetes but reported not using insulin were classified as having type 2 diabetes, as were persons who reported type 2 diabetes, unknown diabetes type, or who would not report diabetes type. Respondents who reported having another diabetes type were classified as having "other type."

Crude prevalence estimates of diagnosed diabetes by type and 95% confidence intervals (CIs) were calculated for the overall population and by selected sociodemographic characteristics. P values were calculated from chi-squared tests and were considered significant at <0.05. Final survey weights were applied to the data to adjust for various probabilities of selection and household nonresponse. Statistical software was used to account for NHIS's complex sampling design.

A total of 3,519 respondents aged ≥18 years reported having diabetes, including 211 classified as having type 1; 3,210 classified as having type 2 (including 182 who reported having type 1, but not taking insulin; 2,897 who reported having type 2; one who reported an unknown type; and one refusal); and 98 classified as having "other" type. In 2016, the overall crude prevalence of diagnosed diabetes among U.S. adults was 9.44% (95% CI = 9.01–9.88). The prevalences of type 1 diabetes, type 2 diabetes, and other diabetes types were 0.55%, 8.58%, and 0.31%, respectively (Table). The weighted percentages of all diagnosed diabetes cases that were type 1 and type 2 were 5.8% and 90.9%, respectively; the remaining were other types. Based on the weighted NHIS population, the estimated numbers of adults with type 1, type 2, and other diabetes types were 1.3 million, 21.0 million, and 0.8 million, respectively.

Estimated crude prevalence of type 1 diabetes among U.S. adults did not significantly vary by age group (p = 0.54) or education (p = 0.14) (Table). The prevalence of type 1 diabetes was higher among men (0.64%) than among women

TABLE. Crude prevalence* of diagnosed diabetes among adults by diabetes type† and selected characteristics — National Health Interview Survey, United States, 2016

	Diabetes type		
	Type 1	Type 2	Other type
Characteristic	% (95% CI)§	% (95% CI)§	% (95% CI)§
Total	**0.55 (0.46–0.66)**	**8.58 (8.17–9.00)**	**0.31 (0.24–0.40)**
Age group (yrs)			
18–29	0.45 (0.27–0.75)	0.66 (0.38–1.13)	—¶
30–44	0.50 (0.35–0.73)	3.29 (2.75–3.93)	0.27 (0.16–0.47)
45–64	0.59 (0.44–0.78)	11.03 (10.24–11.88)	0.44 (0.30–0.65)
≥65	0.65 (0.48–0.88)	19.62 (18.54–20.74)	0.35 (0.23–0.54)
Sex			
Men	0.64 (0.51–0.82)	8.86 (8.30–9.45)	0.23 (0.15–0.36)
Women	0.46 (0.37–0.58)	8.32 (7.79–8.88)	0.38 (0.27–0.53)
Race/Ethnicity			
White, non-Hispanic	0.67 (0.55–0.82)	7.99 (7.54–8.45)	0.29 (0.21–0.39)
Black, non-Hispanic	0.45 (0.26–0.78)	11.52 (10.35–12.80)	0.45 (0.24–0.86)
Asian, non-Hispanic	—¶	6.89 (5.24–9.03)	—¶
Hispanic	0.22 (0.12–0.40)	9.07 (7.91–10.38)	—¶
Education level			
<High school	0.83 (0.56–1.24)	14.20 (12.88–15.64)	0.56 (0.32–0.98)
High school	0.58 (0.40–0.84)	9.99 (9.18–10.86)	0.29 (0.17–0.47)
>High school	0.48 (0.39–0.61)	6.89 (6.47–7.34)	0.27 (0.19–0.38)

Abbreviation: CI = confidence interval.
* Overall crude prevalence of diagnosed diabetes = 9.44% (95% CI = 9.01–9.88).
† Type 1 diabetes was defined as self-report of type 1 diabetes and current insulin use. Respondents who self-reported other diabetes typed were classified as having "Other Type" diabetes. All remaining cases were classified as type 2 diabetes.
§ Estimates are weighted percentages and 95% CIs. CIs were based on a logit transformation and might be asymmetric about the point estimate.
¶ Estimate might be unreliable because of large relative standard error (>30%); data not shown.

(0.46%) (p<0.05) and higher among non-Hispanic whites (whites) (0.67%) than among Hispanics (0.22%) (p<0.01). By age group, the prevalence of type 2 diabetes was highest among adults aged ≥65 years and lowest among adults aged 18–29 years (p<0.001), and by race/ethnicity, was higher among non-Hispanic blacks (11.52%) than among non-Hispanic Asians (6.89%), whites (7.99%), and Hispanics (9.07%) (p<0.001) (Table). The prevalence of type 2 diabetes decreased with higher levels of educational attainment (p<0.001).

Discussion

In 2016, the estimated prevalences of diagnosed type 1 and type 2 diabetes were 0.55% (corresponding to 1.3 million U.S. adults) and 8.6% (corresponding to 21.0 million U.S. adults), respectively. Type 1 and type 2 diabetes accounted for approximately 6% and 91% of all cases of diagnosed diabetes, respectively. Because the prevalence of type 2 diabetes is so much higher than that of type 1, current diabetes surveillance data that do not distinguish diabetes type are more reflective of persons with type 2 diabetes. Recent analysis of diagnosed diabetes prevalence indicates a plateauing among adults aged 20–79 years (*8*), but it is not known whether this trend might differ for type 1 diabetes. Because the etiology, treatment, and outcomes of diabetes vary by type, it is important to distinguish between them.

Summary

What is already known about this topic?

The two most common forms of diabetes are type 1 and type 2. Previous national diabetes prevalence estimates did not distinguish between types among U.S. adults.

What is added by this report?

New data allowed estimation of diagnosed diabetes by type. In 2016, the prevalence of diagnosed type 1 diabetes was 0.55%, representing 1.3 million U.S. adults; the prevalence of diagnosed type 2 diabetes was 8.6%, representing 21.0 million U.S. adults. Non-Hispanic white adults had a higher prevalence of diagnosed type 1 diabetes than did Hispanic adults. Non-Hispanic blacks had the highest prevalence of diagnosed type 2 diabetes. Diagnosed type 2 diabetes prevalence estimates increased with age and decreased with increasing levels of educational attainment.

What are the implications for public health practice?

Knowledge about national prevalence of diagnosed diabetes by type might be helpful in monitoring trends, assessing the burden of disease for education and management programs, and guiding and prioritizing national plans for future type-specific health services.

There is no reference standard for classifying prevalent type 1 diabetes or type 2 diabetes cases in public health surveillance. The presence of autoantibodies against the beta cells of the pancreas and the lack of endogenous insulin secretion are biologic markers of type 1 diabetes. However, beta cell autoantibodies disappear with time and might even be absent at the time of type 1 diabetes diagnosis (*2*). Insulin secretion tests are difficult to perform and interpret, making these tests unsuitable for use in cross-sectional surveys. In administrative health databases and electronic medical records, adults with diabetes frequently have *International Classification of Diseases* codes for both type 1 and type 2 diabetes. For this reason, disease coding has been combined with other information (e.g., current prescriptions for insulin or oral hypoglycemic medication) when estimating diabetes type in these data (*9*,*10*). Using type 1 diabetes self-report and current insulin use to classify diabetes type, the percentage of all diabetes cases that were type 1 diabetes fell reasonably within the range of results from other studies (approximately 5%–10%) (*3*–*5*,*9*).

The findings in this report are subject to at least three limitations. First, the data were self-reported and underestimate the total number of adults with diabetes. Second, data were not validated, which could have led to misclassification of diabetes type. Adults with self-reported type 1 diabetes who did not report insulin use were reclassified as having type 2 diabetes,

which might have resulted in misclassification if they actually used insulin but did not report use. However, self-reported use of insulin is highly specific: <0.02% of persons who reported insulin in a medication log failed to report using it when asked (*5*). Some insulin users with type 2 diabetes might have incorrectly reported type 1 diabetes, assuming that taking insulin meant they had type 1 diabetes (*5*). In addition, because self-reported cases of unknown type were reclassified as type 2 diabetes, the prevalence of type 2 diabetes might have been overestimated. However, according to a Canadian survey-based algorithm to distinguish diabetes types, 99% of adults who self-reported unknown type would have been classified as type 2 diabetes (*7*). Finally, the small sample size of some subgroups limited precision.

Despite these limitations, this first study to estimate the prevalence of diagnosed type 1 and type 2 diabetes based on self-report and current insulin use among U.S. adults provides information to track prevalence of diabetes by type to monitor trends and assess the burden of disease for education and prevention programs. Knowledge about national prevalences of type 1 and type 2 diabetes might facilitate assessment of the long-term cost-effectiveness of public health interventions and policies aimed at improving diabetes management and help to prioritize national plans for future type-specific health services.

Conflict of Interest

No conflicts of interest were reported.

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Trends in Diabetic Ketoacidosis Hospitalizations and In-Hospital Mortality — United States, 2000–2014

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Diabetes is a common chronic condition and as of 2015, approximately 30 million persons in the United States had diabetes (23 million with diagnosed and 7 million with undiagnosed) (*1*). Diabetic ketoacidosis (DKA) is a life-threatening but preventable complication of diabetes characterized by uncontrolled hyperglycemia (>250 mg/dL), metabolic acidosis, and increased ketone concentration that occurs most frequently in persons with type 1 diabetes (*2*). CDC's United States Diabetes Surveillance System* (USDSS) indicated an increase in hospitalization rates for DKA during 2009–2014, most notably in persons aged <45 years. To explore this finding, 2000–2014 data from the Agency for Healthcare Research and Quality's National Inpatient Sample (NIS)† were assembled to calculate trends in DKA hospitalization rates and in-hospital case-fatality rates. Overall, age-adjusted DKA hospitalization rates decreased slightly from 2000 to 2009, then reversed direction, steadily increasing from 2009 to 2014 at an average annual rate of 6.3%. In-hospital case-fatality rates declined consistently during the study period from 1.1% to 0.4%. Better understanding the causes of this increasing trend in DKA hospitalizations and decreasing trend in in-hospital case-fatality through further exploration using multiple data sources will facilitate the targeting of prevention efforts.

NIS is a nationally representative sample of hospital discharges, corresponding to >35 million hospitalizations annually. Discharges with a first-listed, primary *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) code of 250.1 (diabetes with ketoacidosis) were considered DKA hospitalizations (*1*,*3*). To calculate DKA hospitalization rates among persons with diabetes, the civilian, noninstitutionalized population with diabetes was estimated using corresponding years of data from CDC's National Health Interview Survey (NHIS).§ Because diabetes type was not collected in NHIS, rates were not stratified by disease type. In-hospital case-fatality rate was defined as the proportion of persons hospitalized for DKA who died in the hospital.

DKA rates were age-adjusted using four age groups (<45, 45–64, 65–74, and ≥75 years) from the 2000 U.S. Census. Joinpoint regression models,¶ which use permutation tests to identify points where linear trends change significantly in direction or magnitude, were used to analyze trends in DKA hospitalization and case-fatality rates, stratified by age group and sex, allowing for a maximum of two joinpoints. In the final model, each trend segment was described by an annual percent change, and the trend for each period was tested to determine whether the slope was significantly different from zero. A p-value of <0.05 was considered statistically significant. The analysis accounted for the complex sampling designs of NIS and NHIS.

From 2000 to 2009, the age-adjusted rate of DKA hospitalizations among persons with diabetes fluctuated but declined at an average annual rate of 1.1% (Figure) (Table 1). During 2009–2014, however, the rate increased 54.9%, from 19.5 to 30.2 per 1,000 persons, at an average annual rate of 6.3%. The reversal in trend was apparent across all age groups and both sexes. Rates were highest in persons aged <45 years (44.3 per 1,000 in 2014) and lowest in persons aged ≥65 years (<2.0 per 1,000) (Table 1).

In-hospital case-fatality rates declined during 2000–2014 at an annual average rate of 6.8% (from 1.1% to 0.4% [63.6% decline overall]); no joinpoints were found (Figure) (Table 2). The declining rates were seen across all age groups and both sexes. Although the highest case-fatality rates were observed among persons aged ≥75 years, this group experienced the largest absolute decrease across the entire period.

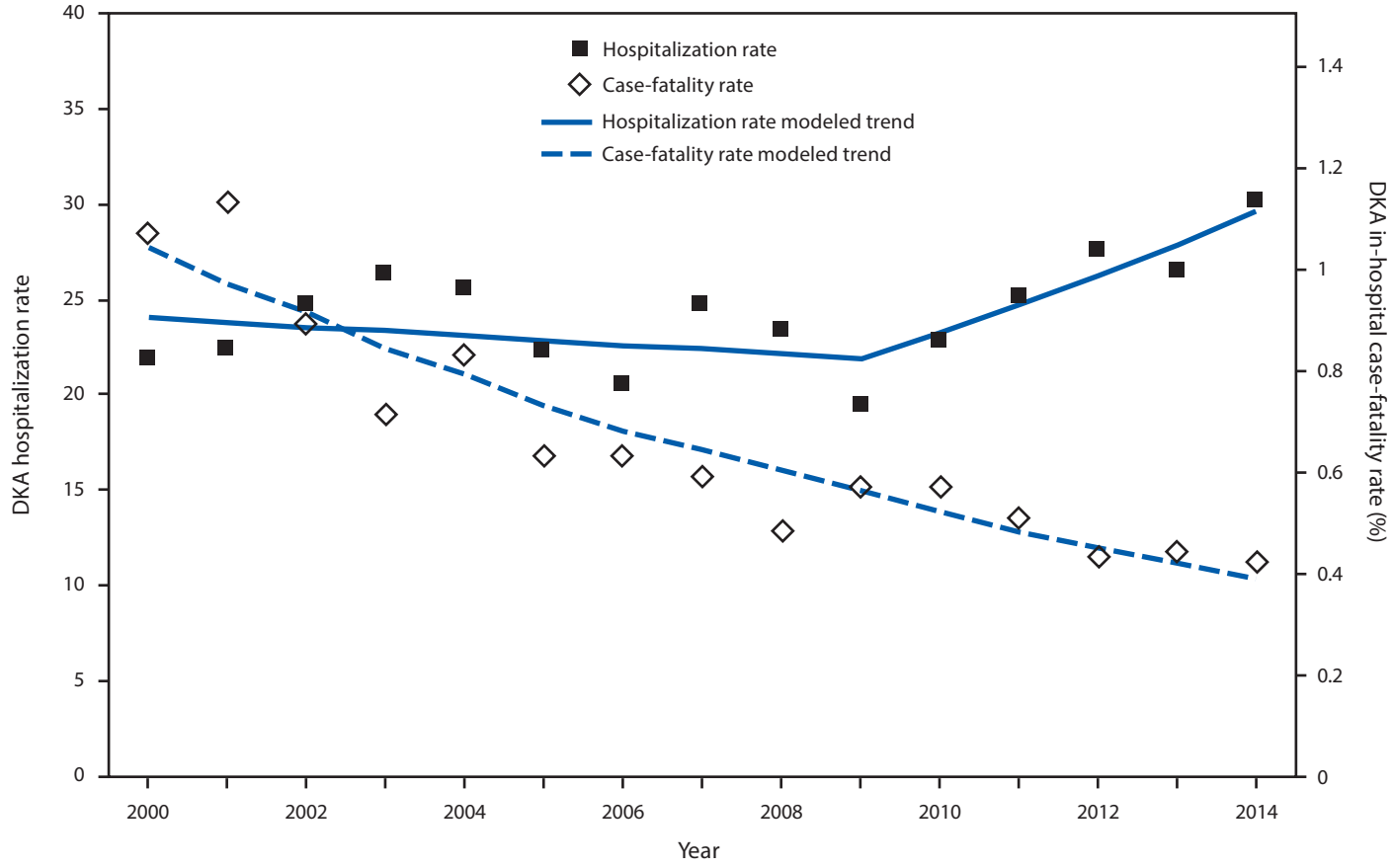
Discussion

Although DKA hospitalization rates among persons with diabetes declined slightly from 2000 to 2009, this trend reversed, with rates increasing 54.9% from 2009 to 2014. From 2009 to 2014 all age groups experienced an increase of ≥6.0% annually in DKA hospitalization rates, with highest rates among persons aged <45 years. This increase in DKA hospitalization rates is concerning because DKA is a life-threatening but avoidable complication of diabetes. Despite the increase in DKA hospitalization rates, however, in-hospital mortality among persons with DKA consistently decreased over the study period. Identification of factors contributing to the increase in hospitalizations for DKA might help target prevention efforts.

Although DKA is more common among persons with type 1 diabetes, it also occurs among persons with type 2 diabetes (*2*).

* https://www.cdc.gov/diabetes/data.
† https://www.hcup-us.ahrq.gov/nisoverview.jsp.
§ https://www.cdc.gov/nchs/nhis/methods.htm.
¶ https://surveillance.cancer.gov/joinpoint.

FIGURE. Age-adjusted diabetic ketoacidosis hospitalization rate per 1,000 persons with diabetes and in-hospital case-fatality rate — United States, 2000–2014*



Abbreviation: DKA = diabetic ketoacidosis.
* Symbols indicate observed points; lines indicate modeled trends. All modeled trend lines were significant at a p-value of <0.05.

TABLE 1. Diabetic ketoacidosis hospitalization rates per 1,000 persons with diabetes, overall and by age group and sex — National Inpatient Sample and National Health Interview Survey, United States, 2000–2014

Characteristic	Year 2000 (N = 12,052,000*) Rate (95% CI)	First joinpoint year	First joinpoint (N = 20,667,000*,†) Rate (95% CI)	Year 2014 (N = 21,953,000*) Rate (95% CI)	APC (95% CI)	
					Period 1§	Period 2§
Total DKA, no.¶	**101,621**	**2009**	**141,704**	**188,950**	**NA**	**NA**
Total rate**	**21.9 (18.9 to 24.9)**	**2009**	**19.5 (16.8 to 22.3)**	**30.2 (26.4 to 34.0)**	**-1.1 (-1.8 to -0.3)**	**6.3 (4.6 to 8.0)**
Age group (yrs)						
<45	31.7 (27.1 to 36.3)	2009	28.5 (24.3 to 32.7)	44.3 (38.5 to 50.0)	-1.0 (-1.8 to -0.2)	6.2 (4.5 to 8.0)
45–64	4.6 (4.1 to 5.1)	2009	3.7 (3.3 to 4.0)	5.2 (4.8 to 5.5)	-1.5 (-1.9 to -1.1)	6.7 (5.8 to 7.5)
65–74	1.5 (1.3 to 1.7)	2007	1.0 (0.9 to 1.2)	1.6 (1.5 to 1.8)	-5.2 (-5.8 to -4.6)	6.4 (5.9 to 6.9)
≥75	1.6 (1.3 to 1.8)	2007	0.9 (0.7 to 1.0)	1.4 (1.2 to 1.5)	-9.3 (-10.3 to -8.3)	6.0 (4.9 to 7.0)
Sex**						
Male	23.9 (18.7 to 29.1)	2009	18.6 (14.6 to 22.5)	30.8 (25.3 to 36.2)	-2.5 (-3.4 to -1.6)	8.0 (6.1 to 10.0)
Female	20.2 (16.8 to 23.6)	2009	20.5 (16.6 to 24.3)	29.6 (24.8 to 34.3)	0.1 (-0.7 to 0.9)	5.1 (3.1 to 7.0)

Abbreviations: APC = annual percent change; CI = confidence interval; DKA = diabetic ketoacidosis; NA = not applicable.
* Data rounded to the nearest thousand.
† Population with diabetes in 2009.
§ Period 1 is from 2000 to first joinpoint year; period 2 is from first joinpoint year to 2014.
¶ Estimated number of DKA hospitalizations in the indicated years.
** Age adjusted to the 2000 U.S. Census using the four age groups listed in the table.

TABLE 2. Diabetic ketoacidosis in-hospital case-fatality rates, overall and by age group and sex — National Health Interview Survey, United States, 2000–2014

Characteristic	Year 2000 (N = 101,621) % (95% CI)	First joinpoint year	First joinpoint (N = 141,704*) % (95% CI)	Year 2014 (N = 188,950) % (95% CI)	APC (95% CI)	
					Period 1†	Period 2†
No. of deaths§	**800**	**2009**	**611**	**620**	**NA**	**NA**
Total¶	**1.1 (0.9 to 1.2)**	—**	—**	**0.4 (0.4 to 0.5)**	**-6.8 (-7.1 to -6.4)**	—**
Age group (yrs)						
<45	0.3 (0.2 to 0.4)	2007	0.1 (0.1 to 0.2)	0.1 (0.1 to 0.1)	-13.1 (-14.6 to -11.5)	-3.3 (-5.2 to -1.2)
45–64	1.0 (0.7 to 1.2)	—**	—**	0.5 (0.3 to 0.6)	-5.4 (-6.1 to -4.7)	—**
65–74	3.4 (2.2 to 4.6)	2007	1.5 (0.6 to 2.3)	1.4 (0.8 to 1.9)	-10.0 (-13.6 to -6.4)	-2.4 (-6.8 to 2.3)
≥75	7.2 (5.2 to 9.2)	—**	—**	2.6 (1.6 to 3.6)	-7.0 (-7.7 to -6.3)	—**
Sex¶						
Male	1.2 (0.9 to 1.5)	—**	—**	0.5 (0.4 to 0.6)	-6.9 (-7.3 to -6.4)	—**
Female	1.0 (0.8 to 1.2)	—**	—**	0.4 (0.3 to 0.5)	-6.6 (-7.1 to -6.1)	—**

Abbreviations: APC = annual percent change; CI = confidence interval; DKA = diabetic ketoacidosis; NA = not applicable.
* Number of DKA hospitalizations in 2009.
† Period 1 is from 2000 to first joinpoint year (or 2014 if no joinpoint); period 2 is from first joinpoint year to 2014.
§ Estimated number of in-hospital deaths.
¶ Age adjusted to the 2000 U.S. Census using the four age groups listed in the table.
** No joinpoints were found.

DKA can be the initial sign of unrecognized type 1 or type 2 diabetes; however, it occurs more frequently in persons with established disease (*4*). Two studies among youths found either stable or decreasing rates of DKA at the time of diagnosis of diabetes, suggesting that younger persons with established disease and poor glucose control might be the group contributing most to the increase in DKA hospitalization rates among persons aged <45 years (*5*,*6*). However, whether DKA is occurring at the time of diagnosis or among persons with established disease in adults is unknown.

The causes of the increase in DKA hospitalization rates are not clear, but several possible explanations include the following: changes in case definition, new medications that might increase the risk for DKA, and higher admission rates because of lower thresholds for hospitalization (i.e., admission of persons with less serious disease). Although the American Diabetes Association definition of DKA has not changed over the years, the most recent 2009 publication described a "euglycemic DKA" type characterized by metabolic acidosis and increased total body ketone concentration, but with glucose levels ≤250 mg/dL, occurring in approximately 10% of patients with DKA (*7*). Euglycemic DKA hospitalizations might have resulted in an increase in the number of hospitalized patients classified as having DKA, but NIS does not have laboratory data to corroborate this hypothesis. This hypothesis assumes that DKA case definitions are uniformly applied in clinical practice, which in a call for standardization of diagnostic criteria for DKA was demonstrated to be unlikely (*8*).

Sodium-glucose cotransporter 2 (SGLT2) inhibitors, a class of prescription medications used to treat type 2 diabetes, were approved in March 2013. In December 2015, the Food and Drug Administration added a label to SGLT2 inhibitors warning that these medications might increase the risk for DKA. Because SGLT2 inhibitors were only recently approved, and DKA rates increased before their introduction, they are likely not a major contributor to the increasing DKA trend but do remain an ongoing concern for future events. More recent higher admission rates for less severe cases of DKA could also explain an increased trend in DKA admissions. Although no evidence that this occurred exists, analyzing emergency department data might help confirm or refute this hypothesis.

The causes of the decrease in DKA in-hospital mortality are also not clear. Better understanding of the pathophysiology of DKA and adoption of DKA treatment guidelines, both of which might have led to better management and treatment, have been proposed as reasons for declines in DKA in-hospital mortality (*2*). Another possibility is that hospital admission of less severe cases has resulted in higher admission rates and contributed to the lower in-hospital case-fatality rates over time.

In the early 2000s, an increase in DKA cases among persons with obesity and type 2 diabetes was reported (*9*). These patients had impaired insulin levels but lacked typical autoimmune markers of type 1 disease, and their beta-cell function recovered quickly after treatment. This disease type, named ketosis-prone type 2 diabetes, has features of both type 1 and type 2 disease. Other variants of diabetes have been described, but no evidence that rates of these disease variants are increasing and thus contributing to the increased DKA hospitalization rates could be found (*10*).

In 2014, the DKA hospitalization rate among persons with diabetes aged <45 years was approximately 27 times the rate among persons aged ≥65 years. Therefore, efforts to understand factors contributing to the increase in hospitalizations for DKA should consider the demographic and clinical characteristics

Summary

What is already known about this topic?

Diabetic ketoacidosis (DKA) is a life-threatening complication of diabetes, a disease that affects approximately 30 million persons in the United States. DKA is more common among persons with type 1 diabetes.

What is added by this report?

After a slight decline during 2000–2009, hospitalizations for DKA increased in the United States during 2009–2014 among all age groups and were highest among persons aged <45 years. Concurrently, in-hospital case-fatality rates among persons with DKA consistently decreased from 2000 to 2014.

What are the implications for public health practice?

DKA is a life-threatening but avoidable complication of diabetes. Prevention measures, such as diabetes self-management education, might help reverse the increasing trend in DKA, especially in persons aged <45 years who have the highest DKA rates.

of youths and young adults. Information from studies among these groups might help determine whether factors such as symptom recognition, adherence to therapy, self-management skills, access to care, or cost of treatment should be a focus of DKA prevention strategies.

The findings in this report are subject to at least four limitations. First, NIS does not include federal hospitals, which would lead to an underestimate of the total number of DKA hospitalizations; however, NIS represents approximately 96% of the U.S. population. Second, although in-hospital DKA case-fatality rates declined, mortality rates at home or in the emergency department setting were not investigated. Third, the DKA case definition used in this analysis was based on an ICD-9-CM code from the hospital discharge record that could not be validated. Misclassification might have occurred leading to over- or underestimation of hospitalization rates. However, misclassification caused by changing coding practices over time is unlikely. Finally, results were not stratified by diabetes type, and persons with type 1 diabetes are at particularly high risk for DKA.

DKA hospitalizations in the United States have increased among all age groups, with the highest rates among persons aged <45 years. Although the continued decline in in-hospital DKA mortality is encouraging, further work might help identify populations at risk. Evidence-based, targeted prevention measures, such as diabetes self-management education and support might help reverse the trend in this potentially life-threatening but avoidable complication of diabetes.

Conflict of Interest

No conflicts of interest were reported.

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Two Cases of Meningococcal Disease in One Family Separated by an Extended Period — Colorado, 2015–2016

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On April 26, 2015, a case of meningococcal disease in a woman aged 75 years was reported to the Colorado Department of Public Health and Environment (CDPHE). As part of routine public health investigation and control activities, all seven family contacts of the patient were advised to receive appropriate postexposure prophylaxis (PEP) to eradicate nasopharyngeal carriage of meningococci and prevent secondary disease (*1*), although it is not known whether the family contacts complied with PEP recommendations. Fifteen months later, on June 6, 2016, CDPHE was notified that the grandchild of the first patient, a male infant aged 3 months who lived with the first patient, also had meningococcal disease. The infant's immediate family members (parents and one sibling) were among family contacts for whom PEP was recommended in 2015. *Neisseria meningitidis* isolates from both patients were found to be serogroup C at the CDPHE laboratory. Whole genome sequence (WGS) analysis at CDC found that both isolates had the same sequence type, indicating close genetic relatedness. These cases represent a possible instance of meningococcal disease transmission within a family, despite appropriate PEP recommendations and with a long interval between cases.

Investigation and Results

On April 24, 2015, the first patient was evaluated at hospital A for aphasia, rigors, chills, and fever. She was hospitalized and treated empirically with ceftriaxone and azithromycin. Blood specimens collected before antibiotic initiation were culture-positive for *N. meningitidis*; Gram stain of the patient's cerebrospinal fluid (CSF), collected after initiation of antibiotics, revealed gram-negative diplococci, characteristic of *Neisseria* species; however, bacterial cultures showed no growth after 7 days. CDPHE was notified of the case on April 26, 2015. Once *N. meningitidis* was identified, the patient received 10 days of ceftriaxone therapy. She was discharged to a skilled nursing facility after 7 days and recovered. The blood isolate was determined to be serogroup C via slide agglutination and real-time polymerase chain reaction (real-time PCR) testing at the CDPHE laboratory.

Fifteen months later, on June 4, 2016, the grandson of the first patient, aged 3 months, was evaluated in the emergency department of hospital B for fever and decreased alertness. A blood specimen was obtained, empirical ceftriaxone was administered, and the patient was airlifted to hospital C, where petechiae were noted, and a lumbar puncture was performed. Gram stain of the patient's blood revealed gram-negative diplococci, and blood culture was positive for *N. meningitidis*. No organisms were detected in the infant's CSF. An assessment of the infant for complement component deficiency, which can increase risk for meningococcal disease (*2*), did not reveal any abnormalities. CDPHE was notified of the case on June 6, 2016. The infant recovered after 7 days of treatment with ampicillin. CDPHE laboratory determined the blood isolate from the infant was also serogroup C *N. meningitidis* via slide agglutination and real-time PCR.

Following the identification of the second patient, isolates from both the grandmother and the grandchild were submitted for WGS analysis at CDC. The two isolates had the same sequence type (sequence type 2006, clonal complex 103) and were more closely related to each other than to other isolates from sporadic cases within the same clonal complex. Antimicrobial susceptibility testing indicated both isolates were pansusceptible.

Public Health Response

In 2015, after the report of the first case, a public health investigation was conducted by Jefferson County Public Health and CDPHE. Seven family contacts of the patient were identified and advised to receive PEP, consisting of oral ciprofloxacin for the six adult contacts and intramuscular ceftriaxone for one child contact.

In 2016, during the public health investigation of the second case, it was learned that the grandmother lived with her grandson and was his child care provider. Oral ciprofloxacin PEP was recommended for five adult contacts and oral rifampin for one child contact (five household contacts and one community contact). All five household contacts had previously been advised to receive PEP following the first patient's illness in 2015.

Discussion

Meningococcal disease is a rare and serious illness; an average of 10 cases per year were reported in Colorado during 2011–2016. *N. meningitidis* is transmitted through direct contact with large-droplet respiratory tract secretions from

persons with meningococcal disease or asymptomatic nasopharyngeal carriage (*2*).

Although the first patient lived with and cared for the second patient during the day, she was appropriately treated for meningococcal disease, and her family contacts, including the parents and sibling of the second patient, were appropriately advised to receive PEP; however, compliance with PEP recommendations was not known. These cases represent a possible instance of meningococcal disease transmission within a family, despite appropriate PEP recommendations and with an interval of 15 months between cases, with the second case occurring in an infant who was not yet born at the time the first case occurred. There have been some documented examples of household transmission of meningococcal disease (*3*–*7*); a review estimated the attack rate among household contacts who received appropriate PEP to be 1.1 cases per 1,000 household contacts (*4*).

The mechanism behind this instance of household transmission is unclear. An unidentified close contact of the grandmother could have been a close contact of the infant patient, or this strain of *N. meningitidis* could have been circulating asymptomatically in the wider community for an extended period. A third possibility is that PEP failed to eradicate carriage within the family, either because of incomplete compliance, nonsimultaneous administration, or incomplete eradication of carriage. Although estimates vary, 5%–10% of adults are colonized with *N. meningitidis* at any given time, and most colonized persons carry nonpathogenic strains and do not develop disease (*1*). Both disease treatment and PEP would be expected to eradicate meningococcal carriage (*1*,*8*). Although PEP was recommended and prescribed for all identified close contacts of the first patient, because compliance was not ascertained, it is not known whether all contacts received PEP. Because *N. meningitidis* can only survive on surfaces for ≤10 days (*9*), it is unlikely that environmental persistence of the bacteria contributed to transmission.

Household links between cases are not routinely documented as part of national meningococcal disease surveillance, and the frequency with which household transmission of meningococcal disease occurs in the United States is not easily known. The 15-month interval between these two cases is longer than in previous reports of household transmission (range = <1 day to 39 weeks) (*3*–*7*). However, some of these studies (*6*,*7*) limited their definition of secondary cases to a specific window of time after the first case, limiting these comparisons. WGS analysis confirmed the same sequence type in both cases, whereas older reports of multiple cases of meningococcal disease within households could determine that isolates were of the same serogroup but lacked the ability to determine the sequence type.

Summary

What is already known about this topic?

Meningococcal disease is a rare and serious illness; an average of 10 cases per year were reported in Colorado during 2011–2016. Both disease treatment and postexposure prophylaxis (PEP) of close contacts of persons with meningococcal disease are expected to eradicate meningococcal carriage.

What is added by this report?

This report describes a possible instance of meningococcal disease transmission within a family, despite appropriate PEP recommendations (but without documentation of compliance), with a 15-month interval between cases and with the second case in an infant who was not yet born at the time the first case occurred. Whole genome sequencing was used to confirm the same sequence type in both cases, whereas older reports of multiple cases of meningococcal disease within households were often limited to the same serogroup, without ability to confirm the exact strain.

What are the implications for public health practice?

Vaccination of close contacts of sporadic meningococcal disease cases in addition to PEP is not currently recommended in the United States for the prevention of secondary cases. Additional evaluations to estimate the secondary attack rate within households and efforts to improve documentation of PEP compliance would be helpful to assess existing recommendations for public health response to meningococcal disease cases in the current U.S. epidemiologic context.

Vaccination of close contacts of patients with sporadic meningococcal disease in addition to PEP is not currently recommended in the United States for the prevention of secondary cases. Additional evaluations to estimate the secondary attack rate within households and efforts to improve documentation of PEP compliance would be helpful to assess existing recommendations for public health response to meningococcal disease cases in the current U.S. epidemiologic context.

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Conflict of Interest

No conflicts of interest were reported.

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Notes from the Field

Nontuberculous Mycobacteria Infections in U.S. Medical Tourists Associated with Plastic Surgery — Dominican Republic, 2017

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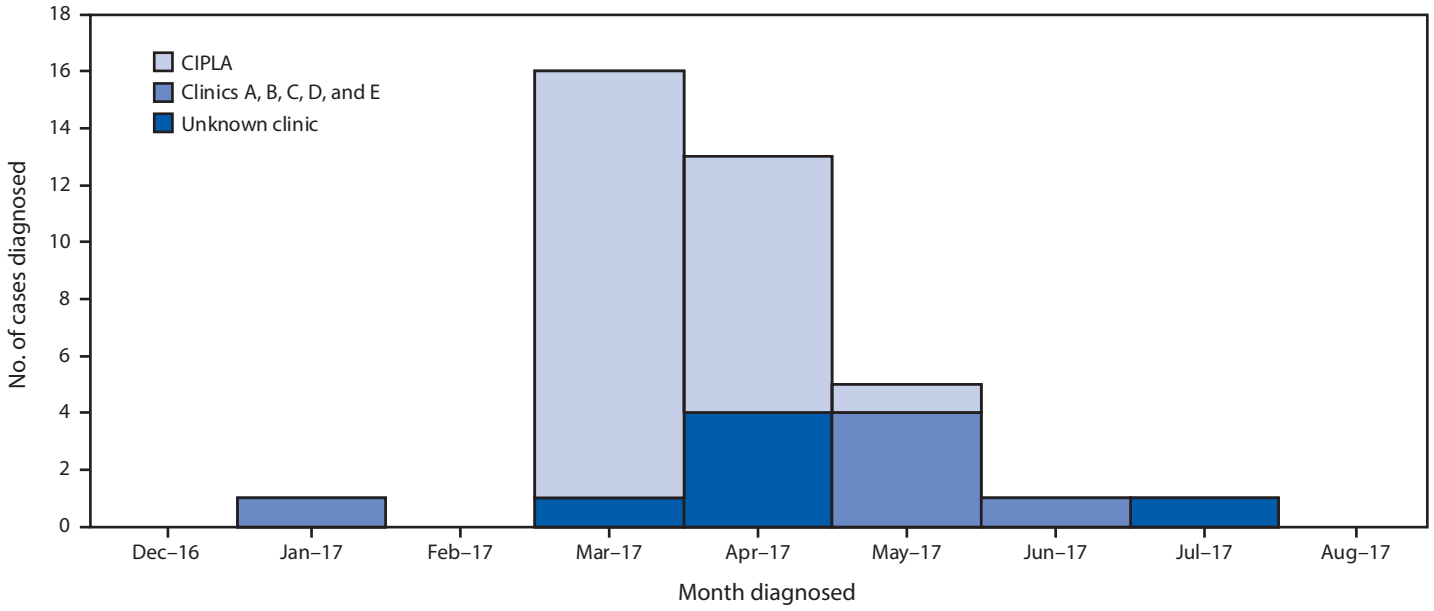
Since 2013, CDC has received reports and investigated serious complications among medical tourists (i.e., persons whose primary purpose for international travel is medical care) upon their return to the United States (*1*). On May 1, 2017, the New York City Department of Health and Mental Hygiene informed CDC of three patients with nontuberculous mycobacteria (NTM) surgical site infections (SSI), all of whom had undergone cosmetic surgical procedures by a single surgeon at Centro Internacional de Cirugía Plástica Avanzada (CIPLA) in the Dominican Republic (*2*).

To identify additional patients, calls for cases were issued via CDC's Epidemic Information Exchange (Epi-X), state-based health alert systems, the Infectious Diseases Society of America's Emerging Infections Network, and the American Society of Plastic Surgeons' email distribution list. State and local health department staff members interviewed reported patients to collect information about medical care received abroad, symptoms, and treatment received after their original surgical procedures. A confirmed case of cosmetic surgery–associated NTM infection was defined as a diagnosed SSI and laboratory evidence confirming the presence of NTM in a U.S. resident who underwent a cosmetic surgery procedure in the Dominican Republic since January 1, 2017.

As of November 8, 2017, CDC had been notified of 52 patients from nine states with an SSI after cosmetic surgery in the Dominican Republic; 38 (73%) met the confirmed case definition. The remaining 14 did not have laboratory evidence of NTM and thus did not meet the confirmed case definition. All confirmed cases occurred in women who reported undergoing surgery during January 4–July 14, 2017 (Figure). Patients meeting the confirmed case definition identified 14 surgeons at seven surgical centers in the Dominican Republic (clinics A, B, C, D, E, CIPLA, and one unknown clinic). Among confirmed cases with available information, 26 (81%) of 32 patients reported undergoing surgery at CIPLA; 11 of 11 with information on treatment received more than one antibiotic, and 14 of 15 required therapeutic surgical procedures after returning to the United States. One death was reported.

FIGURE. Nontuberculous mycobacteria infections (N = 37) associated with cosmetic surgery among U.S. medical tourists, by clinic and month of procedure — Dominican Republic, January–July 2017.



Abbreviation: CIPLA = Centro Internacional de Cirugía Plástica Avanzada.

The New York State Department of Health Wadsworth Center conducted whole genome sequencing of isolates from 22 cases and identified three distinct genetic cluster variants. None of the clusters corresponded to a single clinic or a single surgeon. NTM are ubiquitous in nature and commonly colonize water systems as a mix of clonal variants, which can make speciation less relevant in the context of an outbreak.

CDC notified public health authorities in the Dominican Republic of the investigation and issued a travel notice on July 18, 2017, advising U.S. residents of the risks associated with any surgery at CIPLA (*2*). CIPLA was temporarily closed on July 8, 2017.

Detection of outbreaks among medical tourists relies on clinical recognition and reporting to public health authorities. Patients who attend a single clinic abroad might be sparsely distributed across the United States. Furthermore, extrapulmonary NTM infections are not nationally notifiable and require targeted diagnostic testing, making cluster identification more difficult (*3*).

This investigation, in the context of medical tourism's rapidly growing market, underscores the need for education of prospective medical tourists about possible risks and highlights the importance of health care providers having a high index of suspicion for NTM early in the evaluation of patients with SSI after cosmetic surgery (*4*). CDC continues to seek reports of infections after medical tourism from health departments. The Council of State and Territorial Epidemiologists recently approved a standard case definition to support improved surveillance for extrapulmonary NTM infections (*3*).

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Kathy Seiber, Clinical and Environmental Microbiology Branch, Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, CDC.

Conflict of Interest

No conflicts of interest were reported.

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Notes from the Field

Fatalities Associated with Human Adenovirus Type 7 at a Substance Abuse Rehabilitation Facility — New Jersey, 2017

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On February 3, 2017, a local health department notified the New Jersey Department of Health (NJDOH) of a severe respiratory illness outbreak, including two hospitalizations and one death, at a substance abuse treatment facility. During December 2016–January 2017, NJDOH surveillance for noninfluenza respiratory viruses identified multiple human adenovirus (HAdV) cases in the surrounding community. HAdVs can cause severe respiratory illness, and outbreaks of HAdV type 4 (HAdV-4) and HAdV type 7 (HAdV-7) have been associated with communal living facilities, including military barracks (*1*). A combined HAdV-4 and HadV-7 live oral vaccine is available but is currently limited to military use (*2*). NJDOH and the local health department investigated the outbreak in consultation with CDC to describe outbreak scope and provide infection control recommendations in this communal facility.

The facility has an average outpatient census of 25 persons, an average daily census of 85 inpatients, and 91 staff members. Both staff members and patients congregate in multiple communal areas for group therapy sessions, recreational and social activities, smoking, and eating. In this outbreak, a probable case was defined as the occurrence of an acute respiratory illness (defined as any two of the following: fever ≥100°F [37.8°C], sore throat, cough, rhinorrhea, or nasal congestion) in a patient with an epidemiologic link to the treatment facility during January 1, 2017–March 31, 2017. Confirmed cases met the probable case definition and had a positive test result for HAdV using polymerase chain reaction (PCR) on a nasopharyngeal swab, oropharyngeal swab, or lung tissue specimen. Seventy-nine probable cases including 59 inpatients and 20 staff members were identified. Among these 79 patients, four (5%) were hospitalized, and three died (case fatality rate 4%). Specimens were available from 25 probable cases; four of these, all in hospitalized patients, were confirmed as HAdV by PCR. The three fatal cases included two patients with HAdV-7 identified from nasopharyngeal specimens and one with HAdV-7 identified from a lung tissue specimen at autopsy. HAdV detected from the fourth patient was not typed.

The three persons who died initially developed fever and cough, which rapidly progressed to multifocal pneumonia and acute respiratory distress syndrome that required intubation and mechanical ventilation. Respiratory failure progressed and required extracorporeal membrane oxygenation; respiratory failure was followed by acute renal failure and death. Among the three fatal cases, time from symptom onset to death ranged from 4 to 37 days; patients ranged in age from 54 to 64 years, and two were men. According to the patients' medical histories, one had cirrhosis, one had diabetes mellitus type 2, and one had both cirrhosis and diabetes mellitus type 2. All three deaths occurred in persons who reported a history of alcoholism. Alcohol abuse independently increases the risk for acute respiratory distress syndrome approximately threefold to fourfold (*3*).

The outbreak setting presented challenges in management and control of HAdV transmission because of the communal living and group-therapy environment. Local, state, and federal officials recommended 1) use of U.S. Environmental Protection Agency-approved viricide cleaners on common touch areas in communal gathering places, 2) frequent patient and staff member handwashing, 3) isolation of patients with fever ≥100°F (37.8°C) lasting ≥24 hours, and 4) a 72-hour deferral for new admissions during implementation of recommended infection control measures. No new cases were reported after March 24, 2017.

HAdV-7 is known to cause morbidity and mortality, particularly in military training facilities (*4*). Adenovirus morbidity and mortality associated with nonmilitary congregate settings are less well described, although severe morbidity and mortality have been documented among immunocompromised patients (*5*). This outbreak investigation documents severe morbidity and mortality associated with HAdV-7 among persons in a substance abuse treatment facility with specific comorbidities including diabetes mellitus type 2, alcoholism, and cirrhosis and highlights the challenges of illness containment in a communal environment. Clinicians and public health practitioners should be aware of HAdV-7 as a potential cause of severe respiratory illness in these settings.

Acknowledgment

Cumberland County Health Department, New Jersey.

Conflict of Interest

No conflicts of interest were reported.

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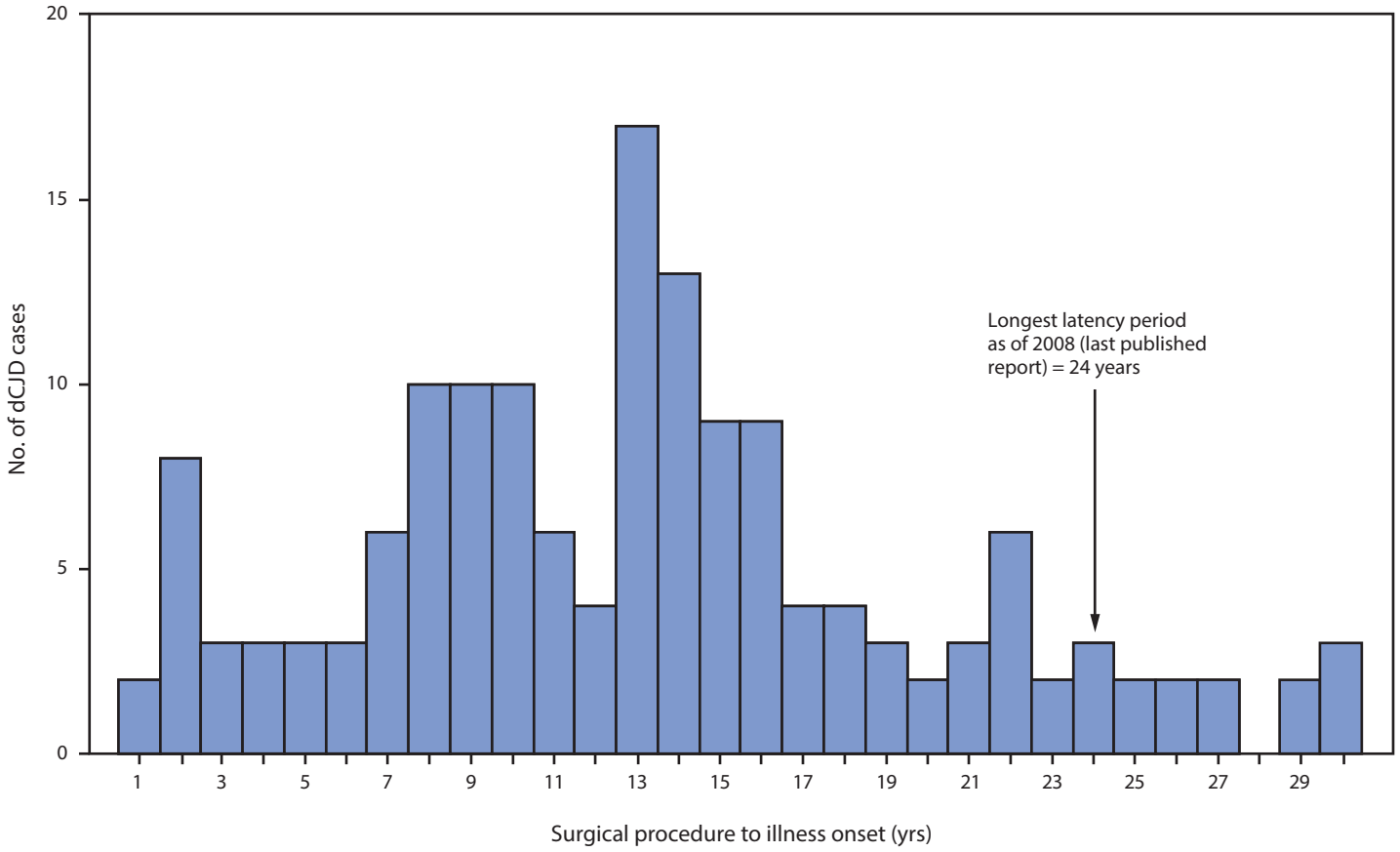
Errata

Vol. 67, No. 9

In the report "Update: Dura Mater Graft–Associated Creutzfeldt-Jakob Disease — Japan, 1975–2017," on page 276, an error occurred in Figure 3. The corrected figure is as follows:



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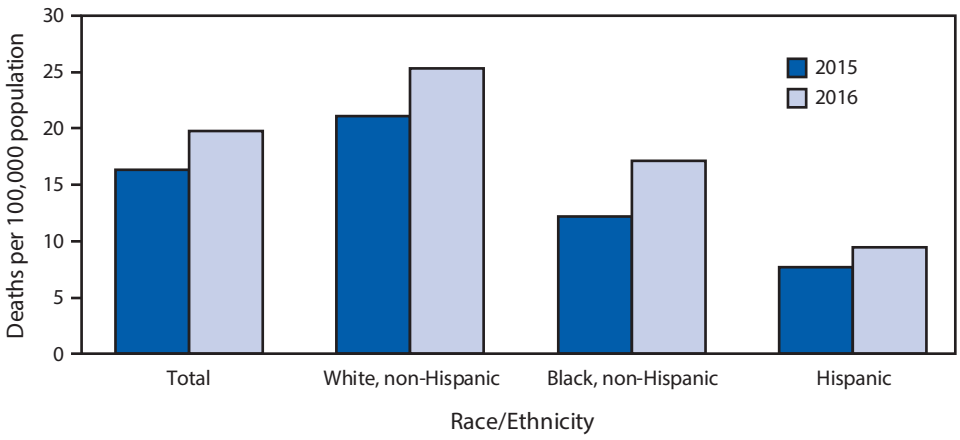
In the report "HIV Diagnoses Among Persons Aged 13–29 Years — United States, 2010–2014," on page 212, the second footnote for Table 1 should have read "† Rates are **single-year rates** per 100,000 population. **Rates for 2010–2014 are comparable to single-year rates and are calculated as number of diagnoses during 2010–2014 divided by number of person-years at risk for diagnosis during 2010–2014 (x 100,000).**" On page 213, the third footnote for Table 2 should have read "§ Rates are **5-year cumulative rates** per 100,000 population. Rates are not calculated by transmission category because of the lack of denominator data."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Death Rates* for Drug Overdose,† by Race/Ethnicity — National Vital Statistics System, United States, 2015–2016



* Deaths per 100,000 population age-adjusted to the 2000 U.S. standard population.
† As underlying cause of death, drug overdose (including accidental, intentional, assault, and undetermined intent) was identified with the *International Classification of Diseases, Tenth Revision* (ICD-10) codes X40-X44, X60-X64, X85, Y10-Y14. The number of drug overdose deaths was 52,404 in 2015 and 63,632 in 2016.

During 2015–2016, the age-adjusted death rates from drug overdose for the total population increased from 16.3 per 100,000 standard population to 19.8 (21.5%). The rate increased from 21.1 to 25.3 (19.9%) for non-Hispanic whites, from 12.2 to 17.1 (40.2%) for non-Hispanic blacks, and from 7.7 to 9.5 (23.4%) for Hispanics.

Source: National Vital Statistics System, Underlying cause of death data, 1999–2016. https://wonder.cdc.gov/ucd-icd10.html.

Reported by: Jiaquan Xu, MD, jiaquanxu@cdc.gov, 301-458-4086.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/drugoverdose/.

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