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Newly Reported Chronic Hepatitis C Among Adults — Alaska, 2016–2023

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Abstract

Hepatitis C virus is a leading cause of chronic liver disease, hepatocellular carcinoma, and liver-related death and is targeted for global elimination as a public health threat by 2030. Universal screening is recommended for all adults aged ≥18 years and pregnant women during each pregnancy; periodic risk-based screening also is recommended. Persons with current infection should be linked to antiviral treatment, which usually results in a virologic cure within 8–12 weeks. To assess progress toward elimination, epidemiologic trends in newly reported chronic hepatitis C cases were assessed among adult Alaska residents during 2016–2023. Overall, 5,352 confirmed chronic hepatitis C cases were newly reported among adults aged ≥18 years. The average annual rate (cases per 100,000 population) was 121 and decreased a relative 30% from 142 during 2016–2019 to 99 during 2020–2023. Statistically significant decreases occurred for most groups. Groups with higher average rates included males, adults aged 18–39 years, residents of rural areas, and American Indian or Alaska Native persons. Hepatitis C surveillance can help monitor trends in health outcomes and identify groups needing tailored testing and treatment interventions toward hepatitis C elimination.

Introduction

Hepatitis C virus (HCV) is a leading cause of chronic liver disease, hepatocellular carcinoma, and liver-related death and is targeted for elimination as a public health threat by 2030 (*1*).* In the United States, an estimated 2.2 million adults had current HCV infection during 2017–2020 (*1*). Hepatitis C incidence and mortality have disproportionately affected American Indian or Alaska Native persons (*2*). Before 2009, hepatitis C risk was highest among persons born during 1945–1965, but recent increases have occurred among young adults in association with increased injection drug use (*3*,*4*). In 2014, direct-acting antiviral treatments for HCV infection became available that result in >95% virologic cure among persons who complete treatment (*4*,*5*). In 2020, CDC recommended universal hepatitis C screening of all adults aged ≥18 years (at least once during their lifetime) and pregnant women during each pregnancy, with subsequent linkage to care for those with current infection; periodic risk-based screening also is recommended (*4*). To assess progress toward elimination, trends in newly reported chronic hepatitis C cases were assessed among adult Alaska residents during 2016–2023.

Methods

Trends in chronic hepatitis C cases among Alaska residents aged ≥18 years during 2016–2023 were analyzed using data from the National Electronic Disease Surveillance System

* https://www.hhs.gov/sites/default/files/Viral-Hepatitis-National-Strategic-Plan-2021-2025.pdf

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Base System† reported to the Alaska Department of Health as of May 21, 2024. A confirmed case of chronic hepatitis C was defined as 1) a positive test result for HCV RNA, 2) no documentation of converting from negative to positive anti-HCV antibody or HCV RNA test results within the previous 12 months, and 3) not meeting the criteria for or having no report of clinical signs or symptoms of acute hepatitis (i.e., jaundice, total bilirubin ≥3 mg/dL, or serum alanine aminotransferase >200 IU/L).§

The numbers and percentage of newly reported chronic hepatitis C cases were analyzed by sex, age group, residential area (urban, rural, and remote),¶ public health region, race, ethnicity, and year that the first positive test result for HCV RNA or antibody was reported. Annual rates were calculated using population estimates from the Alaska Department of Labor and Workforce Development.** Direct age-standardization was performed using U.S. Census Bureau 2020 data†† as a reference population. CIs were estimated using a normal approximation for age-specific rates and a gamma approximation of the Poisson distribution for age-standardized rates. The same method was used to calculate the relative percentage change in age-standardized rates from 2016–2019 to 2020–2023. Data were analyzed using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed not research, and was conducted consistent with federal law and CDC policy.§§

† https://www.cdc.gov/nbs/php/index.html

§ This definition is based on the 2020 confirmed chronic hepatitis C case definition (https://ndc.services.cdc.gov/case-definitions/hepatitis-c-chronic-2020/), which does not substantively differ from the 2016 definition (https://ndc.services.cdc.gov/case-definitions/hepatitis-c-chronic-2016/) in ways that might affect surveillance reporting over time.

¶ Urban was defined as residence in the Municipality of Anchorage, the Fairbanks North Star Borough, or the City and Borough of Juneau. Rural was defined as living in the Matanuska-Susitna or Kenai Peninsula Boroughs, which are on the road system. All other areas were considered remote.

** https://live.laborstats.alaska.gov/data-pages/alaska-population-estimates

†† https://www.census.gov/data/datasets/time-series/demo/popest/2020s-national-detail.html

Results

During 2016–2023, a total of 5,352 confirmed cases of chronic hepatitis C among adults aged ≥18 years were newly reported in Alaska (Table 1). A majority of the cases were among males (66%) and adults aged <40 years (61%). Overall, 25% of cases were reported among women of reproductive age (18–44 years). Median age of newly reported cases was 38 (IQR = 29–54) years in 2016 and 35 (IQR = 30–45) years in 2023.

During 2016–2023, the average annual age-standardized rate of newly reported chronic hepatitis C cases in Alaska was 121 per 100,000 adults (Table 1). By age group, rates were highest among adults aged 30–39 years (196) and 18–29 years (160) and lowest among those aged ≥60 years (60). By location, rates were highest among adults living in rural areas (162) and among residents of Alaska's Southeast (156), Gulf

§§ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect.241(d); 5 U.S.C. Sect.552a; 44 U.S.C. Sect. 3501 et seq.

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Coast (154), and Matanuska-Susitna (153) regions. Average rates by race were highest among American Indian or Alaska Native adults (223).

The rate of newly reported chronic hepatitis C per 100,000 adults decreased a relative 30% (95% CI = 26%–35%) from 142 during 2016–2019 to 99 during 2020–2023 (Table 2) (Figure). From 2016–2019 to 2020–2023, a statistically significant decrease in chronic hepatitis C rates occurred among all age groups except among persons aged 40–49 years. A significant decrease occurred in all regions except the Southwest and Northern regions. A decrease in the chronic hepatitis C rate occurred among American Indian or Alaska Native (–20%), Asian (–45%), White (–26%), and non-Hispanic or Latino persons (–25%). No group experienced a significant increase in chronic hepatitis C.

TABLE 1. Number, percentage, and average age-standardized rate of newly reported chronic hepatitis C cases per 100,000* adults aged ≥18 years, by sociodemographic group — Alaska, 2016–2023†

Characteristic	No. (%)	Rate (95% CI)
Overall	**5,352 (100)**	**121 (118–124)**
Sex		
Female	1,837 (34)	86 (82–90)
Male	3,515 (66)	153 (148–159)
Age group, yrs		
18–29	1,524 (28)	160 (152–168)
30–39	1,746 (33)	196 (187–206)
40–49	739 (14)	106 (98–113)
50–59	666 (12)	90 (83–96)
≥60	677 (13)	60 (55–64)
Area§		
Rural	1,480 (28)	162 (154–170)
Urban	2,884 (54)	110 (105–114)
Remote	917 (17)	104 (97–111)
Unknown	71 (1)	NC
Region		
Southeast	686 (13)	156 (144–168)
Gulf Coast	705 (13)	154 (142–165)
Matanuska-Susitna	913 (17)	153 (144–163)
Anchorage	2,158 (40)	118 (113–124)
Southwest	283 (5)	114 (100–128)
Interior	439 (8)	64 (58–70)
Northern	97 (2)	57 (45–69)
Unknown	71 (1)	NC
Race¶		
AI/AN	1,856 (35)	223 (213–233)
Asian	69 (1)	19 (14–23)
Black or African American	205 (4)	101 (87–116)
NH/PI	51 (1)	22 (4–39)
White	2,521 (47)	78 (75–81)
Other	265 (5)	NC
Unknown	498 (9)	NC
Ethnicity**		
Hispanic or Latino	202 (4)	67 (57–76)
Not Hispanic or Latino	4,106 (77)	100 (97–104)
Unknown	1,044 (20)	NC

Abbreviations: AI/AN = American Indian or Alaska Native; NC= not calculated; NH/PI = Native Hawaiian or Pacific Islander.

* Annual rates were calculated using population estimates from the Alaska Department of Labor and Workforce Development. Direct age-standardization was performed using U.S. Census Bureau 2020 data as a reference population. Age-specific rates were not age-standardized.

† All data are current as of May 21, 2024, and are subject to change, pending further updates.

§ Urban was defined as residence in the Municipality of Anchorage, the Fairbanks North Star Borough, or the City and Borough of Juneau. Rural was defined as living in the Matanuska-Susitna or Kenai Peninsula Boroughs, which are on the road system. All other areas were considered remote.

¶ For race, categories are not mutually exclusive: 112 (2%) persons selected two or more racial groups and are counted more than once in the analysis by racial group.

** Race and ethnicity were reported separately and are not mutually exclusive (i.e., persons reporting Hispanic or Latino ethnicity could have identified as any race).

Discussion

During 2016–2023, the average annual rate of newly reported chronic hepatitis C in Alaska was 121 cases per 100,000 adults. The overall rate decreased by 30% from 2016–2019 to 2020–2023, similar to national trends.¶¶ Similar to previous reports, groups with higher newly reported chronic hepatitis C rates included males, adults aged 18–39 years, American Indian or Alaska Native persons, and residents of rural areas.*** Most groups experienced decreases in chronic hepatitis C rates from 2016–2019 to 2020–2023, and no group experienced an increase.

Rates of newly reported chronic hepatitis C among Alaska adults aged <40 years during the surveillance period were approximately double the national rates reported during 2018 (*3*) and during 2019–2022.††† Reported rates in Alaska by age group, region, and race might reflect differences in testing related to health care access or use. They also might reflect differences in exposure risk related to behavioral, environmental, or social factors (*6*).

Reasons for the decrease in newly reported chronic hepatitis C cases are likely multifactorial, including expanded hepatitis C screening and treatment and changes in health care–seeking, testing practices, or other behaviors, e.g., related to injection drug use or the COVID-19 pandemic. In 2020, national recommendations were expanded to include hepatitis C testing for all adults (*4*). However, the COVID-19 pandemic resulted in a temporary decrease in hepatitis C testing, treatment, and reporting (*7*). During 2021–2023, increases in opiate-related deaths occurred relative to previous years,§§§ and shifts in

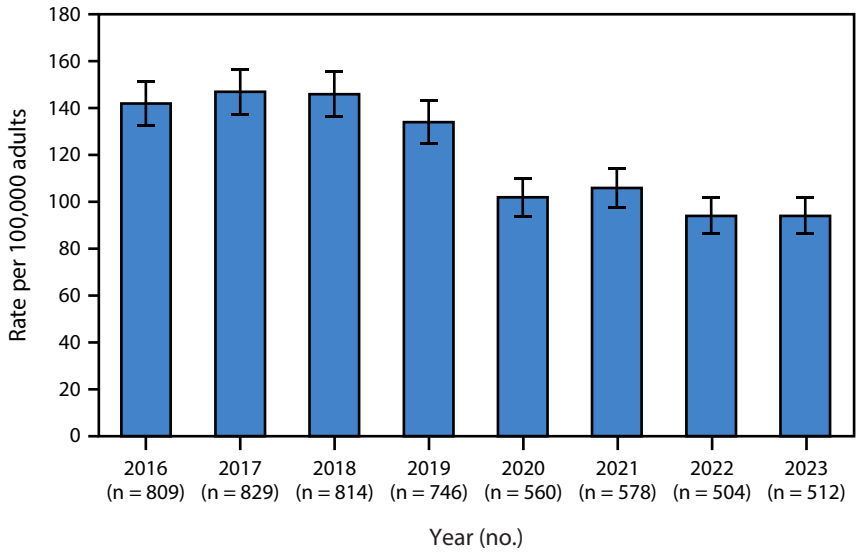
¶¶ National chronic hepatitis C rates decreased from an average of 54 per 100,000 persons of all ages during 2009–2018 to 40 per 100,000 during 2020–2022. https://www.cdc.gov/hepatitis/php/statistics-surveillance/?CDC_AAref_Val

*** https://epi.alaska.gov/bulletins/docs/b2016_19.pdf; https://epi.alaska.gov/bulletins/docs/b2019_15.pdf; https://epi.alaska.gov/bulletins/docs/b2013_13.pdf

††† https://archive.cdc.gov/www_cdc_gov/hepatitis/statistics/2019surveillance/Table3.6.htm; https://www.cdc.gov/hepatitis/statistics/2020surveillance/hepatitis-c/table-3.6.htm; https://www.cdc.gov/hepatitis/statistics/2021surveillance/hepatitis-c/table-3.6.htm; https://www.cdc.gov/hepatitis-surveillance-2022/hepatitis-c/table-3-6.html

§§§ https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm; https://health.alaska.gov/dph/VitalStats/Documents/PDFs/DrugOverdoseMortalityUpdate_2022.pdf

FIGURE. Annual age-standardized rate* and 95% CIs of newly reported chronic hepatitis C cases per 100,000 adults aged ≥18 years — Alaska, 2016–2023



* Annual rates were calculated using population estimates from the Alaska Department of Labor and Workforce Development. Direct age-standardization was performed using U.S. Census Bureau 2020 data as a reference population.

Summary

What is already known about this topic?

Hepatitis C is a substantial cause of morbidity and mortality and is targeted for global elimination by 2030. All adults should receive hepatitis C virus testing, and persons with evidence of current infection should receive antiviral treatment.

What is added by this report?

In Alaska, the average annual rate of newly reported chronic hepatitis C (cases per 100,000 adults) during 2016–2023 was 121; the rate decreased a relative 30% from 142 (2016–2019) to 99 (2020–2023). Rates decreased for most groups but were higher overall among males, persons aged 18–39 years, residents of rural areas, and American Indian or Alaska Native persons.

What are the implications for public health practice?

Continued hepatitis C surveillance can help identify groups needing tailored testing and treatment interventions toward hepatitis C elimination.

opioid use from injection to smoking were noted[¶¶¶] (*8*); both of these factors might have contributed to reduced HCV transmission. Through the efforts of multiple partners in Alaska, hepatitis C screening and treatment has been expanded, including provision of direct-acting antiviral treatment through Medicaid.[****] The impact of these efforts was corroborated in a recent analysis of data from a large commercial laboratory that estimated that 34% of persons with chronic hepatitis C in Alaska achieved viral clearance or cure during 2013–2022, similar to the national rate (the national target is ≥58% by 2025) (*9*).

In Alaska and nationally, challenges remain in ensuring that persons with reactive (positive) HCV antibody test results receive confirmatory testing for HCV RNA (current infection) and subsequent linkage to treatment, especially in remote areas. Efforts are needed to operationalize CDC's updated 2023 guidance to use a single visit to obtain blood specimens for both steps of the HCV testing sequence (*10*). The point-of-care HCV RNA test, which was approved in June 2024, could help complement existing test-and-treat strategies, such as for populations in remote areas without road access and for those who use injection drugs.[††††]

State program goals are to expand hepatitis C screening and linkage to care among disproportionately affected groups, monitor progress through the HCV clearance cascade (from testing to treatment and cure), and improve perinatal hepatitis C surveillance and prevention. Reporting of negative HCV RNA results to the state was instituted in September 2023,[§§§§] which should improve case classification and allow monitoring of testing access and viral clearance and cure. The updated reportable conditions statute also includes provider reporting of pregnancy status among women with hepatitis C, which will improve monitoring to guide perinatal hepatitis C prevention.[¶¶¶¶] The Alaska Hepatitis Advisory Working Group of state partners meets quarterly and is drafting a state plan for viral hepatitis elimination, in alignment with national elimination efforts (J Allison, MPH, Alaska Department of Health, personal communication, July 2024).

Limitations

The findings in this report are subject to at least four limitations. First, the reported rates are those of cases newly reported to Alaska by providers and laboratories; the data do not distinguish incident (new) from prevalent infection and would include persons who received positive test results before 2016 but still need treatment, and persons with hepatitis C

[¶¶¶] https://www.cdc.gov/overdose-prevention/data-research/facts-stats/sudors-dashboard-fatal-overdose-data.html

[****] https://vimeo.com/1061082524; https://nastad.org/sites/default/files/2024-05/Robert%20Lawrence%20-%20Hepatitis%20C%20Elimination%20Alaska%20DOC.pdf

[††††] https://stacks.cdc.gov/view/cdc/164804

[§§§§] https://health.alaska.gov/dph/Epi/Documents/pubs/conditions/ConditionsReportable_LABS.pdf

[¶¶¶¶] https://health.alaska.gov/dph/Epi/Documents/pubs/conditions/ConditionsReportable_HCP.pdf

TABLE 2. Average age-standardized rate* of newly reported hepatitis C cases per 100,000 adults aged ≥18 years and percentage change,† by sociodemographic group — Alaska, 2016–2019 and 2020–2023§

Characteristic	2016–2019		2020–2023		Relative % change (95% CI)
	No (%)	Rate (95% CI)	No (%)	Rate (95% CI)	
Overall	**3,198 (100)**	**142 (137 to 147)**	**2,154 (100)**	**99 (95 to 103)**	**−30 (−35 to −26)**
Sex					
Female	1,129 (35)	104 (98 to 111)	708 (33)	68 (63 to 73)	−35 (−43 to −27)
Male	2,069 (65)	178 (170 to 185)	1,446 (67)	129 (122 to 135)	−27 (−33 to −22)
Age group, yrs					
18–29	976 (31)	199 (186 to 211)	548 (25)	118 (108 to 128)	−40 (−48 to −33)
30–39	938 (29)	215 (201 to 229)	808 (38)	178 (166 to 191)	−17 (−26 to −8)
40–49	393 (12)	113 (102 to 125)	346 (16)	98 (88 to 108)	−13 (−28 to 1)
50–59	442 (14)	112 (102 to 123)	224 (10)	64 (56 to 72)	−43 (−55 to −31)
≥60	449 (14)	85 (77 to 93)	228 (11)	38 (33 to 43)	−55 (−67 to −44)
Area¶					
Rural	899 (28)	200 (186 to 213)	581 (27)	125 (115 to 135)	−37 (−46 to −29)
Urban	1,752 (55)	129 (123 to 136)	1,132 (53)	89 (84 to 94)	−31 (−37 to −25)
Remote	517 (19)	115 (104 to 125)	400 (19)	94 (84 to 103)	−18 (−30 to −6)
Unknown	30 (1)	NC	41 (2)	NC	NC
Region					
Southeast	386 (12)	168 (151 to 186)	300 (14)	144 (127 to 160)	−15 (−29 to 0)
Gulf Coast	455 (14)	197 (179 to 216)	250 (12)	110 (96 to 124)	−44 (−56 to −32)
Matanuska-Susitna	540 (17)	184 (169 to 200)	373 (17)	123 (110 to 135)	−33 (−44 to −23)
Anchorage	1,313 (41)	140 (133 to 148)	845 (39)	96 (89 to 103)	−32 (−39 to −24)
Southwest	139 (4)	112 (93 to 131)	144 (7)	116 (97 to 136)	4 (−21 to 28)
Interior	288 (9)	82 (72 to 91)	151 (7)	46 (38 to 53)	−44 (−59 to −29)
Northern	47 (1)	54 (38 to 70)	50 (2)	60 (43 to 77)	12 (−32 to 55)
Unknown	30 (1)	NC	41 (2)	NC	NC
Race**					
AI/AN	1,028 (32)	248 (233 to 264)	828 (38)	198 (184 to 212)	−20 (−29 to −12)
Asian	42 (1)	25 (17 to 32)	27 (1)	14 (8 to 19)	−45 (−83 to −8)
Black or African American	111 (3)	112 (90 to 135)	94 (4)	92 (72 to 111)	−18 (−45 to 8)
NH/PI	14 (<1)	15 (4 to 25)	37 (2)	29 (4 to 54)	97 (−86 to 280)
White	1,480 (46)	90 (85 to 94)	1,041 (48)	66 (62 to 71)	−26 (−33 to −19)
Other	241 (8)	NC	24 (1)	NC	NC
Unknown	322 (10)	NC	176 (8)	NC	NC
Ethnicity††					
Hispanic or Latino	94 (3)	63 (49 to 76)	108 (5)	70 (56 to 84)	12 (−20 to 43)
Not Hispanic or Latino	2,382 (74)	114 (110 to 119)	1,724 (80)	86 (82 to 90)	−25 (−30 to −19)
Unknown	722 (23)	NC	322 (15)	NC	NC

Abbreviations: AI/AN = American Indian or Alaska Native; NC= not calculated; NH/PI = Native Hawaiian or Pacific Islander.

* Annual rates were calculated using population estimates from the Alaska Department of Labor and Workforce. Direct age-standardization was performed using U.S. Census Bureau 2020 data as a reference population. Age-specific rates were not age-standardized.

† Relative percentage change and 95% CI in age-standardized rates from 2016–2019 to 2020–2023 were calculated using a normal approximation for age-specific rates and a gamma approximation of the Poisson distribution for age-standardized rates.

§ All data are current as of May 21, 2024, and are subject to change, pending further updates.

¶ Urban was defined as residence in the Municipality of Anchorage, the Fairbanks North Star Borough, or the City and Borough of Juneau. Rural was defined as living in the Matanuska-Susitna or Kenai Peninsula Boroughs, which are on the road system. All other areas were considered remote.

** Race categories are not mutually exclusive: 112 (2%) persons selected two or more racial groups and are counted more than once in the analysis by racial group.

†† Race and ethnicity were reported separately and are not mutually exclusive (i.e., persons reporting Hispanic or Latino ethnicity could have identified as any race).

who have not received testing. Second, the number and rate of chronic hepatitis C cases might be underestimated because only confirmed cases are included. Third, some acute hepatitis C cases might have been misclassified as chronic cases because of missing clinical information and limited reporting of negative HCV RNA test results. Finally, the small size of some demographic groups and changes in the completeness of race and ethnicity data over time likely limited the ability to assess changes in some rates.

Implications for Public Health Practice

Hepatitis C surveillance can help monitor health outcomes and identify groups needing tailored testing and treatment interventions aimed toward hepatitis C elimination. Further research is needed to better understand factors that contribute to HCV transmission (e.g., differences in access to testing and treatment); additional efforts are needed to improve access to hepatitis C prevention, testing, and treatment services.

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Fatal Case of Splash Pad–Associated *Naegleria fowleri* Meningoencephalitis — Pulaski County, Arkansas, September 2023

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Abstract

A fatal case of primary amebic meningoencephalitis (PAM), an infection caused by *Naegleria fowleri*, was diagnosed in Arkansas in a young child in September 2023. A public health investigation was completed, with epidemiologic, laboratory, and environmental data suggesting that a splash pad (an interactive water play venue that sprays or jets water on users and has little or no standing water) with inadequately disinfected water was the most likely site of the patient's *N. fowleri* exposure. This case is the third occurrence of splash pad–associated PAM reported in the United States; all three cases involved inadequately disinfected water. PAM should be considered in patients with acute meningoencephalitis and a history of recent possible exposure to fresh water, including treated recreational water (e.g., in splash pads or pools), via the nasal passages. Proper design, construction, operation, and management of splash pads can help prevent illnesses, including *N. fowleri* infections. Increased awareness, collaboration, and communication among clinicians, hospitals, laboratories, CDC, health departments, the aquatics sector, and the public can help support *N. fowleri* infection identification, treatment, prevention, and control efforts.

Case Identification and Clinical Course

On September 1, 2023, a previously healthy child aged 16 months was seen at a local Arkansas hospital with a 3-day history of fever, vomiting, decreased oral intake, decreased activity, and new onset of altered mental status. A noncontrast head computed tomography scan demonstrated ventriculomegaly, a sign concerning for increased intracranial pressure, a possible sequela of meningitis. Empiric treatment for bacterial and viral meningitis was initiated. The patient was admitted to the pediatric intensive care unit for further evaluation and treatment. A lumbar puncture was performed, and findings on laboratory examination of cerebrospinal fluid (CSF) were consistent with possible bacterial meningitis.[§] Qualitative multipathogen nucleic acid–based CSF test results (bioMérieux BioFire FilmArray Meningitis/Encephalitis Panel) were negative; blood and CSF cultures demonstrated no growth after 24 hours. The patient's clinical condition worsened.

On September 3, pathology review of Wright-Giemsa stained cytospin slides of CSF revealed numerous amebic microorganisms morphologically consistent with *Naegleria* spp., a free-living ameba that is found in warm fresh water and soil and causes primary amebic meningoencephalitis (PAM) (Figure 1) (*1*). Family members reported that the patient had played at a splash pad and pool in Pulaski County, Arkansas, on August 26 and 27 (2–3 days before symptom onset). Treatment for *Naegleria fowleri* infection (amphotericin B, azithromycin, dexamethasone, fluconazole, miltefosine, and rifampin) was started. CDC was consulted, and the case was reported to the Arkansas Department of Health (ADH). CSF specimens were sent to CDC's Free-Living and Intestinal Amebas (FLIA) Laboratory for further testing. The patient's condition did not improve, and the patient died on September 4. On September 6, CDC confirmed *N. fowleri* in the child's CSF via real-time polymerase chain reaction (PCR) testing.

Public Health Investigation and Response

CDC supported ADH in the case investigation and response. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[¶]

Splash Pad and Pool Site Investigation

On September 3, 2023, an ADH environmental health specialist conducted a site investigation of the splash pad and adjacent pool where the patient had played 2–3 days before symptom onset. The splash pad (Figure 2) used a recirculating system and a separate water feature pump, which pulled water from an underground tank when users activated the splash pad and directed it through a manifold piping system to a series of laminar nozzles that sprayed water up from the deck. After the water fell onto the splash pad, it flowed down a sloped surface into a return drain lining the perimeter and was plumbed back

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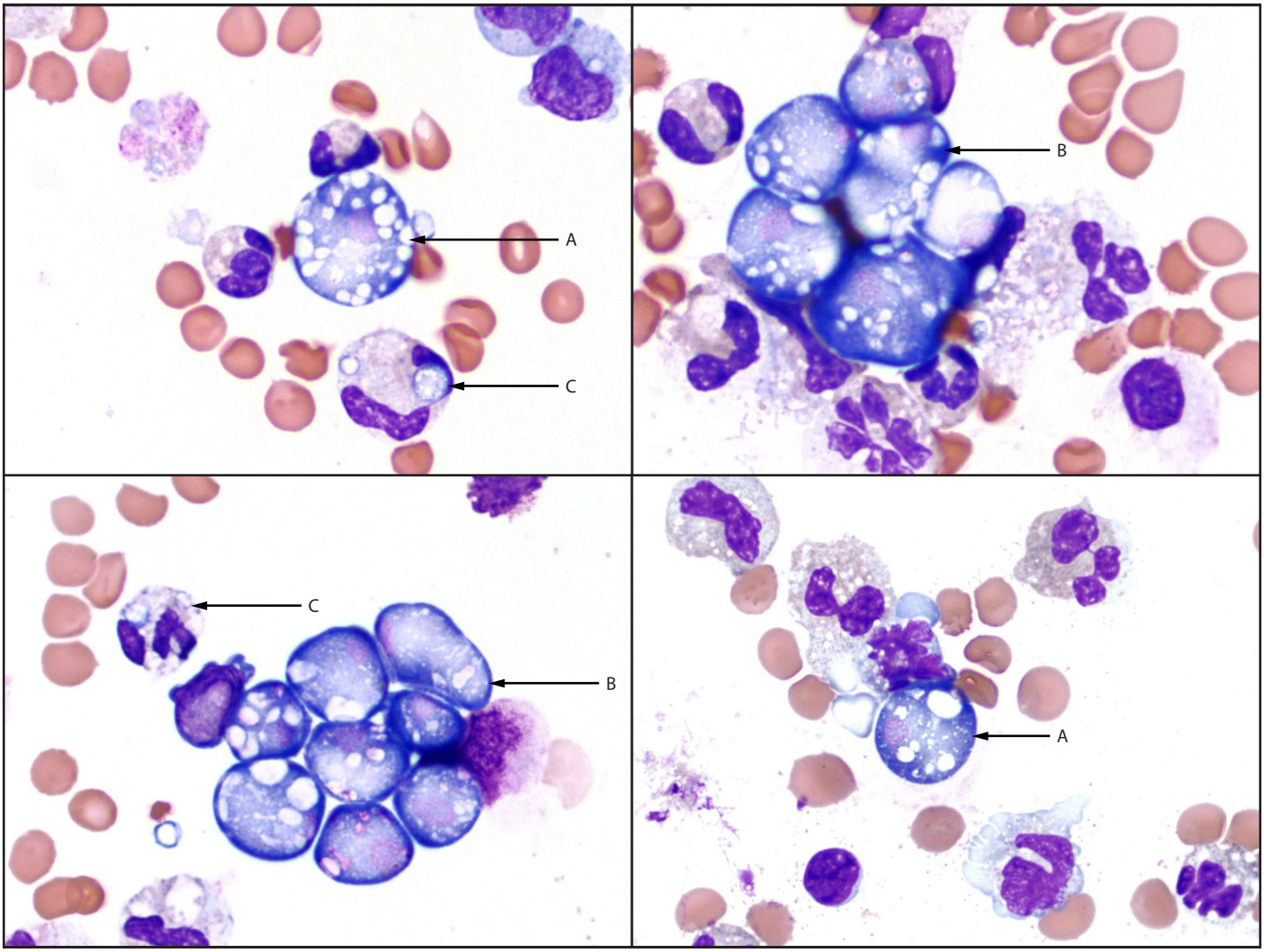
§CSF findings: elevated total nucleated cells (390/μL [reference range = 0–5/μL]) with neutrophil predominance of 71%, elevated red blood cell count (5,150/μL [reference range = 0–0/μL]), elevated protein (610 mg/dL [reference range = 20–70 mg/dL]), and low glucose (<4 mg/dL [reference range = 60% of a simultaneously collected blood glucose value]).

¶45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

FIGURE 1. Wright-Giemsa stained (x1,000 magnification) cerebrospinal fluid cytospin slide images from a patient with fatal primary amebic meningoencephalitis, demonstrating numerous *Naegleria fowleri* trophozoites seen as extracellular single forms (A) or clusters (B), with a predominantly neutrophilic background inflammatory response including neutrophils phagocytizing *N. fowleri* microorganisms (C) — Pulaski County, Arkansas, September 2023



Photos/Jeanette M. Ramos, Arkansas Children's Hospital Department of Pathology

into the tank. A recirculating pump then pulled water from this tank and sent it through a sand filter and, subsequently, calcium hypochlorite tablets and sodium bisulfate tablets were added by a chlorinator and dry acid feeder,** respectively. The water was then returned to the tank until being recirculated again, or until a user activated the splash pad again. The splash pad water source was municipal potable water; in addition, water was also occasionally pumped via hose directly from the pool into the splash pad tank. Overflow outlet piping drained from the splash pad tank to a storm drain and helped prevent the tank from flooding.

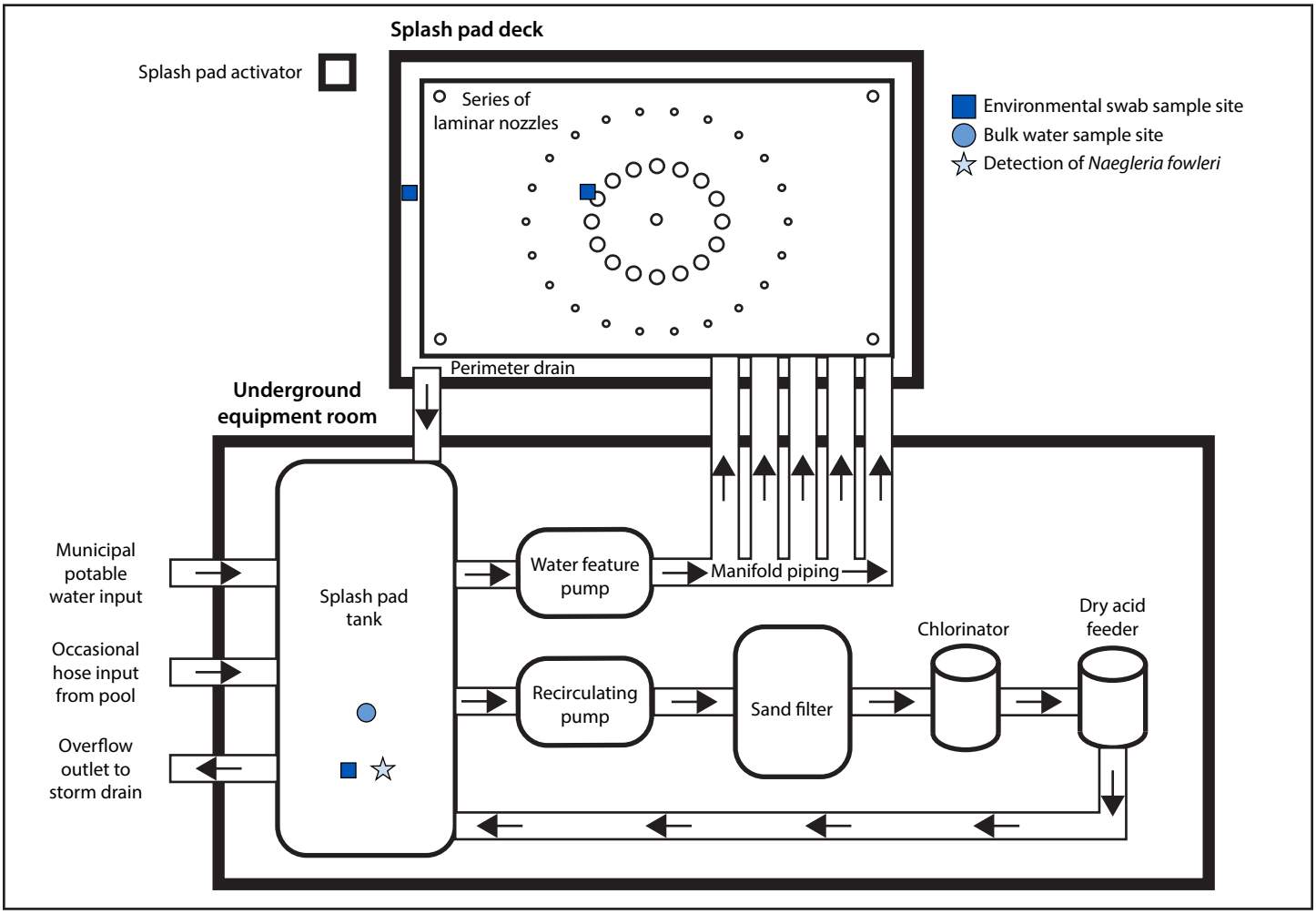
Multiple code violations related to the splash pad were noted. The pH exceeded the test kit measurement limit of 8.2[††]; the residual chlorine concentration exceeded the test kit limit of 5 ppm[§§]; the chlorinator was reported as nonfunctional for approximately 1 month, and chlorine was being hand-fed

** Muriatic acid was reported to be used occasionally when sodium bisulfate tablets were not available on site.

†† pH was tested using a colorimetric *N,N*-diethyl-p-phenylenediamine (DPD) test kit. A maximum pH of 7.8 is permitted by Arkansas's Rules and Regulations Pertaining to Swimming Pools and Other Related Facilities. http://170.94.37.152/REGS/007.04.12-001F-13049.pdf

§§ The residual chlorine concentration, also known as free available chlorine, was tested using a colorimetric DPD test kit. The maximum residual chlorine concentration permitted by Arkansas's Rules and Regulations Pertaining to Swimming Pools and Other Related Facilities is 5.0 ppm. A pH >7.8 decreases how effectively residual chlorine inactivates pathogens.

FIGURE 2. Schematic representation of splash pad water system — Pulaski County, Arkansas, September 2023*



* Includes a recirculating system and a separate water feature pump, which pulled water from an underground tank when users activated the splash pad and directed it through a manifold piping system to a series of laminar nozzles that sprayed water up from the deck. After the water fell onto the splash pad, it flowed down a sloped surface into a return drain lining the perimeter and was plumbed back into the tank. A recirculating pump then pulled water from this tank and sent it through a sand filter and, subsequently, calcium hypochlorite tablets and sodium bisulfate tablets were added by a chlorinator and dry acid feeder, respectively. The water was then returned to the tank until being recirculated again, or until a user activated the splash pad again. The splash pad water source was municipal potable water; in addition, water was also occasionally pumped via hose directly from the pool into the splash pad tank. Overflow outlet piping drained from the splash pad tank to a storm drain and helped prevent the tank from flooding.

daily[¶¶]; no daily operational records were maintained or available for review.[***]

The pool used a separate, similarly laid out recirculating system that also included a surge tank.[†††] Multiple code violations related to the pool were also noted. The pH was >8.2, the test kit upper measurement limit; the pool flow meter was not operating correctly[§§§]; pool water from a large leak in the equipment room was being pumped into the pool surge pit; and no daily operational records were maintained. The splash pad and pool were closed after the investigation.

Environmental Sampling

Environmental swab samples (from the splash pad [drains, laminar nozzles, and biofilm in the tank] and pool [gutter drains and biofilm near the pool leak]) and bulk water samples

[¶¶] Hand-feeding chlorine can lead to inconsistencies in water disinfection. A combined high residual chlorine concentration and pH can occur after a substantial amount of chlorine is added to water, because the addition of certain chlorine products can increase pH.

[***] Daily operational records would include documentation of important details, including water testing results (e.g., residual chlorine concentration and pH) and response to water testing results (e.g., what was added, how much, and when).

[†††] A surge tank receives gravity flow water displaced from the pool through a perimeter gutter system.

[§§§] A pool flow meter, also known as a rate-of-flow indicator, is a device installed on the pool recirculation piping to indicate recirculation flow of the pool. The flow meter allows for monitoring of the turnover rate, the time it takes to run the volume of water equal to a pool's capacity through the recirculation system, within which the water is filtered and disinfected.

(from the splash pad tank, pool, pool leak area, and source water from a deck hose) were collected and sent to CDC's Environmental Microbiology and Engineering Laboratory for testing using temperature-selected culture followed by molecular confirmation (*2*). On September 13, viable *N. fowleri* were detected in the swab collected from the splash pad tank. On September 14, ADH issued a press release notifying the public of a fatal case of *N. fowleri* infection and included information about the public health investigation, *N. fowleri*, and symptoms of infection.¶¶¶ On September 21, viable thermophilic amebas were detected in the bulk water collected from the splash pad tank and pool; *Naegleria* spp. were not detected in these bulk water samples.

Additional Laboratory Investigation and Actions Taken

At CDC's FLIA Laboratory, a genomic typing method using Sanger sequencing of the ITS1 loci region was conducted to compare the clinical and environmental amebas' genetic relatedness (*3*). On September 28, the *N. fowleri* cultured from the patient's CSF and the splash pad tank were confirmed to both be genotype III. Together, the epidemiologic, laboratory, and environmental data suggest the splash pad was the most likely site of the patient's exposure to *N. fowleri.*

The splash pad was disabled and is no longer in use. Corrective actions**** were taken to address the code violations identified during the pool site investigation. A follow-up inspection of the pool was completed on June 3, 2024, and a new operating permit was issued.

Discussion

Naegleria fowleri infections are rare and often fatal; among 164 persons known to have been infected in the United States during 1962–2023, only four (2.4%) have survived (*1*). Infection can occur when water containing the *N. fowleri* ameba enters the body through the nose (*1*). Symptoms typically begin 1–12 days after exposure; PAM progresses rapidly and can lead to brain tissue destruction, brain swelling, and death 1–18 days after symptom onset (median = 5 days) (*1*). Most *N. fowleri* infections have been associated with recreational exposure to fresh water (e.g., swimming or diving in a lake) during summer months (*1*). During 2020–2021, two children in Texas died from PAM after playing at separate "splash pads" with inadequately disinfected water: one was a single-pass, decorative fountain used as a splash pad by the public but not designed, constructed, operated, or managed as a splash pad, and the other was a splash pad that used recirculated water and was not adequately monitored (*4*,*5*). The splash pad–associated PAM case described here represents the third such case in 4 years, indicating that splash pads with inadequately disinfected water are an emerging exposure of concern for transmission of *N. fowleri*.

Clinical diagnosis of PAM is difficult because early signs and symptoms can be nonspecific, and manifestations, including CSF findings, might mimic bacterial meningitis (*6*). PAM should be considered in patients evaluated for acute meningoencephalitis who have a history of recent possible exposure to fresh water, including treated recreational water (e.g., in splash pads or pools), via nasal passages. Prompt diagnosis and treatment are critical to improving chances of survival. *N. fowleri* can be identified in CSF smears or cultures via direct visualization under a microscope using hematoxylin and eosin, periodic acid-Schiff, trichrome, Giemsa, or Wright-Giemsa stains; Gram stain is not sufficient for diagnosis, as *N. fowleri* can be destroyed during heat fixation (*7*). Confirmatory testing (PCR, immunohistochemistry, or indirect immunofluorescent staining) is available at selected U.S. laboratories, including CDC's FLIA Laboratory†††† (*7*). The recommended treatment of *N. fowleri* infections is based on medications used in PAM survivors and those medications with demonstrated antiamebic activity against *N. fowleri* in the laboratory.§§§§

Proper design, construction, operation, and management of splash pads can help prevent transmission of pathogens, including *N. fowleri* (*8*). In this case, because no operational records were maintained and the chlorinator was reported as being nonfunctional for approximately 1 month, it is possible that inadequate disinfection of the splash pad was a chronic problem. Inadequate disinfection, operation, and management over time could lead to growth of biofilm, which can supply nutrients for free-living ameba as well as protection from disinfectants (*9*). CDC's Model Aquatic Health Code provides evidence-based recommendations that jurisdictions and the aquatics sector can collaborate on voluntarily adopting to promote healthy swimming at splash pads, pools, and other treated recreational water venues open to the public (Box) (*10*). Healthy and safe swimming recommendations and resources for the public are also available (*4*).

¶¶¶ https://healthy.arkansas.gov/article/case-of-rare-infection-identified-in-arkansas/

**** Corrective actions included identification and repair of the large pool leak, replacement of pool flow meter, development of a new standard operating procedure (including monitoring and maintaining residual chlorine concentration and pH), and management of daily operational records. Supplementary corrective actions included installation of secondary ultraviolet radiation disinfection system and cleaning of deck drains. Live plants from planters in the pool, as well as nearby landscaping on the pool deck, were removed to help reduce loose soil and plant material contamination in the pool.

†††† Assistance with PAM diagnosis and treatment recommendations is available 24 hours a day, 7 days a week by contacting the CDC Emergency Operations Center at 770-488-7100.

§§§§ https://www.cdc.gov/naegleria/hcp/clinical-care/index.html

BOX. Selected recommendations from CDC's Model Aquatic Health Code* to help prevent pathogen transmission, including *Naegleria fowleri*, in splash pad† water§

- Maintain adequate disinfectant level in the water:
  - Minimum free available chlorine of 1.0 ppm (mg/L), if not using cyanuric acid (such as stand-alone cyanuric acid or stabilized chlorine, commonly known as "dichlor" or "trichlor") (5.7.3.1.1.2.1).
  - Minimum free available chlorine of 2.0 ppm, if using cyanuric acid (5.7.3.1.1.2.2).
  - Minimum total bromine of 3.0 ppm (5.7.3.1.2.2)
- Maintain pH = 7.0–7.8 (5.7.3.4.1).
- Conduct daily inspection before opening to the public, including (6.1.2.1.5.4):
  - Ensure disinfection, secondary disinfection (e.g., ultraviolet and ozone) to inactivate pathogens further and recirculation systems and filters are operating as required.
  - Inspect for and, as needed, remove biofilm from accessible splash pad surfaces (such as the tank, spray nozzles, and drains).
- Test free available chlorine or total bromine concentration and pH before opening to the public each day and maintain adequate disinfectant concentration (5.7.5.1):
  - Test free available chlorine or total bromine and pH every 2–4 hours while open to the public (5.7.5.2– 5.7.5.3).
- Maintain water turnover times at 30 minutes or less (4.7.1.10).
- Ensure that drains prevent standing water from collecting in the water play area (4.8.1.3.1.3).
- Inspect tank regularly and, as needed, clean tank (4.12.8.6).
- Document operation and management activities, such as water testing results, response to testing results, and equipment maintenance (e.g., tank cleaning) (6.1.2.1.4.5, 6.1.2.1.5.4, and 6.4.1.2).

* https://www.cdc.gov/model-aquatic-health-code/php/our-work/index.html
† A splash pad is an interactive water play venue that sprays or jets water on users.
§ Model Aquatic Health Code elements highlighted in this box are followed by their corresponding section numbers to facilitate referencing.

Summary

What is already known about this topic?

Most *Naegleria fowleri* infections are life-threatening and associated with swimming or diving in fresh water, such as a lake. During 2020–2021, two fatal infections associated with splash pads (interactive water play venues that spray or jet water on users) were reported to CDC.

What is added by this report?

In September 2023, a fatal splash pad–associated *N. fowleri* infection in a young child occurred in Arkansas. An investigation identified inadequate disinfection of splash pad water.

What are the implications for public health practice?

Splash pads with inadequately disinfected water are an emerging exposure of concern for *N. fowleri* transmission. Infection should be considered in patients with acute meningoencephalitis and history of recent exposure to fresh water, including treated recreational water (e.g., in splash pads or pools). Proper design, construction, operation, and management of splash pads can help prevent transmission of pathogens, including *N. fowleri*.

Although PAM is not a nationally notifiable disease, it is reportable in some jurisdictions, and CDC tracks *N. fowleri* infections with the voluntary assistance of health departments to monitor disease trends and guide public health recommendations.¶¶¶¶ Ongoing collaboration and communication among clinicians, hospitals, laboratories, CDC, health departments, the aquatics sector, and the public can support efforts to identify, treat, prevent, and control *N. fowleri* infections.

¶¶¶¶ https://www.cdc.gov/naegleria/programs/index.html

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Bobby L. Boyanton, Jr. reports a patent for a specimen adapter for the Siemens Atellica instrument. No other potential conflicts of interest were disclosed.

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Synthetic Opioid and Stimulant Co-Involved Overdose Deaths by Occupation and Industry — United States, 2022

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Abstract

The proportion of synthetic opioid overdose deaths co-involving stimulants has increased in the United States in recent years. Although persons who use opioids have reported increasing stimulant co-use to maintain workplace productivity and alertness, occupational patterns of co-involvement in fatal overdose have not been systematically investigated. In an exploratory study, data on overdose deaths involving synthetic opioids (e.g., fentanyl) from the 2022 National Vital Statistics System were analyzed to characterize patterns of stimulant co-involvement among U.S. residents aged 15–64 years, stratified by decedents' usual occupation and industry. Of 69,893 fatal synthetic opioid overdoses, 53.6% involved stimulants. Occupation and industry groups with the highest percentages of synthetic opioid overdose deaths co-involving psychostimulants with abuse potential (psychostimulants) were typically physically demanding (e.g., construction and extraction occupations), whereas categories with highest percentages of cocaine co-involvement were generally less physically strenuous (e.g., business and financial occupations); these patterns might reflect differences in desired drug effects, cost, and geographic availability. Work-related interventions might be useful in preventing the development of substance use disorder by decreasing rates of occupational injuries and workplace stress, connecting workers with substance use disorder to treatment resources, and reducing fatal overdose through harm reduction.

Introduction

Synthetic opioids (mostly fentanyl) now dominate most U.S. opioid overdose deaths, and the proportion of synthetic opioid–involved overdose deaths that co-involved stimulants, such as psychostimulants with abuse* potential (psychostimulants) or cocaine, more than doubled in the United States between 2018 and 2022 (*1*). Recent qualitative investigations have documented that some persons who use opioids report stimulant co-use to counteract the sedative effects of potent synthetic opioids such as fentanyl, thereby enhancing functionality and alertness in their daily life, particularly in the workplace (*2*,*3*). Understanding occupational differences in the types of stimulants co-involved in synthetic opioid-involved overdose deaths might therefore prove useful for tailoring workplace-oriented overdose prevention efforts (*4*). To this end, National Vital Statistics System (NVSS) data from 2022 were analyzed in an exploratory fashion to examine stimulant co-involvement in synthetic opioid overdoses by decedents' usual occupation and industry.

Methods

Data Source

Mortality data for U.S. residents aged 15–64 years were extracted from the 2022 NVSS mortality multiple cause of death files, which include death certificate data reported from U.S. vital statistics jurisdictions. Synthetic opioid-involved overdose deaths were identified using *International Classification of Diseases, Tenth Revision* (ICD-10) underlying cause of death codes for drug poisoning† and ICD-10 multiple cause of death code T40.4 (poisoning by synthetic opioids other than methadone). Cocaine and psychostimulant involvement were identified using ICD-10 multiple cause of death codes T40.5 and T43.6,§ respectively; psychostimulants included substances such as methamphetamine, amphetamine, methylphenidate, and 4-methylenedioxy-methamphetamine (MDMA). Occupation and industry information within the NVSS mortality multiple cause file is based on narrative text fields, which are coded to 2012 CDC Census Occupation and Industry codes through a collaboration with the National Institute for Occupational Safety and Health. Decedents whose occupation or industry were coded as "military" were excluded.

Data Analysis

Numbers of synthetic opioid-involved overdose deaths and the percentages of synthetic opioid-involved overdoses involving any stimulant (i.e., cocaine, psychostimulants, or both) were stratified by decedents' usual occupation and industry

*The term "abuse" is used in this report to maintain consistency with *International Classification of Diseases, Tenth Revision* (ICD-10) multiple cause of death coding and previous publications from CDC describing stimulant-involved overdose deaths. However, the term should otherwise be limited in use, because "abuse" connotes violent and deliberately harmful behavior and reinforces stigmatizing attitudes toward people who use drugs, thereby undermining efforts to engage this population. A list of preferred terms to use in the context of substance use is available online. https://nida.nih.gov/nidamed-medical-health-professionals/health-professions-education/words-matter-terms-to-use-avoid-when-talking-about-addiction

† ICD-10 underlying cause of death codes X40–X44, X60–X64, X85, and Y10–Y14.

§ ICD-10 multiple cause of death code T43.6, poisoning by psychostimulants with abuse potential, includes poisoning by substances such as methamphetamine, amphetamine, methylphenidate, and MDMA and excludes poisoning by cocaine.

groupings. The percentages of synthetic opioid-involved overdose deaths involving cocaine or psychostimulants within each occupation and industry category were reported. All analyses were conducted using R statistical software (version 4.4.1; R Foundation). This activity was reviewed by CDC, deemed not research involving human subjects, and was conducted consistent with applicable federal law and CDC policy.¶

Results

Synthetic Opioid-Involved Overdose Deaths with Psychostimulants or Cocaine Involved

A total of 69,893 synthetic opioid-involved overdose deaths among U.S. residents aged 15–64 years were identified, 53.6% of which also involved either psychostimulants or cocaine (Table). The occupation and industry groups with highest percentages of synthetic opioid overdoses involving either psychostimulants or cocaine (excluding those labeled "other") were farming, fishing, and forestry (57.5%) and mining (55.9%). Those with the lowest percentages of such overdoses were healthcare practitioners and technical (46.7%) occupations and utilities industries (43.4%).

Overdose Deaths and Occupation

Occupations with the highest percentages of synthetic opioid-involved overdoses involving psychostimulants (excluding those labeled "other") were farming, fishing, and forestry (41.7%); arts, design, entertainment, sports, and media (35.5%); construction and extraction (33.0%); installation, maintenance, and repair (31.9%); and architecture and engineering (30.5%) (Figure 1). Occupations with the highest percentages of synthetic opioid-involved overdoses involving cocaine were healthcare support (34.2%); community and social services (33.5%); business and financial (31.6%); legal (31.5%); and protective services (30.5%).

Overdose Deaths and Industry

Industries with the highest percentages of synthetic opioid overdose deaths involving psychostimulants were mining (42.5%); agriculture, forestry, fishing, and hunting (39.3%); management of companies and enterprises (37.5%); construction (33.0%); and arts, entertainment, and recreation (32.7%) (Figure 2). Industries with the highest percentages of such deaths with cocaine involvement included healthcare and social assistance (31.8%); management of companies and enterprises (31.3%); finance and insurance (31.2%); real estate, rental, and leasing (30.4%); administrative, support, and waste services (30.8%); education services (29.5%); and transportation and warehousing (29.7%).

¶ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE. Percentage of synthetic opioid–involved overdose deaths* co-involving psychostimulants or cocaine,† by decedent's usual occupation or industry — National Vital Statistics System, United States, 2022

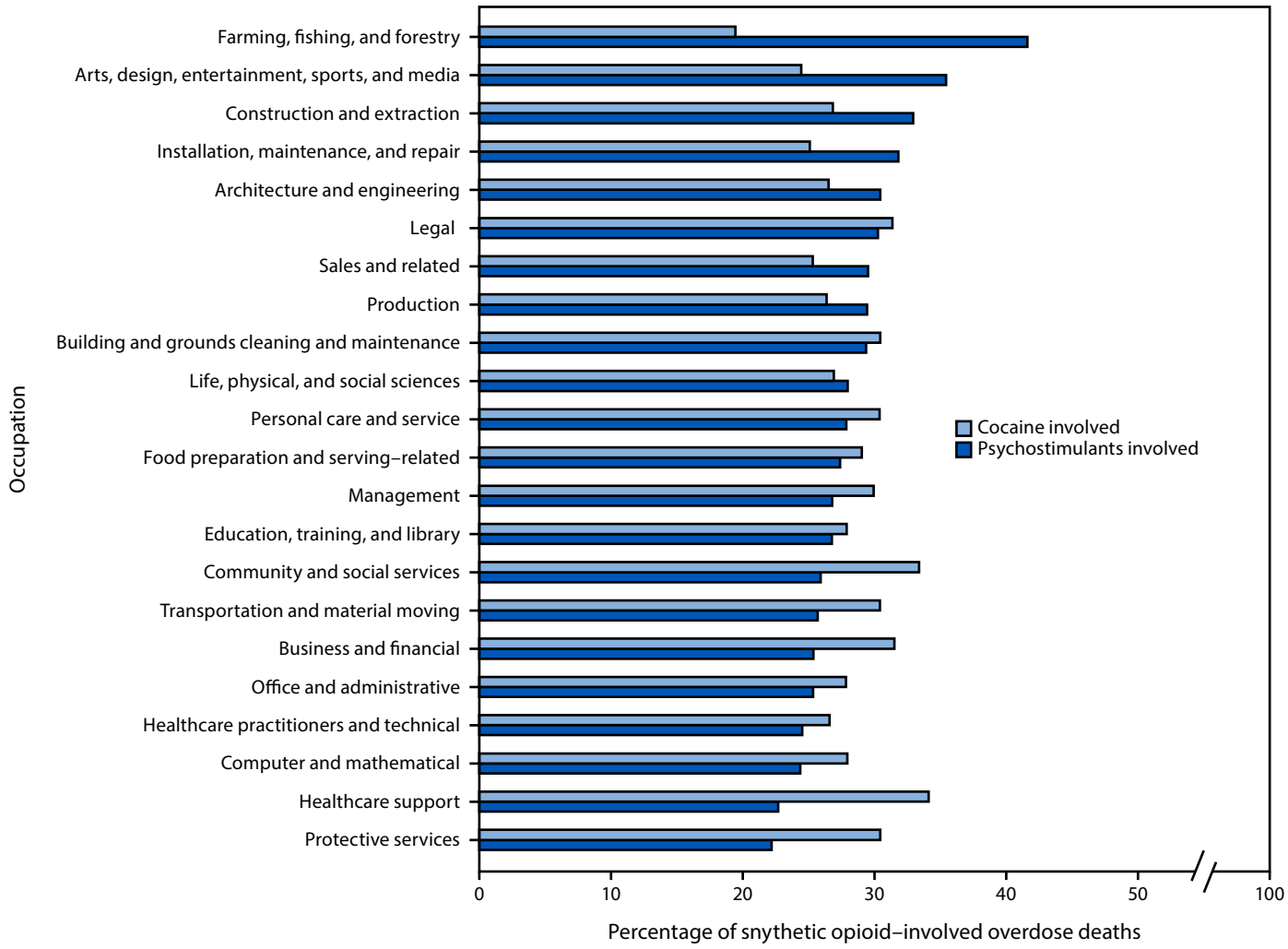
Characteristic	Synthetic opioid overdoses	Percentage involving psychostimulants or cocaine
Total	**69,893**	**53.6%**
Occupation		
Farming, fishing, and forestry	508	57.5%
Building and grounds cleaning and maintenance	3,287	55.8%
Construction and extraction	11,831	55.6%
Other-housewife	2,680	54.8%
Arts, design, entertainment, sports, and media	1,106	54.3%
Community and social services	481	54.3%
Installation, maintenance, and repair	2,922	53.5%
Personal care and service	2,051	53.1%
Healthcare support	1,397	53.0%
Legal	178	52.8%
Food preparation and serving-related	5,672	52.3%
Transportation and material moving	7,045	52.3%
Architecture and engineering	380	52.1%
Management	2,558	51.8%
Production	3,454	51.8%
Sales and related	3,930	50.7%
Business and financial	696	50.4%
Life, physical, and social sciences	189	50.3%
Education, training, and library	354	50.0%
Office and administrative	2,758	49.4%
Protective Services	665	48.4%
Computer and mathematical	446	47.8%
Healthcare practitioners and technical	1,001	46.8%
Other–misc (excluding housewife)	14,304	55.9%
Industry		
Mining	299	55.9%
Construction	12,797	55.7%
Administrative, support, and waste services	3,402	55.2%
Agriculture, forestry, fishing, and hunting	699	54.9%
Arts, entertainment, and recreation	1,384	54.1%
Accommodation and food services	7,023	52.1%
Healthcare and social assistance	4,057	51.0%
Education services	603	50.6%
Wholesale trade	506	50.6%
Manufacturing	4,914	50.5%
Transportation and warehousing	3,411	50.3%
Management of companies and enterprises	16	50.0%
Retail trade	4,497	49.9%
Information	550	49.6%
Real estate, rental, and leasing	497	48.9%
Professional, scientific, and technical services	1,391	48.4%
Finance and insurance	673	48.0%
Public administration	665	46.0%
Utilities	316	43.4%
Other–Misc, missing	18,410	56.2%
Other services (except public administration)	3,783	56.0%

Abbreviations: ICD-10 = *International Classification of Diseases, Tenth Revision*; Misc = miscellaneous.

* Synthetic opioid-involved overdose deaths were identified using ICD-10 underlying cause of death codes for poisoning (X40–X44, X60–X64, X85, and Y10–Y14) and multiple cause of death codes for poisoning by synthetic opioids excluding methadone (T40.4).

† Stimulant co-involvement was identified using ICD-10 multiple cause of death codes T40.5 (poisoning by cocaine) or T43.6 (poisoning by psychostimulants with abuse potential).

FIGURE 1. Percentage of fatal synthetic opioid–involved overdoses* co-involving psychostimulants† or cocaine§ for 22 major occupation groups¶ — National Vital Statistics System, United States, 2022**



Abbreviations: ICD-10 = *International Classification of Diseases, Tenth Revision*; Misc = miscellaneous.

* Synthetic opioid–involved overdose deaths were identified using ICD-10 underlying cause of death codes for poisoning (X40–X44, X60–X64, X85, and Y10–Y14) and multiple cause of death codes for poisoning by synthetic opioids excluding methadone (T40.4).

† Psychostimulant involvement was identified using ICD-10 multiple cause of death code T43.6, poisoning by psychostimulants with abuse potential, which includes poisoning by substances such as methamphetamine, amphetamine, methylphenidate, and 4-methylenedioxy-methamphetamine and excludes poisoning by cocaine.

§ Cocaine involvement was identified using ICD-10 multiple cause of death code T40.5, poisoning by cocaine.

¶ Excluding "other–Misc, missing" or "Other-Housewife" occupations.

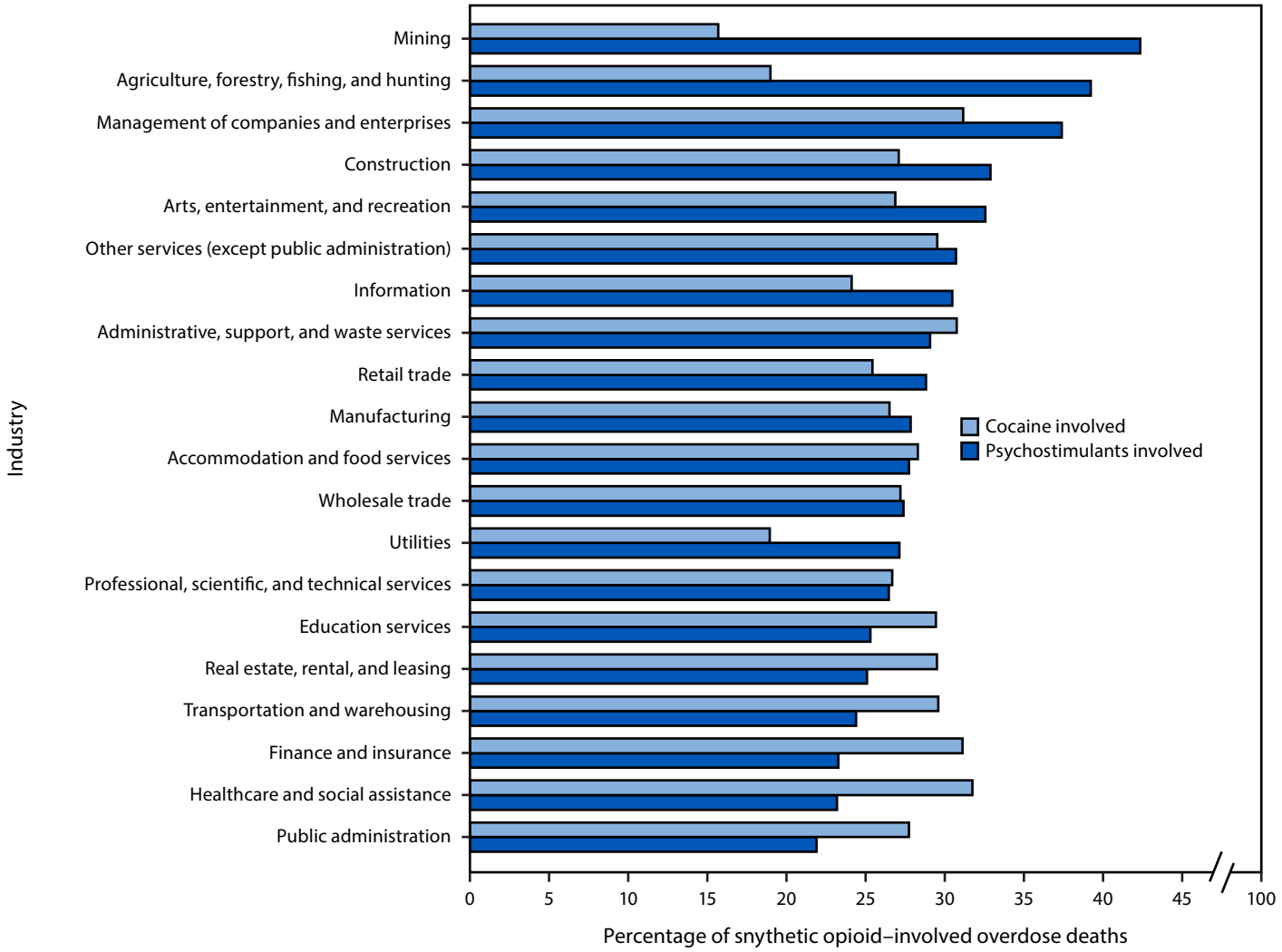
** ICD-10 multiple cause of death codes are not mutually exclusive. Therefore, decedents included in this analysis might have had both psychostimulants and cocaine present at the time of their death and the percentages included in this figure might not equal the total percent with any stimulant present.

Discussion

In this exploratory analysis of occupational patterns of psychostimulant or cocaine involvement in synthetic opioid-involved overdose deaths, occupations and industries with high percentages of synthetic opioid-involved overdoses co-involving psychostimulants tended to be those likely involving manual labor. Occupations and industries with higher percentages of cocaine involvement were those often considered to be less physically strenuous.

One potential explanation for these patterns is that psychostimulants are better suited for counteracting opioid-involved lethargy in physically demanding occupations, particularly given that the drug effects of psychostimulants such as methamphetamine are longer-lasting than those of cocaine (*5*). Previous studies have observed that persons who use opioids report intentional co-use of methamphetamine to improve functioning in their fast-paced, manual occupations (*2*). Similarly, workers in construction and landscaping jobs

FIGURE 2. Percentage of fatal synthetic opioid–involved overdoses* co-involving psychostimulants† or cocaine§ for 20 major industry groups¶ — National Vital Statistics System, United States, 2022**



Abbreviations: ICD-10 = *International Classification of Diseases, Tenth Revision*; Misc = miscellaneous.

* Synthetic opioid–involved overdose deaths were identified using ICD-10 underlying cause of death codes for poisoning (X40–X44, X60–X64, X85, and Y10–Y14) and multiple cause of death codes for poisoning by synthetic opioids excluding methadone (T40.4).

† Psychostimulant involvement was identified using ICD-10 multiple cause of death code T43.6, poisoning by psychostimulants with abuse potential, which includes poisoning by substances such as methamphetamine, amphetamine, methylphenidate, and 4-methylenedioxy-methamphetamine and excludes poisoning by cocaine.

§ Cocaine involvement was identified using ICD-10 multiple cause of death code T40.5, poisoning by cocaine.

¶ Excluding "other–Misc, missing" industries.

** ICD-10 multiple cause of death codes are not mutually exclusive. Therefore, decedents included in this analysis might have had both psychostimulants and cocaine present at the time of their death, and the percentages included in this figure might not equal the total percentage with any stimulant present.

report using methamphetamine to reduce pain associated with working in these labor-intensive jobs (*6*). Another contributing factor could be the relative difference in cost between psychostimulants and cocaine. Persons who work in more physically demanding occupations (e.g., farming, fishing, and forestry occupations) are frequently paid lower wages than are those in occupations requiring less manual labor (e.g., business and financial occupations) (*7*); use of psychostimulants such as methamphetamine might therefore be more prevalent within certain occupation groups given that it tends to be less expensive than cocaine (*3*,*8*).

Geography might also play a role in the overlap between employment in certain industries and co-use of opioids with specific stimulants. For instance, data indicate that recent increases in psychostimulant-involved opioid overdose deaths were most rapid in the Appalachian region (*9*). Compared with

other regions, Appalachia has higher rates of employment in the mining industry (*10*), which had the highest percentage of psychostimulant involvement of any industry in this study. Conversely, industries with high cocaine involvement, such as education services or healthcare and social assistance, might be less geographically localized. Others, such as financial services, might be more common in urban areas, where rates of cocaine-involved overdoses are higher than are those in rural areas (*1*).

Limitations

The findings in this report are subject to at least five limitations. First, although qualitative reports suggest that many persons who co-use opioids and stimulants do so intentionally, particularly in the context of counteracting opioid-related lethargy in the workplace, NVSS does not include data on intent of co-use. Second, usual (or longest held) occupation and industry within NVSS are collected as part of death certificate reporting; for some decedents, there might be a discrepancy between what occupation or industry they were usually employed in and that in which they were employed at the time of death. Third, this report focused on stimulant involvement in synthetic opioid-involved overdose deaths, and its findings cannot be generalized to opioid overdoses not involving synthetic opioids. However, as of 2023, synthetic opioids other than methadone were involved in approximately 70% of overdose fatalities in the U.S. and were therefore the focus of this report (*1*). Fourth, within-group differences in proportions in stimulant co-involved deaths tended to be small. Finally, this analysis was exploratory, with no guiding hypotheses; therefore, these findings should be considered hypothesis-generating and warrant confirmation.

Implications for Public Health Practice

These hypothesis-generating findings warrant confirmation but point to a potential role for work-related substance use and overdose prevention interventions. The National Institute for Occupational Safety and Health has developed the Workplace Supported Recovery (WSR) initiative, which guides employers in bolstering the employment and retention of persons with substance use disorders and in facilitating access to treatment (*4*). The WSR initiative also aims to address the determinants of substance use disorders and overdose through the reduction of work-related risk factors, including occupational injury and work-related stress (*4*). To maximize their potential benefit, WSR and other workplace-oriented interventions might need to tailor their approaches based on potential psychostimulant or cocaine use within a given occupation or industry. Nevertheless, increased access to harm reduction resources and evidence-based treatments for opioid use disorder and stimulant use disorder, both within and outside of a workplace setting, will be needed to address the current U.S. overdose crisis.

Summary

What is already known about this topic?

Overdose deaths involving both synthetic opioids and stimulants have increased sharply in recent years. Although some persons who co-use opioids and stimulants have cited motivations related to functionality and alertness in the workplace, occupational patterns of co-use remain uninvestigated.

What is added by this report?

In this exploratory analysis of multiple cause of death data from 2022, occupations and industries with higher percentages of psychostimulant involvement in synthetic opioid overdose deaths tended to be physically demanding, whereas those with higher percentages of cocaine involvement tended to be less so.

What are the implications for public health practice?

Employers and other entities seeking to implement work-related substance use and overdose prevention programs might need to tailor their approaches based on potential in psychostimulant or cocaine use within a given occupation or industry.

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Notes from the Field

Fatal *Acanthamoeba* Encephalitis in a Patient Who Regularly Used Tap Water in an Electronic Nasal Irrigation Device and a Continuous Positive Airway Pressure Machine at Home — New Mexico, 2023

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Acanthamoeba is a genus of free-living ameba that can cause severe disease of the brain, eyes, sinuses, skin, and other organs, particularly among immunocompromised persons. Approximately three to 12 persons are infected with nonkeratitis *Acanthamoeba* infections in the United States annually, and a majority die (*1*). Because of the unknown incubation period of *Acanthamoeba* spp., which might be weeks or months, and its ubiquity in the environment, the source of exposure is typically unknown. In a case series of ten immunocompromised patients with nonkeratitis *Acanthamoeba* infection, all reported performing nasal irrigation before becoming ill, many using tap water, but no confirmation of this exposure route through environmental testing was reported (*2*). This report confirms the link between intranasal exposure to contaminated tap water and the development of *Acanthamoeba* granulomatous amebic encephalitis in an older patient and highlights the risk associated with using tap water in electronic medical devices.

Investigation and Outcomes

On November 15, 2023, CDC was notified of a patient aged 66 years who had died approximately 3 weeks after being hospitalized for altered mental status and weakness. Symptoms progressed to include seizures, fever, and respiratory and gastrointestinal complications. Brain lesions were noted on magnetic resonance imaging and, at autopsy, histopathologic evidence of granulomatous amebic encephalitis was identified. The patient had reported no recent recreational water exposure but regularly used tap water in an electronic nasal irrigation device and a continuous positive airway pressure (CPAP) machine at home. Information about how these devices were cleaned was not available. The patient had a history of diabetes mellitus, obstructive sleep apnea, alcohol use disorder, and ulcerative colitis requiring a total colectomy.

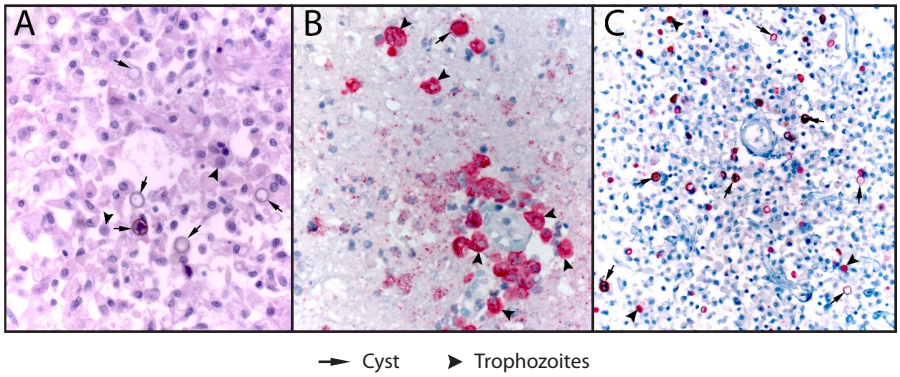
On January 4, 2024, CDC received patient brain specimens for testing through coordination with the New Mexico Department of Health. The diagnosis of granulomatous amebic encephalitis caused by *Acanthamoeba* (Figure) was confirmed using an *Acanthamoeba* species immunohistochemical assay and polymerase chain reaction (PCR) (*3*). *Acanthamoeba* was also detected by culture in the electronic nasal irrigation device and in the drained water receptacle from the patient's CPAP machine, followed by real-time PCR confirmation on February 5* (*3*). All detected *Acanthamoeba* strains belonged to the T4 genotype, which is the most common genotype detected among encephalitis cases† (*4*,*5*). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.§

* *Acanthamoeba* spp. testing included rinsing objects three times with a total of 175 ml William Balamuth saline/0.01% Tween 80 solution. The rinse solution was then pelleted by centrifugation at 1500 x *g* for 15 minutes at 77°F (25°C), followed by culture for amebas on nonnutrient agar with *Escherichia coli* lawn at 86°F (30°C) for ≤14 days. Specimens with observed ameba via microscopy were scraped for genomic testing using the ZymoBIOMICS DNA/RNA Miniprep kit for nucleic acid extraction and real-time PCR.

† Sanger amplicon sequencing of a region of the 18S rRNA gene was conducted to determine genetic relatedness of the isolate genotypes to one another.

§ 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

FIGURE. Histopathologic findings in a fatal case of granulomatous amebic encephalitis caused by *Acanthamoeba* T4 genotype*



Photos/Infectious Disease Pathology Branch, CDC

* Extensive granulomatous inflammation and necrosis surrounding cysts and trophozoites of *Acanthamoeba* species in brain tissue (A). An *Acanthamoeba* species immunohistochemical assay highlighted amebic antigens in cysts and trophozoites located in subacute perivascular microabscesses (B) and areas of chronic granulomatous inflammation (C).

Summary

What is already known about this topic?

Acanthamoeba, a free-living ameba, can cause encephalitis and disseminated disease that are nearly always fatal. Immunocompromised persons are at highest risk for these infections.

What is added by this report?

In November 2023, a patient died from an *Acanthamoeba* infection, likely acquired by using tap water in electronic medical devices. *Acanthamoeba* was detected in the patient's brain tissue, an electronic nasal irrigator, and a continuous positive airway pressure (CPAP) machine; all strains were of the same genotype.

What are the implications for public health practice?

Patients should always follow manufacturer instructions regarding the type of water to use and recommended cleaning practices for electronic medical devices such as CPAP machines. Distilled, sterile, or boiled and cooled tap water can be used in nasal irrigation devices.

Preliminary Conclusions and Actions

Prevention of *Acanthamoeba* infections has been challenging because of lack of information about risk behaviors and transmission of this environmentally ubiquitous pathogen. Although nearly all cases occur among immunocompromised persons, the route of transmission is unknown for a majority of cases. This case investigation confirms that intranasal exposure to tap water can cause *Acanthamoeba* infection. Inadequate cleaning and drying of nasal irrigation devices and medical devices might have been contributing factors in this case, given that some of these devices have parts that are difficult to access for proper cleaning and drying. Although more work is needed to elucidate whether the risk for *Acanthamoeba* infection might be increased by inadequate cleaning practices, all persons who use nasal irrigation devices or electronic medical devices should follow cleaning guidance provided by the manufacturer. Health care providers should consider counseling patients about *Acanthamoeba* infections and encourage the use of distilled, sterile, or boiled and cooled tap water when performing nasal irrigation and adherence to manufacturer recommendations when using electronic medical devices such as CPAP machines.[¶,**]

CDC offers a 24-hour, 7 days-a-week free-living ameba clinical consultation service to provide diagnostic and treatment advice to health care providers.[††] Clinicians are encouraged to report cases of *Acanthamoeba* infection to local or state public health officials. CDC recommends that public health officials report cases to CDC to enhance ongoing surveillance activities.

[¶] https://www.cdc.gov/naegleria/prevention/sinus-rinsing.html

[**] https://www.cdc.gov/drinking-water/prevention/preventing-waterborne-germs-at-home.html

[††] The CDC Free-Living Ameba Clinical Consultation service can be reached by calling the CDC Emergency Operations Center at 770-488-7100.

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