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School District Crisis Preparedness, Response, and Recovery Plans — United States, 2006, 2012, and 2016

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Children spend the majority of their time at school and are particularly vulnerable to the negative emotional and behavioral impacts of disasters, including anxiety, depressive symptoms, impaired social relationships, and poor school performance (*1*). Because of concerns about inadequate school-based emergency planning to address the unique needs of children and the adults who support them, Healthy People 2020 includes objectives to improve school preparedness, response, and recovery plans (Preparedness [PREP]-5) (*2*). To examine improvements over time and gaps in school preparedness plans, data from the 2006, 2012, and 2016 School Health Policies and Practices Study (SHPPS) were analyzed to assess changes in the percentage of districts meeting PREP-5 objectives. Findings from these analyses indicate that districts met the PREP-5 objective for requiring schools to include post-disaster mental health services in their crisis preparedness plans for the first time in 2016. However, trend analyses did not reveal statistically significant increases from 2006 to 2016 in the percentage of districts meeting any of the PREP-5 objectives. Differences in preparedness were detected in analyses stratified by urbanicity and census region, highlighting strengths and challenges in emergency planning for schools. To promote the health and safety of faculty, staff members, children, and families, school districts are encouraged to adopt and implement policies to improve school crisis preparedness, response, and recovery plans.

SHPPS is a national survey periodically conducted by CDC to assess school health policies and practices (*3*). This report used district-level data from the 2006, 2012, and 2016 surveys. In each study year, a nationally representative sample of public school districts is drawn using a two-stage sample design. Five to seven questionnaires, each assessing a different component of school health, are administered in each sampled district via paper and pencil or online. This report summarizes results from the crisis preparedness module within the healthy and safe school environment questionnaire. Across the three study years, the number of sampled districts that completed this questionnaire ranged from 461 to 697, and the response rates ranged from 64.0% to 66.5%.

Each district identified the respondent who had primary responsibility for, or was most knowledgeable about, the content of each questionnaire. Respondents to the crisis preparedness module were asked whether their school district required schools to have a comprehensive plan to address crisis

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preparedness, response, and recovery that included four specific topics identified in PREP-5: family reunification procedures, procedures for responding to pandemic influenza or other infectious disease outbreaks (only asked in 2012 and 2016), provisions for students and staff members with special needs, and provision of mental health services for students and staff members after a crisis. Respondents also were asked whether their district provided funding for training or offered training on their crisis preparedness plans to school faculty and staff members, students, and students' families, and whether their district offered education on crisis preparedness, response, and recovery to students' families. To categorize SHPPS school districts accurately into U.S. Census regions, SHPPS data were linked to extant data from the Market Data Retrieval database (*4*), a commercial database that compiles a list of K–12 schools in the United States along with their characteristics. Analyses were stratified by census region (Midwest, Northeast, South, or West); urbanicity (city, suburb, town, or rural); and district enrollment size (small [≤4,999 students], medium [5,000–9,999], or large [≥10,000]).

Data from each study year were weighted to provide national estimates. Analyses using statistical software accounted for the complex sample design. Prevalence estimates and 95% confidence intervals were computed for all point estimates. Statistical significance ($p<0.05$) for linear trends was determined using logistic regression analyses with data from all 3 years. The 2016 data only were used for descriptive statistics related to training and education. T-tests were used to determine differences between subgroups, with p-values <0.05 considered statistically significant.

Overall, no significant changes over time were detected in the percentage of districts that required schools to include specific topics in their school crisis preparedness, response, and recovery plans that correspond to the Healthy People 2020 PREP-5 objectives (Table 1) (Table 2). Notably, the Healthy People 2020 district requirements for school plans to include provision of mental health services for students, faculty, and staff members after a crisis (PREP-5.4; target ≥76.2%) was met (77.6%) for the first time in 2016 (Table 2).

Assessing district requirements by subgroup identified a significant increase in the percentage of districts in suburban areas that required schools to include family reunification procedures in their plans (PREP-5.1) from 2006 to 2016 and a linear increase in this requirement among districts in the Northeast ($p = 0.05$) (Table 1). The percentage of school districts that required schools to include procedures for responding to pandemic influenza or other infectious disease outbreaks in their plans (PREP-5.2) decreased significantly in rural areas ($p<0.05$) and among districts in the South ($p = 0.05$) (Table 1). By 2016, all Healthy People 2020 targets assessed were met in large school districts, although trends were not statistically significant.

In 2016, large districts were significantly more likely than were small districts to provide funding for or offer training on crisis preparedness for school faculty, staff members, and students' families ($p<0.05$) (Table 3). Compared with districts

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TABLE 1. Percentage of districts that require schools to include family reunification or infectious disease outbreak in their school crisis preparedness, response, and recovery plans by selected characteristics — School Health Policies and Practices Study, United States, 2006, 2012, 2016

District characteristic	Year, % (95% CI)			P-value
	2006	2012	2016	
Topic: family reunification procedures* (PREP† 5.1 target = 74.6%)				
No. of observations	**402**	**599**	**559**	**—**
Percentage of districts	**65.3 (59.5–70.6)**	**67.8 (63.8–71.5)**	**74.4 (70.5–77.9)**	**0.068**
Urbanicity				
City	64.0 (34.6–85.6)	87.7 (76.4–94.0)	85.6 (69.8–93.9)	0.079
Suburb	70.8 (59.7–79.8)	75.4 (68.4–81.3)	82.5 (74.6–88.4)	0.029§
Town	68.5 (52.6–81.0)	63.0 (52.5–72.4)	77.4 (67.7–84.8)	0.392
Rural	63.3 (55.8–70.2)	61.0 (54.8–66.8)	65.8 (59.8–71.3)	0.673
District enrollment size (no. of students)				
Small (≤4,999)	64.0 (57.8–69.7)	65.3 (60.9–69.5)	71.6 (67.2–75.6)	0.130
Medium (5,000–9,999)	77.9 (57.4–90.2)	83.8 (70.5–91.8)	87.7 (73.3–94.9)	0.268
Large (≥10,000)	76.6 (52.0–90.8)	83.2 (68.6–91.8)	89.9 (77.8–95.8)	0.107
U.S. Census region¶				
Midwest	57.7 (48.5–66.3)	60.2 (53.4–66.7)	69.4 (62.8–75.3)	0.062
Northeast	61.7 (46.1–75.2)	72.0 (62.9–79.6)	77.4 (68.6–84.3)	0.050**
South	72.8 (62.5–81.1)	71.6 (64.3–78.0)	81.1 (74.2–86.5)	0.248
West	74.3 (58.8–85.4)	73.6 (63.0–82.1)	72.3 (61.0–81.4)	0.836
Topic: procedures for responding to pandemic influenza or other infectious disease outbreak†† (PREP† 5.2 target = 75.9%)				
No. of observations	**404**	**595**	**560**	**—**
Percentage of districts	**—**	**69.0 (65.0–72.7)**	**65.3 (61.2–69.3)**	**0.359**
Urbanicity				
City	—	80.6 (67.7–89.2)	72.6 (55.0–85.2)	0.423
Suburb	—	70.8 (63.5–77.2)	75.8 (67.2–82.7)	0.237
Town	—	70.4 (60.0–79.0)	69.4 (59.2–78.1)	0.870
Rural	—	65.3 (59.1–70.9)	56.2 (50.0–62.1)	0.012§
District enrollment size (no. of students)				
Small (≤4,999)	—	66.7 (62.3–70.8)	62.9 (58.3–67.3)	0.321
Medium (5,000–9,999)	—	84.0 (69.9–92.3)	73.5 (57.6–85.0)	0.219
Large (≥10,000)	—	83.4 (69.1–91.8)	83.4 (69.7–91.6)	0.994
U.S. Census region¶				
Midwest	—	57.9 (51.1–64.5)	57.3 (50.3–63.9)	0.904
Northeast	—	75.2 (66.3–82.4)	70.9 (62.0–78.5)	0.403
South	—	79.4 (72.4–85.0)	69.9 (62.0–76.8)	0.053**
West	—	68.5 (57.5–77.7)	69.2 (57.4–79.0)	0.935

* Adopted a policy requiring schools' crisis plans to include family reunification procedures.

† *Healthy People 2020* Preparedness (PREP) objective 5.

§ Statistically significant (p<0.05).

¶ Regions: *Northeast*: Connecticut, Maine, Massachusetts, New Jersey, New Hampshire, 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.

** p = 0.05.

†† Adopted a policy requiring schools' crisis plans to include procedures for responding to pandemic influenza or other infectious disease outbreak. Question was not asked in 2006.

in the Midwest, districts in the South were less likely to provide funding for training or offer training on crisis preparedness for school faculty and staff members (p<0.05). In contrast, districts in the Midwest were less likely than were those in the Northeast, South, and West to provide funding for training or to offer training on crisis preparedness for students' families (p<0.05). Districts in the Midwest also were less likely than were those in the West to offer education on crisis preparedness, response, and recovery to students' families (p<0.05).

Discussion

These findings highlight strengths and challenges in emergency planning for schools. In 2016, the Healthy People 2020 goal requiring school districts to have plans in place that include provision of mental health services for students, faculty, and staff members after a crisis was achieved nationally for the first time, suggesting that school districts increasingly recognize the importance of addressing post-disaster mental health needs as a vital part of crisis recovery. In addition, over the past decade, improvements were made for inclusion of

TABLE 2. Percentage of districts that require schools to include provisions for special needs or mental health services in their school crisis preparedness, response, and recovery plans by selected characteristics — School Health Policies and Practices Study, United States, 2006, 2012, 2016

District characteristic	Year, % (95% CI)			P-value
	2006	2012	2016	
Topic: provisions for students and staff members with special needs[¶] (PREP[†] 5.3 target = 87.9%)				
No. of observations	**404**	**596**	**561**	**—**
Percentage of districts	**77.4 (72.1–82.0)**	**79.9 (76.3–83.0)**	**79.8 (76.2–83.0)**	**0.538**
Urbanicity				
City	91.2 (68.8–98.0)	88.7 (77.1, 94.8)	84.9 (69.7–93.2)	0.511
Suburb	84.6 (74.8–91.1)	85.0 (78.8–89.6)	90.6 (84.0–94.7)	0.150
Town	79.2 (63.1–89.5)	82.1 (72.6–88.8)	82.1 (72.8–88.7)	0.663
Rural	74.8 (67.7–80.7)	74.5 (68.7–79.6)	71.6 (65.7–76.8)	0.460
District enrollment size (no. of students)				
Small (≤4,999)	76.5 (70.7–81.4)	78.5 (74.5–82.0)	77.8 (73.7–81.4)	0.727
Medium (5,000–9,999)	88.2 (74.2–95.1)	87.2 (74.1–94.2)	90.3 (76.3–96.4)	0.778
Large (≥10,000)	82.8 (54.6–95.1)	90.8 (78.0–96.5)	90.7 (79.1–96.1)	0.353
U.S. Census region[§]				
Midwest	72.4 (63.5–79.8)	72.2 (65.6–78.0)	75.8 (69.6–81.1)	0.571
Northeast	78.6 (63.1–88.8)	87.6 (80.0–92.5)	87.1 (80.0–91.9)	0.211
South	81.5 (71.8–88.4)	87.8 (81.8–92.0)	86.2 (79.8–90.8)	0.272
West	82.6 (67.9–91.4)	73.0 (62.3–81.6)	71.7 (60.1–81.0)	0.228
Topic: provision of mental health services for students, faculty, and staff members after a crisis occurred[¶] (PREP[†] 5.4 target = 76.2%)				
No. of observations	**404**	**595**	**560**	**—**
Percentage of districts	**73.0 (67.4–77.9)**	**69.3 (65.4–73.0)**	**77.6 (73.9–80.9)**	**0.424**
Urbanicity				
City	91.3 (68.8–98.1)	84.1 (72.2–91.5)	81.6 (63.9–91.7)	0.343
Suburb	84.0 (75.3–90.1)	75.2 (68.1–81.1)	87.2 (79.5–92.2)	0.632
Town	70.5 (53.9–83.0)	65.7 (55.1–74.9)	83.2 (74.6–89.3)	0.169
Rural	70.1 (62.8–76.5)	63.9 (57.8–69.7)	68.7 (62.8–74.1)	0.669
District enrollment size (no. of students)				
Small (≤4,999)	70.9 (64.8–76.3)	67.7 (63.4–71.8)	75.8 (71.6–79.5)	0.405
Medium (5,000–9,999)	90.8 (78.0–96.5)	75.3 (61.1–85.6)	88.0 (73.9–95.0)	0.566
Large (≥10,000)	93.3 (76.3–98.4)	83.7 (69.6–92.0)	86.1 (70.8–94.0)	0.294
U.S. Census region[§]				
Midwest	70.6 (61.7–78.2)	60.1 (53.3–66.6)	74.2 (67.9–79.6)	0.753
Northeast	72.6 (56.8–84.2)	80.4 (71.9–86.7)	85.8 (78.4–90.9)	0.046**
South	74.1 (63.8–82.3)	72.7 (65.3–78.9)	79.2 (71.7–85.1)	0.493
West	79.2 (63.3–89.4)	71.6 (60.8–80.3)	73.2 (61.7–82.2)	0.462

* Adopted a policy requiring schools' crisis plans to include family reunification procedures.
† *Healthy People 2020* Preparedness (PREP) objective 5.
§ Regions: *Northeast*: Connecticut, Maine, Massachusetts, New Jersey, New Hampshire, 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.
¶ Adopted a policy requiring schools' crisis plans to include provision of mental health services for students, faculty, and staff members after a crisis occurred.
** Statistically significant (p< 0.05).

family reunification procedures after a crisis at the national level, particularly in suburban schools and schools in the northeastern United States (*5*).

Despite this progress, gaps in achieving school preparedness goals at the national level persist, and progress in many essential areas is minimal. Whereas the majority of school districts have plans to address mental health needs and family reunification after an emergency, nationally, approximately one in four districts fall short of these goals, and one in three school districts does not have policies in place to prepare for an infectious disease outbreak. Because schools often function as community hubs, these gaps in preparedness planning leave communities potentially vulnerable to critical public health threats.

Preparedness planning was not consistent across localities. The percentage of rural school districts that included procedures for responding to pandemic influenza or other infectious disease outbreaks in their preparedness plans decreased significantly over time and was lower than the percentage among urban and suburban districts and towns. Furthermore, compared with large districts, a significantly lower percentage of small districts provided funding for training or offered training for crisis preparedness for school faculty, staff members, and students' families. Because schools can be a central gathering

TABLE 3. Percentage of districts that provided funding for training or offered training on crisis preparedness, by district-level characteristics — School Health Policies and Practices Study (SHPPS), United States, 2016

Group offered training	Provided funding for training or offered training on crisis preparedness,* % (95% CI): School faculty and staff members	Students	Students' families	Offered education to students' families†, % (95% CI)
No. of observations	**543**	**537**	**539**	**558**
Percentage of districts	**89.6 (86.4–92.0)**	**59.5 (55.0–63.7)**	**17.6 (14.2–21.0)**	**21.6 (18.2–25.5)**
District characteristic				
Urbanicity				
City	88.4 (70.3–96.0)	58.6 (42.0–73.5)	23.2 (12.2–39.6)	20.9 (10.8–36.7)
Suburb	92.5 (86.1–96.1)	61.4 (51.9–70.1)	18.8 (12.4–27.3)	21.1 (14.3–29.8)
Town	86.4 (76.7–92.5)	58.2 (47.5–68.2)	17.6 (11.2–26.5)	20.1 (12.7–30.3)
Rural	89.2 (84.7–92.5)	59.3 (53.0–65.2)	15.4 (11.2–20.7)	21.8 (17.1–27.3)
District enrollment size (no. of students)				
Small (≤4,999)	88.4§ (84.8–91.3)	58.0 (53.1–62.6)	15.0§ (11.9–18.8)	20.5 (16.9–24.7)
Medium (5,000–9,999)	92.6 (79.0–97.6)	65.4 (48.9–78.9)	20.4 (10.7–35.5)	21.8 (11.3–38.0)
Large (≥10,000)	97.4 (88.3–99.5)	68.5 (51.5–81.6)	37.9 (23.4–55.0)	32.9 (19.4–50.0)
U.S. Census region¶				
Midwest	93.5** (89.3–96.1)	63.0 (56.1–69.5)	8.4**,††,§§ (5.2–13.1)	16.0§§ (11.7–21.6)
Northeast	88.6 (80.1–93.8)	55.0 (45.3–64.4)	20.9 (14.1–29.7)	21.1 (14.2–30.0)
South	86.7 (80.0–91.3)	57.2 (48.8–65.2)	20.3 (14.4–27.9)	23.7 (17.3–31.4)
West	86.3 (75.4–92.9)	60.1 (47.5–71.4)	28.3 (18.5–40.7)	30.5 (20.8–42.4)
Total	**89.6 (86.4–92.0)**	**59.5 (55.0–63.7)**	**17.6 (14.2–21.0)**	**21.6 (18.2–25.5)**

* Districts that responded "yes" to the question "During the past two years, has your district provided funding for or offered training on the crisis preparedness, response and recovery plan to…a) school faculty and staff members, b) students, c) students' families?"

† Districts that responded "yes" to the question "During the past two years, has your district offered education on crisis preparedness, response, and recovery to students' families?"

§ Significant difference (p<0.05) between districts with small and large enrollment size.

¶ Regions: *Northeast*: Connecticut, Maine, Massachusetts, New Jersey, New Hampshire, 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.

** Significant difference (p<0.05) between Midwest and South districts.

†† Significant difference (p<0.05) between Midwest and Northeast districts.

§§ Significant difference (p<0.05) between Midwest and West districts.

place during an emergency in low population density areas, the decreases in infectious disease preparedness plans and lack of resources to support emergency preparedness could lead to a gap in coverage when an event occurs. School administrators have the opportunity to lead health promotion and safety in rural and smaller communities. Schools can serve as a centralized, familiar rallying point for communities during crises; however, technical support and resources are needed to ensure successful planning for administrators. Regular training regarding crisis preparedness, response, and recovery for students and their families is essential to ensuring that communities are ready when disaster strikes. School districts can partner with local and regional public health departments to determine how best to use limited resources, identify emerging themes in responses, and review emergency operations plans to identify best practices.

To promote the health and safety of faculty, staff members, children, and families and meet the Healthy People 2020 preparedness targets, more school districts can adopt and implement preparedness policies. Adoption of family reunification procedures might include steps to determine alternative school sheltering locations and family communication messaging (e.g., text messaging) to allow schools and communities to avoid extensive challenges to reuniting families, such as those observed after Hurricane Katrina (*6*,*7*). Timely family reunification promotes post-disaster recovery for adults and children, benefitting the health of communities and the population as a whole (*7*). Strengthening policies and planning for infectious disease outbreaks is vital to ensuring that communities remain healthy and productive (*8*). The 2014 Ebola outbreak in West Africa closed schools in affected areas for up to 10 months (*9*), compromising the health and well-being of children, staff members, and faculty who rely on schools for a sense of normalcy during a crisis. Therefore, school districts should consider developing customized protocols in the event of an outbreak of seasonal influenza (*10*). In the United States, the U.S. Department of Education, Office of Safe and Healthy Student, Readiness and Emergency Management for Schools Technical Assistance Center* and CDC's Children's Preparedness Unit† have developed a suite of publications and

* https://rems.ed.gov/.

† https://www.cdc.gov/childrenindisasters/before-during-after.html.

Summary

What is already known about this topic?

Healthy People 2020 includes objectives to improve school preparedness, response, and recovery plans in the event of a disaster.

What is added by this report?

Analyses of data found differences in trends by urbanicity in district requirements for crisis plans. In 2016, large districts (≥10,000 students) were significantly more likely than were small districts (≤4,999 students) to provide funding for or offer training on crisis preparedness for school faculty, staff members, and students' families.

What are the implications for public health practice?

To meet Healthy People 2020 targets, increases are needed in district adoption and implementation of policies. Strengthening plans for infectious disease outbreaks, especially in rural districts, could help ensure that children and communities remain healthy and productive.

tools to help schools and families prepare for, respond to, and recover from emergencies.

The findings in this report are subject to at least three limitations. First, SHPPS data are self-reported and thus are subject to bias. Second, SHPPS documentation states that the word "policy" refers to any law, rule, regulation, administrative order, or similar kind of mandate issued by the local school board or other local agency with authority over schools in districts; this might be interpreted differently by individual respondents. Finally, the binary response option (yes/no) does not indicate whether a school district has taken action on the policy in question.

During the past decade, more school districts have adopted policies requiring certain preparedness measures for schools. However, school districts have not met all of the target goals of the Healthy People 2020 PREP-5 objectives, indicating suboptimal preparedness planning in some localities. Findings from this report highlight the need for wider adoption of policies on family reunification, pandemic influenza and other infectious disease outbreak procedures, and provisions for students and staff members with special needs, particularly in rural areas. School district-specific information on school crisis preparedness planning and training might help identify and address disparities and critical gaps in preparedness and response policies and plans for children. Adoption of strong policies by school districts can promote the health and safety of faculty, staff members, children, and families and meet the Healthy People 2020 preparedness objectives [PREP-5] for safe school environments.

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Conflict of Interest

No conflicts of interest were reported.

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References

1. Pfefferbaum B, Noffsinger MA, Sherrieb K, Norris FH. Framework for research on children's reactions to disasters and terrorist events. Prehosp Disaster Med 2012;27:567–76. https://doi.org/10.1017/S1049023X12001343
2. US Department of Health and Human Services. Healthy people 2020. Washington, DC: US Department of Health and Human Services; 2017. https://www.healthypeople.gov/2020/topics-objectives/topic/preparedness/objectives
3. CDC. Results from the school health policies and practices study–2016. Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/healthyyouth/data/shpps/results.htm
4. Dun & Bradstreet. Market data retrieval K-12 database. Shelton, CT: Dun & Bradstreet; 2018. https://mdreducation.com/education-database/
5. Silverman B, Chen B, Brener N, et al. School district crisis preparedness, response, and recovery plans—United States, 2012. MMWR Morb Mortal Wkly Rep 2016;65:949–53. https://doi.org/10.15585/mmwr.mm6536a2
6. Agency for Healthcare Research and Quality. School-based emergency preparedness: a national analysis and recommended protocol. No. 09–0013. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2009. https://archive.ahrq.gov/prep/schoolprep/schoolprep.pdf
7. Abramson D, Stehling-Ariza T, Garfield R, Redlener I. Prevalence and predictors of mental health distress post-Katrina: findings from the Gulf Coast child and family health study. Disaster Med Public Health Prep 2008;2:77–86. https://doi.org/10.1097/DMP.0b013e318173a8e7
8. United Nations Children's Fund; CDC; World Health Organization. Key messages for safe school operations in countries with outbreaks of Ebola. New York, NY: United Nations Children's Fund; Atlanta, GA: US Department of Human Services, CDC; Geneva, Switzerland: World Health Organizaiton; 2015. https://www.cdc.gov/vhf/ebola/pdf/ebola-safe-school-messages2015.pdf
9. The World Bank. Back to school after the Ebola outbreak. Washington, DC: The World Bank; 2015. http://www.worldbank.org/en/news/feature/2015/05/01/back-to-school-after-ebola-outbreak
10. US Department of Education. ERCMExpress: schools respond to infectious disease. Washington, DC: US Department of Education; 2006. https://rems.ed.gov/docs/PandemicFluNewsletter_072106.pdf

Characteristics of Tianeptine Exposures Reported to the National Poison Data System — United States, 2000–2017

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Tianeptine (marketed as Coaxil or Stablon) is an atypical tricyclic drug used as an antidepressant in Europe, Asia, and Latin America. In the United States, tianeptine is not approved by the Food and Drug Administration (FDA) for medical use and is an unscheduled pharmaceutical agent* (*1*). Animal and human studies show that tianeptine is an opioid receptor agonist (*2*). Several case studies have reported severe adverse effects and even death from recreational abuse of tianeptine (*3*–*5*). To characterize tianeptine exposures in the United States, CDC analyzed all exposure calls related to tianeptine reported by poison control centers to the National Poison Data System (NPDS)† during 2000–2017. Tianeptine exposure calls, including those for intentional abuse or misuse, increased across the United States during 2014–2017, suggesting a possible emerging public health risk. Most tianeptine exposures occurred among persons aged 21–40 years and resulted in moderate outcomes. Neurologic, cardiovascular, and gastrointestinal signs and symptoms were the most commonly reported health effects, with some effects mimicking opioid toxicity. A substantial number of tianeptine exposure calls also reported clinical effects of withdrawal. Among 83 tianeptine exposures with noted coexposures, the most commonly reported coexposures were to phenibut, ethanol, benzodiazepines, and opioids.

CDC used NPDS data to review all tianeptine exposure telephone calls reported by U.S. poison control centers during 2000–2017. Calls for drug information or identification were excluded. Trends in exposure by year were compiled for all tianeptine exposure calls and for calls related to intentional abuse or misuse. Descriptive statistics were compiled for all exposure calls by U.S. Census region (Midwest, Northeast, South, and West),§ caller source (self or health care professional), demographics (sex and age group), exposure type (intentional, unintentional, withdrawal, or unknown/other), exposure route (ingestion, parenteral, or inhalation), and coexposures. Tianeptine-only exposures were defined as those that reported only tianeptine use with no other substances. Tianeptine-only exposures (excluding withdrawal-associated calls) were analyzed for reported related clinical effects by body systems, performed therapies, and level of care (evaluated, treated, and released from the emergency department (ED), admission to noncritical care units, admission to critical care units, or other).

Exposure medical outcomes were classified according to American Association of Poison Control Centers (https://www.aapcc.org/) definitions as either no effect, minor outcome, moderate outcome, severe outcome, or death. Minor outcomes were defined as symptoms that were minimally bothersome to the patient, usually resolved rapidly, and often involved skin or mucous membrane manifestations, after which the patient returned to a preexposure state of well-being with no residual disability or disfigurement. Moderate outcomes were defined as symptoms that were more pronounced, more prolonged, or of a more systemic nature than minor symptoms but were not life threatening; usually requiring some form of treatment, after which the patient returned to a preexposure state of well-being with no residual disability or disfigurement. Major outcomes were defined as symptoms that were life threatening or resulted in a significant residual disability or disfigurement. Withdrawal-associated tianeptine calls were analyzed separately for clinical effects and performed therapies. Summaries of two cases reported in 2016 are presented for illustrative purposes (Supplementary Table, https://stacks.cdc.gov/view/cdc/57404).

Frequencies for categorical variables and mean values for continuous variables were calculated using statistical software. Tests for the trend for all tianeptine exposure calls and for calls related to intentional abuse or misuse during 2014–2017 were performed. Fisher's exact test was used to test for associations between reported outcome severity and tianeptine-only exposures versus tianeptine with coexposures, age group, and sex. Statistical significance was defined as $p<0.05$.

During 2000–2017, NPDS received 218 calls related to tianeptine exposure, including one from outside the United States. Tianeptine-only exposures, excluding 29 withdrawal-associated calls, accounted for 114 (52.3%) calls. During the first 14 years of the study period (2000–2013), NPDS received a total of 11 tianeptine exposure calls. From 2014

* Drugs, substances, and certain chemicals used to make drugs are classified by the Drug Enforcement Administration into five schedules depending upon the drug's acceptable medical use and the drug's abuse or dependency potential. https://www.dea.gov/druginfo/ds.shtml.

† NPDS is a national database of information provided by the country's regional poison centers serving all 50 states, the District of Columbia, the U.S. Virgin Islands, and Puerto Rico. The American Association of Poison Control Centers maintains the database. NPDS case records are the result of call reports made by members of the public or health care providers. https://www.aapcc.org/data-system/.

§ https://www.census.gov/geo/reference/webatlas/regions.html.

through 2017, there was a statistically significant increase in calls related to exposure (p<0.001) and intentional abuse or misuse (p<0.001). The total number of tianeptine exposure calls increased from five in 2014 to 38 in 2015, 83 in 2016, and 81 in 2017 (Figure). The majority of calls (91.2%) came from health care providers; by U.S. Census region, the highest percentage of calls came from the South (34.6%). Among 213 (97.7%) exposure calls for which information on age was available, the mean age was 35 years (range = 1–80 years) (Table 1).

Among the 114 tianeptine-only exposures, excluding withdrawal-related calls, the most commonly reported related clinical effects were neurologic (48.3%), cardiovascular (32.5%), and gastrointestinal (10.5%) (Table 2). The most commonly administered therapies included fluids (35.1%), benzodiazepines (27.2%), and oxygen (10.5%) (Table 2). Among the 105 exposure calls for which level of care was reported, 46 (44%) persons were treated, evaluated, and released from the ED, and 25 (24%) were admitted to a critical care unit. Among the 93 tianeptine-only exposures with a known medical outcome, 50 (54%) had moderate outcomes. No deaths were reported.

Poison control centers reported 29 withdrawal-associated calls. Among those, tianeptine was the only substance reported to be associated with withdrawal in 21 (72.4%) calls; among those 21 calls, the most frequently reported signs and symptoms were agitation (33.3%), nausea (33.3%), vomiting (19%), tachycardia (19.1%), hypertension (14.3%), diarrhea (9.5%), tremor (9.5%), and diaphoresis (9.5%). The most frequently administered therapies included benzodiazepines (57.1%), fluids (38.1%), and antiemetics (19.1%).

Summary

What is already known about this topic?

Tianeptine is an antidepressant drug that is not approved by the Food and Drug Administration (FDA). Clinical effects of tianeptine abuse and withdrawal can mimic opioid toxicity and withdrawal.

What is added by this report?

Tianeptine exposure calls to U.S. poison control centers increased during 2014–2017, suggesting a possible emerging public health risk. The associated health effects included neurologic, cardiovascular, and gastrointestinal signs and symptoms, with some effects mimicking opioid toxicity and withdrawal.

What are the implications for public health practice?

Health care provider and public education about adverse effects associated with tianeptine use is warranted. Health care providers and public health officials need to report adverse effects to the FDA MedWatch reporting system and contact poison control centers for clinical guidance.

Among the 183 exposure calls with a known outcome, significant associations were found between outcome severity for tianeptine-only exposures versus tianeptine with coexposures (p = 0.01) and between outcome severity and sex (p = 0.02). Persons reporting coexposure along with tianeptine were more likely to have major outcomes than those with tianeptine-only exposures. Men were more likely than women to have a moderate outcome. No differences were found between outcome severity and age group (<20, 21–40, 41–60, and ≥61 years) (p = 0.93).

FIGURE. Number of tianeptine exposure telephone calls reported (N = 218) — National Poison Data System, United States, 2000–2017

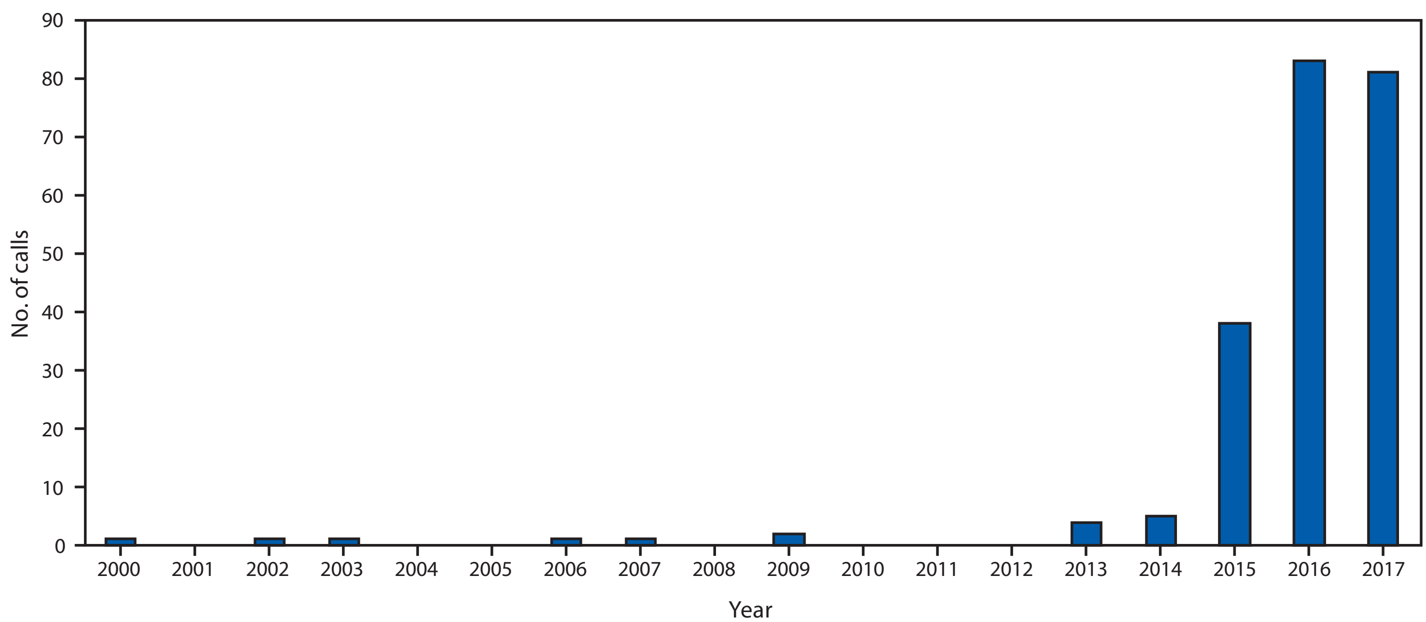

TABLE 1. Characteristics of telephone calls related to tianeptine exposure (N = 218) — National Poison Data System, United States, 2000–2017

Characteristic (no. with known information)	No.	(%)
Call source (218)		
Health care provider	198	(91.2)
Caller residence	13	(6.0)
Other	7	(3.2)
U.S. Census region (217)		
South	75	(34.6)
West	54	(24.9)
Midwest	47	(21.6)
Northeast	41	(18.9)
Sex (215)		
Male	177	(82.3)
Female	38	(17.7)
Age group (yrs) (213)		
<20	25	(11.7)
21–40	121	(56.8)
41–60	59	(27.7)
≥61	8	(3.8)
Exposure route (218)		
Ingestion	183	(83.9)
Parenteral	15	(6.9)
Inhalation	4	(1.8)
Unknown/Other	16	(7.4)
Exposure type (218)		
Intentional	119	(54.6)
Unintentional	23	(10.5)
Withdrawal	29	(13.3)
Unknown/Other	47	(21.6)
Coexposure (83)		
Phenibut	26	(31.3)
Ethanol	13	(15.7)
Benzodiazepines	10	(12.0)
Opioids	10	(12.0)

TABLE 2. Common clinical effects associated with tianeptine exposures (N = 114) and therapies received — National Poison Data System, United States, 2000–2017

Clinical effect*	No.	(%)
Cardiovascular effect	**37**	**(32.5)**
Tachycardia	29	(25.4)
High blood pressure	13	(11.4)
Conduction delays	5	(4.4)
Neurologic effect	**55**	**(48.3)**
Agitation	25	(21.9)
Drowsiness	19	(16.7)
Confusion	15	(13.2)
Coma	5	(4.4)
Gastrointestinal effect	**12**	**(10.5)**
Nausea	9	(7.9)
Vomiting	5	(4.4)
Diarrhea	3	(2.6)
Dermal effect	**10**	**(8.8)**
Pallor	3	(2.6)
Pain	3	(2.6)
Cellulitis	2	(1.8)
Constitutional effect	**10**	**(8.8)**
Diaphoresis	8	(7.0)
Fever	3	(2.6)
Pain	1	(0.9)
Respiratory effect	**8**	**(7.0)**
Respiratory depression	6	(5.3)
Dyspnea	3	(2.6)
Tachypnea	1	(0.9)
Ocular effect	**6**	**(5.3)**
Mydriasis	4	(3.5)
Miosis	2	(1.8)
Renal effect	**5**	**(4.4)**
Urinary retention	3	(2.6)
Creatinine abnormality	2	(1.8)
Kidney failure	1	(0.9)
Metabolic effect	**5**	**(4.4)**
Electrolyte disturbances	3	(2.6)
Acidosis	2	(1.8)
Musculoskeletal effect	**5**	**(4.4)**
Muscle weakness	2	(1.8)
Rigidity	1	(0.9)
Psychiatric effect	**2**	**(1.8)**
Delusions	2	(1.8)
Therapy		
Fluids	40	(35.1)
Benzodiazepines	31	(27.2)
Oxygen	12	(10.5)
Naloxone	11	(9.7)
Antibiotics	11	(9.7)
Sedation	9	(7.9)
Antiemetics	7	(6.1)
Intubation	5	(4.4)
Ventilator support	5	(4.4)
Antihistamine	3	(2.6)

* Patient exhibited one or more type of clinical effect in a category.

Discussion

This study revealed a nationwide increase in tianeptine exposure calls and calls related to intentional abuse and misuse during 2014–2017. Approximately half of all reported exposures occurred among users aged 21–40 years. The increase in exposures from 2014 to 2017 might be explained by a 2014 study in animals and humans that showed that tianeptine is an effective mu- and delta-opioid receptor agonist (*2*). Deaths associated with misuse of tianeptine have been reported outside the United States (*3*,*4*). Recently, two deaths that were not reported to NPDS during the study period and were attributed to tianeptine toxicity were reported in the United States in persons who purchased the drug online (*5*).

Several case reports showed that tianeptine toxicity mimicked opioid toxicity and that naloxone was an effective therapy (*6*,*7*). Tolerance to tianeptine and withdrawal have been reported (*8*). Neonatal abstinence syndrome mimicking opioid neonatal abstinence syndrome has occurred after tianeptine dependence during pregnancy (*9*). This study further highlights that the withdrawal effects of tianeptine mimic those of opioid withdrawal.

Tianeptine has an abuse potential in former opiate drug users (*3*). In the country of Georgia, the health authority withdrew tianeptine from the market in June 2010, and the health authorities of Russia and Armenia classified tianeptine as a controlled substance in July 2010 (*3*). Similar measures were implemented in Ukraine in January 2011 (*3*). Although tianeptine is not FDA approved in the United States, it is readily available for purchase online as a dietary supplement or research chemical. Several online discussion forums among users describe the euphoregenic effects of tianeptine. Users have also reported combining tianeptine with other drugs like phenibut for a potentiated effect. In this study, among 83 calls with reported coexposures, phenibut (26 [31%]) was the most commonly reported coexposure with tianeptine. In light of the ongoing U.S. opioid epidemic, any emerging trends in drugs with opioid-like effects raise concerns about potential abuse and public health safety.

The findings in this report are subject to at least three limitations. First, NPDS relies on data voluntarily reported to poison control centers by health care providers and the public, who might not have reported all tianeptine exposures to poison control centers. Second, unintentional coding errors could have occurred during documentation. Finally, NPDS data provide only limited clinical information. For example, information on treatment response, length of hospital stay, or residual sequelae are not available.

This analysis highlights recent increases in reported tianeptine use and the potential for abuse and effects associated with withdrawal that can make it difficult to reduce or discontinue use. The associated outcomes and health effects associated with tianeptine use suggest a possible emerging public health risk and underscore the need for public outreach to increase awareness. Tianeptine testing is not routinely available, but specialty-testing laboratories might have that capacity. Health care providers and public health officials need to be vigilant for potential cases of tianeptine exposure and, when applicable, report adverse effects to the FDA MedWatch reporting system (https://www.fda.gov/Safety/MedWatch/default.htm). Clinicians and other health care providers can contact their local poison control center by telephone at 1-800-222-1222 for clinical guidance as needed.

Conflict of Interest

No conflicts of interest were reported.

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References

1. Gupta S, Wallace R, Sloshower J. Online sales of unscheduled pharmaceutical agents: a case report of tianeptine use in the United States. J Addict Med 2017;11:411–2. https://doi.org/10.1097/ADM.0000000000000342
2. Gassaway MM, Rives ML, Kruegel AC, Javitch JA, Sames D. The atypical antidepressant and neurorestorative agent tianeptine is a μ-opioid receptor agonist. Transl Psychiatry 2014;4:e411. https://doi.org/10.1038/tp.2014.30
3. Durmus N, Ozbilen G, Kasap Y, et al. Risk management in tianeptine abuse in Turkey: a national experience. Bulletin of Clinical Psychopharmacology 2013;23:149–54. https://doi.org/10.5455/bcp.20130426010958
4. Proença P, Teixeira H, Pinheiro J, Monsanto PV, Vieira DN. Fatal intoxication with tianeptine (Stablon). Forensic Sci Int 2007;170:200–3. https://doi.org/10.1016/j.forsciint.2007.03.035
5. Bakota EL, Samms WC, Gray TR, Oleske DA, Hines MO. Case reports of fatalities involving tianeptine in the United States. J Anal Toxicol 2018. https://doi.org/10.1093/jat/bky023
6. Dempsey SK, Poklis JL, Sweat K, Cumpston K, Wolf CE. Acute toxicity from intravenous use of the tricyclic antidepressant tianeptine. J Anal Toxicol 2017;41:547–50. https://doi.org/10.1093/jat/bkx034
7. Ari M, Oktar S, Duru M. Amitriptyline and tianeptine poisoning treated by naloxone. Hum Exp Toxicol 2010;29:793–5. https://doi.org/10.1177/0960327110372403
8. Kisa C, Bulbul DO, Aydemir C, Goka E. Is it possible to be dependent to tianeptine, an antidepressant? A case report. Prog Neuropsychopharmacol Biol Psychiatry 2007;31:776–8. https://doi.org/10.1016/j.pnpbp.2007.01.002
9. Bence C, Bonord A, Rebillard C, et al. Neonatal abstinence syndrome following tianeptine dependence during pregnancy. Pediatrics 2016;137:e20151414. https://doi.org/10.1542/peds.2015-1414

Coal Workers' Pneumoconiosis–Attributable Years of Potential Life Lost to Life Expectancy and Potential Life Lost Before Age 65 Years — United States, 1999–2016

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Coal workers' pneumoconiosis (CWP) is a preventable occupational lung disease caused by inhaling coal mine dust that can lead to premature* death (*1*,*2*). To assess trends in premature mortality attributed to CWP (*3*), CDC analyzed underlying† causes of death data from 1999 to 2016, the most recent years for which complete data are available. Years of potential life lost to life expectancy (YPLL) and years of potential life lost before age 65 years ($YPLL_{65}$)§ were calculated (*4*). During 1999–2016, a total of 38,358 YPLL (mean per decedent = 8.8 years) and 2,707 $YPLL_{65}$ (mean per decedent = 7.3 years) were attributed to CWP. The CWP-attributable YPLL decreased from 3,300 in 1999 to 1,813 in 2007 ($p<0.05$). No significant change in YPLL occurred after 2007. During 1996–2016, however, the mean YPLL per decedent significantly increased from 8.1 to 12.6 per decedent ($p<0.001$). Overall, CWP-attributable $YPLL_{65}$ did not change. The mean $YPLL_{65}$ per decedent decreased from 6.5 in 1999 to 4.3 in 2002 ($p<0.05$), sharply increased to 8.9 in 2005, and then gradually decreased to 6.5 in 2016 ($p<0.001$). Increases in YPLL per decedent during 1999–2016 indicate that over time decedents aged ≥25 years with CWP lost more years of life relative to their life expectancies, suggesting increased CWP severity and rapid disease progression. This finding underscores the need for strengthening proven prevention measures to prevent premature CWP-associated mortality.

The National Vital Statistics System's multiple cause-of-death data during 1999–2016 were analyzed to examine CWP mortality. For this analysis, CWP deaths were identified from death certificates listing the *International Classification of Diseases, Tenth Revision* (ICD-10) code J60 (coal workers' pneumoconiosis) as the underlying cause of death. Because CWP is entirely attributable to occupational exposure (*1*), only deaths of persons aged ≥25 years were considered. Years of potential life lost to life expectancy (YPLL) and before age 65 years ($YPLL_{65}$) were calculated for each decedent. Time-trends in death rates¶ (per 1 million population), age-adjusted to the 2000 U.S. standard population and YPLL/$YPLL_{65}$, were assessed (*5*). Information on decedents' usual industry and occupation** was coded†† in accordance with the U.S. Census 2000 Industry and Occupation Classification System.

During 1999–2016, 4,344 decedents aged ≥25 years had CWP assigned as the underlying cause of death, accounting for 38,358 YPLL (mean per decedent = 8.8). Among these decedents, 369 (8.5%) were aged 25–64 years, accounting for 2,707 $YPLL_{65}$ (mean per decedent = 7.3) (Table). Overall, CWP deaths among U.S. residents aged ≥25 years significantly decreased (73%), from 409 in 1999 to 112 in 2016 (Table) (Figure 1). The decline was steeper during 1999–2008 ($p<0.01$) than during 2008–2016 ($p<0.001$). CWP deaths among U.S. residents aged ≥65 years decreased 77%, from 389 in 1999 to 88 in 2016. The decline was steeper during 1999–2008 ($p<0.001$) than during 2008–2016 ($p<0.001$). Among U.S. residents aged 25–64 years, there was no significant change in the number of CWP deaths during 1999–2016 (Table).

Age-adjusted CWP death rates among U.S. residents aged ≥25 years declined 81%, from 2.31 per million in 1999 to

* Early pneumoconiosis (i.e., simple CWP) is often asymptomatic, but the disease can progress to more severe forms associated with substantial impairment, including progressive massive fibrosis. Progression can occur despite cessation of exposure. Progression might be more rapid after high levels of exposure to coal mine dust or if the dust has a high respirable crystalline silica content. There are no accepted specific therapies to prevent progression of CWP.

† Underlying cause of death is defined as "the disease or injury which initiated the chain of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury." https://webappa.cdc.gov/ords/norms.html.

§ YPLL to life expectancy may be considered as a loss of years from the overall life span. YPLL to life expectancy was a sum of the differences between the age at death and life expectancy for each decedent, internally adjusted by race and sex (https://www.cdc.gov/nchs/products/life_tables.htm). $YPLL_{65}$ may be considered as a loss of years from a traditional working life. $YPLL_{65}$ were calculated as a sum of the differences between age 65 years and the age at death for each decedent.

¶ The Joinpoint Regression program fits the simplest joinpoint model that the data allow. It determines years when changes in the number of deaths/YPLL/mean YPLL per decedent and the annual percentage change in log-transformed age-adjusted mortality rate occur by performing a sequence of permutation tests using Monte Carlo sampling and the Bonferroni correction for multiple testing. The overall statistical significance level was $\alpha = 0.05$, with a maximum of three joinpoints and four trend segments allowed.

** Twenty-six states provided data for the years 1999, 2003, 2004, and 2007–2012: Colorado, Florida, Georgia, Hawaii, Idaho, Indiana, Kansas, Kentucky, Louisiana, Michigan, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Rhode Island, South Carolina, Texas, Utah, Vermont, Washington, West Virginia, and Wisconsin. The state represents the state where the death took place. https://www.cdc.gov/niosh/topics/noms/default.html.

†† https://webappa.cdc.gov/ords/norms-glossary.html#ind-occ.

TABLE. Years of potential life lost to life expectancy (YPLL) and before age 65 years* ($YPLL_{65}$) for decedents aged ≥25 years with coal workers' pneumoconiosis,[†] by sex, race, state of residence, year of death, and industry and occupation[§] — United States, 1999–2016

	All deaths				Deaths at age <65 years			
Characteristic	**No. (%)**	**Age-adjusted[¶] rate per million**	**YPLL**	**Mean YPLL per decedent**	**No. (%)**	**Age-adjusted[¶] rate per million**	**$YPLL_{65}$**	**Mean $YPLL_{65}$ per decedent**
Total	**4,344 (100.0)**	**1.18**	**38,358**	**8.8**	**369 (100.0)**	**0.11**	**2,707**	**7.3**
Sex								
Men	4,292 (98.8)	3.00	37,498	8.7	353 (95.7)	0.20	2,512	7.1
Women	52 (1.2)	0.02	860	16.5	16 (4.3)	Unreliable**	195	12.2
Race								
White	4,208 (96.9)	1.28	37,211	8.8	357 (96.5)	0.11	2,605	7.3
Black	124 (2.9)	0.41	1,009	8.1	10 (2.9)	Unreliable	83	8.3
Other[††]	12 (0.3)	Unreliable	138	11.5	2 (0.6)	Unreliable	19	9.5
State								
Alabama	47 (1.1)	0.84	359	7.6	—[§§]	—	—	—
Arizona	19 (0.4)	Unreliable	136	7.2	—	—	—	—
Arkansas	18 (0.4)	Unreliable	174	9.7	—	—	—	—
California	34 (0.8)	0.08	387	11.4	—	—	—	—
Colorado	32 (0.7)	0.66	212	6.6	—	—	—	—
Florida	81 (1.9)	0.28	571	7.0	—	—	—	—
Georgia	13 (0.3)	Unreliable	120	9.2	—	—	—	—
Illinois	82 (1.9)	0.53	705	8.6	—	—	—	—
Indiana	61 (1.4)	0.81	472	7.7	—	—	—	—
Kentucky	554 (12.8)	10.55	6,422	11.6	95 (25.7)	1.91	650	6.8
Maryland	15 (0.3)	Unreliable	114	9.8	—	—	—	—
Michigan	34 (0.8)	0.27	229	6.7	—	—	—	—
Missouri	12 (0.3)	Unreliable	78	6.5	—	—	—	—
New Jersey	14 (0.3)	Unreliable	104	7.4	—	—	—	—
New Mexico	39 (0.9)	1.72	269	6.9	—	—	—	—
New York	13 (0.3)	Unreliable	83	6.4	—	—	—	—
North Carolina	40 (0.9)	0.36	388	9.7	—	—	—	—
Ohio	156 (3.6)	1.02	1,166	7.5	—	—	—	—
Oklahoma	10 (0.2)	Unreliable	102	10.2	—	—	—	—
Pennsylvania	1,360 (31.3)	6.96	9,109	6.7	24 (6.5)	0.14	172	7.2
South Carolina	20 (0.5)	0.35	268	13.4	—	—	—	—
Tennessee	99 (2.3)	1.35	953	9.6	12 (3.3)	Unreliable	98	8.2
Texas	18 (0.4)	Unreliable	199	11.1	—	—	—	—
Utah	45 (1.0)	2.10	352	7.8	—	—	—	—
Virginia	558 (12.8)	6.37	6,103	10.8	84 (22.8)	0.94	649	7.7
West Virginia	892 (20.5)	33.37	8,543	9.6	86 (23.3)	3.62	507	5.9
Wyoming	14 (0.3)	Unreliable	131	9.4	—	—	—	—
All other states[¶¶]	64 (1.5)	—	671	—	68 (18.4)	—	—	—
Year								
1999	409 (9.4)	2.31	3,300	8.1	20 (5.4)	0.13	129	6.5
2000	389 (9.0)	2.18	3,044	7.8	19 (5.1)	Unreliable	136	7.2
2001	367 (8.4)	2.04	2,858	7.8	12 (3.3)	Unreliable	65	5.4
2002	354 (8.1)	1.94	2,741	7.7	21 (5.7)	0.14	90	4.3
2003	318 (7.3)	1.70	2,513	7.9	18 (4.9)	Unreliable	99	5.5
2004	292 (6.7)	1.52	2,375	8.1	20 (5.4)	0.09	192	9.6
2005	270 (6.2)	1.41	2,155	8.0	21 (5.7)	0.14	187	8.9
2006	266 (6.1)	1.34	2,259	8.5	18 (4.9)	Unreliable	160	8.9
2007	209 (4.8)	1.06	1,813	8.7	16 (4.3)	Unreliable	142	8.9
2008	183 (4.2)	0.90	1,756	9.6	21 (5.7)	0.12	196	9.3
2009	206 (4.7)	0.96	2,162	10.5	32 (8.7)	0.15	271	8.5
2010	213 (4.9)	1.01	2,024	9.5	23 (6.2)	0.12	187	8.1
2011	160 (3.7)	0.72	1,560	9.8	18 (4.9)	Unreliable	138	7.7
2012	158 (3.6)	0.69	1,634	10.3	21 (5.7)	0.09	139	6.6
2013	150 (3.5)	0.66	1,485	9.9	18 (4.9)	Unreliable	119	6.6
2014	155 (3.6)	0.64	1,769	11.4	27 (7.3)	0.11	188	7.0
2015	133 (3.1)	0.54	1,497	11.3	20 (5.4)	0.09	114	5.7
2016	112 (2.6)	0.44	1,413	12.6	24 (6.5)	0.11	155	6.5

See table footnotes on the next page.

TABLE. (*Continued*) Years of potential life lost to life expectancy (YPLL) and before age 65 years* ($YPLL_{65}$) for decedents aged ≥25 years with coal workers' pneumoconiosis,† by sex, race, state of residence, year of death, and industry and occupation§ — United States, 1999–2016

	All deaths				Deaths at age <65 years			
Characteristic	No. (%)	Age-adjusted¶ rate per million	YPLL	Mean YPLL per decedent	No. (%)	Age-adjusted¶ rate per million	$YPLL_{65}$	Mean $YPLL_{65}$ per decedent
Industry								
Coal mining	560 (75.7)	—	5,415	9.7	63 (74.1)	—	417	6.6
Construction	31 (4.2)	—	306	9.9	—	—	—	—
Nonpaid worker or nonworker including at home	14 (1.9)	—	161	11.5	—	—	—	—
All other industries	135 (18.2)	—	1,350	10.0	22 (25.9)	—	197	9.0
Occupation								
Mining machine operators	504 (68.1)	—	4,822	9.6	52 (61.2)	—	365	7.0
Electricians	16 (2.2)	—	152	9.5	—	—	—	—
Laborers and freight, stock, and material movers	14 (1.9)	—	147	10.5	—	—	—	—
Construction laborers	13 (1.8)	—	135	10.4	—	—	—	—
First-line supervisors or managers of construction trades and extraction workers	13 (1.8)	—	134	10.3	—	—	—	—
Homemakers	13 (1.8)	—	143	11.0	—	—	—	—
Driver-sales workers and truck drivers	11 (1.5)	—	170	15.5	—	—	—	—
All other occupations	156 (21.1)	—	1,532	9.8	33 (38.8)	—	249	7.5

Source: National Vital Statistics System; https://wonder.cdc.gov/ (for rates) and multiple cause-of-death data, National Center for Health Statistics, CDC (for YPLL and $YPLL_{65}$).

Abbreviations: YPLL = years of potential life lost to life expectancy; $YPLL_{65}$ = years of potential life lost before age 65 years.

* YPLL to life expectancy was a sum of the differences between the age at death and life expectancy for each decedent internally adjusted by race and sex (https://www.cdc.gov/nchs/products/life_tables.htm). YPLL65 was a sum of the differences between 65 years and the age at death for each decedent.

† Decedents whose death certificates listed the *International Classification of Diseases, Tenth Revision* (ICD-10) code J60 (coal workers' pneumoconiosis) as the underlying cause of death.

§ Industry and occupation data available for 740 (94.6%) of 782 CWP deaths among U.S. residents aged ≥25 years and for 85 (89.5%) of 95 CWP deaths among U.S. residents aged 25–64 years that occurred in 26 states during 1999, 2003, 2004, and 2007–2012. https://www.cdc.gov/niosh/topics/noms/default.html.

¶ Adjusted to the 2000 U.S. standard population.

** Relative standard error ≥23%; rate considered statistically unreliable. https://wonder.cdc.gov/wonder/help/ucd.html#Unreliable.

†† Includes American Indian or Alaska Native and Asian or Pacific Islander.

§§ Suppressed because of confidentiality constraints (<10 decedents reported). https://wonder.cdc.gov/wonder/help/ucd.html#Assurance of Confidentiality.

¶¶ States with <10 decedents.

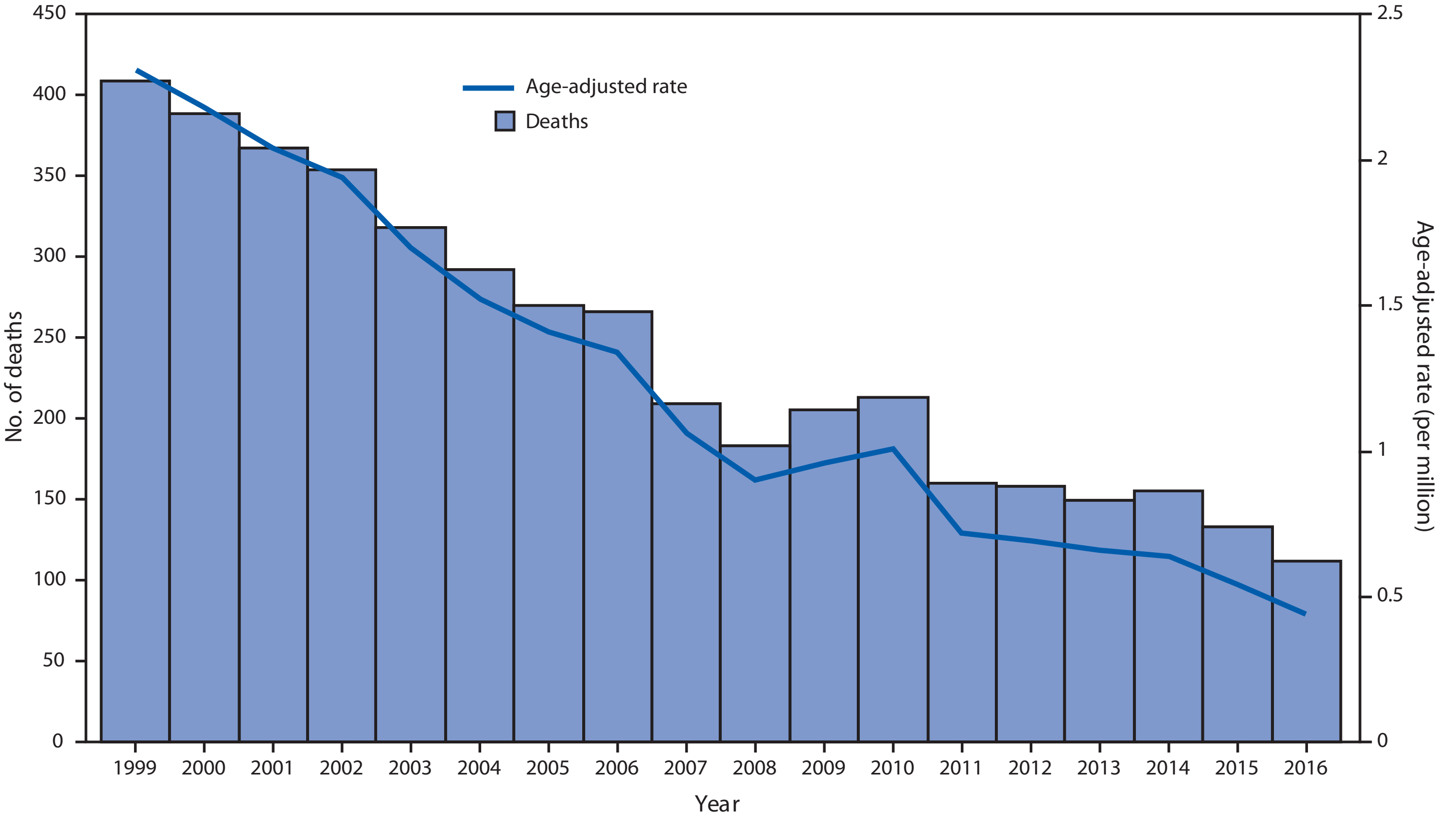
0.44 in 2016 (annual percent change [APC] = -9.0%; 95% confidence interval [CI] = -9.6 to -8.3; $p<0.05$) (Figure 1). Age-adjusted CWP death rates among residents aged ≥65 years declined 84% from 11.30 per million in 1999 to 1.82 in 2016 (APC = -9.6%; 95% CI = -10.3 to -8.9; $p<0.05$).

The CWP-attributable YPLL decreased 42.8% from 3,300 in 1999 to 1,413 in 2016 (Table) (Figure 2). The decline was steeper during 1999–2007 ($p<0.001$) than during 2007–2016 ($p<0.05$). During 1999–2016, the mean YPLL per decedent increased 55.6%, from 8.1 to 12.6 years per decedent. No significant change in the mean YPLL per decedent was observed during 1999–2003; however, mean YPLL per decedent increased significantly from 2003 to 2016 ($p<0.001$).

CWP-attributable $YPLL_{65}$ varied annually, from a high of 271 (mean per decedent = 8.5) in 2009 to a low of 65 (mean per decedent = 5.4) in 2001 (Table) (Figure 2). Overall, no change in the $YPLL_{65}$ from 1999 to 2016 was observed. The time-trend analysis indicates that the mean CWP-attributable $YPLL_{65}$ per decedent aged 25–64 years decreased 34% from 6.5 $YPLL_{65}$ per decedent in 1999 to 4.3 in 2002 ($p<0.05$), sharply increased 107% to 8.9 in 2005 ($p = 0.06$), and then gradually decreased 27% to 6.5 in 2016 ($p<0.001$). In these three respective periods, highest mean $YPLLs_{65}$ per decedent were 7.2 in 2000; 9.6 in 2004, and 9.3 in 2008.

During 1999–2016, ≥10 CWP deaths among persons aged ≥25 years occurred in 27 states. Deaths in Pennsylvania (1,360; 9,109 YPLL; mean per decedent = 6.7), West Virginia (892; 8,543 YPLL; 9.6), Virginia (558; 6,013 YPLL; 10.8), and Kentucky (554; 6,422 YPLL; 11.6) accounted for 77.6% of all decedents and 78.4% of the total YPLL (Table). CWP deaths among persons aged 25–64 years in Kentucky (95; 650 $YPLL_{65}$; mean per decedent = 6.8), West Virginia (86; 507 $YPLL_{65}$; 5.9), Virginia (84; 649 $YPLL_{65}$; 7.7), and Pennsylvania (24; 172 $YPLL_{65}$; 7.2), accounted for 78.3% of all decedents and 73.1% of the total $YPLL_{65}$.

FIGURE 1. Age-adjusted coal workers' pneumoconiosis deaths and deaths* per million persons aged ≥25 years with coal workers' pneumoconiosis,† by year of death — United States, 1999–2016



Source: National Vital Statistics System. https://wonder.cdc.gov/.

* Adjusted to the 2000 U.S. standard population.

† Decedents whose death certificates listed the *International Classification of Diseases, Tenth Revision* (ICD-10) code J60 (coal workers' pneumoconiosis) as the underlying cause of death.

Industry and occupation data were available for 740[§§] (94.6%) of 782 CWP deaths among U.S. residents aged ≥25 years that occurred in 26 states during 1999, 2003, 2004, and 2007–2012 (Table). By industry, three quarters of deaths occurred among residents who worked in the coal mining industry (560; 75.7%) accounting for 5,415 YPLL (mean per decedent = 9.7). By occupation, approximately two thirds of deaths occurred among mining machine operators (504; 68.1%) accounting for 4,822 YPLL (mean per decedent = 9.6). Remaining CWP deaths were associated with 68 other industries and 79 other occupations.

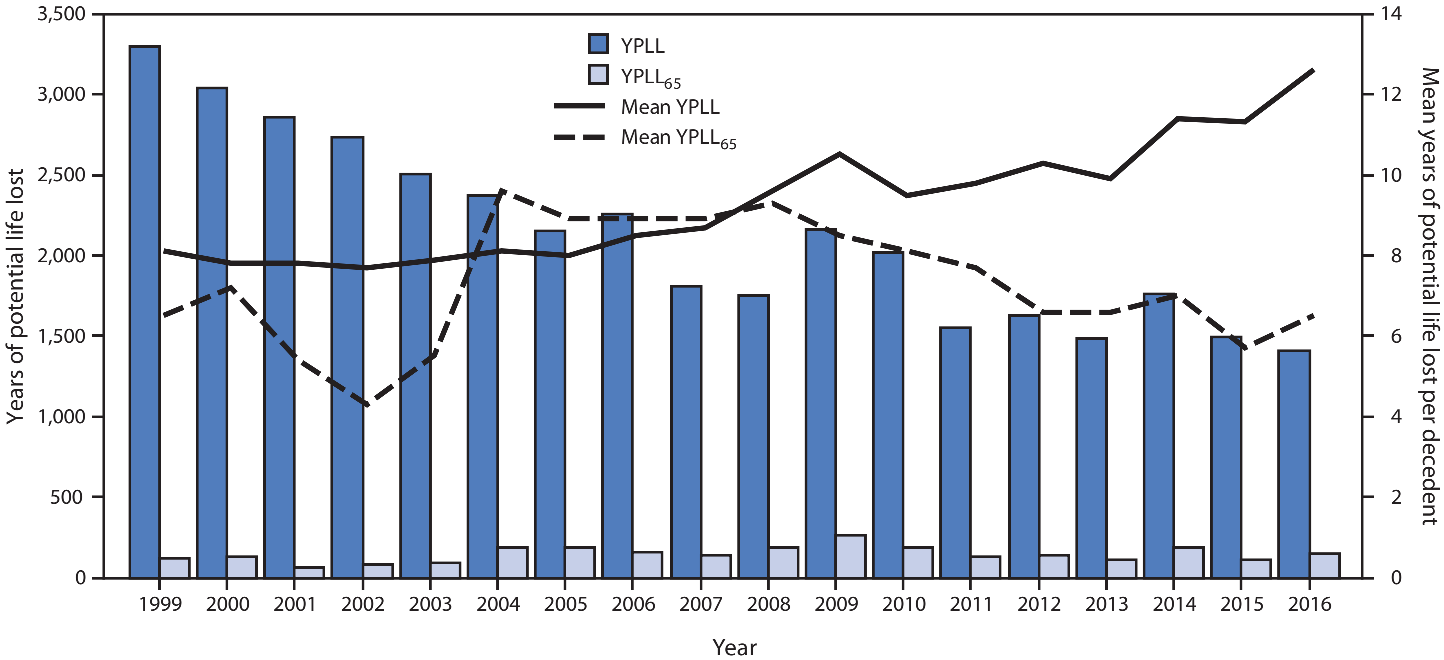
Discussion

CDC's National Institute for Occupational Safety and Health (NIOSH) examined information on CWP deaths reported during 1968–2006, which indicated that CWP deaths and annual $YPLL_{65}$ attributed to CWP have been decreasing (*3*). The findings in the current report indicate that CWP deaths among U.S. residents aged ≥65 years continued to decrease during 1999–2016; however, no significant changes in CWP deaths among persons aged 25–64 years and CWP-attributable $YPLL_{65}$ were observed. Furthermore, there was a sharp increase in the mean $YPLL_{65}$ per decedent since 2002, with a peak (9.6 years) in 2004, followed by a continual, albeit slow, decline. Also, while there was a decline in YPLL during 1999–2016, the increase in the mean YPLL per decedent during this period indicates that each year, on average, decedents aged ≥25 years with CWP lost more years of life relative to their life expectancies. These premature deaths are consistent with observed increased severity and rapid progression of disease (*6*–*8*).

The decline in age-adjusted CWP death rates and CWP-attributable YPLL might be explained, in part, by the decline in employment in the mining industry. The growing gap between each decedent's actual age at death from CWP and his or her life expectancy corroborates recent reports of increasing

§§ For 42 residents of these 26 states, deaths occurred in states other than the state of residence that did not code the industry and occupation information.

FIGURE 2. Years of potential life lost to life expectancy (YPLL) and before age 65 years ($YPLL_{65}$) and mean YPLL and $YPLL_{65}$ per decedent for decedents aged ≥25 years with coal workers' pneumoconiosis,* by year of death — United States, 1999–2016



Source: Multiple cause-of-death data, National Center for Health Statistics, CDC.

* Decedents whose death certificates listed the *International Classification of Diseases, Tenth Revision* (ICD-10) code J60 (coal workers' pneumoconiosis) as the underlying cause of death.

Summary

What is already known about this topic?

Coal workers' pneumoconiosis (CWP) is a preventable occupational lung disease caused by inhaling coal mine dust; CWP can progress to respiratory failure and premature death.

What is added by this report?

During 1999–2016, the mean CWP-attributable years of potential life lost per decedent increased from 8.1 to 12.6 years, likely because of increased severity and rapid progression of CWP.

What are the implications for public health practice?

The continuing occurrence of premature deaths from CWP underscores the need for primary prevention by preventing hazardous exposures to coal mine dust, secondary prevention by early disease detection and prevention of further hazardous exposures, and tertiary prevention by providing appropriate medical care to persons with CWP.

prevalence and severity of CWP and of rapid disease progression among coal miners (*6–8*). In particular, an 8.6-fold increase in the prevalence of progressive massive fibrosis (PMF) from an annual average of 0.37% during 1994–1998 to 3.23% during 2008–2012, was identified among longer-tenured Kentucky, Virginia, and West Virginia underground coal miners participating in the Coal Workers' Health Surveillance Program (*6,7*). Most of the CWP deaths in this report (68%) occurred among mining machine operators. This finding is consistent with a report describing a cluster of PMF cases identified in coal miners at a clinic in Kentucky, which found that a high proportion (76%) of miners reported working as roof bolters or continuous miner operators (*6*). In addition, a recent study of 416 primarily former miners with PMF served by a network of three Black Lung Clinics in Southwest Virginia represents the largest known cluster of PMF reported in the scientific literature; one third of miners with CWP had indications of exceptionally severe and rapidly progressive disease (*9*). Moreover, an increase in lung transplants performed for patients with CWP has been reported during 2008–2014 (*10*).

The findings in this report are subject to at least four limitations. First, CWP diagnosis as the underlying cause of death could not be validated. Some deaths from CWP might have been attributed to other interstitial lung diseases (e.g., idiopathic pulmonary fibrosis) or other chronic diseases (e.g., chronic obstructive pulmonary disease) occurring in coal miners. Second, there is no specific ICD-10 code for PMF to allow better identification of decedents with severe CWP. Third, complete work histories were not available for analyses. Finally, YPLL and $YPLL_{65}$ in this report did not account for reduced quality of life or work years lost attributed to disability from CWP.¶¶

In 2014, a new Federal Rule*** on miners' occupational exposure to respirable coal mine dust was introduced. The rule decreased allowable exposure to respirable coal mine dust, made changes in dust monitoring, and directed NIOSH to expand medical monitoring for coal mine dust lung diseases. CDC provides information about diseases caused by coal mine dust and the Coal Workers' Health Surveillance Program.††† The continuing occurrence of premature deaths from CWP underscores the need for primary prevention through prevention of exposures to hazardous levels of coal mine dust, secondary prevention through early disease detection and prevention of further hazardous exposures, and tertiary prevention through provision of appropriate medical care to persons with CWP.

¶¶ Persons with CWP can live for many years with severely impaired lung function and be unable to work. Coal mining has also been associated with silicosis, mixed dust pneumoconiosis, dust-related diffuse fibrosis, and chronic obstructive pulmonary disease (COPD) including emphysema and chronic bronchitis. COPD might develop independently of CWP.

*** https://www.gpo.gov/fdsys/pkg/FR-2014-05-01/pdf/2014-09084.pdf.

††† https://www.cdc.gov/niosh/topics/cwhsp.

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Conflict of Interest

No conflicts of interest were reported.

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References

1. Laney AS, Weissman DN. Respiratory diseases caused by coal mine dust. J Occup Environ Med 2014;56(Suppl 10):S18–22. https://doi.org/10.1097/JOM.0000000000000260
2. Kimura K, Ohtsuka Y, Kaji H, et al. Progression of pneumoconiosis in coal miners after cessation of dust exposure: a longitudinal study based on periodic chest X-ray examinations in Hokkaido, Japan. Intern Med 2010;49:1949–56. https://doi.org/10.2169/internalmedicine.49.2990
3. Mazurek JM, Laney AS, Wood JM. Coal workers' pneumoconiosis-related years of potential life lost before age 65 years—United States, 1968–2006. MMWR Morb Mortal Wkly Rep 2009;58:1412–6.
4. Wise RP, Livengood JR, Berkelman RL, Goodman RA. Methodological alternatives for measuring premature mortality. Am J Prev Med 1988;4:268–73. https://doi.org/10.1016/S0749-3797(18)31160-7
5. National Cancer Institute, Statistical Methodology and Applications Branch, Surveillance Research Program. Joinpoint Regression Program. Version 4.5.0.1. Rockville, MD: US Department of Health and Human Services, National Institutes of Health, National Cancer Institute; 2017. https://surveillance.cancer.gov/joinpoint/
6. Blackley DJ, Crum JB, Halldin CN, Storey E, Laney AS. Resurgence of progressive massive fibrosis in coal miners—eastern Kentucky, 2016. MMWR Morb Mortal Wkly Rep 2016;65:1385–9. https://doi.org/10.15585/mmwr.mm6549a1
7. Blackley DJ, Halldin CN, Laney AS. Resurgence of a debilitating and entirely preventable respiratory disease among working coal miners. Am J Respir Crit Care Med 2014;190:708–9. https://doi.org/10.1164/rccm.201407-1286LE
8. Antao VC, Petsonk EL, Sokolow LZ, et al. Rapidly progressive coal workers' pneumoconiosis in the United States: geographic clustering and other factors. Occup Environ Med 2005;62:670–4. https://doi.org/10.1136/oem.2004.019679
9. Blackley DJ, Reynolds LE, Short C, et al. Progressive massive fibrosis in coal miners from three clinics in Virginia. JAMA 2018;319:500–1. https://doi.org/10.1001/jama.2017.18444
10. Blackley DJ, Halldin CN, Cummings KJ, Laney AS. Lung transplantation is increasingly common among patients with coal workers' pneumoconiosis. Am J Ind Med 2016;59:175–7. https://doi.org/10.1002/ajim.22551

Rat Lungworm Infection Associated with Central Nervous System Disease — Eight U.S. States, January 2011–January 2017

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Angiostrongyliasis is caused by infection and migration to the brain of larvae of the parasitic nematode *Angiostrongylus cantonensis*, or rat lungworm. Adult *A. cantonensis* reside in the lungs of the definitive wild rodent host, where they produce larvae passed in feces, which are then ingested by snails and slugs (gastropods). Human infection typically occurs when gastropods containing mature larvae are inadvertently ingested by humans. Although human infection often is asymptomatic or involves transient mild symptoms, larval migration to the brain can lead to eosinophilic meningitis, focal neurologic deficits, coma, and death. The majority of cases of human angiostrongyliasis occur in Asia and the Pacific Islands, including Hawaii, but autochthonous and imported cases have been reported in the continental United States (*1*,*2*), underscoring the importance of provider recognition to ensure prompt identification and treatment. The epidemiologic and clinical features of 12 angiostrongyliasis cases in the continental United States were analyzed. These cases were identified through *A. cantonensis* polymerase chain reaction (PCR) testing (*3*) of cerebrospinal fluid (CSF) submitted to CDC from within the continental United States. Six cases were likely a result of autochthonous transmission in the southern United States. All 12 patients had CSF pleocytosis and eosinophilia, consistent with eosinophilic meningitis. Health care providers need to be aware of the possibility of angiostrongyliasis in patients with eosinophilic meningitis, especially in residents in the southern United States or persons who have traveled outside the continental United States and have a history of ingestion of gastropods or contaminated raw vegetables.

Cases of human angiostrongyliasis were identified through review of results of *A. cantonensis* PCR (*3*) testing performed at CDC on CSF specimens from January 2011, when this test became available, through January 2017. A presumptive case was defined as detection of *A. cantonensis* DNA by PCR testing of a clinical CSF specimen submitted to CDC by a diagnostic laboratory located in the continental United States. A confirmed case was a presumptive case with health care provider documentation of clinically compatible disease. Clinical and epidemiologic information was also obtained directly from providers based on review of medical records with patient consent and, when available, from published case reports. Abstracted data included vital signs, clinical signs and symptoms at the time of initial evaluation, hospital course, clinical progression, and laboratory data.

A. cantonensis DNA was detected in 34 (49.3%) of 69 persons whose CSF specimens were received and tested by CDC during January 2011–January 2017. Specimens from 17 of these 34 patients were submitted from within the continental United States and, therefore, were considered presumptive angiostrongyliasis cases. In one presumptive case, the patient was determined by the provider to have an alternative diagnosis, and the PCR result (which required >32 cycles to detect DNA) was considered to be a false positive. Among the remaining 16 presumptive cases, the median patient age was 20 years (range = 1–68 years), and 10 were male. The 16 patient specimens were submitted from eight states, including six from California, four from Texas, and one each from Utah, Colorado, Arizona, Alabama, Tennessee, and New York. Eight patients had traveled to areas outside the continental United States (Asia, the Caribbean, or Pacific Islands) during the 12 months preceding initial evaluation, six (four in Texas and one each in Tennessee and Alabama) had no history of travel outside the continental United States, and the travel history was unknown for two patients in California.

Six of 11 patients reported consumption of raw vegetables, three from local gardens (Table 1). Two of 12 patients had consumed raw snails and for two others, family members reported the presence of snails in the environment. Two of nine patients reported consumption of prawns (with one patient specifying the prawns as being cooked), and one of nine patients ate cooked crab. One of 11 patients was reported to have consumed slugs, and one had possible exposure to slugs. Among the six patients who had not traveled outside the continental United States, two had consumed raw vegetables, three had possible exposure to snails or slugs, and one had a history of geophagia.

A diagnosis of angiostrongyliasis was confirmed in 13 of the 16 presumptive cases from providers (10 patients), published case reports (two) (*1*,*4*), and personal communications (one). Complete clinical information was available for 12 of these patients (Table 2). The most frequently reported symptoms were subjective fever, generalized weakness, headache, and numbness/tingling. Neurologic exam findings during initial evaluation included cranial nerve deficits (five of 11), nuchal

TABLE 1. Exposures reported in 16 patients with presumed angiostrongyliasis with detectable *A. cantonensis* DNA on polymerase chain reaction testing at CDC — continental United States, January 2011–January 2017

Exposure	No. of exposures		
	Yes (%)*	Possible	No
Raw vegetables[†]	6/11 (55)	0	5
Prawns	2/9 (22)	0	7
Snails	2/12 (17)	2	8
Crabs	1/9 (11)	0	8
Slugs	1/11 (9)	1[§]	9
Frogs	0/8 (0)	0	8

* Percentages were calculated using denominators based on availability of complete exposure data.
† Three patients were known to have consumed vegetables from a local garden.
§ This patient was a toddler who was often permitted to crawl in a yard known to contain slugs.

rigidity (four of 12), focal weakness (three of 10), and paresthesias (one of eight). Irritability was noted in three patients, two of whom also had ataxia during the initial evaluation; a separate patient had ataxia at 20 days. During initial evaluation, 10 of 12 patients had peripheral eosinophilia (>600 eosinophils/mm^3). All 12 patients with CSF microscopy and chemistry results had pleocytosis during initial evaluation; 10 had CSF eosinophilia (≥10% of all leukocytes in CSF or ≥10 eosinophils/mm^3) on initial evaluation and two on subsequent lumbar puncture. Six of 11 patients also had hypoglycorrhachia (CSF glucose <40 mg/dL) at the time of initial evaluation. Repeat lumbar punctures were performed in eight of 11 patients. On magnetic resonance imaging or computed tomography, eight of 11 patients had brain abnormalities, and five of six had spinal cord abnormalities. Abnormalities were also observed in the optic nerve of two patients. A chest computed tomography scan in one patient had multiple small focal areas of consolidation.

Eleven of 12 patients with confirmed cases received systemic steroids, as advised in treatment recommendations (*5*). Seven patients received an antiparasitic (albendazole). Two months after initial evaluation, all 12 patients were alive, 11 had improvement of symptoms, and four had ongoing focal neurologic symptoms (cranial nerve palsies or lower extremity weakness). Only one patient developed seizures (5 months after the initial diagnosis) for which antiepileptics were given.

Discussion

Among 12 confirmed cases of angiostrongyliasis in the continental United States during January 2011–January 2017, six likely resulted from autochthonous transmission in the southern United States. The possibility of autochthonous transmission is supported by evidence of infection with *A. cantonensis* among intermediate snail hosts and nonhuman vertebrate hosts in the southern United States. Infection has been observed in exotic and native snail species in Florida and Louisiana (*6*,*7*) and in rat species in Louisiana, Florida, and Oklahoma (*6*). Infection with larvae has been documented in other vertebrates including opossums and nine-banded

TABLE 2. Symptoms, physical exam findings, and laboratory results for 12 patients with angiostrongyliasis with detectable *A. cantonensis* DNA on polymerase chain reaction testing at CDC — continental United States, January 2011–January 2017

Observation/Finding*	Present, No.	Absent, No.	Proportion with symptom/sign present (%)[†]
Symptom/Sign			
Subjective fever	8	2	8/10 (80)
Generalized weakness	7	2	7/9 (78)
Headache	6	2	6/8 (75)
Numbness/Tingling	3	3	3/6 (50)
Photophobia	4	5	4/9 (44)
Visual changes	3	4	3/7 (43)
Vomiting	3	6	3/9 (33)
Stiff neck	2	7	2/9 (22)
Rash	2	7	2/9 (22)
Nausea	1	5	1/6 (17)
Phonophobia	1	6	1/7 (14)
Abdominal pain	1	7	1/8 (13)
Itching	1	8	1/9 (11)
Diarrhea	3	NA	NA
Hyperesthesias/diffuse allodynia	2	NA	NA
Physical exam			
Vital signs			
Fever (temperature ≥100.4°F [≥38.0°C])	3	8	3/11 (27)
Tachycardia (>100 bpm in adults aged ≥16 yrs, age-dependent in persons aged <16 yrs)	1	10	1/11 (9)
Hypoxia (O_2 saturation <90%)	0	10	0/10 (0)
Neurologic exam findings			
Cranial nerve deficits	5	6	5/11 (45)
Nuchal rigidity	4	8	4/12 (33)
Focal weakness	3	7	3/10 (30)
Paresthesias	1	7	1/8 (12)
Loss of consciousness	0	10	0/10 (0)
Irritability	3	NA	NA
Ataxia	2	1[§]	NA
Laboratory results on initial evaluation			
Cerebrospinal fluid			
Pleocytosis of CSF (≥6 WBC/mm^3)	12	0	12/12 (100)
CSF eosinophilia (eosinophils ≥10% of all leukocytes in CSF or ≥10 eosinophils/mm^3)	10	2[¶]	10/12 (83)
Hypoglycorrhachia (CSF glucose <40 mg/dL)	6	5	6/11 (54)
Complete blood count			
Peripheral eosinophilia (>600 eosinophils/mm^3)	8	2	8/10 (80)
Leukocytosis (>11×10^3 WBC/mm^3 in persons aged >21 yrs, age-dependent in persons aged ≤21 yrs)	3	9	3/12 (25)

Abbreviations: bpm = beats per minute; CSF = cerebrospinal fluid; NA = not available; O_2 = oxygen; WBC = white blood cells.
* Confirmed by the patient's health care provider
† Percentages were calculated with different denominators based on availability of complete clinical data.
§ This patient developed ataxia 20 days after initial evaluation.
¶ These two patients were found to have CSF eosinophilia on repeat lumbar puncture.

Summary

What is already known about this topic?

Ingestion of snails or slugs containing *Angiostrongylus cantonensis* larvae can result in angiostrongyliasis, characterized by eosinophilic meningitis. Angiostrongyliasis typically occurs in Asia and the Pacific Islands.

What is added by this report?

CDC identified 12 angiostrongyliasis cases in the continental United States occurring from January 2011 through January 2017. Consumption of raw vegetables was reported in the majority of cases (55%). Six were likely autochthonous cases occurring in the southern United States.

What are the implications for public health practice?

Health care providers, especially those in the southern United States, need to consider angiostrongyliasis in patients with eosinophilic meningitis, particularly those with a history of ingestion of gastropods or raw vegetables contaminated with larvae.

armadillos in Louisiana and Florida (*8*), an American miniature horse in Mississippi, and captive exotic primates in Louisiana, Florida, and Alabama (*7*).

The majority of patients in this series had subjective fever, generalized weakness, headache, and CSF pleocytosis consistent with meningitis. Most also had presence of eosinophils in both peripheral blood and CSF, and hypoglycorrhachia, which is usually associated with bacterial, fungal, or tuberculous meningitis. All 12 patients eventually developed CSF eosinophilia, as did all hospitalized patients during a 2000 outbreak of eosinophilic meningitis caused by *A. cantonensis* among travelers to the Caribbean (*2*). Although no specific treatment for *A. cantonensis* infection currently exists (https://www.cdc.gov/parasites/angiostrongylus/), nearly all patients in this series were treated with systemic steroids, which have been determined to decrease the duration of headaches (*5*), and approximately half of patients were treated with albendazole, for which conflicting evidence of efficacy in treating headache can be found (*9*,*10*). Whether these treatments affected the clinical course for these patients is unclear.

The findings in this report are subject to at least two limitations. First, all cases in this series were identified from specimens tested at CDC, and consequently might not be a comprehensive description of all illnesses caused by *A. cantonensis* in the continental United States during this time. Second, exposures are incompletely reported in some cases, and clinical histories from three presumptive cases could not be obtained.

Health care providers in the United States, especially those in areas in the southern United States where autochthonous cases have been reported, need to be aware of the possibility of angiostrongyliasis in patients with eosinophilic meningitis. Ingestion of gastropods or locally obtained raw vegetables* contaminated with *A. cantonensis* larvae in the southern United States, even in the absence of a travel history, should increase provider suspicion for angiostrongyliasis.

* Because cooking is not feasible for much of the potentially contaminated produce (e.g., lettuces), actions that might be taken to prevent Angiostrongyliasis are removing snails, slugs, and rats found near houses and gardens and thoroughly washing produce, especially if eaten raw.

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References

1. Foster CE, Nicholson EG, Chun AC, et al. *Angiostrongylus cantonensis* infection: a cause of fever of unknown origin in pediatric patients. Clin Infect Dis 2016;63:1475–8. https://doi.org/10.1093/cid/ciw606
2. Slom TJ, Cortese MM, Gerber SI, et al. An outbreak of eosinophilic meningitis caused by *Angiostrongylus cantonensis* in travelers returning from the Caribbean. N Engl J Med 2002;346:668–75. https://doi.org/10.1056/NEJMoa012462
3. Qvarnstrom Y, Xayavong M, da Silva AC, et al. Real-time polymerase chain reaction detection of *Angiostrongylus cantonensis* DNA in cerebrospinal fluid from patients with eosinophilic meningitis. Am J Trop Med Hyg 2016;94:176–81. https://doi.org/10.4269/ajtmh.15-0146
4. Thomas AR, Uppalapu S. March 2013 Critical care case of the month: beware the escargot. Southwest J Pulm Crit Care 2013;6:103–11.
5. Chotmongkol V, Sawanyawisuth K, Thavornpitak Y. Corticosteroid treatment of eosinophilic meningitis. Clin Infect Dis 2000;31:660–2. https://doi.org/10.1086/314036
6. Stockdale Walden HD, Slapcinsky JD, Roff S, et al. Geographic distribution of *Angiostrongylus cantonensis* in wild rats (*Rattus rattus*) and terrestrial snails in Florida, USA. PLoS One 2017;12:e0177910. https://doi.org/10.1371/journal.pone.0177910

7. Stockdale-Walden HD, Slapcinsky J, Qvarnstrom Y, McIntosh A, Bishop HS, Rosseland B. *Angiostrongylus cantonensis* in introduced gastropods in southern Florida. J Parasitol 2015;101:156–9. https://doi.org/10.1645/14-553.1
8. Dalton MF, Fenton H, Cleveland CA, Elsmo EJ, Yabsley MJ. Eosinophilic meningoencephalitis associated with rat lungworm (*Angiostrongylus cantonensis*) migration in two nine-banded armadillos (*Dasypus novemcinctus*) and an opossum (*Didelphis virginiana*) in the southeastern United States. Int J Parasitol Parasites Wildl 2017;6:131–4. https://doi.org/10.1016/j.ijppaw.2017.05.004
9. Chotmongkol V, Wongjitrat C, Sawadpanit K, Sawanyawisuth K. Treatment of eosinophilic meningitis with a combination of albendazole and corticosteroid. Southeast Asian J Trop Med Public Health 2004;35:172–4.
10. Chotmongkol V, Kittimongkolma S, Niwattayakul K, Intapan PM, Thavornpitak Y. Comparison of prednisolone plus albendazole with prednisolone alone for treatment of patients with eosinophilic meningitis. Am J Trop Med Hyg 2009;81:443–5.

Deaths Related to Hurricane Irma — Florida, Georgia, and North Carolina, September 4–October 10, 2017

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Three powerful and devastating hurricanes from the 2017 Atlantic hurricane season (Harvey [August 17–September 1], Irma [August 30–September 13], and Maria [September 16–October 2]) resulted in the deaths of hundreds of persons. Disaster-related mortality surveillance is critical to an emergency response because it provides government and public health officials with information about the scope of the disaster and topics for prevention messaging. CDC's Emergency Operations Center collaborated with state health departments in Florida, Georgia, and North Carolina to collect and analyze Hurricane Irma–related mortality data to understand the main circumstances of death. The most common circumstance-of-death categories were exacerbation of existing medical conditions and power outage. Further analysis revealed two unique subcategories of heat-related and oxygen-dependent deaths in which power outage contributed to exacerbation of an existing medical condition. Understanding the need for subcategorization of disaster-related circumstances of death and the possibility of overlapping categories can help public health practitioners derive more effective public health interventions to prevent deaths in future disasters.

Hurricane Irma, a Category 5 hurricane (185-mph winds), caused catastrophic damage in the Caribbean before moving northwest and making landfall in Florida on September 10, 2017, as a Category 4 hurricane. Wind damage compromised power lines, and a storm surge caused extensive flooding, primarily along the coast. Irma affected the entire state of Florida; 7 million residents were evacuated (*1*) and 6.7 million utility customers lost power (*2*). As Irma traveled inland, it weakened to a tropical depression; despite this weakening, 75,000 customers in North Carolina (*3*) and >900,000 customers in Georgia (*4*) experienced storm-related power losses.

As part of CDC's public health response to the hurricanes, the Epidemiology and Surveillance Task Force in the Emergency Operations Center tracked online media reports of hurricane-associated deaths and contacted states for confirmation (*5*,*6*). The Georgia Department of Public Health and North Carolina Department of Health and Human Services provided CDC with information on confirmed hurricane-related deaths. Concurrently, the Florida Department of Health identified deaths associated with Hurricane Irma through examination of vital statistics death data from the electronic death registration system, reports from the Florida Medical Examiners Commission, and media reports. To identify hurricane-related deaths, Florida used text-parsing algorithms to query "How Injury Occurred" and "Literal Cause of Death" fields on the death certificates. Researchers developed a circumstance-of-death categorization scheme based on previous research (*7*) and used it to classify Hurricane Irma–related deaths (Box). This report summarizes the circumstances of confirmed Hurricane Irma–related deaths from September 4 to October 10, 2017, in Florida, Georgia, and North Carolina and highlights the need for detailed analysis of disaster-related circumstances of death.

Among the 129 hurricane-related deaths identified in Florida, Georgia, and North Carolina, 123 (95.3%) occurred in Florida; 88 (68.2%) decedents were male, and the median age was 63 years (range = 1–99 years). Eleven (8.5%) deaths were directly related to the hurricane, 115 (89.1%) were indirectly related, and three (2.3%) were possibly related (Table).

The most common category of indirect circumstance of death was exacerbation of an existing medical condition (46; 35.7%) (Table). Specifically, 23 (17.8%) deaths were associated with chronic health problems, such as cardiac disease, that were exacerbated by stress and anxiety related to the hurricane. Three (2.3%) deaths in chronically ill patients were attributed to disruption of emergency medical services. The remaining 20 (15.5%) deaths associated with exacerbation of an existing medical condition could also be categorized as power outage–related deaths (Figure). Seventeen (13.2%) heat-related deaths were associated with lack of air conditioning, and three (2.3%) deaths occurred in patients whose medical treatment (e.g., supplemental oxygen) was electricity-dependent. Fourteen (10.9%) of the heat-related deaths occurred among geriatric patients with existing chronic diseases who resided in an assisted-living facility in Florida that was without power for several days during a period of hot weather after the hurricane's landfall. An additional 27 (20.9%) power outage–related deaths were not related to exacerbation of an existing medical condition. These included 16 (12.4%) carbon monoxide poisonings.

Discussion

Currently no published standardized methodology exists for analyzing disaster-related mortality data to inform public health action and prevent additional deaths. The death certification reference guide released in October 2017 by

BOX. Categorization scheme used to classify circumstances of deaths associated with Hurricane Irma — Florida, Georgia, and North Carolina, September 4–October 10, 2017

Directly hurricane-related

Accident

- Trauma from wind/rain-associated structural collapse, falling structures, or flying debris during storm
- Drowning or asphyxiation from rain/floods/landslides
  - Automobile-related
  - Boat-related
  - Residence/Building-related
  - Other or unknown mechanism
- Electrocution from lightning

Indirectly hurricane-related

Natural

- Hazardous environmental conditions (e.g., leptospirosis)
- Exacerbation of existing medical condition
  - Emergency medical issue inadequately addressed because of loss/disruption of emergency transportation services
  - Loss/Disruption of usual access to medical/mental health care (e.g., clinics, pharmacies)
  - Loss/Disruption of public utilities (e.g., electricity) needed for medical treatment (e.g., dialysis, oxygen, refrigerated medications, etc.)
  - Loss/Disruption of heat or cooling systems where excess heat/cold exacerbated preexisting medical conditions
  - Primarily induced by stress/anxiety before, during, or after the storm where access to medical services was available (e.g., myocardial infarction)

Accident

- Poisoning
  - Carbon monoxide
  - Industrial hazards
- Vehicular accident
  - Precipitated by hazardous road/traffic conditions
  - Not precipitated by hazardous conditions, but occurring while in route to or from hurricane-affected area (e.g., involving evacuation of disaster response/aid
- Preparation/Repair
  - Fall from roof, ladder, etc.
  - Sharp force injury during preparation/repair (e.g., chainsaw injury)
  - Electrocution while working on nonfunctional power line
- Loss/Disruption of emergency services (e.g., fire department)
  - Burn or smoke inhalation
- Hazardous or unfamiliar environmental conditions
  - Fall from standing height caused by inadequate lighting, storm debris in walkway, or unfamiliar environment
  - Collapse of unstable structures after storm
  - Electrocution from contact with downed power line

Possibly hurricane-related

Homicide

Suicide

Undetermined

Source: Categorization scheme based on report by Combs et al. (https://academic.oup.com/ije/article/28/6/1124/771525).

Note: Direct deaths are caused by environmental forces of the hurricane and direct consequences of these forces and indirect deaths are caused by unsafe or unhealthy conditions because of loss or disruption of usual services, personal loss, or lifestyle disruption; possibly related deaths include deaths attributed to the hurricane in which the indirect or direct relation of the death to the hurricane is not clear.

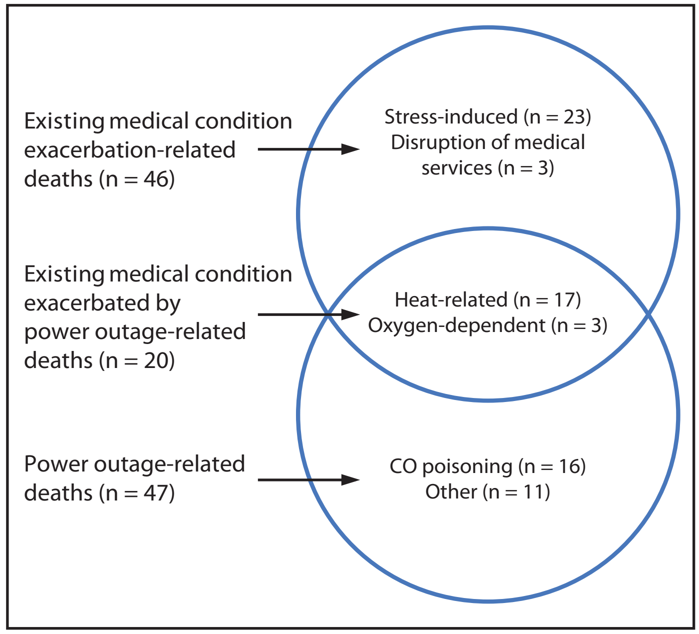
TABLE. Circumstances of confirmed deaths* related to Hurricane Irma — Florida, Georgia, and North Carolina, September 4–October 10, 2017†

Circumstance of death	No. of deaths	% of total deaths§
Directly hurricane-related¶	**11**	**8.5**
Accident	11	8.5
Drowning related to flooding	7	5.4
Tree-related injuries	4	3.1
Indirectly hurricane-related¶	**115**	**89.1**
Natural	48	37.2
Existing medical condition exacerbation	46	35.7
Stress-related cardiac disease	23	17.8
Heat-related	17	13.2
Oxygen-dependent disease	3	2.3
Disruption of emergency medical services	3	2.3
Floodwater infection	2	1.6
Accident	67	51.9
Carbon monoxide poisoning	16	12.4
Preparation/Repair injury	15	11.6
Motor vehicle crash	13	10.1
Falls from standing height**	13	10.1
Other††	12	9.3
Possibly hurricane-related¶	**3**	**2.3**
Homicide	1	0.8
Suicide	1	0.8
Undetermined	1	0.8

* N = 129.
† Among the 129 total deaths, 123 are from Florida. The mortality data are accurate as of July 16, 2018.
§ Might not sum to 100% because of rounding.
¶ Direct deaths are caused by environmental forces of the hurricane and direct consequences of these forces. Indirect deaths are caused by unsafe or unhealthy conditions because of loss or disruption of usual services, personal loss, or lifestyle disruption. Possibly related deaths include deaths attributed to the hurricane in which the indirect or direct relation of the death to the hurricane is not clear.
** Falls from standing height occurred in elderly persons. The word "hurricane" was recorded in the death certificates. Four of the 13 decedents died after the surveillance end date of October 10, 2017, from complications of falls that occurred during the hurricanes.
†† Includes deaths caused by drowning not related to flooding (n = 5) and collapse of unstable structures after the hurricane had passed (n = 1). Drowning not related to flooding includes persons found floating in swimming pools. These death certificates contain no mention of flooding.

the National Center for Health Statistics informs medical examiners and coroners about completing death certificates for disaster-related deaths (*6*). Public health practitioners can refer to this document to understand current disaster-related death certification processes and how they can collaborate with medical examiners and coroners to obtain the specific mortality data needed to shape disaster-related public health communication strategies. Many public health agencies use traditional surveillance systems and social media surveillance to collect near real-time morbidity and mortality data. The more accurate and thorough the information, the more specifically communicators can target vulnerable groups with appropriate prevention messages.

FIGURE. Overlapping circumstances of deaths associated with existing medical condition exacerbation and power outages caused by Hurricane Irma — Florida, Georgia, and North Carolina, September 4–October 10, 2017*,†



Abbreviation: CO = carbon monoxide.
* Total number of deaths = 73.
† Fourteen of the 17 heat-related deaths occurred in residents of an assisted living facility in Florida that was without power for several days.

Because circumstance of death typically provides more detailed information than cause of death, using circumstance of death for disaster-related mortality data analysis is more likely to guide public health action. A single cause of death might be associated with multiple circumstances of death. For example, a cause of death such as "blunt force trauma" could be associated with a motor vehicle crash or being struck by a falling object. The specific circumstances can inform different prevention messages. However, abstracting circumstance of death from the death certificate is more challenging than ascertaining the cause of death. Whereas "Cause of Death" is a labeled field in the death certificate, circumstance of death is determined through assessment of information in other free-text fields within the death certificate, such as "How Injury Occurred."

Literature on U.S. hurricane-related mortality from recent decades has categorized circumstances of death (*8*,*9*). However, because each disaster is unique, the level of detail available in the circumstance-of-death categories varies across these reports. Not all disasters require a detailed analysis of all death circumstances; however, subcategorization of the most prevalent circumstances of death might reveal additional information that can be used to inform public health messages and interventions. For example, the circumstance of exacerbation of an existing medical condition might include subcategories such as stress-induced, disruption of emergency medical services, and power outage.

Public health messaging about hurricane safety and prevention of hurricane-related injuries should be communicated effectively in the hurricane preparation and response phases (*10*). With a sound understanding that death circumstances can be subcategorized and that categories might overlap, public health practitioners can perform supplemental analyses that will inform more specific and effective public health messaging and interventions to reduce disaster-related injury and illness. By looking at overlapping circumstances of death, analysis of Hurricane Irma mortality data revealed two unique subcategories of heat-related and oxygen-dependent deaths in which power outage contributed to exacerbation of an existing medical condition. Deaths associated jointly with power outages and existing medical condition exacerbation can be minimized by prioritizing power restoration to locations with vulnerable populations, including elderly persons and those with chronic diseases who are especially prone to heat-related illness. In addition, public health messages emphasizing generator safety and widespread use of carbon monoxide detectors can help reduce power outage–related carbon monoxide poisoning.

The findings in this report are subject to at least one limitation. The data might not include all deaths related to Hurricane Irma. As during any disaster, delayed reports of indirectly related deaths might not be recorded because of the imposed end dates of disaster-related mortality surveillance. In addition, death certifiers might change and refine circumstances of death as new information becomes available after registration of the death certificate; these death records are not included. Understanding the need for subcategorization of disaster-related circumstances of death can help public health practitioners develop more effective public health interventions to prevent deaths in future disasters.

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No conflicts of interest were reported.

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Summary

What is already known about this topic?

Collecting and analyzing mortality data is important for understanding the main circumstances of deaths related to a disaster such as Hurricane Irma.

What is added by this report?

Among deaths attributed to Hurricane Irma, the most common circumstance-of-death categories were exacerbation of existing medical conditions and power outage. Further analysis revealed two unique subcategories of heat-related and oxygen-dependent deaths in which power outage contributed to exacerbation of an existing medical condition.

What are the implications for public health practice?

Understanding the need for subcategorization of disaster-related circumstances of death can help public health practitioners develop more effective public health interventions to prevent deaths in future disasters.

References

1. Breslin S. FEMA chief to Florida Keys residents: "you're on your own." The Weather Channel. September 9, 2017. https://weather.com/storms/hurricane/news/hurricane-irma-florida-tampa-miami-impacts
2. Florida Division of Emergency Management. Gov. Scott: more than 65 percent of power outages restored statewide. Tallahassee, FL: Florida Division of Emergency Management; 2017. https://www.floridadisaster.org/news-media/news/gov.-scott-more-than-65-percent-of-power-outages-restored-statewide/
3. WRAL News. About 45,000 without power after Irma blows through parts of NC. WRAL News. September 12, 2017. https://www.wral.com/about-45-000-without-power-after-irma-blows-through-parts-of-nc/16942561/
4. Chappell B. Power outages persist for millions in Florida, Georgia and Carolinas after Irma. NPR: The Two-Way. September 13, 2017. https://www.npr.org/sections/thetwo-way/2017/09/13/550674848/power-outages-persist-for-millions-in-florida-georgia-and-carolinas-after-irma
5. CDC. Death scene investigation after natural disaster or other weather-related events toolkit: first edition. Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/nceh/hsb/disaster/docs/DisasterDeathSceneToolkit508.pdf
6. National Center for Health Statistics. A reference guide for certification of deaths in the event of a natural, human-induced, or chemical/radiological disaster. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2017. https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg01.pdf
7. Combs DL, Quenemoen LE, Parrish RG, Davis JH. Assessing disaster-attributed mortality: development and application of a definition and classification matrix. Int J Epidemiol 1999;28:1124–9. https://doi.org/10.1093/ije/28.6.1124
8. Jani AA, Fierro M, Kiser S, et al. Hurricane Isabel-related mortality—Virginia, 2003. J Public Health Manag Pract 2006;12:97–102. https://doi.org/10.1097/00124784-200601000-00016
9. CDC. Deaths associated with Hurricane Sandy—October–November 2012. MMWR Morb Mortal Wkly Rep 2013;62:393–7.
10. CDC 2017 Hurricane Incident Management System Team. Hurricane season public health preparedness, response, and recovery guidance for health care providers, response and recovery workers, and affected communities—CDC, 2017. MMWR Morb Mortal Wkly Rep 2017;66:995–8. https://doi.org/10.15585/mmwr.mm6637e1

Progress Toward Poliomyelitis Eradication — Afghanistan, January 2017–May 2018

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Afghanistan, Pakistan, and Nigeria remain the only countries where transmission of endemic wild poliovirus type 1 (WPV1) continues (*1*). This report describes polio eradication activities, progress, and challenges to eradication in Afghanistan during January 2017–May 2018 and updates previous reports (*2*,*3*). Fourteen WPV1 cases were confirmed in Afghanistan in 2017, compared with 13 in 2016; during January–May 2018, eight WPV1 cases were reported, twice the number reported during January–May 2017. To supplement surveillance for acute flaccid paralysis (AFP) and laboratory testing of stool samples, environmental surveillance (testing of sewage samples) was initiated in 2013 and includes 20 sites, 15 of which have detected WPV1 circulation. The number of polio-affected districts increased from six in 2016 to 14 in 2017 (including WPV1 cases and positive environmental samples). Access to children for supplementary immunization activities (SIAs) (mass campaigns targeting children aged <5 years with oral poliovirus vaccine [OPV], regardless of vaccination history), which improved during 2016 to early 2018, worsened in May 2018 in security-challenged areas of the southern and eastern regions. To achieve WPV1 eradication, measures to maintain and regain access for SIAs in security-challenged areas, strengthen oversight of SIAs in accessible areas to reduce the number of missed children, and coordinate with authorities in Pakistan to track and vaccinate mobile populations at high risk in their shared transit corridors must continue.

Immunization Activities

The World Health Organization (WHO) and UNICEF estimated national routine vaccination coverage of infants aged <12 months with 3 doses of OPV (OPV3) in Afghanistan at 60% in both 2015 and 2016 (*4*). As a proxy indicator for national OPV3 coverage, the percentage of children aged 6–23 months with nonpolio acute flaccid paralysis (NPAFP) who received 3 OPV doses through routine immunization services was 67% in 2016 and 68% in 2017. Administrative OPV3 coverage (calculated by dividing the number of doses administered by the estimated target population) in 2017 ranged from 100% in the central provinces of Kapitsa and Panjsher to 24% and 9% in the southern provinces of Helmand and Kabul, respectively. The proportion of children aged 6–23 months nationally with NPAFP who never received OPV through routine immunization services or SIAs (i.e., "zero-dose" children) was approximately 1% during 2016–2017. High proportions of zero-dose children were reported in 2017 in Kabul (9%) and Kandahar (4%) provinces in the southern region, Kunar (8%) province in the eastern region, and Paktika (7%) province in the southeastern region.

During January 2017–May 2018, SIAs targeted children aged <5 years for receipt of monovalent OPV (containing only type 1 vaccine virus) or bivalent OPV (containing types 1 and 3 vaccine viruses) including six national immunization days (NIDs), nine subnational immunization days and one "mop-up" SIA (door-to-door immunization campaigns carried out in specific areas where the virus is known or suspected to still be circulating). Injectable inactivated poliovirus vaccine (IPV) was administered during SIAs to 1,248,749 children aged 4–59 months who lived in districts designated as very high-risk for polio circulation or in areas that had been inaccessible for previous SIAs to help boost their immunity to the virus and decrease the risk for paralytic disease.

During the period covered by this report, NIDs targeted 9,999,227 children aged <5 years. Children missed for vaccination during NIDs are recorded either as inaccessible* or as accessible but missed because of campaign quality issues including vaccine refusal; team failure to reach the home; or child being sick, asleep, or absent. During the September 2017 NIDs, a total of 362,276 children (3.6%) were reported as having been missed, including 152,201 (1.5%) reported as inaccessible and 210,075 (2.1%) as accessible. During the March 2018 NID, the number of missed children was reduced to 290,510 (2.9%) with 101,561 (1.1%) inaccessible and 188,949 (1.8%) accessible. In May 2018 NIDs, the number of inaccessible children increased to 996,326 (9.9%) with the greatest numbers missed in Helmand (76.2% of all targeted children) and Urozgan (100% of targeted) provinces in the southern region because of a ban on vaccination. During this round, 204,354 (2.0%) children also were missed in accessible areas.

* SIA access at the district level is divided into four categories: not accessible, partially accessible, accessible with limitation, and fully accessible. Partially accessible indicates that the campaign was implemented fully but only in part of the district, whereas implemented with limitation indicates that the campaign was implemented throughout the entire district but with restrictions to monitoring.

Lot quality assurance sampling[†] surveys are used to assess the quality of SIAs in accessible areas. The percentage of districts that reportedly failed at the 80% threshold was 16.7% during the September 2017 NID, 7.1% during the March 2018 NID, and 8.3% during the May 2018 NID, which indicates improved campaign quality during 2017–2018 to date.

Children aged <5 years also are targeted for vaccination along major travel routes throughout the country, at transit points from inaccessible areas, and at border crossing points with Pakistan and Iran (which target children aged <10 years). Approximately 13 million OPV doses were administered at transit points during 2017, and approximately 5.7 million doses were administered during January–May 2018. At border crossings, approximately 830,000 children were vaccinated during 2017, and approximately 340,000 during 2018 to date.

Poliovirus Surveillance

Acute flaccid paralysis surveillance. Surveillance for AFP, which is a highly sensitive surveillance system to detect a case of polio, is a critical component of the global polio eradication initiative; the target is ≥2 NPAFP cases per 100,000 persons aged <15 years (*5*). The surveillance network includes government and private health facilities, shrines, traditional healers, and approximately 35,000 reporting volunteers. In 2017, the annual national NPAFP rate was 15.3 per 100,000 persons aged <15 years (provincial range, 11.4–20.4) (Table). The percentage of AFP cases with adequate stool specimens[§] collected was 93.5% (range, 87.5%–96.9%); the target is ≥80% of AFP cases. During January 2017–May 2018, the NPAFP rate exceeded 12 per 100,000 persons aged <15 years, and the percentage of AFP cases with adequate stool specimens exceeded 91% across all SIA access categories.

Environmental surveillance. Supplementary poliovirus surveillance in Afghanistan is conducted through sampling of sewage at 20 sites in nine provinces. Sampling frequency from eight sites in the southern region has been increased from monthly in 2016 to every 2 weeks since 2017. WPV1 was detected in two (1%) of 184 specimens tested in 2016, 42 (13%) of 316 specimens tested in 2017, and 21 (16%) of 148 specimens tested in 2018 to date (from Nangarhar, Kunar, Kandahar, Helmand, and Kabul provinces).

Epidemiology of WPV Cases

During 2017, 14 WPV1 cases were reported in five provinces (Kandahar [seven cases], Nangarhar [three], Helmand [two], Zabul [one], and Kunduz [one]) compared with 13 in four provinces in 2016. Eight WPV1 cases were reported during January–May 2018, compared with four during

[†] Lot quality assurance sampling is a rapid survey method used to assess the quality of vaccination activities after SIAs in predefined areas, such as health districts (referred to as "lots"), using a small sample size. Lot quality assurance sampling involves dividing the population into lots and randomly selecting persons in each lot. If the number of unvaccinated persons in the sample exceeds a predetermined value, then the lot is classified as having an unsatisfactory level of vaccination coverage, and mop-up activities are recommended. If the threshold of ≥80% is met, the area or district is classified as having passed, although mop-up activities might still be indicated in certain areas.

[§] At least 80% of AFP cases should have adequate stool specimens collected. Adequate stool specimens are defined as two stool specimens of sufficient quantity for laboratory analysis, collected ≥24 hours apart, both within 14 days of paralysis onset, and arriving in good condition at a WHO-accredited laboratory with reverse cold chain maintained and without leakage or desiccation and with proper documentation.

TABLE. Acute flaccid paralysis (AFP) surveillance indicators and reported cases of wild poliovirus (WPV), by region and period — Afghanistan, January 2017–May 2018*

Region of Afghanistan	AFP surveillance indicators (2017)			No. of WPV cases reported		
	No. of AFP cases	Rate of nonpolio AFP[†]	% of AFP cases with adequate specimens[§]	Jan–Jun 2017	Jul–Dec 2017	Jan–May 2018
All Regions	**3,078**	**15.3**	**93.5**	**5**	**9**	**8**
Badakhshan	65	11.4	95.4	0	0	0
Northern	345	13.7	92.8	0	0	0
Northeastern	421	18.7	91.9	1	0	0
Central	545	11.8	96.9	0	0	0
Eastern	363	18.3	93.9	0	3	3
Southeastern	250	12.7	94.8	0	0	0
Southern	543	15.4	87.5	4	6	5
Western	546	20.4	95.1	0	0	0

Abbreviation: WHO = World Health Organization.
* Data current through May 15, 2018.
[†] Per 100,000 persons aged <15 years. Surveillance target is ≥2/100,000 persons aged <15 years.
[§] Surveillance target is that ≥80% of AFP cases have adequate stool specimens collected. Adequate stool specimens are defined as two stool specimens of sufficient quality for laboratory analysis, collected ≥24 hours apart, both within 14 days of paralysis onset, and arriving in good condition at a WHO–accredited laboratory with reverse cold chain maintained and without leakage or desiccation and with proper documentation.

January–May 2017 (Figure 1) (Figure 2). The number of districts reporting WPV1 cases increased from four in 2016 to nine in 2017. As of June 29, 2018, eight cases had been reported, including five from Kandahar, two from Kunar, and one from Nangarhar provinces. Among the 22 cases reported during January 2017–May 2018, 17 (77%) were among children aged <36 months, nine of 22 (41%) had never received OPV by any means (i.e., routine immunization or SIA), two (9%) had received 1 or 2 doses, and 11 (50%) had received ≥3 doses each; 15 (68%) of the 22 children with polio had never received OPV through routine immunization services.

Genomic sequence analysis of poliovirus isolates identified multiple episodes of cross-border transmission during 2017–2018 between Pakistan and Afghanistan, with sustained local transmission in both countries. During January 2017–May 2018, 11 (50%) of 22 isolates from patients with AFP and 35 (57%) of 62 isolates from environmental testing identified in Afghanistan had closest genetic links to earlier WPV1 isolates from Pakistan; the remaining isolates were most closely linked to isolates identified in Nangarhar, Kabul, Kandahar, and Helmand provinces of Afghanistan. During 2018, two genetic clusters (viruses sharing ≥95% of sequence identity) were detected from AFP cases; one cluster of five cases occurred in the southern province of Kandahar and the other three cases occurred in two adjacent provinces (Nangarhar and Kunar) in eastern Afghanistan. Whereas the number of yearly cases has been fairly steady from 2016 to 2018 to date, the geographic location of WPV cases in 2018 has been restricted to the historically shared reservoirs of poliovirus transmission between Afghanistan and Pakistan, known as the Northern and Southern Corridors.¶

Discussion

During the period covered by this report, the number of WPV1 cases and positive environmental isolates in Afghanistan has increased modestly each year since 2016. However, the geographic extent of virus circulation appears limited to the southern and eastern regions. Despite security challenges, the major surveillance performance indicators are being met across all levels of access. Critical issues that need to be addressed to interrupt WPV1 circulation are reaching children for vaccination in inaccessible areas, reaching a higher proportion of children in accessible areas, and coordinating vaccination programs with Pakistan to better reach mobile populations at high risk that travel between the two countries.

Inaccessibility continues to be a barrier to reaching children during SIAs, particularly in the eastern and southern regions. The primary strategy to address access has been to engage in dialogue with local influencers and antigovernment elements. This strategy has been successful in reducing the number of inaccessible areas; however, access has become increasingly

¶ The Northern Corridor includes the provinces of Nangarhar, Kunar, Laghman, and Nuristan in Afghanistan and Bajour agency, Mohmand agency, Khyber agency, and FR Peshawar in the Northern Federally Administered Tribal Areas and the districts of Peshawar, Nowshera, and Charsadda, Mardan, Swabi, Swat, Malakand, Dir Lower, Dir Upper, and Chitral Khyber Pakhtunkhwa in Peshawar in Pakistan. The Southern Corridor includes Kandahar and Helmand provinces in Afghanistan and the districts of Quetta, Killa Abdullah, and Pishin in Baluchistan province of Pakistan.

FIGURE 1. Number of wild poliovirus type 1 (WPV1) cases (n = 83) — Afghanistan, January 2014–May 2018

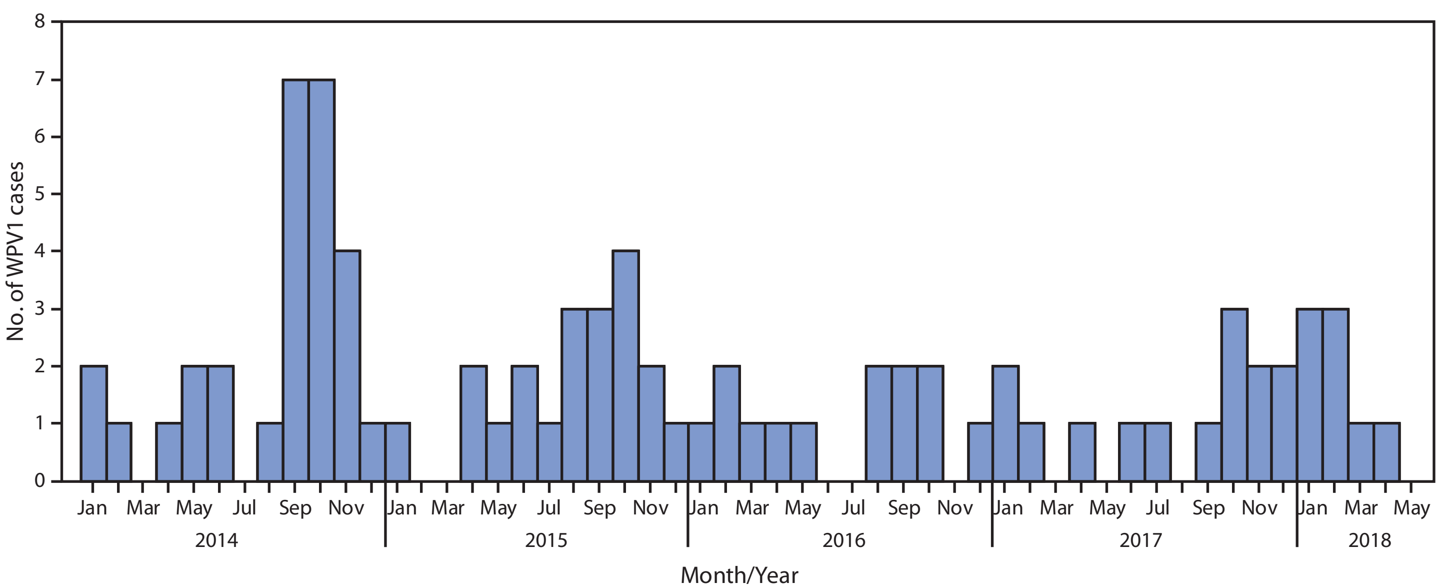
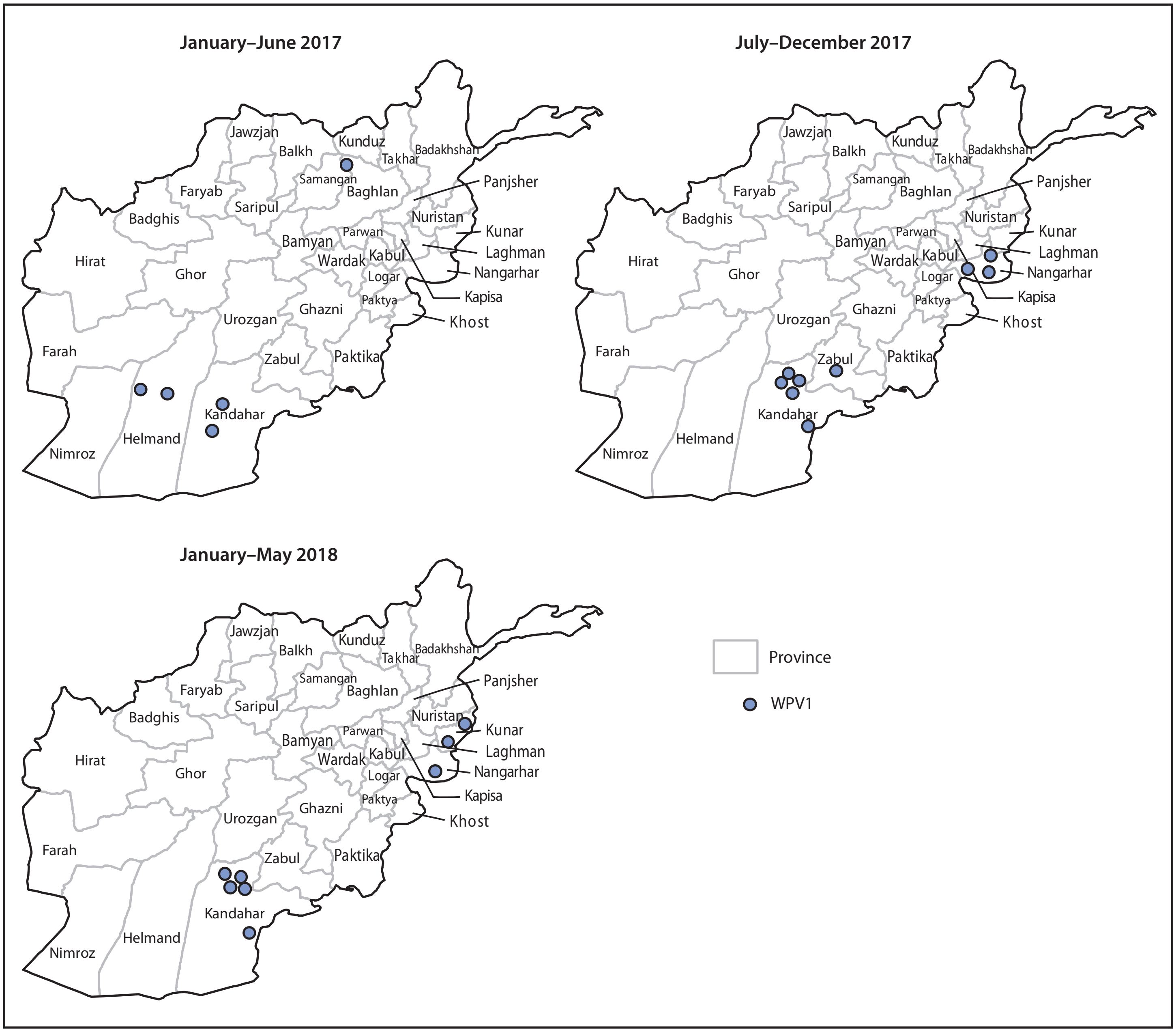


FIGURE 2. Cases of wild poliovirus type 1(WPV1),* by province — Afghanistan, January 2017–May 2018



* Each dot represents one case. Dots are randomly placed within provinces.

challenging in recent months because the number of bombings, attacks, active conflicts, and campaign bans have increased. In the face of mounting insecurity, the program must continue to identify ways to gain and maintain access to children in security-compromised areas.

The quality of campaigns in accessible areas has improved, as evidenced by lot quality assurance sampling surveys and postcampaign coverage data. To improve SIA quality in accessible areas, religious leaders and prominent community members are asked to identify children missed in SIAs and to dispel misperceptions about vaccination. A national exercise is underway to update all microplans throughout the country to ensure the house locations for all eligible children are identified, so that they are included in each NID. Measures to vaccinate accessible children missed during SIAs because of poor campaign quality need to be enhanced, particularly regarding vaccine refusals.

During 2017-2018, the polio program in Afghanistan identified 28 districts at highest risk for poliovirus circulation and developed action plans in coordination with the Pakistan polio

Summary

What is already known about this topic?

Afghanistan is one of three countries where transmission of wild poliovirus continues.

What is added by this report?

The annual number of reported wild poliovirus cases in Afghanistan has remained steady since 2016 although the geographic spread has decreased. Access to children for immunization campaigns improved during 2017 through early 2018 but worsened in May 2018 in security-challenged areas of the southern and eastern regions.

What are the implications for public health practice?

To interrupt wild poliovirus transmission in Afghanistan, progress is needed toward regaining campaign access in security-challenged areas, improving campaign quality in accessible areas, and enhancing coordination with Pakistan to track and vaccinate mobile populations at high risk.

program for their shared high-risk areas in the Northern and Southern Corridors. Cross-border coordination with Pakistan continues to be enhanced to identify, track, and vaccinate mobile populations at high risk. Both countries have synchronized their vaccination campaign schedules to ensure that mobile populations are not missed. The number of permanent transit teams targeting mobile populations at high risk and children exiting inaccessible areas continues to be increased.

To interrupt WPV transmission, the country program must continue to identify innovative ways to access children in security-compromised areas and enhance measures to vaccinate accessible children missed during SIAs and among mobile populations at high risk. The country program also must cooperate closely with the polio program in Pakistan.

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Conflict of Interest

No conflicts of interest were reported.

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References

1. Global Polio Eradication Initiative. Annual report 2016. Geneva, Switzerland: World Health Organization; 2016. http://polioeradication.org/wp-content/uploads/2017/08/AR2016_EN.pdf
2. Martinez M, Shukla H, Nikulin J, et al. Progress toward poliomyelitis eradication—Afghanistan, January 2016–June 2017. MMWR Morb Mortal Wkly Rep 2017;66:854–8. https://doi.org/10.15585/mmwr.mm6632a5
3. Mbaeyi C, Shukla H, Smith P, et al. Progress toward poliomyelitis eradication—Afghanistan, January 2015–August 2016. MMWR Morb Mortal Wkly Rep 2016;65:1195–9. https://doi.org/10.15585/mmwr.mm6543a4
4. World Health Organization. WHO vaccine-preventable diseases monitoring system: 2018 global summary. Geneva, Switzerland: World Health Organization; 2018. http://apps.who.int/immunization_monitoring/globalsummary
5. Gardner TJ, Diop OM, Jorba J, Chavan S, Ahmed J, Anand A. Surveillance to track progress toward polio eradication—worldwide, 2016–2017. MMWR Morb Mortal Wkly Rep 2018;67:418–23. https://doi.org/10.15585/mmwr.mm6714a3

Notes from the Field

Toxigenic *Vibrio cholerae* O141 in a Traveler to Florida — Nebraska, 2017

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Vibrio cholerae serogroups O1 and O139 are toxigenic strains associated with epidemic cholera; however, other *Vibrio cholerae* serogroups, such as O75 and O141, can also produce cholera toxin, leading to a cholera-like illness identified as vibriosis (*1*). Cholera and vibriosis are more common in the Gulf Coast region of the United States and are related to exposure to coastal water sources and consumption of raw or undercooked shellfish. Persons typically become ill approximately 24–72 hours after exposure. Symptoms can last from 3 to 7 days and range from mild diarrhea to profuse watery diarrhea and vomiting, which can lead to severe dehydration, hospitalization, and death (*2*).

In October 2017, Nebraska state and local health department officials received an electronic laboratory report of stool culture positive for *V. cholerae*. The Three Rivers Health Department in Fremont, Nebraska, began an investigation and completed a patient interview using the Cholera and Other *Vibrio* Illness Surveillance (COVIS)* system form.

The patient, a woman from Nebraska aged 51 years, had recently traveled to Florida. She reported exposure of her feet in the Gulf of Mexico and consumption of raw oysters at a local restaurant. She developed diarrhea approximately 36–48 hours after eating at the restaurant. Upon return to Nebraska, she sought medical care and a stool specimen was collected, from which *V. cholerae* was isolated. The patient was not hospitalized and recovered from the illness. The isolate was forwarded to the Nebraska Public Health Laboratory where additional phenotypic testing presumptively identified the isolate as *V. cholerae.* The isolate was subsequently submitted to CDC for serotyping and molecular testing to confirm the species identification and to test for the presence of cholera toxin genes. The isolate, which was confirmed as *V. cholerae* by *rpoB* gene sequencing, was subsequently identified as serogroup O141 and reported as positive for the *ctxA* cholera toxin gene and the *ompW* gene but negative for the *toxR* and *tcpA* genes. Although genes coding virulence within the *V. cholerae* strains can vary, these virulence genes can be used to assess the epidemic potential of this species. For example, both the *ctx*A gene and the *tox*R gene (the regulatory gene that controls expression of cholera toxin) are commonly found in the O1 and O139 epidemic strains of *V. cholerae*. A traceback investigation by the Florida Department of Agriculture found that the oysters consumed were harvested from the Gulf Coast region in either Florida or Louisiana. No other cases were identified.

Although O141 has not been found to be an outbreak-associated strain, toxigenic *V. cholerae* serogroup O141 has been associated with sporadic illness in the United States (*1*,*3*). These infections have been associated with seafood exposure in Florida and New Jersey and freshwater exposure in Arizona, Michigan, Missouri, and Texas. Since the initiation of COVIS in 1988, 16 cases of toxigenic O141 have been reported in the United States. This is the first case reported from Nebraska.

Vibriosis has been a nationally notifiable condition since 2007. *Vibrio* species are difficult to culture, because they are not easily identified using routine enteric media and often require selective media. However, detection of *Vibrio* species might become more common with increased use of culture-independent diagnostic testing (CIDT) using molecular-based methods, which are considered to be more sensitive than are standard cultures. Some of these CIDT assays are designed to detect a subset of *Vibrio* species and might not identify all cases or only identify cases as vibriosis without species information. For example, the FilmArray Gastrointestinal Panel (BioFire Diagnostics, LLC) has genomic targets for both *Vibrio* species and *Vibrio cholerae.* The manufacturer's instructions for this assay indicate a limitation for detecting strains of *V. cholerae* that do not carry the *toxR* gene, suggesting that the isolate in this case, without culture follow-up, could have been detected only as a *Vibrio* species. Therefore, CDC asks that state health departments submit all *V. cholerae* isolates for confirmatory testing and additional characterization and suggests that states consider reflex culture testing on specimens identified through CIDT as *Vibrio* species or *V. cholerae*. States that require reporting of vibriosis cases should consider the role confirmatory culture testing plays in the assessment of relevant risk factors to improve public health detection and case management.

* https://www.cdc.gov/vibrio/surveillance.html.

Conflict of Interest

No conflicts of interest were reported.

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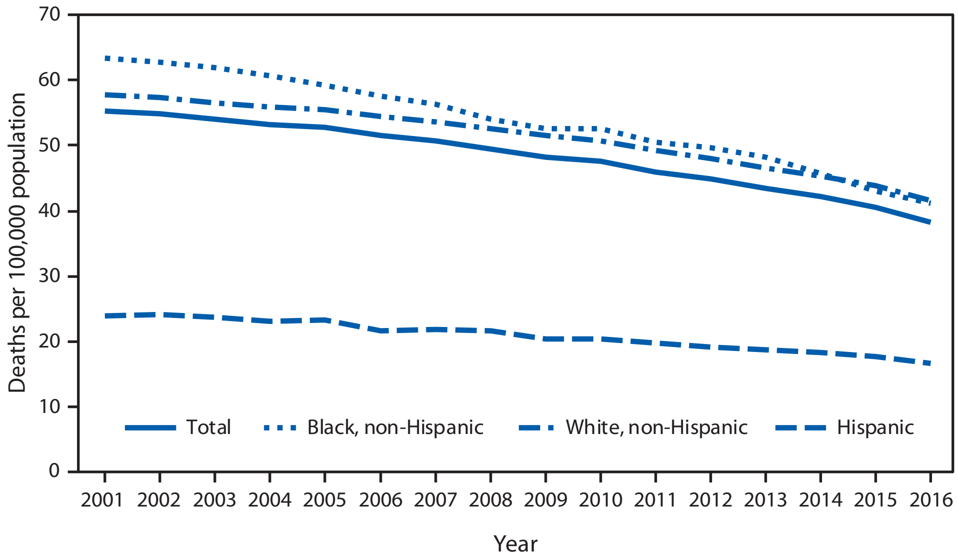
References

1. Crowe SJ, Newton AE, Gould LH, et al. Vibriosis, not cholera: toxigenic *Vibrio cholerae* non-O1, non-O139 infections in the United States, 1984–2014. Epidemiol Infect 2016;144:3335–41. https://doi.org/10.1017/S0950268816001783
2. CDC. Cholera—*Vibrio cholerae* infection. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/cholera/general/index.html
3. Crump JA, Bopp CA, Greene KD, et al. Toxigenic *Vibrio cholerae* serogroup O141–associated cholera-like diarrhea and bloodstream infection in the United States. J Infect Dis 2003;187:866–8. https://doi.org/10.1086/368330

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Death Rates* from Lung Cancer,† by Race/Ethnicity — National Vital Statistics System, United States, 2001–2016



* Deaths per 100,000 population age-adjusted to the 2000 U.S. standard population.
† Lung cancer-related deaths were those with underlying cause of death coded as C34 in the *International Classification of Diseases, Tenth Revision* (ICD-10).

During 2001–2016, the lung cancer death rates for the total population declined from 55.3 to 38.3 as well as for each racial/ethnic group shown. During 2001–2016, the death rate for the non-Hispanic black population decreased from 63.3 to 41.2, for the non-Hispanic white population from 57.7 to 41.5, and for the Hispanic population from 23.9 to 16.6. Throughout this period, the Hispanic population had the lowest death rate.

Sources: CDC/National Center for Health Statistics, National Vital Statistics System, 2001–2016, Mortality. CDC Wonder online database. https://wonder.cdc.gov/ucd-icd10.html.

Reported by: Deepthi Kandi, MS, DKandi@cdc.gov, 301-458-4953; Sibeso Joyner, MPH.

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