Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 66 / No. 34
September 1, 2017

International Overdose Awareness Day — August 31, 2017

International Overdose Awareness Day is a global event held each year on August 31. This event aims to raise awareness that overdose deaths are preventable, reduce stigma about substance use disorders and drug-related deaths, highlight community drug-related services, and support evidence-based policies and programs to prevent or reduce drug-related harms. Additional information is available at https://www.overdoseday.com.

The opioid overdose epidemic resulted in the deaths of approximately 300,000 persons in the United States during 1999–2015, including 33,000 in 2015 (*1*). The first wave of deaths began in 1999 and included deaths involving prescription opioids (*1*). It was followed by a second wave, beginning in 2010, and characterized by deaths involving heroin (*2*). A third wave started in 2013, with deaths involving synthetic opioids, particularly illicitly manufactured fentanyl (IMF) (*3*). IMF is now being used in combination with heroin, counterfeit pills, and cocaine (*3*).

Reports in this issue of *MMWR* 1) highlight how increases in deaths and death rates related to heroin and synthetic opioids mirror data tracking illicit drugs and 2) describe the role of IMF and fentanyl analogs in 281 overdose deaths in 2 months in Ohio. Additional data and information on CDC's state-level efforts to address drug-related deaths are available at https://www.cdc.gov/drugoverdose/index.html.

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Trends in Deaths Involving Heroin and Synthetic Opioids Excluding Methadone, and Law Enforcement Drug Product Reports, by Census Region — United States, 2006–2015

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Opioid overdose deaths quadrupled from 8,050 in 1999 to 33,091 in 2015 and accounted for 63% of drug overdose deaths in the United States in 2015. During 2010–2015, heroin overdose deaths quadrupled from 3,036 to 12,989 (*1*). Sharp increases in the supply of heroin and illicitly manufactured fentanyl (IMF) are likely contributing to increased deaths (*2–6*). CDC examined trends in unintentional and undetermined deaths involving heroin or synthetic opioids excluding methadone (i.e., synthetic opioids)* by the four U.S. Census regions during 2006–2015. Drug exhibits (i.e., drug products) obtained by law enforcement and reported

* Death data are from CDC WONDER (https://wonder.cdc.gov/). "Synthetic opioids excluding methadone" is a defined cause of death category.

INSIDE

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

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to the Drug Enforcement Administration's (DEA's) National Forensic Laboratory Information System (NFLIS) that tested positive for heroin or fentanyl (i.e., drug reports) also were examined. All U.S. Census regions experienced substantial increases in deaths involving heroin from 2006 to 2015. Since 2010, the South and West experienced increases in heroin drug reports, whereas the Northeast and Midwest experienced steady increases during 2006–2015.† In the Northeast, Midwest, and South, deaths involving synthetic opioids and fentanyl drug reports increased considerably after 2013. These broad changes in the U.S. illicit drug market highlight the urgent need to track illicit drugs and enhance public health interventions targeting persons using or at high risk for using heroin or IMF.

Full-year estimates of fentanyl or heroin drug reports§ per 100,000 population (using DEA's NFLIS)¶ and unintentional or undetermined intent heroin and synthetic opioid death rates per 100,000 population (using the National Vital Statistics System multiple cause-of-death mortality files) were stratified by the four U.S. Census regions for 2006–2015. The following *International Classification of Diseases, Tenth Revision* codes were used to identify deaths involving heroin and synthetic opioids: 1) underlying cause-of-death codes X40–X44 (unintentional) or Y10–Y14 (undetermined)** and 2) opioid-specific multiple cause-of-death codes of T40.1 for heroin and T40.4 for synthetic opioids. Total deaths involving heroin (i.e., deaths involving heroin with or without synthetic

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

§ The Drug Enforcement Administration's National Forensic Laboratory Information System (NFLIS) estimates of drug exhibits are calculated using the National Estimates Based on All Reports method, which incorporates weighting to account for nonsampled laboratories. https://www.nflis.deadiversion.usdoj.gov/DesktopModules/ReportDownloads/Reports/NFLIS2015AR.pdf .

¶ DEA's NFLIS collects drug identification results from reports submitted to state and local and national laboratories. https://www.deadiversion.usdoj.gov/nflis/. Drug report estimates are calculated from state and local laboratory reports and were obtained on July 6, 2017.

** Suicides and homicides were excluded because the focus was on unintentional overdoses. Trends in unintentional overdose deaths are expected to be different from those of intentional poisoning deaths. During 2006–2015, only 1.1% and 9.1% of deaths involving heroin or synthetic opioids were categorized as homicides or suicides, respectively (https://wonder.cdc.gov/). Undetermined intent overdoses were included because they might have been unintentional; only 7% of analyzed deaths were categorized as undetermined.

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

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2017;66:[inclusive page numbers].

opioids) and total deaths involving synthetic opioids (i.e., deaths involving synthetic opioids with or without heroin) were categorized further into three groups: 1) deaths involving heroin without synthetic opioids, 2) deaths involving synthetic opioids without heroin, and 3) deaths involving use of both heroin and synthetic opioids.†† Changes in deaths involving synthetic opioids after 2013 have been primarily driven by IMF and thus are a proxy for changes in deaths involving fentanyl after 2013 (*5*,*6*).§§ Piecewise linear regression analyses were used to examine hypotheses that regional trends mirrored the national trends in which deaths involving heroin and heroin drug reports increased at faster rates starting in 2010 and deaths involving synthetic opioids and fentanyl drug reports increased at faster rates starting in 2013. To examine the impact of synthetic opioids on the increase in deaths involving heroin without synthetic opioids, rate increases in deaths involving heroin without synthetic opioids were examined before and after 2013.

The rate of deaths involving heroin increased during 2006–2015 nationally and in all four U.S. Census regions (Table). Total deaths involving heroin increased more sharply during 2010–2015 than during 2006–2009 in all regions, with the largest increases occurring during 2010–2015 in the Northeast (average yearly increase of 1.02 deaths per 100,000 population) and Midwest (average yearly increase of 0.89 deaths per 100,000 population) (Table). Heroin drug report trends mirrored trends in total deaths involving heroin, with overall increases during 2006–2015 in all regions. The South and West experienced larger average yearly increases in rates of heroin drug reports during 2010–2015 than during 2006–2009 (Table). In contrast, the Northeast and Midwest experienced steady increases in rates of heroin drug reports during 2006–2015 (Figure 1).

†† "Deaths involving heroin without synthetic opioids" and "deaths involving synthetic opioids without heroin" exclude deaths with synthetic opioids and heroin, respectively, but other substances could have contributed to the deaths.

§§ Fentanyl-related overdose deaths were estimated to have increased by 2,295 from 1,905 in 2013 to 4,200 in 2014 (https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_10.pdf). This accounts for approximately 94% of the increase in deaths involving synthetic opioid excluding methadone from 3,105 to 5,544.

TABLE. Average yearly changes in rates of overdose deaths involving heroin and synthetic opioids excluding methadone, and law enforcement drug reports of heroin and fentanyl, by census region — United States, 2006–2015

		U.S. Census region*			
	National	Northeast	Midwest	South	West
Event, period	Rate change (95% CI)	Rate change (95% CI)	Rate change (95% CI)	Rate change (95% CI)	Rate change (95% CI)
Total deaths involving heroin					
2006–2009	0.13 (0.01–0.26)†	0.11 (-0.04–0.27)	0.26 (0.00–0.53)†	0.08 (-0.10–0.26)	0.10 (0.02–0.18)†
2010–2015	0.62 (0.55–0.68)†,§	1.02 (0.93–1.10)†,§	0.89 (0.74–1.03)†,§	0.49 (0.39–0.59)†,§	0.28 (0.24–0.33)†,§
Heroin drug reports¶					
2006–2009	2.24 (0.51–3.96)†	4.49 (-0.55–9.52)	4.88 (1.46–8.30)†	0.24 (-0.77–1.26)	1.40 (-0.09–2.88)
2010–2015	4.52 (3.60–5.44)†,§	8.51 (5.81–11.20)†	6.00 (4.17–7.83)†	2.74 (2.20–3.28)†,§	3.33 (2.53–4.12)†,§
Total deaths involving synthetic opioids					
2006–2012	0.01 (-0.05–0.06)	0.02 (-0.08–0.12)	-0.06 (-0.18–0.07)	0.03 (-0.02–0.08)	0.02 (-0.01–0.06)
2013–2015	0.98 (0.78–1.18)†,§	2.15 (1.77–2.52)†,§	1.35 (0.88–1.81)†,§	0.81 (0.63–0.98)†,§	0.07 (-0.07–0.20)
Fentanyl drug reports¶					
2006–2012	-0.10 (-0.29–0.08)	-0.20 (-0.64–0.24)	-0.31 (-0.75–0.13)	-0.002 (-0.053–0.049)	0.017 (-0.002–0.037)
2013–2015	2.09 (1.40–2.79)†,§	5.08 (3.42–6.75)†,§	3.64 (1.99–5.29)†,§	1.08 (0.89–1.27)†,§	0.11 (0.03–0.18)†,§
Deaths involving heroin without synthetic opioids					
2006–2012	0.17 (0.09–0.25)†	0.26 (0.07–0.44)†	0.33 (0.25–0.41)†	0.08 (0.02–0.14)†	0.10 (0.04–0.15)†
2013–2015	0.33 (0.03–0.62)†	0.31 (-0.37–0.99)	0.23 (-0.07–0.53)	0.43 (0.20–0.67)†,§	0.27 (0.05–0.49)†
Deaths involving synthetic opioids without heroin					
2006–2012	0.01 (-0.03–0.05)	0.02 (-0.05–0.08)	-0.05 (-0.14–0.04)	0.03 (-0.01–0.07)	0.02 (-0.01–0.06)
2013–2015	0.60 (0.45–0.75)†,§	1.31 (1.07–1.55)†,§	0.73 (0.38–1.07)†,§	0.54 (0.38–0.69)†,§	0.05 (-0.08–0.19)
Deaths involving use of both heroin and synthetic opioids					
2006–2012	-0.001 (-0.021–0.020)	0.001 (-0.037–0.039)	-0.008 (-0.055–0.040)	0.002 (-0.010–0.013)	0.001 (-0.001–0.003)
2013–2015	0.384 (0.307–0.460)†,§	0.842 (0.701–0.982)†,§	0.622 (0.444–0.800)†,§	0.269 (0.228–0.311)†,§	0.014 (0.005–0.023)†,§

Abbreviation: CI = confidence interval.

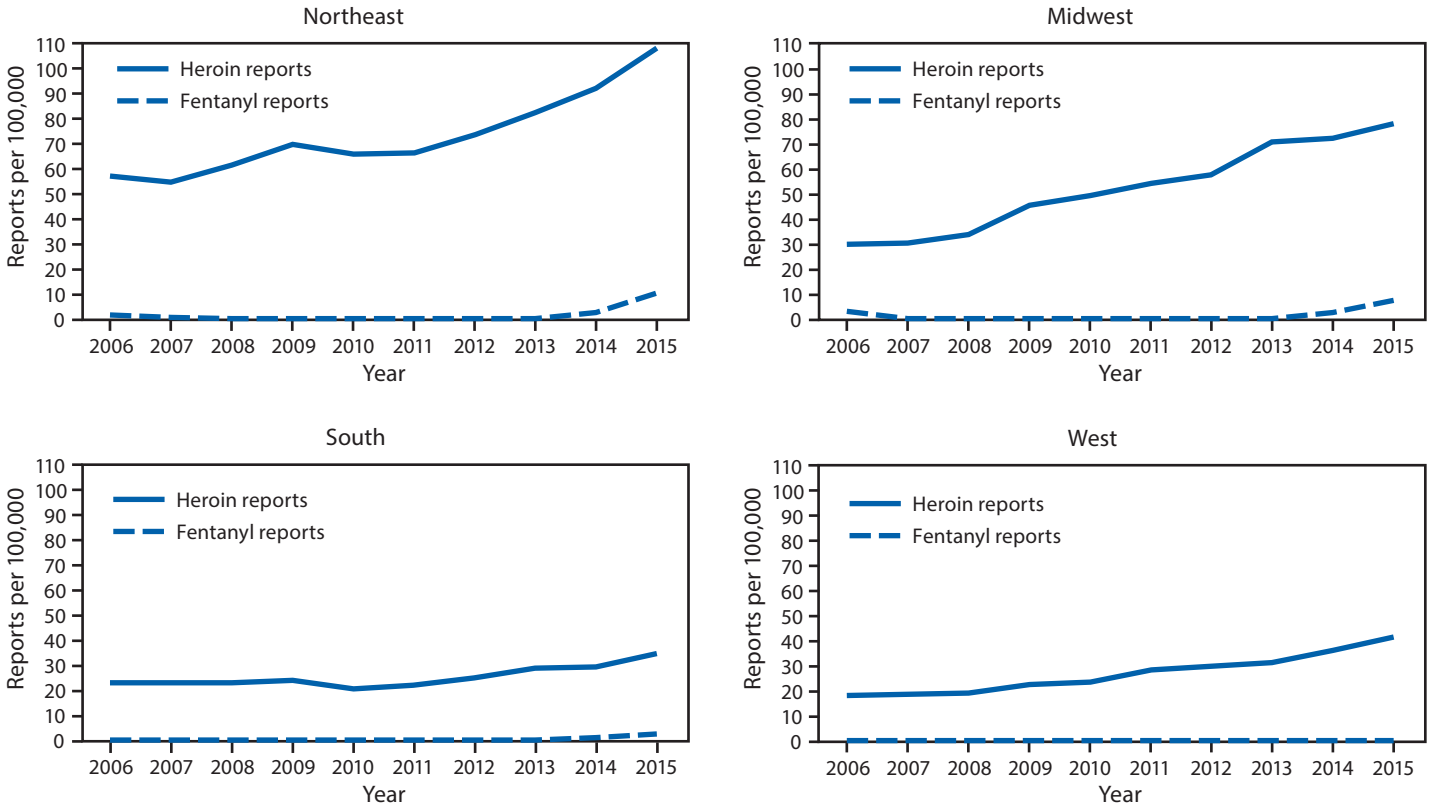
* *Northeast:* Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *Midwest:* Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *South:* Alabama, Arkansas, Delaware, District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

† Slope estimates are statistically significantly different from zero (p<0.05).

§ Slope for the later period is statistically significantly different from that of the earlier period (p<0.05).

¶ Drug exhibits (i.e., drug products) obtained by law enforcement that tested positive for heroin or fentanyl and were reported to the Drug Enforcement Administration's National Forensic Laboratory Information System.

FIGURE 1. Number of law enforcement drug reports for heroin and fentanyl per 100,000 population, by census region* — United States, 2006–2015



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

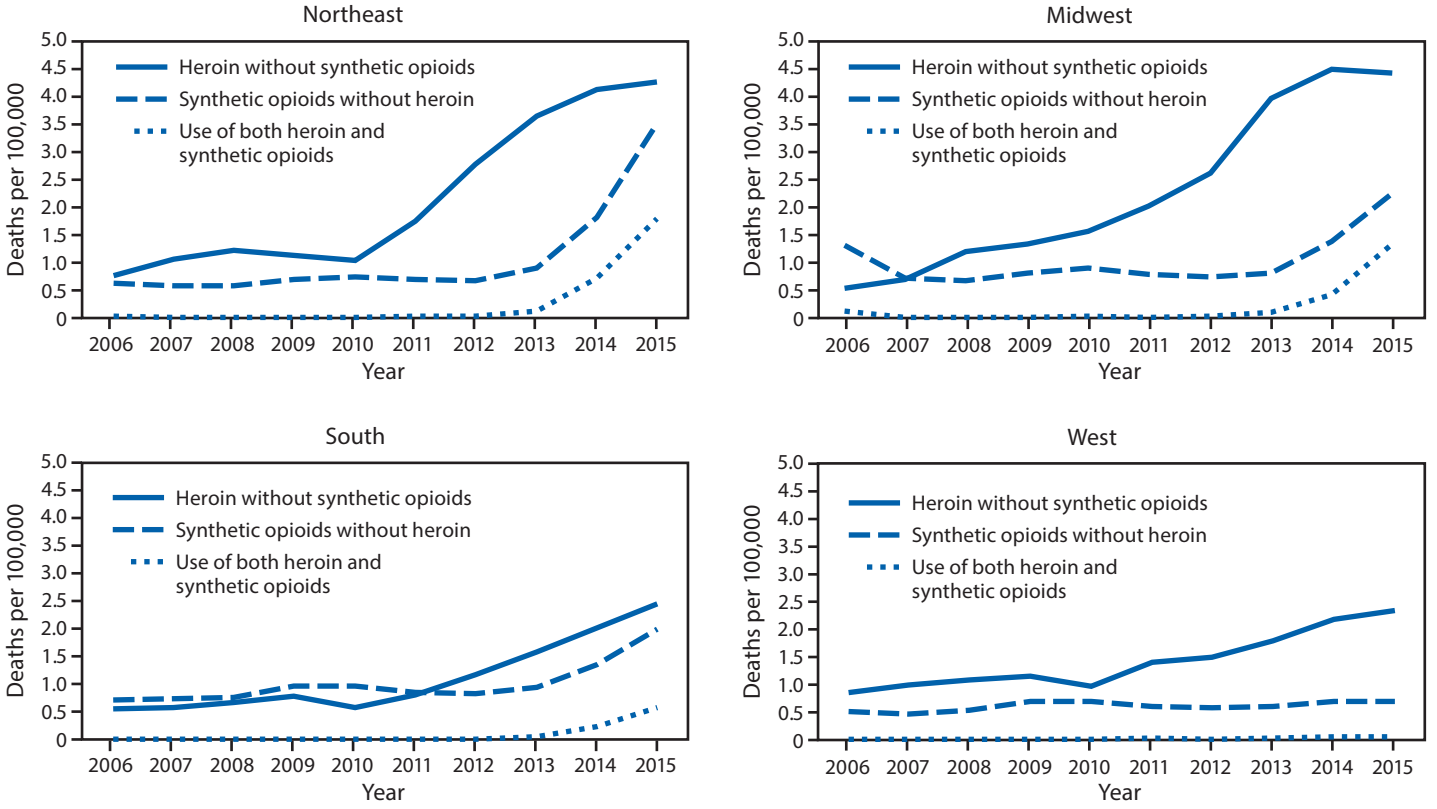
During 2013–2015, deaths involving synthetic opioids without heroin increased at faster rates than did deaths involving heroin without synthetic opioids in the Northeast, Midwest, and South (Table) (Figure 2). Deaths involving use of both heroin and synthetic opioids had larger average yearly rate increases after 2013 than did deaths involving heroin without synthetic opioids in the Northeast (0.84 compared with 0.31 per 100,000 population) and Midwest (0.62 compared with 0.23), the two regions that experienced the largest increases in total deaths involving heroin (Table). Mirroring the pattern in deaths involving synthetic opioids, rates of fentanyl drug reports increased significantly nationally and across all regions starting in 2013 after having remained level during 2006–2012 (Figure 1).

Discussion

Three interconnected trends drove increases in unintentional or undetermined deaths involving heroin and synthetic opioids in the United States during 2006–2015: increases in the supply and use of heroin (*3*), mixing of fentanyl into the heroin supply, and increases in deaths involving synthetic opioids without heroin. Large increases in the heroin supply coincided with increases in deaths involving heroin across all U.S. Census regions, with the largest increases in the Northeast and Midwest. In 2016, many state and local law enforcement agencies in these regions reported that heroin could be easily obtained in their communities and was the top drug threat (*2*). The increasing availability of heroin comes at a time when an estimated 2 million persons reported a substance use disorder involving misuse of prescription opioids and nearly 600,000 reported a substance use disorder involving heroin in 2015.¶¶ Increased heroin availability combined with high potency and relatively low price might have made heroin a viable substitute

¶¶ The National Survey on Drug Use and Health collects data on prescription pain reliever use. Although survey respondents can write in nonopioid pain relievers, all pain relievers specifically asked about are opioids. Therefore, misuse of pain relievers is a close approximation of misuse of prescription opioid pain relievers. Misuse of pain relievers was defined as any use in a way not directed by a doctor. https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015.pdf.

FIGURE 2. Number of deaths per 100,000 population involving heroin without synthetic opioids, synthetic opioids without heroin, and use of both heroin and synthetic opioids, by census region* — United States, 2006–2015



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

because its effects are similar to those of prescription opioids (*7*). The strongest risk factor for heroin use and dependence is misuse of or dependence on prescription opioids; approximately 75% of persons who initiate heroin first misused prescription opioids (*7*), although only a small percentage of persons misusing prescription opioids begin using heroin.***

The second trend contributing to increases in deaths involving heroin and synthetic opioids is the mixing of fentanyl into the heroin supply by drug traffickers and persons misusing opioids. In 2015, DEA and CDC released a nationwide alert and a public health advisory††† about large increases in fentanyl drug reports and deaths across multiple states in the Northeast, Midwest, and South, beginning in late 2013 (*8*). The high potency and rapid onset of action of fentanyl and fentanyl analogs and the difficulty of mixing nonlethal doses makes fentanyl more dangerous to use than heroin (*8*).

Approximately half of the increase in deaths involving heroin after 2013 is attributable to increases in deaths involving use of both heroin and fentanyl. In the Northeast and Midwest, the U.S regions reporting the sharpest increases in fentanyl drug reports, deaths involving use of both heroin and synthetic opioids accounted for 77% of the total increase in deaths involving heroin. One possible reason for the relative stability of total deaths involving synthetic opioids and fentanyl drug reports in the West is that the form of heroin sold primarily west of the Mississippi River (black tar heroin) is difficult to mix with fentanyl, whereas white powder heroin, the type primarily sold east of the Mississippi, is more easily mixed with fentanyl (*2*). Reports from 14 states§§§ have shown that increases in deaths involving fentanyl (from 2,418 in 2014 to 4,980 in 2015) accounted for most of the increase in deaths

*** https://www.samhsa.gov/data/sites/default/files/NSDUH-FFR2-2015/NSDUH-FFR2-2015.htm.

††† https://emergency.cdc.gov/han/han00384.asp.

§§§ Connecticut, Florida, Georgia, Kentucky, Maine, Maryland, New Hampshire, North Carolina, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia. Georgia and Pennsylvania reported deaths testing positive for fentanyl; the remaining 12 states reported fentanyl-related deaths.

Summary

What is already known about this topic?

Opioid overdose deaths in the United States have been increasing since 1999, initially driven by prescription opioid misuse and more recently by heroin and other illicit opioid use.

What is added by this report?

Rates of deaths involving heroin increased in all U.S. Census regions from 2006 to 2015. The increase appears to be driven in part by increases in the heroin supply after 2010 and by the introduction of illicitly manufactured fentanyl (IMF), a synthetic opioid, into the heroin market. Deaths involving both heroin and synthetic opioids increased sharply after 2013. The largest increases were in regions where white powder heroin is primarily used. Deaths involving synthetic opioids without heroin also increased sharply after 2013, indicating emergence of synthetic products without heroin or mixing of IMF into other drugs, including cocaine.

What are the implications for public health practice?

Changes in the supply and potency of illicit drug products can substantially contribute to increases in overdose deaths regardless of rates of opioid misuse. With continued increases in the heroin and synthetic opioid supply and deaths in the context of prescription opioid misuse, sustained, targeted, and multisectoral responses to the opioid overdose epidemic are needed, including timely surveillance, safer opioid prescribing, education on opioid overdose and naloxone, linkage and access to treatment, leveraging of community-based services, and collaboration between public health and public safety agencies.

involving synthetic opioids (from 2,658 in 2014 to 4,806 in 2015). These data, coupled with recent public health and law enforcement reports, continue to demonstrate that increases in deaths involving synthetic opioids are primarily driven by IMF (*2*,*5*,*6*).

Finally, multiple factors are likely driving the substantial increases in deaths involving synthetic opioids without heroin after 2013. First, the difficulty in distinguishing deaths involving morphine from deaths involving heroin might result in misclassifying some deaths as involving synthetic opioids without heroin (*9*). Also, drug products containing IMF are rapidly evolving, with IMF distributed in counterfeit prescription pills (*4*), mixed with and sold as cocaine, or sold as powders to persons using heroin with and without their knowledge that the product contains fentanyl (*2*,*6*).

The findings in this report are subject to at least five limitations. First, deaths involving heroin and synthetic opioids are likely underestimated because 17% of death certificates for drug overdose deaths lack information on the specific drug(s) involved, and this percentage varies widely by state (*1*). Second, although analyses excluded intentional deaths, it is possible that deaths involving heroin and synthetic opioids of undetermined intent might include homicides or suicides; however, only 7% of the analyzed deaths were categorized as undetermined. Third, toxicologic testing for synthetic opioids might have increased during 2006–2015, leading to higher rates because of better detection. Fourth, deaths involving synthetic opioids were a proxy for change in deaths involving fentanyl, but deaths involving other synthetic opioids, like tramadol, were included, which might result in underestimating increases in deaths involving fentanyl. Finally, NFLIS drug reports might vary because of jurisdictional differences in drug evidence submission and testing practices.

The heroin and IMF drug market in the United States is rapidly expanding in the context of widespread prescription opioid misuse. As a result, opioid-involved deaths are currently at peak reported levels. Enhanced, timely surveillance of the illicit drug supply and opioid overdoses is critical to rapidly track and respond to broad changes in the illicit opioid drug market, including the introduction of fentanyl analogs. Comprehensive testing of opioid overdose deaths is needed because fentanyl analogs, including potent analogs such as carfentanil, are increasingly distributed in illicit markets[¶¶¶] (*10*). Evidence-based interventions such as implementing safer opioid prescribing,[****] increasing naloxone availability,[††††] and linking persons at high risk for an opioid overdose (e.g., persons treated in the emergency department for an overdose or persons released from prison, with a history of substance use disorder[§§§§]) to medication-assisted treatment, as well as geographically tailored responses linking law enforcement and public health, could help reduce opioid-involved morbidity and mortality. Finally, community-based services, like syringe exchange programs, can be leveraged to prevent infectious disease transmission among persons who inject drugs and as opportunities to connect persons with substance use disorders into care, risk-reduction services, and long-term recovery.

¶¶¶ https://emergency.cdc.gov/han/han00395.asp.
**** https://www.cdc.gov/drugoverdose/prescribing/guideline.html.
†††† https://aspe.hhs.gov/system/files/pdf/107956/ib_OpioidInitiative.pdf.
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Conflict of Interest

No conflicts of interest were reported.

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Morbidity and Mortality Weekly Report

Overdose Deaths Related to Fentanyl and Its Analogs — Ohio, January–February 2017

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Ohio is experiencing unprecedented loss of life caused by unintentional drug overdoses (*1*), with illicitly manufactured fentanyl (IMF) emerging as a significant threat to public health (*2*,*3*). IMF is structurally similar to pharmaceutical fentanyl, but is produced in clandestine laboratories and includes fentanyl analogs that display wide variability in potency (*2*); variations in chemical composition of these drugs make detection more difficult. During 2010–2015, unintentional drug overdose deaths in Ohio increased 98%, from 1,544 to 3,050.* In Montgomery County (county seat: Dayton), one of the epicenters of the opioid epidemic in the state, unintentional drug overdose deaths increased 40% in 1 year, from 249 in 2015 to 349 in 2016 (estimated unadjusted mortality rate = 57.7 per 100,000) (*4*). IMFs have not been part of routine toxicology testing at the coroner's offices and other types of medical and criminal justice settings across the country (*2*,*3*). Thus, data on IMF test results in the current outbreak have been limited. The Wright State University and the Montgomery County Coroner's Office/Miami Valley Regional Crime Laboratory (MCCO/MVRCL) collaborated on a National Institutes of Health study of fentanyl analogs and metabolites and other drugs identified in 281 unintentional overdose fatalities in 24 Ohio counties during January–February 2017. Approximately 90% of all decedents tested positive for fentanyl, 48% for acryl fentanyl, 31% for furanyl fentanyl, and 8% for carfentanil. Pharmaceutical opioids were identified in 23% of cases, and heroin in 6%, with higher proportions of heroin-related deaths in Appalachian counties. The majority of decedents tested positive for more than one type of fentanyl. Evidence suggests the growing role of IMFs, and the declining presence of heroin and pharmaceutical opioids in unintentional overdose fatalities, compared with 2014–2016 data from Ohio and other states (*3*–*5*). There is a need to include testing for IMFs as part of standard toxicology panels for biological specimens used in the medical, substance abuse treatment, and criminal justice settings.

The MCCO Toxicology laboratory provides postmortem forensic toxicology services to approximately 30 of Ohio's 88 counties. Data from 281 unintentional overdose fatalities that occurred in Montgomery County and 23 additional counties† during January and February 2017, were analyzed by the MCCO Toxicology laboratory, and had assigned causes of death as of May 8, 2017, were included in this study. Montgomery County data include all unintentional drug overdose deaths that occurred in the county during the specified period. Other county data include all cases that were sent to MCCO for analysis, but might not represent all unintentional overdose deaths that occurred in those counties. A liquid-chromatography-tandem mass spectrometry–based method, developed and validated by toxicologists at the MCCO Toxicology Laboratory and Department of Chemistry, Wright State University, was used to test for 25 fentanyl analogs, metabolites, and synthetic opioids§ in biologic matrices (human blood and urine specimens).

Toxicologic testing for other substances (heroin, pharmaceutical opioids, benzodiazepines, cocaine, methamphetamine, marijuana, and alcohol) was also conducted. Information on demographic characteristics including age, sex, and race was collected for each decedent. Counties were grouped into the following four urban/rural categories used by the Ohio Department of Health: 1) urban (Montgomery), 2) suburban, 3) rural, non-Appalachian, and 4) Appalachian. The chi-square statistic was used to assess differences among the four county groups in terms of demographic and drug-related characteristics. To examine polydrug patterns, reports of the presence of other fentanyl analogs/metabolites and other drugs were examined for decedents with positive test results for 1) fentanyl, 2) acryl fentanyl, 3) furanyl fentanyl, and 4) carfentanil, one of the most potent fentanyl analogs.

Among the 281 decedents, 122 (43.3%) were from Montgomery County (City of Dayton), a large urban county with a population of approximately 530,000 persons (Table 1). Decedents from four suburban counties, who accounted

* http://www.odh.ohio.gov/-/media/ODH/ASSETS/Files/health/injury-prevention/2015-Overdose-Data/2015-Ohio-Drug-Overdose-Data-Report-FINAL.pdf.

† Selected data include all cases analyzed during January 1–February 28, 2017, from Montgomery County and all other nonurban counties that submitted cases for analysis to the Montgomery County Coroner's Office Toxicology Laboratory.

§ The 25 compounds are 1) 1-3-methylfentanyl; 2) 4-ANPP; 3) acetyl fentanyl; 4) acetyl fentanyl 4-methylphenethyl; 5) acryl fentanyl; 6) alfentanil; 7) beta-hydroxythiofentanyl; 8, 9) butyryl fentanyl/isobutyryl fentanyl; 10) butyryl norfentanyl; 11) carfentanil; 12) despropionyl para-fluorofentanyl; 13) fentanyl; 14) furanyl fentanyl; 15) furanyl norfentanyl; 16) norfentanyl; 17, 18) fluorobutyryl/fluoroisobutyrylfentanyl; 19) para-methoxyfentanyl; 20) remifentanil; 21) remifentanil metabolite; 22) sufentanil; 23) valeryl fentanyl; 24) AH7921; and 25) U-47700. The latter two are synthetic opioids not structurally related to fentanyl.

Summary

What is already known about this topic?

Illicitly manufactured fentanyl has become a significant contributor to unintentional overdose deaths in the United States.

What is added by this report?

Approximately 90% of unintentional overdose deaths examined in 24 Ohio counties that occurred during January–February 2017 involved fentanyl, fentanyl analogs, or both, whereas heroin was identified in the minority (6%) of cases, with somewhat higher prevalence in Appalachian counties. Fentanyl is commonly appearing in combination with other analogs.

What are the implications for public health practice?

These findings highlight the urgent need to make illicitly manufactured fentanyl testing a part of standard toxicology panels for biological specimens. Because multiple naloxone doses are often required to reverse overdoses from illicitly manufactured fentanyl, assuring that sufficient supplies are provided to first responders and distributed through community overdose prevention programs can mitigate the effects of opioid overdoses.

for 52 (18.5%) unintentional overdose deaths, were primarily from areas that are a part of or adjacent to the Dayton Metro area. Seventy-six (27.0%) decedents were from rural, non-Appalachian counties, primarily from the Southwestern part of the state, and 31 (11.0%) were from the Appalachian counties that are located in the Southern part of the state.

Males accounted for 181 (64.4%) unintentional overdose deaths, and 257 (91.5%) decedents were white; this proportion was higher in rural (98.7%) and Appalachian (96.8%) counties (p = 0.007) (Table 2). Over half (57.7%) of deaths occurred in persons aged 25–44 years. Approximately 7% of all decedents were not residents of the county where they died, with larger numbers of out of county resident deaths in urban Montgomery County (9.8%).

Overall, 253 (90.0%), 136 (48.4%), and 87 (31.0%) decedents tested positive for fentanyl, acryl fentanyl, and furanyl fentanyl, respectively (Table 2). The proportions of decedents that were positive for acryl fentanyl and furanyl fentanyl were lower in Appalachian counties (29.0% and 19.4%, respectively), although these differences were not statistically significant. There were statistically significantly more decedents in urban and suburban counties that tested positive for despropionylfentanyl (4-ANPP) (45.1% and 55.8%, respectively) than in rural (34.2%) and Appalachian (25.6%) counties (p = 0.021).

Only 16 (5.7%) of all 281 decedents tested positive for heroin, with a significantly higher proportion in Appalachian counties (25.8%) than in urban (2.5%), suburban (3.8%) or rural non-Appalachian counties (3.9%). Among all 16 heroin-positive cases, 12 also tested positive for IMF. Overall, 64 (22.8%) decedents tested positive for pharmaceutical opioids, 75 (26.6%) for benzodiazepines, and 86 (30.6%) for cocaine; a higher percentage of decedents who tested positive for cocaine died in urban (37.7%) and suburban (42.3%) counties than in rural (22.4%) or Appalachian (3.2%) counties (p<0.001) (Table 2).

Over half (53.8%) of specimens from fentanyl-positive decedents also tested positive for acryl fentanyl, and approximately one third (34.0%) for furanyl fentanyl (Table 3). Approximately 62% of fentanyl-positive decedents did not test positive for norfentanyl. All specimens from acryl fentanyl deaths also tested positive for fentanyl, and 39.7% tested positive for furanyl fentanyl. Approximately 99% of furanyl fentanyl deaths tested positive for fentanyl, 62.1% for acryl fentanyl, and 86.2% for 4-ANPP.

Twenty-one decedents (including 11 [52%] in Montgomery County) tested positive for carfentanil. Among these, 15 (71.4%) decedents also tested positive for fentanyl, five (23.8%) for acryl fentanyl, and eight (38.1%) for furanyl

TABLE 1. Categories of Ohio counties where unintentional overdose fatalities occurred (N = 281), January–February 2017

County type/name	No. (%) of decedents*
Urban	**122 (43.4)**
Montgomery	122 (43.4)
Suburban	**52 (18.5)**
Clark	26 (9.3)
Greene	14 (5.0)
Madison	4 (1.4)
Miami	8 (2.8)
Rural, non-Appalachian	**76 (27.0)**
Champaign	5 (1.8)
Clinton	6 (2.1)
Darke	7 (2.5)
Fayette	9 (3.2)
Hardin	2 (0.7)
Logan	6 (2.1)
Preble	9 (3.2)
Shelby	9 (3.2)
Warren	15 (5.3)
Wayne	8 (2.8)
Appalachian	**31 (11.0)**
Adams	1 (0.3)
Athens	1 (0.3)
Brown	4 (1.4)
Gallia	2 (0.7)
Highland	4 (1.4)
Lawrence	1 (0.3)
Pike	3 (1.1)
Ross	2 (0.7)
Scioto	10 (3.6)
Washington	3 (1.1)
Total	**281 (100)**

* For counties other than Montgomery, these numbers represent cases sent to the Montgomery County coroner's office for an autopsy and might not reflect all overdose deaths in the county.

TABLE 2. Demographic and toxicologic characteristics of unintentional overdose fatalities (N = 281), by county type — Ohio, January–February 2017

Characteristic	No. (%)					P-value*
	All cases (N = 281)	Urban (n = 122)	Suburban (n = 52)	Rural (n = 76)	Appalachian (n = 31)	
Sex						
Male	**181 (64.4)**	76 (62.3)	34 (65.4)	50 (65.8)	21 (67.7)	0.925
Female	**100 (35.6)**	46 (37.7)	18 (34.6)	26 (34.2)	10 (32.3)	—
Age group (yrs)						
<25	**25 (8.9)**	10 (8.2)	3 (5.8)	7 (9.2)	5 (16.1)	0.438
25–34	**82 (29.2)**	32 (26.2)	17 (32.7)	25 (32.9)	8 (25.8)	0.682
35–44	**80 (28.5)**	35 (28.7)	15 (28.8)	21 (27.6)	9 (29.0)	0.998
45–54	**54 (19.2)**	28 (23.0)	6 (11.5)	14 (18.4)	6 (19.4)	0.376
≥55	**40 (14.2)**	17 (13.9)	11 (21.2)	9 (11.8)	3 (9.7)	0.402
Race						
White, non-Hispanic	**257 (91.5)**	109 (89.3)	43 (82.7)	75 (98.7)	30 (96.8)	0.007
African American or Other	**24 (8.7)**	13 (10.6)	7 (17.3)	1 (1.3)	1 (3.2)	—
Residence status						
Out of county residents	**19 (6.8)**	12 (9.8)	—	6 (7.9)	1 (3.2)	—
Synthetic opioids/Fentanyl analogs/Metabolites						
Fentanyl	**253 (90.0)**	113 (92.6)	46 (88.5)	67 (88.2)	27 (87.1)	0.648
Norfentanyl	**157 (55.9)**	72 (59.0)	26 (50.0)	44 (57.9)	15 (48.4)	0.563
Acryl fentanyl	**136 (48.4)**	61 (50.0)	31 (59.6)	35 (46.1)	9 (29.0)	0.056
Despropionylfentanyl (4-ANPP)	**118 (42.0)**	55 (45.1)	29 (55.8)	26 (34.2)	8 (25.6)	0.021
Despropionyl para-Fluorofentanyl	**1 (0.4)**	—	—	—	1 (3.2)	—
Furanyl Fentanyl	**87 (31.0)**	45 (36.9)	19 (36.5)	17 (22.4)	6 (19.4)	0.062
Furanyl Norfentanyl	**2 (0.7)**	1 (0.8)	—	1 (1.3)	—	—
Carfentanil	**21 (7.5)**	11 (9.0)	3 (5.8)	6 (7.9)	1 (3.2)	—
Acetyl fentanyl	**4 (1.4)**	2 (1.6)	—	1 (1.3)	1 (3.2)	—
Butyryl/Isobutyrylfentanyl	**4 (1.4)**	1 (0.8)	3 (5.8)	—	—	—
Butyryl norfentanyl	**2 (0.7)**	—	2 (3.8)	—	—	—
Fluorobutyryl/Fluoroisobutyrylfentanyl	**3 (1.1)**	—	1 (1.9)	1 (1.3)	1 (3.2)	—
U-47700†	**2 (0.7)**	1 (0.8)	1 (1.9)	—	—	—
Any type of fentanyl/analog	**259 (92.2)**	117 (95.9)	47 (90.4)	68 (89.5)	27 (87.1)	0.216
Other opioids						
Heroin§	**16 (5.7)**	3 (2.5)	2 (3.8)	3 (3.9)	8 (25.8)	<0.001
Heroin, no type of fentanyl/analog	**4 (1.4)**	—	1 (1.9)	2 (2.6)	1 (3.2)	–
Any pharmaceutical opioid	**64 (22.8)**	26 (21.3)	11 (21.2)	18 (23.7)	9 (29.0)	0.813
Hydrocodone	**15 (5.3)**	5 (4.1)	3 (5.8)	5 (6.6)	2 (6.5)	0.874
Oxycodone	**30 (10.7)**	11 (9.0)	4 (7.7)	9 (11.8)	6 (19.4)	0.335
Oxymorphone	**3 (1.1)**	—	—	1 (1.3)	2 (6.5)	—
Methadone	**10 (3.6)**	7 (5.7)	1 (1.9)	1 (1.3)	1 (3.2)	—
Morphine¶	**9 (3.2)**	5 (4.1)	2 (3.8)	0	2 (6.5)	—
Buprenorphine**	**1 (0.7)**	—	—	1 (1.3)	—	—
Loperamide**	**1 (0.7)**	—	—	1 (1.3)	—	—
Tramadol	**10 (3.5)**	4 (3.3)	3 (5.8)	3 (3.9)	—	—
Other drugs						
Cocaine	**86 (30.6)**	46 (37.7)	22 (42.3)	17 (22.4)	1 (3.2)	<0.001
Methamphetamine	**33 (11.7)**	14 (11.5)	5 (9.6)	9 (11.8)	5 (16.1)	0.847
Marijuana	**99 (35.2)**	43 (35.2)	20 (38.5)	23 (30.3)	13 (41.9)	0.644
Alcohol	**57 (20.3)**	25 (20.5)	11 (21.2)	16 (21.1)	5 (16.1)	0.943
Benzodiazepines (any)	**75 (26.6)**	37 (30.3)	12 (23.1)	20 (26.0)	6 (19.4)	0.562
Gabapentin**	**11 (3.9)**	2 (1.6)	2 (3.8)	4 (5.2)	3 (9.7)	—

* Chi-square p-value for comparison across four county groups; p<0.05 is considered statistically significant.
† Synthetic opioid not structurally related to fentanyl.
§ Cases that tested positive for 6-MAM and/or were identified by the coroner as heroin-related.
¶ Only cases that tested for morphine but not 6-MAM, and were not identified by the coroner as heroin-related.
** Not all cases were tested for buprenorphine, loperamide, or gabapentin. Testing was performed only when evidence of misuse was present.

fentanyl. Many of the carfentanil decedents tested positive for other central nervous system depressants, such as pharmaceutical opioids (23.8%) and benzodiazepines (42.9%). Approximately 30% of fentanyl, acryl fentanyl, and furanyl fentanyl cases tested positive for cocaine. Among carfentanil cases, approximately 40% were positive for cocaine (Table 3).

TABLE 3. Presence of other drugs in fentanyl-, acryl fentanyl–, furanyl fentanyl– and carfentanil-positive unintentional overdose deaths (N = 281) — Ohio, January–February 2017

Type of drug/metabolite	No. (%)			
	Fentanyl (n = 253)	Acryl fentanyl (n = 136)	Furanyl fentanyl (n = 87)	Carfentanil (n = 21)
Fentanyl	NA	136 (100)	86 (98.9)	15 (71.4)
Acryl fentanyl	136 (53.8)	NA	54 (62.1)	5 (23.8)
Furanyl fentanyl	86 (34.0)	54 (39.7)	NA	8 (38.1)
Carfentanil	15 (5.9)	5 (3.7)	8 (9.2)	NA
Norfentanyl	157 (62.1)	80 (58.8)	54 (62.1)	10 (47.6)
Despropionylfentanyl (4-ANPP)	117 (46.2)	72 (52.9)	75 (86.2)	11 (52.4)
Despropionyl para-fluorofentanyl	1 (0.4)	1 (0.7)	—	—
Furanyl norfentanyl	2 (0.8)	1 (0.7)	2 (2.3)	1 (4.8)
Acetyl fentanyl	4 (1.6)	3 (2.2)	2 (2.3)	—
Butyryl/Isobutyrylfentanyl	4 (1.6)	1 (0.7)	1 (1.1)	—
Butyryl norfentanyl	2 (0.8)	—	1 (1.1)	—
Fluorobutyryl/Fluoroisobutyrylfentanyl	3 (1.2)	1 (0.7)	—	—
U-47700	2 (0.8)	1 (0.7)	2 (2.3)	—
Other drugs				
Heroin	12 (4.7)	3 (2.2)	3 (3.4)	—
Pharmaceutical opioids (any)	51 (20.2)	265(18.4)	18 (20.7)	5 (23.8)
Benzodiazepines (any)	65 (25.7)	35 (24.6)	24 (27.6)	9 (42.9)
Cocaine	78 (30.8)	41 (30.1)	29 (33.3)	9 (42.9)
Methamphetamine	32 (12.6)	13 (9.6)	10 (11.5)	2 (9.5)
Marijuana	91 (36.0)	44 (32.4)	38 (43.7)	12 (57.1)
Alcohol	46 (18.2)	19 (14.0)	15 (17.2)	2 (9.5)

Abbreviation: NA = not applicable.

Discussion

Evidence from the toxicologic analyses of unintentional overdose deaths in Ohio from the beginning of 2017 indicate the increasing and substantial role of IMFs, and the declining presence of heroin and pharmaceutical opioids in overdose fatalities, compared with 2014–2016 data from Ohio and other states (*3*–*5*). Approximately 90% of unintentional overdose deaths in 24 Ohio counties that occurred during January and February 2017 involved fentanyl, fentanyl analogs, or both. Approximately 32% of fentanyl-positive decedents did not test positive for norfentanyl, a major metabolite for fentanyl, suggesting a very rapid death (*6*). Twenty-one decedents tested positive for carfentanil, a highly toxic IMF compound (approximately 10,000 times more potent than morphine), which is frequently used in veterinary medicine for sedation of large animals. Approximately one third of unintentional overdose deaths that tested positive for IMF also tested positive for cocaine. It is not known whether these data indicate a pattern of intended polydrug use or if cocaine and IMF mixtures were sold to unsuspecting illicit opioid or cocaine users.

The study documents the high numbers of acryl fentanyl– and furanyl fentanyl–associated deaths among unintentional overdose fatalities in the United States. Acryl fentanyl is more potent than fentanyl (*7*); in 2016, there were reports of furanyl fentanyl–related overdoses in Canada caused by smoking contaminated cocaine (*8*). These drugs are commonly advertised on cryptomarkets, which are commercial web-based marketplaces for transactions involving drugs and other illicit goods that provide anonymity to both buyers and sellers via their location on the "Dark" web (internet content that requires specific software or authorization to access) and use of cryptocurrencies (e.g., bitcoin) for payment. Nearly half of fentanyl positive cases and approximately 90% of furanyl fentanyl positives tested positive for 4-ANPP. 4-ANPP is used as a precursor for the manufacture of fentanyl-type drugs; it is also an impurity found in fentanyl preparations and is a metabolite of fentanyl and furanyl fentanyl (*9*).

The findings in this report are subject to at least four limitations. First, for counties other than Montgomery, unintentional overdose numbers represent cases sent to MCCO for an autopsy and might not reflect all overdose deaths in that county. Further, it is not known whether there are systemic differences across counties (other than Montgomery County) regarding the types of cases sent to MCCO for testing. Second, toxicology reports cannot distinguish between pharmaceutical and illicitly manufactured fentanyl, although previous reports indicate that the majority of fentanyl linked to fatal unintentional overdoses in the country is suspected to be IMF (*10*). Third, toxicology data on decedents testing positive for multiple drugs cannot determine if the decedent knowingly or unknowingly used combinations of different drugs. Finally, data were obtained from 24 Ohio counties, and findings might not be generalizable to the entire state.

Overall, IMFs are appearing in combination with other fentanyl analogs, and co-occurrence of other drugs is common. The high percentage of overdose fatalities testing positive for

combinations of IMFs might indicate that available street drugs include mixtures of different types of IMFs or that persons use drugs obtained from multiple sources, with different toxicologic profiles. Expansion of access to evidence-based treatment is an important strategy for preventing fentanyl-related overdoses (*3*). These findings highlight the urgent need to make IMF testing a part of standard toxicology panels for biological specimens used by substance abuse treatment centers, criminal justice institutions, and medical providers. Implementation of harm reduction initiatives could also help reduce the adverse consequences of IMF use (*3*,*5*). Because multiple naloxone doses are often required to reverse overdoses from IMFs (*5*), assuring that sufficient supplies are provided to first responders and distributed through community overdose prevention programs can mitigate the effects of opioid overdoses.

Acknowledgments

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Conflict of Interest

No conflicts of interest were reported.

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Awareness, Beliefs, and Actions Concerning Zika Virus Among Pregnant Women and Community Members — U.S. Virgin Islands, November–December 2016

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As of May 2, 2017, the U.S. Virgin Islands (USVI), comprising St. Thomas, St. John, and St. Croix, had reported 1,021 probable or confirmed cases* of Zika virus disease in its population of approximately 100,000 (*1*); 222 symptomatic and asymptomatic pregnant women in the USVI had tested positive for Zika virus. In January 2016, USVI Department of Health (USVI DOH) initiated Zika response measures, including surveillance, vector control, and a communications program. Interventions included education and outreach, distribution of Zika prevention kits† to pregnant women in the USVI, and provision of free Zika virus laboratory testing and vector control services. In November 2016, USVI DOH staff members conducted interviews with convenience samples of community members and pregnant women to gather feedback about current and proposed interventions (*2*). Pregnant women reported taking a median of two actions to protect themselves from Zika, with repellent use being the most commonly reported action. Community members reported taking a median of one action and were supportive of several proposed vector control approaches. Whereas multiple pregnant women and community members reported hearing messages about the cause and consequences of Zika virus infections, few recalled messages about specific actions they could take to protect themselves. Integrating evaluation into response measures permits ongoing assessment of intervention effectiveness and supports improvement to serve the population's needs.

During November 15–December 9, 2016, interviews were conducted with 269 pregnant women and community members living in the USVI to assess awareness, beliefs, and actions related to Zika virus and local prevention and control measures. USVI DOH interviewers identified commercial and clinic (public and private) locations to conduct interviews; these locations represented different locales and demographic groups of each island (*3*). Interviews were conducted in English and included open- and closed-ended questions. Pregnant women were asked about receipt, use, and usefulness of interventions including Zika prevention kits, laboratory testing, and vector control services. Community members were asked about their level of support for backpack spraying, spraying from trucks, spraying from airplanes, and placement of mosquito traps in yards. Interviewers received training on obtaining consent for participation and use of the interview instruments and Epi Info for Mobile Devices,§ which permitted audio recording of questions and responses. This project was determined by CDC as not subject to Institutional Review Board review. An Atlanta-based analytics team reviewed audio files and provided feedback to field staff members to improve fidelity to protocols, analyzed closed-ended and multiple-choice responses, and transcribed, coded, and analyzed responses to open-ended questions.

A systematic process for tallying the number of interview requests and refusals was not used; however, refusals were rare. The final sample included 269 completed interviews with 104 (38.7%) pregnant women and 165 (61.3%) nonpregnant community members, including 120 (44.6%) participants on St. Croix, 116 (41.3%) on St. Thomas, and 33 (12.3%) on St. John (Table 1). The median age of pregnant women respondents was 27 years (range = 18–43 years). Among 95 pregnant respondents for whom information on race/ethnicity and education was available, 58 (61.1%) were non-Hispanic black, 28 (29.5%) were Hispanic, and eight (8.4%) were non-Hispanic white. Thirty-six (37.9%) pregnant respondents were high school graduates, 25 (26.3%) attended some college, 17 (17.9%) were college graduates, and six (6.3%) had postgraduate education. Most pregnant women were in their third (48.1%) or second (37.5%) trimester of pregnancy.

Among 165 community members who were interviewed, 74 (45.7%) were male; the median age was 45 years (range = 18–81 years); 113 (70.2%) were non-Hispanic black, 21 (13.0%) were Hispanic, and 17 (10.6%) were non-Hispanic white. Fifty-one (31.5%) had less than a high school education, 43 (26.5%) were high school graduates, 45 (27.8%) had

* These cases include immunoglobulin M–probable and polymerase chain reaction/plaque-reduction neutralization testing confirmed cases of Zika virus disease among symptomatic persons; asymptomatic pregnant women are not included.

† The Zika prevention kit included the following items: insect repellent, permethrin, condoms, a mosquito bed net, mosquito dunks (a larvicide used to treat standing water), and educational materials.

§ https://www.cdc.gov/epiinfo/mobile.html.

TABLE 1. Demographic characteristics of pregnant women and community member respondents — U.S. Virgin Islands Department of Health, U.S. Virgin Islands, November–December 2016

Characteristic	No. (%)	
	Pregnant women (N = 104)	Community members (N = 165)
Location of interview		
St. Croix	51 (49.0)	69 (41.8)
St. Thomas	45 (43.3)	71 (43.0)
St. John	8 (7.7)	25 (15.2)
Sex*		
Male	NA	74 (45.7)
Female	104 (100)	88 (54.3)
Age group (yrs)		
18–24	38 (36.5)	11 (7.1)
25–34	42 (40.4)	34 (21.8)
35–44	13 (12.5)	32 (20.5)
45–54	0 (—)	38 (24.4)
55–64	0 (—)	29 (18.6)
≥65	0 (—)	12 (7.7)
Refused	11 (10.6)	0 (—)
Highest level of education*		
None	1 (1.1)	0 (—)
Preschool through grade 12	10 (10.5)	51 (31.5)
High school diploma	36 (37.9)	43 (26.5)
Some college	25 (26.3)	45 (27.8)
College graduate	17 (17.9)	11 (6.8)
Postgraduate	6 (6.3)	12 (7.4)
Missing	9 (8.7)	0 (—)
Race/Ethnicity†		
White, non-Hispanic	8 (8.4)	17 (10.6)
Black, non-Hispanic	58 (61.1)	113 (70.2)
Hispanic	28 (29.5)	21 (13.0)
Other, non-Hispanic	1 (1.0)	1 (0.6)
Refused	0 (—)	9 (5.7)
Pregnancy trimester		
First	14 (13.5)	NA
Second	39 (37.5)	NA
Third	50 (48.1)	NA
Missing	1 (1.0)	NA

Abbreviation: NA = not applicable.
* Proportion for community members is from a sample of 162 community members.
† Proportion for pregnant women is from a sample of 95; proportion for community members is from a sample of 161.

attended some college, 11 (6.8%) were college graduates, and 12 (7.7%) had postgraduate education.

Pregnant women provided a median of two responses (range = 1–5) to the question, "What have you heard about Zika?" and the most common responses were that Zika causes microcephaly or brain defects in babies (67.3%) and is transmitted by mosquitoes (34.6%) (Table 2). Community members provided a median of one response (range = 0–5); the most common response was that Zika is transmitted by mosquitoes (48.5%). Only 11.5% of pregnant women and 9.1% of community members reported hearing that Zika virus can be sexually transmitted. Less than 3% of pregnant women or community members mentioned hearing about individual actions that could be taken to prevent Zika virus infection. Only 3.8% of pregnant women and 6.1% of community members stated that Zika virus transmission was occurring in the USVI.

Among 103 pregnant women, 56 (54.4%) reported being moderately or extremely concerned about becoming infected with Zika virus. Whereas 14 (13.9%) of 101 pregnant women stated it was likely or extremely likely that they would become infected, 86 (83.5%) of 103 said they were confident or very confident in their ability to protect themselves and their baby from infection during their pregnancy. Zika virus was reported as a serious or very serious health concern to the community by 124 (75.6%) community members, and to them personally by 82 (49.7%), with 69 (41.8%) stating that it was likely or very likely that they would become infected (Table 2). A majority of pregnant women and community members reported having either no conversations or only one or two conversations with family members or friends about Zika in the past month (Table 2).

When asked, "What actions have you taken to protect yourself from getting infected with Zika virus since you found out you were pregnant?" women reported taking a median of two actions (range = 0–6) with use of mosquito repellent (74.0%) and wearing clothing that covers arms and legs (26.9%) as the most frequently reported actions (Table 2). When community members were asked what actions they had taken to protect themselves, they reported taking a median of one action (range = 0–9) with use of mosquito repellent (42.4%) the most commonly reported action (Table 2).

Pregnant women were asked questions about their receipt of specific interventions and performance of specific behaviors. Among 97 pregnant women, 69 (71.1%) reported having received a Zika prevention kit (Table 3) with 67.2% stating that the repellent was the most important item in the kit and the one most frequently depleted. Among 95 pregnant women for whom information on Zika testing was available, 74 (77.9%) reported having been tested; 67.6% reported receiving their test results within 2 weeks; 22 (22.4%) reported that their partner had also been tested. Among 97 pregnant women, 48 (49.5%) said they heard about the availability of vector control services. Among the 31 pregnant women who reported hearing about and being offered vector control services, 25 wanted the service and 21 had been contacted by the USVI DOH to schedule the appointment for service delivery. Twenty (80%) of the 25 pregnant women who wanted vector control services reported receiving them.

Among 102 pregnant women, 44 (43.1%) reported using insect repellent in the last 24 hours, 13 (12.7%) reported having slept under a bed net in the last 24 hours, and 27 (28.4%) reported removing standing water from their property in the

TABLE 2. Awareness, risk perceptions, and actions taken among pregnant women and community members — U.S. Virgin Islands (USVI) Department of Health, U.S. Virgin Islands, November–December 2016

Awareness of Zika*	No. (%) Pregnant women (N = 104)	No. (%) Community members (N = 165)
Health effects of Zika		
Causes microcephaly or brain defects in babies	70 (67.3)	53 (32.1)
Pregnant women should try not to get it	23 (22.1)	12 (7.3)
Causes fever, rash, and conjunctivitis	14 (13.5)	19 (11.5)
Dangerous	4 (3.8)	12 (7.3)
Like dengue and chikungunya	3 (2.9)	12 (7.3)
Can be life-threatening can cause paralysis, GBS	1 (1.0)	1 (0.6)
Transmission		
Get it from mosquitoes	36 (34.6)	80 (48.5)
Can be transmitted by sex from a man to a woman	12 (11.5)	15 (9.1)
Persons in USVI are getting infected with Zika	4 (3.8)	10 (6.1)
Protective actions		
Wear repellent	3 (2.9)	1 (0.6)
Wear clothing that covers arms and legs	1 (1.0)	0 (—)
Eliminate standing water	2 (1.9)	3 (1.8)
Put screens on windows and doors	1 (1.0)	0 (—)
Haven't heard anything	2 (1.9)	16 (9.7)
Other (specify)†	17 (16.3)	55 (33.3)
Beliefs about risks		
Serious or very serious health concern to you personally	NA	82 (49.7)
Serious or very serious health concern to your community	NA	124 (75.6)
Moderately or extremely concerned about Zika virus for yourself and your baby§	56 (54.4)	NA
Likely or extremely likely that you will be infected with the Zika virus (for pregnant women: infected during your pregnancy)¶	14 (13.9)	69 (41.8)
Confident or very confident in your ability to protect yourself from getting infected with the Zika virus during your pregnancy§	86 (83.5)	NA
Personal protective behaviors**		
Used repellent	77 (74.0)	70 (42.4)
Wore clothes that cover arms and legs	28 (26.9)	13 (7.9)
Sprayed permethrin on clothes	11 (10.6)	0 (—)
Used mosquito net at night	11 (10.6)	4 (2.4)
Don't go outside at all	10 (9.6)	2 (1.2)
Used mosquito net during the day	6 (5.8)	1 (0.6)
Used a condom/had my partner use a condom in all sexual relations	6 (5.8)	1 (0.6)
Don't go outside at night	3 (2.9)	4 (2.4)
Got tested and/or got my partner tested for Zika	1 (1.0)	0 (—)
Abstained from sexual intercourse	0 (—)	2 (1.2)
Prayed to God	0 (—)	2 (1.2)
Looked for more information about Zika	0 (—)	1 (0.6)
Mosquito control around home		
Removed standing water	18 (17.3)	50 (30.3)
Sprayed inside my home	14 (13.5)	24 (14.6)
Put screens on windows and doors	14 (13.5)	17 (10.3)
Sprayed outside my home	11 (10.6)	8 (4.8)
Used mosquito coil/light fires to keep mosquitoes away	10 (9.6)	14 (8.5)
Closed windows and doors	8 (7.7)	12 (7.3)
Used larvicides (like mosquito dunks)	4 (3.8)	4 (2.4)
Cleaned household environment	4 (3.8)	5 (3.0)
Used air conditioning	3 (2.9)	2 (1.2)
Cleaned/Scrubbed water source/storage unit/water container(s)	1 (1.0)	3 (1.8)
Cut grass	1 (1.0)	6 (3.6)
Put cover(s) over the water source/storage unit/water container(s)	0 (—)	6 (3.6)
Haven't done anything	3 (2.9)	26 (15.8)
No answer given	8 (7.7)	3 (1.8)
Other (specify)††	25 (24.0)	32 (19.4)
Frequency of conversation with family members and friends about Zika in past month†		
Not at all	25 (24.3)	63 (38.2)
Only once or twice	33 (32.0)	45 (27.3)
Sometimes	24 (23.3)	26 (15.8)
Often	15 (14.6)	22 (13.3)
Every day	6 (5.8)	9 (5.5)

Abbreviations: GBS = Guillain Barré syndrome; NA= not applicable.

* Responses given to the open-ended question, "What have you heard about Zika?"

† Pregnant women: a lot of things, how to prevent, how it's spread, and large outbreaks in Brazil. Community members: affects pregnant women, makes them sick, it's a virus, it came from other countries, Zika is bad and should be avoided, theories on how it got here, it's like the flu, and tires and drums a source.

§ Proportion is from a sample of 103 pregnant women.

¶ Proportion is from a sample of 101 pregnant women.

** Responses to open-ended questions. Pregnant women were asked, "What actions have you taken to protect yourself from getting infected with the Zika virus since you found out you were pregnant?" Community members were asked, "What actions have you taken to protect yourself from getting infected with the Zika virus?"

†† Pregnant women: used Zika prevention kit, avoided areas with mosquitoes, wore no perfume, and protection used by family. Community members: used herbal remedies, used a mosquito swatter, sprayed in general (no place specified), avoid mosquitoes, maintained a healthy lifestyle, kept mosquitoes out of house, and wore light colored clothing.

past week (Table 3). Among 81 pregnant women who reported having sexual intercourse since becoming pregnant, only 15 (18.8%) reported using a condom every time they had sex, whereas 46 (57.5%) reported they never used a condom. At the time of the interview, 45.5% of pregnant women were observed to be wearing long pants and 22.2% were wearing long sleeves.

Community members were asked about their level of support for vector control methods to reduce mosquito populations in their community. Among those who responded, most supported or strongly supported putting mosquito traps in their yard (91.2%) and backpack spraying (75%); 66.5% and 23.9% supported spraying from trucks and airplanes, respectively.

TABLE 3. Receipt of interventions and self-reported performance of recommended Zika prevention behaviors among pregnant women — U.S. Virgin Islands Department of Health, U.S. Virgin Islands, November–December 2016

Interventions/Behaviors	No. (%) Pregnant women (N =104)
Interventions received	
Zika Prevention Kit*	69 (71.1)
Pregnant woman test for Zika virus†	74 (77.9)
Husband/Partner test for Zika virus§	22 (22.4)
Vector control services around home (among 25 respondents who desired services)	20 (80.0)
Responded affirmatively to closed-ended questions about recommended Zika prevention behaviors	
Used mosquito repellent yesterday¶	44 (43.1)
Used a condom every time they had sex (among 81 sexually active respondents)	15 (18.8)
Never used a condom when they had sex (among 81 sexually active respondents)	46 (57.5)
Removed standing water†	27 (28.4)
Used mosquito bed net yesterday¶	13 (12.7)
Interviewer observation	
Wearing long pants right now**	45 (45.5)
Wearing long sleeved shirt right now**	22 (22.2)

* Among a sample of 97 pregnant women.
† Among a sample of 95 pregnant women.
§ Among a sample of 98 pregnant women.
¶ Among a sample of 102 pregnant women.
** Among a sample of 99 pregnant women.

Summary

What is already known about this topic?

U.S.-based surveys conducted throughout 2016 have shown high levels of awareness of the Zika virus outbreak, moderate levels of concern about Zika, and low levels of knowledge about how Zika is transmitted.

What is added by this report?

Zika-related awareness, beliefs, and actions among residents of the U.S. Virgin Islands, who are not included in U.S.-based surveys, were assessed in interviews of pregnant women and community members. Multiple respondents reported hearing that Zika virus is transmitted by mosquitoes and causes microcephaly in babies. Fewer mentioned hearing about sexual transmission of Zika virus or what actions to take to prevent infection. Most respondents reported Zika virus as a serious concern although there were varying levels in perceptions of susceptibility and protective actions taken. Most pregnant women reported receiving interventions offered to them and most community members expressed support for several vector control approaches.

What are implications for public health practice?

The feedback from these interviews helped the U.S. Virgin Islands Department of Health identify information gaps that can be addressed through communication, education, and community engagement. Gathering feedback about key aspects of a response effort from community members is vital to ensure that interventions reach them and are translated into effective prevention programs.

Discussion

Most USVI respondents believed that Zika is a serious health concern. Reported levels of concern about Zika virus infection among USVI respondents were slightly higher than those reported in surveys conducted in the continental United States (*4*–*8*). Two thirds of pregnant women and one third of community members in the USVI mentioned that Zika virus infection can cause serious birth defects. Surveys of residents of the continental United States showed wide variation in knowledge of the link between Zika virus infection and birth defects (*4*,*6*,*7*,*9*), with USVI residents generally having slightly higher knowledge levels than did respondents to the U.S.-based surveys. Approximately one third of pregnant women and less than half of community members in USVI mentioned that Zika virus can be transmitted by mosquitos and few pregnant women and community members (11.5% and 9.1%, respectively) mentioned that Zika can be sexually transmitted, suggesting gaps in awareness of modes of transmission, and possibly, reluctance to discuss sex. U.S. surveys revealed a similar pattern, with most respondents aware that Zika is spread by mosquitoes and fewer respondents aware of sexual transmission (*5*–*10*). Although the majority of pregnant respondents expressed concern about Zika, they also reported a high level of confidence in their ability to protect themselves and their baby and a belief that it was unlikely that they would become infected during their pregnancy, despite the relatively low reported prevalence of practicing protective behaviors. Reasons for this incongruity are not clear. It is possible that pregnant women were unaware of local cases of Zika virus disease, because <4% of them mentioned Zika virus transmission in USVI, or that Zika prevention messages were not reaching pregnant women, because <3% mentioned hearing messages about protective actions. That pregnant women reported limited recent conversations with family or friends about Zika might indicate a relative lack of importance of Zika in their lives or desensitization associated with living in an area where vectorborne diseases are prevalent. In addition, most pregnant participants were in their second or third trimester, and might have believed that protective actions were less essential later in pregnancy. Finally, women's confidence might have been related to their receiving Zika-related services and to beliefs in their effectiveness.

Information collected from this assessment enabled program planners to tailor activities to address needs. For example, the community support of traps, backpack spraying, and truck spraying were important in developing USVI's vector control plan. This assessment also provided feedback to USVI DOH staff members about how messages were being received,

perceived, and acted upon. Recognizing prevention program strengths and deficiencies allowed program planners to reframe and refocus messaging to educate the public about transmission and emphasize protective actions.

The findings in this report are subject to at least three limitations. First, the convenience sample of interview venues were selected by USVI DOH staff members most familiar with their communities to ensure demographic diversity and were not population-based. Second, because the interviews were conducted during the Zika response, answers from respondents might have been subject to social desirability bias. Finally, responses were self-reported and not verified.

Despite these limitations, gaining insights into the awareness, beliefs, and actions of USVI pregnant women and community members allowed Zika responders to improve messaging and bolster the response effort. Building in a rapid assessment during an outbreak response offers an essential feedback loop to local public health authorities about their interventions.

Acknowledgments

Residents and clinics of the U.S. Virgin Islands; Marques Adams, Robery Alvey, Jr., Amy Callis, Monifa Carillo, Susan Dugan, Martha Ebener, Alina Flores, Gary Goolsby, Mohammad Islam, Joy Joseph, Francine Lang, Perry Levons, Ann O'Leary, Derval N. Petersen, Charlon Richardson, Michelle Rose, Lee Samuel, Fred Smith, Sharon Tooson, Laura Youngblood.

Conflict of Interest

No conflicts of interest were reported.

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Notes from the Field

Fatal Yellow Fever in a Traveler Returning From Peru — New York, 2016

Alexandra P. Newman, DVM[1]; Rebecca Becraft[2]; Amy B. Dean PhD[3]; Rene Hull[3]; Bryon Backenson, MS[1]; Gillian Hale, MD[4]; Janeen Laven[5]; Julu Bhatnagar, PhD[4]; J. Erin Staples, MD, PhD[5]

In October 2016, a male New York resident aged 74 years developed fever, myalgia, nausea, and vomiting while traveling in Peru, 3 days after visiting the northern Amazon area. During the next 2 days, he experienced fever, abdominal pain, and watery diarrhea and was admitted to a hospital in Peru, where *Entamoeba histolytica* was detected in his stool. He was treated with intravenous fluids and antibiotics and released 1 day after admission. His condition worsened, however, and he returned to New York and immediately sought care at a hospital emergency department, where he was found to be afebrile, slightly confused, and jaundiced. Laboratory tests revealed leukopenia, thrombocytopenia, acute renal failure, liver dysfunction, and a metabolic acidosis (Table). He was transferred from the emergency department to a tertiary care center, where he was admitted and received intravenous fluids, antibiotics, and hemodialysis. During the next 2 days, he developed melena and disseminated intravascular coagulation. He experienced multiple episodes of ventricular fibrillation and died 3 days after admission. Autopsy revealed gastrointestinal hemorrhage and subtotal hepatocellular necrosis. Testing for selected viral, bacterial, and parasitic agents was negative, except for antibody to Salmonella H type A/B (Table). He had not received yellow fever vaccine before traveling. Serum specimens and tissues were sent to Wadsworth Center, the New York State Public Health Laboratory, and CDC to test for yellow fever virus and other pathogens.

A serum specimen collected 7 days after illness onset tested positive for flaviviral RNA by reverse transcription–polymerase chain reaction (RT-PCR), and the amplicon sequencing was consistent with yellow fever virus. A serum specimen obtained at autopsy was positive for yellow fever immunoglobulin M antibodies. Yellow fever RT-PCR assays performed on RNA extracted from formalin-fixed, paraffin-embedded liver tissue were positive; amplicon sequence analysis revealed highest identity with wild-type yellow fever virus strains. An immunohistochemical assay for yellow fever virus performed on the liver tissue demonstrated staining of necrotic hepatocytes throughout the lobules, without mesenchymal staining. The morphologic features of fulminant active hepatitis and the immunohistochemical staining pattern and sequencing results, in combination with the patient's travel history to a region of Peru where yellow fever is endemic, lack of yellow fever vaccination, and clinical history supported the diagnosis of infection with wild-type yellow fever virus (*1*).

TABLE. Clinical laboratory results* and infectious disease test results for patient with a fatal case of yellow fever — New York, 2016

Laboratory test	Result	Reference range
White blood cell count	3,600†	3,800–10,600/μl
Platelet count	5,300†	150,000–400,000/μl
Bicarbonate	10†	22–303 mmol/L
Sodium	135	134–145 mmol/L
Potassium	5.7†	3.5–5.1 mmol/L
Blood urea nitrogen	151†	9–20 mg/dL
Creatinine	13.7†	0.8–1.5 mg/dL
Alanine amino transferase	3,584†	21–72 U/L
Aspartate amino transferase	3,596†	17–59 U/L
Total bilirubin	11.8†	0.0–1.0 mg/dL
Alkaline phosphatase	349†	38–126 U/L
Albumin	3.4	3.5–5.0 g/dL
Lactic acid	3.6†	0.7–2.1 mmol/L
Bacterial cultures (blood)	No growth	No growth
Leptospiral DNA (urine)	Not detected	Not detected
Dengue viral RNA (serum)	Not detected	Not detected
Salmonella H type A/B antibodies (serum)	Positive†	Negative
Q fever antibodies (serum)	Negative	Negative
Hepatitis A virus antibodies (serum)	Nonreactive	Nonreactive
Hepatitis B virus antibodies (serum)	Nonreactive	Nonreactive
Hepatitis C virus antibodies (serum)	Nonreactive	Nonreactive
Yellow fever virus immunoglobulin M antibodies	Positive†	Negative
Yellow fever virus neutralizing antibodies	640†	<10

* Upon hospital admission.
† Outside the reference range.

Yellow fever is a mosquitoborne viral disease endemic to sub-Saharan Africa and tropical areas of South America. Most infections are asymptomatic or result in a nonspecific febrile illness. The severe form of yellow fever results in jaundice and hemorrhage; approximately 50% of severe cases are fatal (*2*).

During 1970–2015, 11 yellow fever cases were reported among U.S. and European travelers (*3*). Before the current case, the last yellow fever case diagnosed in a U.S. resident was in 2002 (*4*). However, after large outbreaks in Africa and South America during 2016–2017, the number of cases confirmed in travelers from countries without endemic yellow fever transmission increased substantially, including at least 11 workers infected in Angola; two travelers in Peru; one each in Suriname and Bolivia; and this case (*5*,*6*).

No specific treatment for yellow fever exists; care is based on symptoms. Prevention of infection is through vaccination and avoidance of mosquito bites. Yellow fever vaccine is recommended for persons aged ≥9 months who are traveling

to or living in areas at risk for yellow fever virus transmission (*3*). However, because serious adverse events can occur after yellow fever vaccination, contraindications and precautions to vaccination, such as patient age, should be considered before administering the vaccine. Health care providers should consider and test for yellow fever in unvaccinated persons with fever and jaundice or hemorrhage who live in or have traveled to an area with yellow fever virus transmission. Information on current yellow fever outbreaks and vaccination requirements and recommendations for specific countries are available on CDC Travelers' Health website (https://www.cdc.gov/travel/).

Conflict of Interest

No conflicts of interest were reported.

[1]New York State Department of Health; [2]Chemung County Health Department, Elmira, New York; [3]Wadsworth Center, New York State Department of Health; [4]Division of High-Consequence Pathogens and Pathology, National Center for Emerging and Zoonotic Infectious Diseases, CDC; [5]Division of Vector-borne Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC, Ft. Collins, Colorado.

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Notes from the Field

Lead Poisoning in an Infant Associated with a Metal Bracelet — Connecticut, 2016

Patricia Garcia, MD[1]; Jennifer Haile, MD[1]

In September 2016, routine screening of a female infant aged 9 months in Manchester, Connecticut, showed normocytic anemia and a blood lead level of 41 μg/dL (levels exceeding 5 μg/dL are abnormal) (*1*). The child was cared for only in the home, which was built in 1926. Epidemiologic investigation identified two interior window wells with peeling lead-based paint; however, the health department concluded that the windows were unlikely the source of exposure, given the lack of accessibility to these areas by the child. The child's three siblings, ranging in age from 3–5 years, had blood lead levels of <3 μg/dL.

The parents reported that the child intermittently wore a handmade "homeopathic magnetic hematite healing bracelet" that they had purchased from an artisan at a local fair (Figure). The child wore the bracelet for teething related discomfort and was sometimes noted to chew on it. Small spacer beads from the bracelet tested at the Manchester Health Department were positive for lead (17,000 ppm). No identifying marks indicating metal content or manufacturer were found on the bead. The vendor records were not available, and the bracelet maker could not be located.

Lead poisoning occurs primarily through oral ingestion of lead containing products. Lead paint, dust, and contaminated soil are the most common sources of lead exposure in children; however, nonpaint sources are often identified in acute poisonings (*1*,*2*). Cases of severe lead poisoning and death were linked to lead-containing charms and jewelry marketed to children in 2003 (*3*) and 2006 (*4*), resulting in large-scale recalls. In 2010, the Consumer Product Commission set the limit of lead content in items manufactured and marketed for children at 100 ppm.* This standard results in numerous recalls of children's jewelry each year[†,§] but does not apply to items that are not intended for use by or in children's products.

Clinicians should be aware of the potential for lead poisoning in children who have ingested or mouthed any metal objects, especially jewelry. Caregivers should be made aware of the risks for lead poisoning resulting from children wearing or handling handmade or adult metal jewelry, even if items are manufactured or purchased in the United States, because infants have natural mouthing behaviors; these items can also pose a choking hazard for small children (*5*). Cases of lead poisoning in these situations should be reported immediately to local public health departments so that timely investigation can be conducted and the source eliminated to prevent further cases of poisoning.

FIGURE. Bracelet with spacer beads containing lead, resulting in lead poisoning of an infant — Connecticut, 2016

Photo/Kimberly Dubanoski, Manchester Health Department, Connecticut

Acknowledgment

Kimberly Dubanoski, chief sanitarian at the Manchester Health Department.

Conflict of Interest

No conflicts of interest were reported.

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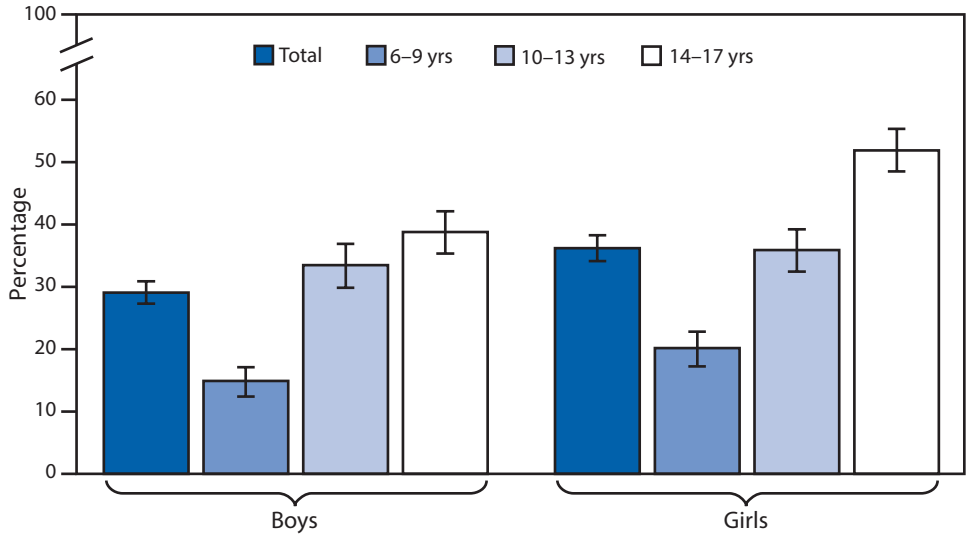
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Children Aged 6–17 Years Who Wear Glasses or Contact Lenses,† by Sex and Age Group — National Health Interview Survey, 2016§



* With 95% confidence intervals indicated with error bars.
† Based on the survey response of "yes" to the question "Does (child's name) wear eyeglasses or contact lenses?" Children who are blind were excluded from these estimates.
§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the National Health Interview Survey Sample Child component.

In 2016, the percentage of children aged 6–17 years who wear eyeglasses or contact lenses was higher among girls (36.2%) compared with boys (29.1%). Girls aged 6–9 years (20.2%) and 14–17 years (51.9%) were more likely than boys of the same age group (14.9% and 38.8%, respectively) to wear eyeglasses or contact lenses. There was no statistically significant difference by sex for children aged 10–13 years (35.9% among girls, 33.5% among boys). Among both girls and boys, children aged 14–17 years were most likely to wear eyeglasses or contact lenses, and children aged 6–9 years were least likely to wear eyeglasses or contact lenses.

Source: National Center for Health Statistics. National Health Interview Survey, 2016. https://www.cdc.gov/nchs/nhis.htm.

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ISSN: 0149-2195 (Print)