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Cardiovascular Health Status by Occupational Group — 21 States, 2013

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Cardiovascular disease (CVD) accounts for one of every three deaths in the United States, making it the leading cause of mortality in the country (*1*). The American Heart Association established seven ideal cardiovascular health behaviors or modifiable factors to improve CVD outcomes in the United States. These cardiovascular health metrics (CHMs) are 1) not smoking, 2) being physically active, 3) having normal blood pressure, 4) having normal blood glucose, 5) being of normal weight, 6) having normal cholesterol levels, and 7) eating a healthy diet (*2*). Meeting six or all seven CHMs is associated with a lower risk for all-cause, CVD, and ischemic heart disease mortalities compared with the risk to persons who meet none or only one CHM (*3*). Fewer than 2% of U.S. adults meet all seven of the American Heart Association's CHMs (*4*). Cardiovascular morbidity and mortality account for an estimated annual $120 billion in lost productivity in the workplace; thus, workplaces are viable settings for effective health promotion programs (*5*). With over 130 million employed persons in the United States, accounting for about 55% of all U.S. adults, the working population is an important demographic group to evaluate with regard to cardiovascular health status. To determine if an association between occupation and CHM score exists, CDC analyzed data from the 2013 Behavioral Risk Factor Surveillance System (BRFSS) industry and occupation module, which was implemented in 21 states. Among all occupational groups, community and social services employees (14.6%), transportation and material moving employees (14.3%), and architecture and engineering employees (11.6%) had the highest adjusted prevalence of meeting two or fewer CHMs. Transportation and material moving employees also had the highest prevalence of "not ideal" ("0" [i.e., no CHMs met]) scores for three of the seven CHMs: physical activity (54.1%), blood pressure (31.9%), and weight (body mass index [BMI]; 75.5%). Disparities in cardiovascular health status exist among U.S. occupational groups, making occupation an important consideration in employer-sponsored health promotion activities and allocation of prevention resources.

BRFSS is a national, random-digit–dialed telephone survey conducted annually by U.S. states and territories to gather data on health-related risk behaviors, chronic illnesses and conditions, and use of health-related services among non-institutionalized, civilian residents aged ≥18 years.* BRFSS includes a standard set of core questions that are asked every year; however, states can chose from optional modules on specific subjects or include state-added questions. In 2013, 21 states† adopted the optional industry and occupation module or asked state-added questions regarding industry and occupation. Combined landline and cell phone response

* http://www.cdc.gov/brfss/annual_data/2013/pdf/overview_2013.pdf.
† California, Florida, Illinois, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oregon, Utah, Washington, Wisconsin, and Wyoming.

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rates[§] in the 21 states ranged from 31.1% in Washington to 59.2% in North Dakota, with an overall median of 44.0%. The optional module contained two questions on industry and occupation. Participants who were employed for wages, self-employed, or out of work for <1 year were asked, "What kind of business or industry do you work in?" and "What kind of work do you do?" Participant responses were open-ended, and were later coded to one of the 574 Bureau of Census (2002) occupation numeric codes; these were grouped for analysis into 22 Standard Occupational Classification System major groups.[¶] Respondents were excluded if information about employment was missing, if they were on active military duty, or if they were unpaid or retired workers. Responses for each of the seven CHMs were scored as "0" for not ideal or "1" for meeting the ideal of that individual metric based on self-reported responses to questions about whether or not the respondent had ever been told by a health care provider that he or she had high blood pressure, high cholesterol, or diabetes. Other questions about smoking, exercise, and weight were calculated from BRFSS or derived from multiple BRFSS questions.[**] The seven CHMs were summed for a score, with a range of 0–7. For the purposes of this study, the CHM score was dichotomized into two groups: 0–2 and 3–7. CHM scores were analyzed by occupational group, adjusted for sociodemographic variables, including age, sex, race/ethnicity, and education level, using logistic regression models in SUDAAN.

[§] http://www.cdc.gov/brfss/annual_data/2013/pdf/2013_DQR.pdf.

[¶] http://www.bls.gov/soc/.

[**] Individual cardiovascular health metrics (BRFSS questions): *Blood pressure*: "Have you ever been told by a doctor, nurse or other health professional that you have high blood pressure?" Options: Met ideal (1) = No; Not ideal (0) = Yes; *Cholesterol*: "Have you ever been told by a doctor, nurse or other health professional that your blood cholesterol is high?" Options: Met ideal (1) = No; Not ideal (0) = Yes; *Glucose*: "Have you ever been told you have diabetes?" Met ideal (1) = No; Not ideal (0) = Yes; *Smoking status*: BRFSS calculated variable; Met ideal (1) = respondents who reported they had not smoked at least 100 cigarettes in their lifetime, those who reported having smoked 100 cigarettes in their lifetime but do not currently smoke; Not ideal (0) = respondents who reported having smoked at least 100 cigarettes in their lifetime and currently smoke; *Physical activity*: BRFSS calculated variable; Met ideal (1) = respondents who meet the recommendation of ≥150 minutes per week of moderate intensity activity, ≥75 minutes of vigorous-intensity activity, or an equivalent combination of aerobic physical activity; Not ideal (0) = respondents who did not meet the previously listed recommendation of physical activity; *Body mass index (BMI)*: BRFSS calculated variable; Met ideal (1) = respondents who have a BMI ≥18.5 kg/m2, also a BMI <25 kg/m2; Not ideal (0) = respondents who have a BMI ≥25 kg/m2; *Diet*: Derived from multiple BRFSS questions. Fruit and vegetable intake was reported via a six-item screener on consumption of 100% fruit juice, whole fruit, dried beans, dark green vegetables, and other vegetables during the previous month. Persons were classified as having an ideal diet if their consumption met or exceeded age- and sex-specific federal fruit and vegetable intake recommendations for persons with a sedentary lifestyle (http://aje.oxfordjournals.org/content/181/12/979.full.pdf+html).

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Adjusted prevalence and prevalence ratios were obtained for CHM scores of 0–2, and for each of the seven individual metrics that contribute to the CHM score, an adjusted prevalence was calculated for not ideal scores. All analyses were weighted unless otherwise noted. Significance was determined by evaluating confidence intervals at $\alpha = 0.05$.

Overall, 102,258 BRFSS participants were currently employed and, therefore, considered for analyses. Among these, 20,771 were excluded because occupation information was missing (n = 16,412 [16%]) or they were on active military duty (n = 268 [0.3%]), unpaid or retired workers (n = 149 [0.1%]), or had a diagnosis of CVD (n = 3,942 [4%]). Among the remaining 81,487 participants, 14,878 were excluded because responses were missing for one or more of the 12 BRFSS questions used to calculate the CHM score. A total of 66,609 respondents (65.1% of the original sample of currently employed) were left for analysis. Adults aged 35–44, 45–54, and 55–64 years accounted for approximately 70% of the sample population; men accounted for approximately 53%, and non-Hispanic whites accounted for 66%. Approximately 39% of the sample population had graduated from college or technical school. The prevalence of meeting two or fewer CHMs was highest among persons aged ≥65 years (18.6%), men (11.1%), non-Hispanic blacks (12.2%), and persons with less than a high school education (17.7%) (Table 1).

Among all occupational groups combined, 3.5% of workers met all seven CHMs (score = 7). Transportation and material moving employees had the highest adjusted prevalence of not ideal (e.g., 0) scores for physical activity (54.1%), blood pressure (31.9%), and BMI (75.5%) (Table 2). Food preparation and serving employees had the highest adjusted prevalence of not ideal scores for smoking (22.8%), and computer and mathematical employees had the highest adjusted prevalence of not ideal scores for cholesterol (39.9%). In addition, personal care and service employees had the highest adjusted prevalence of not ideal scores for blood glucose (10.3%), and farming, fishing, and forestry employees had the highest prevalence of not ideal scores for diet (84.3%).

The prevalence of meeting two or fewer CHMs among all 22 occupational groups was 9.6% (Table 3). Transportation and material moving employees (14.3%) and community and social services employees (14.6%) had the highest adjusted prevalence of meeting two or fewer CHM, and farming, forestry, and fishing employees (5.0%), production (7.7%) and arts, design, entertainment, sports, and media employees (5.9%) had the lowest adjusted prevalence of meeting two or fewer CHM compared with the other occupational groups. The adjusted prevalence ratios (aPRs) indicate community and social services employees (aPR = 1.56) and transportations and material moving employees (aPR = 1.55) are significantly more likely to meet two or fewer CHM compared with the other occupational groups.

Discussion

In 21 states, cardiovascular health indicators measured by CHM score differed among occupational groups, after

TABLE 1. Demographic characteristics and prevalence of meeting ≤2 cardiovascular health metric scores among currently employed adults — Behavioral Risk Factor Surveillance System, 21 states, 2013

Characteristic	Unweighted frequency	Weighted percentage of total sample population % (95% CI)	Prevalence of meeting ≤2 CHM % (95% CI)
Age group (yrs)			
18–24	1,841	5.8 (5.3–6.3)	1.7 (0.8–2.5)
25–34	7,494	17.8 (17.1–18.6)	3.8 (2.8–4.9)
35–44	12,635	22.9 (22.1–23.6)	6.2 (5.2–7.1)
45–54	18,957	28.3 (27.5–29.1)	11.8 (10.6–12.9)
55–64	18,911	19.7 (19.1–20.4)	15.4 (14.1–16.7)
≥65	6,771	5.5 (5.2–5.8)	18.6 (16.0–21.1)
Sex			
Male	30,604	52.8 (52.0–53.7)	11.1 (10.3–11.9)
Female	36,005	47.2 (46.3–48.0)	7.9 (7.2–8.5)
Race/Ethnicity			
White, non-Hispanic	54,390	66.0 (65.1–66.9)	9.2 (8.7–9.7)
Black, non-Hispanic	4,090	9.2 (8.7–9.7)	12.2 (10.2–14.3)
Hispanic	4,188	15.6 (14.8–16.4)	10.1 (8.2–11.9)
Other race or multiracial, non-Hispanic	3,190	9.2 (8.5–9.9)	8.7 (6.0–11.4)
Education			
Less than high school	2,022	8.0 (7.3–8.7)	17.7 (14.2–21.2)
Graduated high school	14,147	22.0 (21.2–22.7)	12.1 (11.0–13.2)
Attended college/technical school	18,564	31.2 (30.4–32.0)	10.4 (9.4–11.4)
Graduated college/technical school	31,876	38.8 (38.0–39.6)	5.8 (5.3–6.3)

Abbreviation: CHM = cardiovascular health metric; CI = confidence interval.

adjusting for age, sex, race/ethnicity, and education level. Persons working in community and social services and transportation and material moving had the highest prevalences of not ideal individual CHMs and were 56% and 55% more likely, respectively, than all other occupational groups to have met two or fewer CHMs. The findings for transportation and material moving occupations are consistent with a previous National Institute for Occupational Safety and Health study on the health of long-haul truck drivers. That study found that approximately 61% of truck drivers reported having two or more of the following health-related risk factors: high blood pressure, obesity, smoking, high cholesterol, no physical activity, or ≤6 hours of sleep within a 24-hour period (*6*).

The findings in this report are subject to at least five limitations. First, respondents who were excluded because of missing data for one or more of the CHM variables were found to be significantly different from respondents who were not missing these data, based on demographic variables, including occupation. This likely biases the results toward the null,

Summary

What is already known about this topic?

Work conditions and organization have a direct impact on health. Findings from studies indicate the existence of an association between cardiovascular disease and certain job factors and between specific cardiovascular disease health behaviors (e.g., smoking status, etc.) and occupational group.

What is added by this report?

Using population-based data, occupational group was found to be significantly associated with both the individual cardiovascular health metrics (CHMs) and the CHM summary score. In 2013, prevalence of meeting two or fewer CHMs ranged from 5.0% among farming, fishing, and forestry employees to 14.6% among community and social services employees.

What are the implications for public health practice?

With significant health disparities among different occupational groups, the results of this study can be used by state organizations and private companies to target cardiovascular disease prevention programs and improve workplace health promotion.

TABLE 2. Adjusted prevalence of individual cardiovascular health metric (CHM) scores of "not ideal" (0) among currently employed adults, by occupational group and CHM — Behavioral Risk Factor Surveillance System, 21 states, 2013

	Adjusted* prevalence of CHM scores % (95% CI)						
Occupational Group (SOC group)	**Smoking status**	**Physical activity**	**Blood pressure**	**Cholesterol**	**Blood glucose**	**Weight (BMI)**	**Diet**
Management (11)	12.2 (10.6–14.0)	44.0 (41.3–46.7)	26.9 (24.7–29.2)	30.3 (28.1–32.6)	6.7 (5.4–8.4)	69.4 (67.0–71.7)	80.4 (78.1–82.5)
Business and Financial Operations (13)	13.4 (10.9–16.4)	45.1 (40.9–49.3)	25.7 (22.4–29.2)	32.3 (28.6–36.3)	7.0 (5.4–9.0)	66.8 (63.5–70.0)	80.3 (76.8–83.4)
Computer and Mathematical (15)	12.4 (9.2–16.4)	45.9 (41.1–50.8)	27.0 (23.2–31.2)	39.9 (35.5–44.5)	7.3 (5.1–10.3)	66.5 (62.0–70.8)	78.7 (73.9–82.8)
Architecture and Engineering (17)	10.1 (7.0–14.5)	46.8 (41.3–52.4)	26.9 (22.5–31.7)	32.6 (28.1–37.4)	7.5 (4.4–12.4)	65.3 (60.5–69.8)	77.7 (72.8–82.0)
Life, Physical, and Social Sciences (19)	10.1 (6.6–15.2)	39.1 (33.3–45.2)	19.4 (15.6–23.9)	29.7 (24.9–35.0)	6.2 (3.5–10.7)	61.4 (55.5–67.0)	79.8 (74.7–84.0)
Community and Social Services (21)	18.1 (12.7–25.2)	48.8 (42.6–55.1)	28.0 (22.6–34.0)	32.9 (27.4–38.9)	9.6 (5.7–15.8)	73.5 (68.3–78.2)	82.5 (78.3–86.1)
Legal (23)	9.9 (6.2–15.5)	43.5 (37.4–49.9)	21.7 (17.3–26.8)	32.0 (26.9–37.6)	8.4 (5.1–13.5)	63.0 (57.1–68.6)	78.3 (72.8–82.9)
Education, Training, and Library (25)	8.5 (6.6–10.9)	42.6 (39.2–46.1)	27.2 (23.9–30.8)	30.9 (27.5–34.4)	7.5 (5.6–9.9)	70.3 (67.6–72.9)	78.1 (75.4–80.7)
Arts, Design, Entertainment, Sports and Media (27)	11.3 (8.1–15.7)	39.1 (33.2–45.2)	22.2 (18.1–26.9)	31.9 (27.4–36.8)	5.3 (3.7–7.6)	57.6 (51.9–63.1)	70.8 (63.9–76.9)
Healthcare Practitioners and Technical (29)	10.9 (9.2–13.0)	46.6 (43.5–49.7)	25.1 (22.5–27.9)	32.3 (29.4–35.4)	6.6 (5.0–8.6)	64.8 (62.1–67.4)	77.0 (74.3–79.4)
Healthcare Support (31)	12.6 (9.7–16.3)	47.2 (41.3–53.1)	26.0 (21.7–30.9)	34.2 (28.9–39.9)	6.1 (4.2–8.7)	74.7 (69.8–79.0)	79.4 (74.4–83.6)
Protective Service (33)	11.9 (8.9–15.8)	38.3 (32.8–44.1)	25.6 (21.2–30.7)	30.0 (24.8–35.8)	5.9 (3.6–9.5)	73.2 (67.0–78.7)	81.0 (75.1–85.8)
Food Preparation and Serving (35)	22.8 (18.5–27.8)	47.0 (40.9–53.2)	22.9 (18.5–28.1)	32.0 (26.3–38.3)	7.8 (5.3–11.2)	63.6 (58.1–68.8)	70.6 (63.6–76.7)
Building and Grounds Cleaning and Maintenance (37)	17.8 (14.6–21.4)	48.7 (43.1–54.4)	30.2 (25.8–35.0)	35.2 (30.4–40.3)	8.6 (6.2–11.7)	67.7 (62.3–72.6)	80.9 (75.5–85.3)
Personal Care and Service (39)	15.3 (12.4–18.7)	40.8 (35.9–45.9)	29.9 (25.3–35.0)	34.0 (29.4–39.0)	10.3 (7.6–13.8)	72.6 (68.1–76.7)	76.8 (72.3–80.8)
Sales and Related (41)	14.5 (12.6–16.7)	45.1 (42.0–48.2)	25.2 (22.8–27.9)	30.8 (28.1–33.6)	6.5 (5.2–8.3)	64.9 (62.1–67.6)	78.9 (75.8–81.7)
Office and Administrative Support (43)	13.3 (11.6–15.2)	47.9 (45.1–50.8)	28.3 (26.0–30.7)	31.5 (29.2–33.8)	8.3 (7.0–9.8)	70.9 (68.5–73.2)	81.3 (78.9–83.4)
Farming, Fishing, and Forestry (45)	8.0 (3.7–16.7)	47.1 (34.2–60.3)	21.7 (13.3–33.3)	27.1 (17.4–39.7)	4.2 (1.9–9.0)	68.7 (55.1–79.6)	84.3 (73.6–91.2)
Construction and Extraction (47)	20.7 (17.5–24.3)	51.1 (46.4–55.8)	26.7 (22.8–31.1)	24.9 (21.5–28.8)	4.0 (2.9–5.7)	67.4 (62.6–71.8)	81.2 (76.2–85.3)
Installation, Maintenance, and Repair (49)	17.4 (13.9–21.5)	50.7 (44.8–56.6)	28.9 (24.2–34.2)	28.3 (23.6–33.6)	3.8 (2.4–6.1)	67.0 (61.5–72.1)	79.0 (73.2–83.9)
Production (51)	14.2 (12.0–16.7)	50.1 (45.7–54.5)	26.5 (22.9–30.4)	28.3 (24.8–32.0)	5.2 (4.0–6.9)	67.6 (62.8–72.1)	79.0 (74.1–83.1)
Transportation and Material Moving (53)	19.7 (16.5–23.4)	54.1 (49.4–58.6)	31.9 (28.0–36.1)	30.0 (26.1–34.3)	7.8 (5.8–10.5)	75.5 (71.4–79.2)	83.4 (79.1–86.9)
All occupational groups	**14.4 (13.8–15.0)†**	**46.3 (45.4–47.2)†**	**26.4 (25.6–27.2)†**	**30.8 (30.0–31.6)†**	**6.9 (6.4–7.3)†**	**67.9 (67.0–68.7)†**	**79.5 (78.8–80.3)†**

Abbreviations: BMI = body mass index; CI = confidence interval; SOC = Standard Occupational Classification.
* Adjusted for age, sex, race/ethnicity, education.
† Unadjusted.

because respondents who did not have missing data were more likely to be white, female, have a higher education level, and to hold a white-collar job. Had the overall sample with all respondents included been used, the significance of results presented would likely have been greater. Second, because BRFSS data are cross-sectional, it is not possible to make causal inferences. Third, BRFSS data are self-reported and therefore, rely on the accuracy of a participant's memory and willingness to be truthful and are subject to recall and social desirability bias. Fourth, the data used in this study were from an optional industry and occupation module administered by 21 states, so findings might not be nationally representative. Finally, the CHM score equally weights all seven metrics, which might not accurately reflect the individual impact of each metric on a person's cardiovascular health.

Although the CHMs are considered to be modifiable at the individual level, it is important to consider the impact that occupational factors might have on the metrics, including such factors as exposure to chemical and physical agents; workplace stress and adverse work organization related to workload and total hours; shift rotation; job assignment and design; and organizational culture (*7*,*8*). Additional research is needed to elucidate the relationship between work factors and cardiovascular health. The CDC Worksite Health ScoreCard was created to help employers evaluate their occupational safety and health and health promotion programs for prevention of heart disease, stroke, and other cardiovascular-related health effects. The scorecard, which was validated in a study of 93 employers in more than 32 states, includes 125 questions that solicit information on a various topics, such as occupational health and safety, physical activity, stress management, diabetes prevention, and organization support (*9*). The American Heart Association projects that by 2030, 43.9% of the U.S. population will have some type of CVD, and indirect costs attributed to lost productivity will increase by 58% to $290 billion (*1*). A growing body of scientific literature indicates that employment status and occupational group are important factors to consider in cardiovascular health research. The workplace is a viable and necessary site for carrying out cardiovascular health interventions, and attention to work conditions as a risk factor for CVD warrants further consideration (*7*,*10*).

TABLE 3. Adjusted prevalence and adjusted prevalence ratio of meeting two or fewer cardiovascular health metrics among currently employed adults, by occupational group — Behavioral Risk Factor Surveillance System, 21 states, 2013

	Adults meeting ≤2 CHMs		
Occupational group (SOC group)	**Unweighted frequency**	**Adjusted* prevalence % (95% CI)**	**aPR* (95% CI)†**
Management (11)	7,404	9.7 (8.3–11.3)	1.02 (0.87–1.19)
Business and Financial Operations (13)	2,991	8.8 (7.1–10.8)	0.92 (0.74–1.14)
Computer and Mathematical (15)	1,879	9.4 (7.3–12.2)	0.99 (0.76–1.29)
Architecture and Engineering (17)	1,781	11.6 (7.6–17.3)	1.23 (0.82–1.84)
Life, Physical, and Social Science (19)	1,225	7.6 (4.7–12.0)	0.80 (0.50–1.28)
Community and Social Services (21)	1,494	14.6 (9.8–21.2)	1.56 (1.07–2.29)§
Legal (23)	936	7.1 (4.3–11.5)	0.75 (0.46–1.23)
Education, Training, and Library (25)	5,480	9.3 (6.6–13.1)	1.00 (0.71–1.39)
Arts, Design, Entertainment, Sports and Media (27)	1,423	5.9 (4.3–8.1)	0.62 (0.45–0.84)§
Healthcare Practitioners and Technical (29)	5,783	8.3 (6.7–10.1)	0.86 (0.70–1.06)
Healthcare Support (31)	1,389	8.6 (6.2–11.8)	0.89 (0.64–1.23)
Protective Service (33)	1,257	8.0 (6.0–10.5)	0.82 (0.61–1.09)
Food Preparation and Serving Related (35)	1,432	8.0 (5.7–11.1)	0.81 (0.57–1.15)
Building and Grounds Cleaning and Maintenance (37)	1,820	11.5 (8.8–14.7)	1.18 (0.91–1.54)
Personal Care and Service (39)	1,823	10.8 (8.1–14.3)	1.13 (0.85–1.51)
Sales and Related (41)	5,323	9.1 (7.6–10.8)	0.95 (0.79–1.13)
Office and Administrative Support (43)	7,417	9.9 (8.6–11.3)	1.04 (0.90–1.21)
Farming, Fishing, and Forestry (45)	387	5.0 (2.5–9.9)	0.50 (0.25–1.00)
Construction and Extraction (47)	2,596	9.4 (7.3–11.9)	0.95 (0.74–1.22)
Installation, Maintenance, and Repair (49)	1,649	9.2 (6.8–12.5)	0.94 (0.69–1.28)
Production (51)	2,365	7.7 (6.2–9.7)	0.78 (0.61–0.98)§
Transportation and Material Moving (53)	2,421	14.3 (11.6–17.6)	1.55 (1.25–1.92)§
All occupational groups	**60,275**	**9.6 (9.0–10.1)**	**—¶**

Abbreviations: aPR = adjusted prevalence ratio; CHM = cardiovascular health metric; CI = confidence interval; SOC = Standard Occupational Classification.
* Adjusted for age, sex, race/ethnicity, and education.
† For calculation of aPR, each occupational group was compared with all other occupational groups.
§ Results are statistically significant.
¶ Unadjusted.

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Incidence of Neonatal Abstinence Syndrome — 28 States, 1999–2013

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Neonatal abstinence syndrome (NAS) is a postnatal drug withdrawal syndrome that occurs primarily among opioid-exposed infants shortly after birth, often manifested by central nervous system irritability, autonomic overreactivity, and gastrointestinal tract dysfunction (*1*). During 2000–2012, the incidence of NAS in the United States significantly increased (*2*,*3*). Several recent publications have provided national estimates of NAS (*2*,*3*); however, data describing incidence at the state level are limited. CDC examined state trends in NAS incidence using all-payer, hospital inpatient delivery discharges compiled in the State Inpatient Databases of the Healthcare Cost and Utilization Project (HCUP) during 1999–2013. Among 28 states with publicly available data in HCUP during 1999–2013, the overall NAS incidence increased 300%, from 1.5 per 1,000 hospital births in 1999, to 6.0 per 1,000 hospital births in 2013. During the study period, significant increases in NAS incidence occurred in 25 of 27 states with at least 3 years of data, with annual incidence rate changes ranging from 0.05 (Hawaii) to 3.6 (Vermont) per 1,000 births. In 2013, NAS incidence ranged from 0.7 cases per 1,000 hospital births (Hawaii) to 33.4 cases per 1,000 hospital births (West Virginia). The findings underscore the importance of state-based public health programs to prevent unnecessary opioid use and to treat substance use disorders during pregnancy, as well as decrease the incidence of NAS.

NAS is a postnatal withdrawal syndrome that comprises a constellation of symptoms in newborns, including central nervous system irritability (e.g., tremors, increased muscle tone, high-pitched crying, and seizures), gastrointestinal dysfunction (e.g., feeding difficulties), and temperature instability (*1*). Although other substances have been implicated, NAS is most often attributed to in utero opioid exposure. This exposure can result from maternal prescription opioid use, which has increased nationally in recent years (*2*,*4*), nonmedical opioid use, or medication-assisted treatment, which is long-term treatment with a longer acting but less euphoric opioid under medical supervision for opioid use disorder. Data on long-term developmental outcomes related to opioid exposure during pregnancy and NAS are limited.

The State Inpatient Databases include de-identified administrative data from all hospital inpatient discharges in a given state, regardless of payer. Data from State Inpatient Databases are compiled by state partners and then translated into a uniform format as part of HCUP, which is sponsored by the Agency for Healthcare Research and Quality. This analysis includes data from 28 states* whose data for 1999–2013 were publicly available on HCUP's online central distributor (https://www.hcup-us.ahrq.gov/tech_assist/centdist.jsp). Consistent with previous methodology (*2*,*3*), in-hospital births were identified using *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes V30.X–V39.X ending in 00 or 01 (indicating single or multiple live born infants), among all hospital discharge records during 1999–2013. Discharge records that did not have a principal or secondary diagnosis code indicating a hospital birth, or that indicated a transfer from another acute care hospital or health care facility, were excluded. Cases of NAS were identified with *ICD-9-CM* code 779.5 (drug withdrawal syndrome in a newborn). Cases of possible iatrogenic withdrawal, resulting from complications related to prolonged neonatal intensive care stay and not exposure during the antenatal period (*ICD-9-CM* codes*:* 765.01–765.05, 770.7, 772.1X, 779.7, 777.5X, 777.6), were excluded from the numerator.

Total incidence rates of NAS (cases per 1,000 births) were calculated for 1999 and 2013, using data available from 14 and 21 states, respectively. In addition, incidence rates of NAS were calculated for each state and year with available data during 1999–2013. Linear trends were assessed using logistic regression with NAS incidence as the outcome variable and infant birth year as the independent variable for the 27 states with at least 3 years of data. Annual incidence rate changes, which reflect average annual change in the incidence rate of NAS over time, were calculated from the beta coefficient of the infant's birth year with a state-specific intercept for states with significant linear trends. P-values <0.05 were considered to be statistically significant.

During 1999–2013, among 29,944,574 hospital births that occurred in the 28 states included in this report, 74,576 NAS cases occurred, reflecting an overall incidence rate of 2.5 cases per 1,000 hospital births. In 1999 (the first year), 2,419 NAS cases were identified among 1,610,733 births in 14 reporting states (1.5 per 1,000 births). In 2013, 8,270 NAS cases were identified among 1,385,371 births in 21 states (6.0 per 1,000 births).

Data for at least 5 consecutive years were available for 27 states (Table). In 1999, NAS incidence ranged from

* Arizona, Arkansas, California, Colorado, Florida, Hawaii, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Mississippi, Nebraska, Nevada, New Jersey, New Mexico, New York, North Carolina, Oregon, Rhode Island, South Carolina, South Dakota, Utah, Vermont, Washington, West Virginia, and Wisconsin.

TABLE. Neonatal abstinence syndrome (NAS) incidence rates per 1,000 hospital births,* by state and year — State Inpatient Databases, Healthcare Cost and Utilization Project, 1999–2013†

State	Year															Annual change in incidence rate§
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Arizona	1.3	1.0	1.0	1.0	1.1	1.3	1.1	1.0	1.2	1.5	1.7	2.6	3.6	3.6	3.9	0.2
Arkansas	—¶	—¶	—¶	—¶	—¶	0.4	0.9	0.4	0.7	1.0	1.3	1.4	2.2	2.7	2.6	0.3
California	1.2	1.2	1.2	—¶	1.1	1.1	1.1	1.0	1.0	1.1	1.2	1.3	1.3	—¶	—¶	—¶
Colorado	0.4	0.6	0.6	0.7	0.6	0.9	0.9	0.9	1.3	1.3	1.4	2.3	2.5	2.8	2.9	0.2
Florida	0.4	0.4	0.5	0.6	0.7	0.7	0.9	1.3	1.7	2.3	3.4	4.9	5.9	5.9	6.3	0.6
Hawaii	—¶	0.1	0.4	0.1	0.4	0.6	—¶	0.6	0.5	0.7	0.5	0.7	0.8	0.8	0.7	0.05
Iowa	0.3	0.4	0.3	0.5	0.6	0.4	0.4	0.5	0.6	0.7	0.8	1.1	1.3	1.9	2.2	0.1
Kentucky	—¶	0.4	0.9	1.3	2.0	2.4	2.5	3.3	3.8	4.7	6.4	7.8	10.5	12.3	15.0	1.3
Maine	1.1	0.9	2.0	3.0	5.2	—¶	—¶	—¶	12.6	15.5	19.0	21.5	21.3	30.4	—¶	3.0
Maryland	7.6	6.5	7.1	6.7	6.3	6.2	6.6	6.6	6.5	7.1	8.2	9.5	10.6	11.4	—¶	0.3
Massachusetts	2.2	2.5	2.7	2.6	2.9	3.8	4.4	5.0	6.1	6.7	8.5	10.0	10.8	12.5	—¶	0.9
Michigan	—¶	0.4	0.5	0.6	0.8	0.9	1.2	1.2	1.7	2.0	2.9	3.6	5.0	5.4	6.7	0.6
Mississippi	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	1.2	1.3	—¶	—¶	—¶
Nebraska	—¶	—¶	0.2	0.1	0.3	0.2	0.7	0.4	0.2	0.4	0.7	1.0	0.8	1.4	1.6	0.1
Nevada	—¶	—¶	—¶	1.1	0.8	1.3	1.5	1.2	1.3	1.6	2.0	3.0	3.3	5.0	4.8	0.4
New Jersey	3.3	3.2	3.5	3.0	3.1	2.6	2.9	2.5	2.7	2.8	3.4	4.1	4.6	5.0	5.2	0.1
New Mexico	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	3.7	4.2	5.8	7.8	8.5	1.5
New York	1.4	1.5	1.3	1.2	1.2	1.3	1.2	1.2	1.4	1.5	1.8	1.9	2.6	2.8	3.6	0.1
North Carolina	—¶	0.3	0.4	0.7	0.7	0.9	1.3	1.3	1.6	1.7	2.7	3.5	4.2	5.3	6.4	0.6
Oregon	1.0	1.0	1.2	1.5	1.3	2.1	2.1	2.0	2.0	2.3	2.9	3.7	4.4	4.5	5.0	0.3
Rhode Island	—¶	—¶	—¶	2.8	3.3	3.5	4.6	3.4	5.1	5.6	6.0	5.8	8.1	7.3	—¶	0.5
South Carolina	1.3	0.9	0.6	0.4	0.7	1.1	1.1	1.5	1.3	1.5	1.9	2.2	2.7	3.3	3.9	0.2
South Dakota	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	0.2	0.9	0.8	1.0	1.3	0.8	0.8	—¶
Utah	—¶	0.8	0.9	1.3	1.0	1.3	2.0	1.9	2.3	2.5	2.5	3.5	4.1	—¶	—¶	0.3
Vermont	—¶	—¶	0.7	2.7	3.7	4.1	8.1	9.1	12.5	15.8	20.9	25.3	26.2	30.5	33.3	3.6
Washington	1.5	1.3	1.6	1.7	2.1	2.7	3.5	3.4	3.2	3.6	4.5	5.6	6.7	6.9	7.9	0.5
West Virginia	—¶	0.5	1.0	1.7	3.3	3.4	6.9	7.1	7.5	10.2	11.0	14.2	16.9	21.7	33.4	2.7
Wisconsin	0.4	0.4	0.3	0.5	0.6	1.1	0.9	1.7	1.9	2.5	2.9	4.1	5.5	5.7	7.9	0.7

* Incidence rate numerator consisted of NAS cases excluding cases of iatrogenic withdrawal; incidence rate denominator consisted of state in-hospital births excluding transfers from another acute care hospital or healthcare facility.
† Linear trends were assessed using logistic regression model for states with at least 3 years of data; p-values for linear trends were significant at <0.05 for all states except California and South Dakota.
§ Annual change in incidence rates per 1000 hospital births were only assessed for states that had a significant linear trend, assessed using logistic regression, and estimated from the beta coefficient of the infant's birth year with a state specific intercept.
¶ Data not available or annual change in incidence rates not calculated because of insufficient data or nonsignificant linear trend.

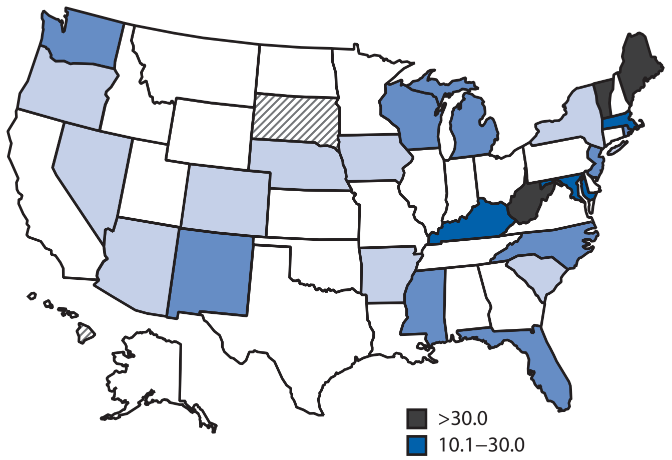
0.3 per 1,000 births in Iowa to 7.6 per 1,000 births in Maryland. In 2013, NAS incidence ranged from 0.7 per 1,000 births in Hawaii to 33.4 per 1,000 births in West Virginia. During 2012–2013, three of 25 states (Maine, Vermont, and West Virginia), reported NAS incidence rates >30 per 1,000 hospital births (Figure). From 1999 to 2013, the incidence of NAS significantly increased in 25 of the 27 states with at least 3 years of data included in this report (Table). NAS incidence rates did not change significantly in California and South Dakota during 1999–2013. The annual incidence rate change over 1999–2013 was lowest in Hawaii (0.05 per 1,000 births) and highest in Vermont (3.6 per 1,000 births).

Discussion

The overall incidence of NAS in the states included in this report has increased almost 300% during 1999–2013, from 1.5 to 6.0 cases per 1,000 hospital births. This increase in NAS incidence is consistent with that reported by other studies, which have described a national increase in incidence of 383% (from 1.2 cases per 1,000 hospital births in 2000 to 5.8 cases per 1,000 hospital births in 2012)(*2*,*3*). Substantial variation in NAS incidence and trends by state exist, with incidences in 2013 ranging from 0.7 (Hawaii) to 33.4 per 1,000 births (West Virginia). Differences in NAS incidence might be caused by variations across states in opioid prescribing rates (*5*), prevalence of illicit opioid use, or use of the *ICD-9* code that identifies NAS.

State governments partially finance and fully administer Medicaid programs, direct block-grant funds relevant to treatment of substance use disorders and maternal and child health programs, and license health care professionals. Previous research indicates that Medicaid programs were financially responsible for approximately 80% of the estimated $1.5 billion in NAS-related annual hospital charges in 2012 (*3*). Taken together, these factors make state-specific NAS estimates important to the formulation of public health plans to improve the health of mothers and infants affected by opioid use.

FIGURE. Neonatal abstinence syndrome (NAS) incidence rate* — 25 states, 2012–2013†



Source: State Inpatient Databases, Healthcare Cost and Utilization Project.
* NAS cases per 1,000 hospital births.
† Incidence rates reported are for 2013, except for four states (Maine, Maryland, Massachusetts, and Rhode Island) for which 2013 data were not available; 2012 data are reported for these states.

Summary

What is already known about this topic?

Neonatal abstinence syndrome (NAS) is a postnatal drug withdrawal syndrome in newborns caused primarily by in utero exposure to opioids. In the United States, the incidence of NAS increased 383% during 2000–2012, and an estimated 80% of hospital charges for NAS are covered by state Medicaid programs.

What is added by this report?

During 1999–2013, state-specific NAS incidence rates increased significantly in 25 of 27 states with at least 3 years of data, with annual changes in incidence rates ranging from 0.05 (Hawaii) to 3.6 (Vermont) per 1,000 hospital births. In 2013, NAS incidence ranged from 0.7 (Hawaii) to 33.4 cases (West Virginia) per 1,000 hospital births.

What are the implications for public health practice?

Prevention efforts, such as promotion of effective use of prescription drug monitoring programs, are needed to reduce inappropriate prescribing and dispensing of opioids. Clinicians should follow recommended guidelines on appropriate prescribing of opioid medications and provide screening and treatment for opioid use disorder among pregnant and nonpregnant women of reproductive age. Monitoring state-specific NAS incidence rates is important to ensure that adequate treatment and resources exist to address the effects of maternal opioid use and NAS within jurisdictions.

The findings in this report are subject to at least four limitations. First, the State Inpatient Databases include de-identified administrative data, and counts of NAS cases are based on information collected at the delivery hospitalization. In this analysis, only cases at the originating hospitals were counted. Cases identified as transfers from another hospital were not counted, to minimize possible duplication of counts and thus, overreporting of infants with NAS who might need a higher level of care. However, these rates are likely underestimates, as hospital administrative data identify fewer cases of NAS than does clinical reporting (*6*). Second, these estimates are not generalizable to births that occur outside of the hospital; however, out-of-hospital deliveries represented only 1.5% of births in 2014 (*7*). Third, although statistically significant annual changes in incidence rates were observed, these changes might not represent large increases in actual numbers of affected infants, depending on the birth population in each state. Finally, data are not generalizable to the entire United States, but only to the 28 states included in this report.

Primary prevention measures are important in curbing the incidence of NAS. In 2016, CDC released the *Guideline for Prescribing Opioids for Chronic Pain*, which recommends that clinicians 1) consider nonopioid pharmacologic therapy for chronic pain management, 2) discuss family planning and how long-term opioid use might affect future pregnancies before initiating opioid therapy in reproductive-aged women, and 3) prescribe the lowest effective dose when opioids are started (*8*). Individual states have implemented strategies to address the opioid epidemic and NAS. Prescription drug monitoring programs are operational or will be implemented in 49 states and the District of Columbia (www.cdc.gov/drugoverdose/pdmp) to track prescribing and dispensing of controlled prescription drugs; these programs have been shown to reduce inappropriate prescribing and overdose deaths (*9*). In addition, Florida, Georgia, Kentucky, and Tennessee have made NAS a reportable condition to state health departments to improve public health surveillance. Implementation of this type of passive surveillance of NAS can help states successfully target prevention and treatment measures, including access to medication-assisted treatment, the standard of care recommended by the American College of Obstetricians and Gynecologists for pregnant women with opioid use disorders (*10*). As part of the Protecting Our Infants Act of 2015,† CDC continues to provide technical assistance to states and American Indian tribes to improve NAS surveillance and to support implementation of effective public health measures.

† https://www.congress.gov/bill/114th-congress/senate-bill/799.

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Evaluating the Impact of National Public Health Department Accreditation — United States, 2016

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In 2011, the nonprofit Public Health Accreditation Board (PHAB) launched the national, voluntary public health accreditation program for state, tribal, local, and territorial public health departments. As of May 2016, 134 health departments have achieved 5-year accreditation through PHAB and 176 more have begun the formal process of pursuing accreditation. In addition, Florida, a centralized state in which the employees of all 67 local health departments are employees of the state, achieved accreditation for the entire integrated local public health department system in the state. PHAB-accredited health departments range in size from a small Indiana health department that serves approximately 17,000 persons to the much larger California Department of Public Health, which serves approximately 38 million persons. Collectively, approximately half the U.S. population, or nearly 167 million persons, is covered by an accredited health department. Forty-two states and the District of Columbia now have at least one nationally accredited health department. In a survey conducted through a contract with a social science research organization during 2013–2016, >90% of health departments that had been accredited for 1 year reported that accreditation has stimulated quality improvement and performance improvement opportunities, increased accountability and transparency, and improved management processes.

In 2003, the Institute of Medicine published a report on the future of the public's health in the 21st century. The report discussed the need to strengthen public health infrastructure, and recommended accreditation as a potential strategy (*1*). With support from CDC and the Robert Wood Johnson Foundation, and participation by hundreds of public health practitioners and other technical experts, the first national accreditation program for health departments was developed (*2*). PHAB was incorporated in 2007. Its mission is to improve and protect the health of the public by advancing and transforming the quality and performance of governmental public health departments,* of which there are approximately 2,500 in the United States. Drawing on existing public health standards, and using a consensus process (*3*), PHAB developed and tested a set of standards and measures organized around the 10 Essential Public Health Services.† Health departments are encouraged to assess themselves against the standards and measures to identify and fill gaps before applying. The amount of time health departments spend in preparation for accreditation will vary based on their readiness. Once they determine they are ready, they submit an application, pay a fee based on the size of the population of the jurisdiction they serve, and provide documentation for each measure, including a community health assessment, a community health improvement plan, and an organizational strategic plan. Volunteer peer site visitors review the documentation and assess its conformity with the measures. The PHAB Accreditation Committee reviews the site visit report and determines whether the applicant will be accredited at that time or be required to develop and implement an action plan (*4*). Using this process, health departments in 45 states and the District of Columbia have applied for accreditation. (Figure). Working with CDC and other national partners, PHAB is widely disseminating the benefits of accreditation to health departments and the communities they serve, and working to raise awareness about technical assistance and other resources to support the pursuit of accreditation.

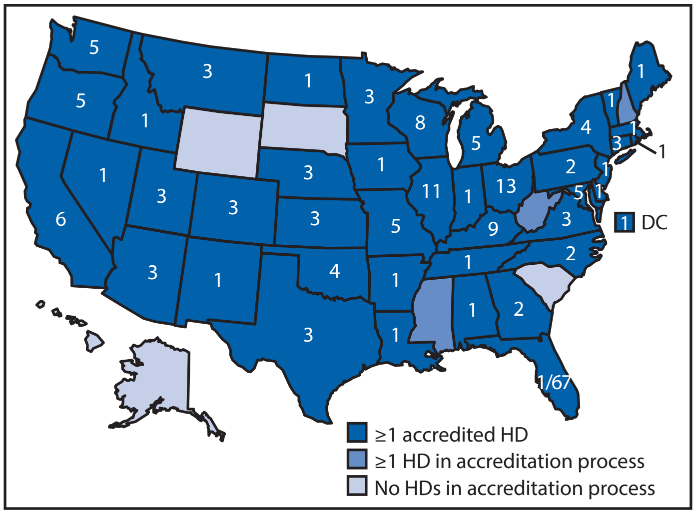
To identify opportunities to improve the accreditation process and to understand the impact of accreditation, in 2013, PHAB contracted with a social science research organization, NORC at the University of Chicago,§ to conduct an evaluation. Among other data collection and analysis strategies, NORC surveys health departments 1 year after they have been accredited. Most survey questions ask respondents to indicate whether they "strongly agree," "agree," "disagree," or "strongly disagree" with (or "don't know" about) a series of

* http://www.phaboard.org.

† The 10 Essential Public Health Services are to 1) monitor health status to identify and solve community health problems; 2) diagnose and investigate health problems and health hazards in the community; 3) inform, educate, and empower persons about health issues; 4) mobilize community partnerships to identify and solve health problems; 5) develop policies and plans that support individual and community health efforts; 6) enforce laws and regulations that protect health and ensure safety; 7) link persons to needed personal health services and assure the provision of health care when otherwise unavailable; 8) assure competent public and personal health care workforce; 9) evaluate effectiveness, accessibility, and quality of personal and population-based health services; and 10) research for new insights and innovative solutions to health problems. http://www.cdc.gov/nphpsp/essentialservices.html.

§ http://www.norc.org.

FIGURE. Number*,† of Public Health Accreditation Board–accredited health departments (HDs) — United States, May 2016



* Number indicates the total number of accredited HDs in that state.
† Accreditation of Florida's local public health department system, made up of 67 HDs.

accreditation-related statements. Data in this report were obtained from surveys sent to health departments quarterly throughout October 2013–January 2016. During this time, the survey was sent to 60 health departments, 52 (87%) of which responded. In addition to this survey, NORC conducted three focus groups and 18 interviews with health department personnel and stakeholders to gain additional insights about health departments' experiences with accreditation and its perceived impact.

The overwhelming majority of survey respondents agreed or strongly agreed that accreditation stimulated quality and performance improvement opportunities within the health department (98%), allowed the health department to better identify strengths and weaknesses (96%), helped the health department document capacity to deliver the three core functions of public health (i.e., assessment, policy development, and assurance) and the 10 Essential Public Health Services (94%), stimulated greater accountability and transparency within the health department (92%), and improved the management processes used by the leadership team in the health department (90%) (Table). Most respondents also agreed or strongly agreed that accreditation improved the health department's accountability to external stakeholders (83%) and allowed the health department to communicate better with the board of health or governing entity (67%). Other accreditation benefits reported by accredited health departments that participated in focus groups and interviews include improved visibility, credibility, and reputation among their community partners, board of health, and public health peers within the state and nationally; improved identification and use of evidence-based programs and metrics; and increased cross-department collaboration.

Because quality improvement is an important focus of the accreditation process, the evaluation gathered additional information about health departments' engagement in quality improvement. Among health departments that had been accredited for 1 year, 98% of survey respondents agreed or strongly agreed that, as a consequence of the accreditation process, the health department had used information from quality improvement processes to inform decisions. In addition, 92% of survey respondents agreed or strongly agreed that because of accreditation, the health department had a strong quality improvement culture (Table). In a focus group discussion with 12 accredited local health departments, participants described how accreditation provided an opportunity for their health department to evolve from one that only periodically used quality improvement to an organization that viewed improvement and data-driven performance management as part of standard operations.

TABLE. Impacts of public health accreditation and the accreditation process reported by health departments accredited by the Public Health Accreditation Board for 1 year (n = 52), 2014–2016

Impact of accreditation	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Don't know (%)
Stimulated quality and performance improvement opportunities within the health department	31 (60)	20 (38)	1 (2)	0 (0)	0 (0)
Allowed the health department to better identify strengths and weaknesses	33 (63)	17 (33)	2 (4)	0 (0)	0 (0)
Helped the health department document the capacity to deliver the three core functions of public health and Ten Essential Public Health Services	25 (48)	24 (46)	2 (4)	0 (0)	1 (2)
Stimulated greater accountability and transparency within the health department	22 (42)	26 (50)	3 (6)	0 (0)	1 (2)
Improved the management processes used by the leadership team in the health department	16 (32)	29 (58)	3 (6)	0 (0)	2 (4)
Improved the health department's accountability to external stakeholders	17 (33)	26 (50)	7 (13)	0 (0)	2 (4)
Allowed the health department to better communicate with the board of health or governing entity	10 (19)	25 (48)	12 (23)	1 (2)	4 (8)
Improved the health department's competitiveness for funding opportunities	11 (21)	15 (29)	13 (25)	3 (6)	10 (19)
Quality improvement					
Health department has used information from the quality improvement processes to inform decisions	27 (53)	23 (45)	1 (2)	0 (0)	0 (0)
Health department has a strong culture of quality improvement	17 (33)	30 (59)	3 (6)	0 (0)	1 (2)

Summary

What is already known about this topic?

In 2011, the Public Health Accreditation Board launched the national, voluntary public health accreditation program as a strategy to advance the quality and performance of governmental public health departments. As of May 2016, 134 state and local health departments have been accredited. In addition, Florida, in which employees of all 67 local health departments are employees of the state, achieved accreditation for the entire integrated local public health department system in the state. Collectively, nearly 167 million persons, approximately half the U.S. population, are covered by an accredited health department.

What is added by this report?

A survey of health departments that had been accredited for one year indicates that >90% report experiencing benefits such as stimulation of quality improvement and performance improvement opportunities; increased accountability and transparency; and improved management processes.

What are the implications for public health practice?

As governmental public health departments work to promote and protect the public's health, it is critical that they have a strong infrastructure. Accreditation has the potential to strengthen health departments' cross-cutting capacities and infrastructure by fostering their engagement in quality improvement, strengthening management processes, and improving accountability.

Discussion

Health departments undergoing the accreditation process report multiple benefits, including increased transparency, strengthened management processes, and improved ability to identify organizational weaknesses. One of the foremost reported benefits is the increased use of quality improvement information in decision- making and in supporting a stronger culture of quality improvement. A report on a series of studies examining the response of public health decision-makers to accreditation, quality improvement, and public reporting initiatives suggests that quality improvement can strengthen implementation of evidence-based strategies and enhance the efficiency and effectiveness of public health programs (*5*). Health departments also report that as a result of accreditation they communicate better with their governing entities. Although this benefit is reported less frequently than some of the others, in response to an open-ended question, several health departments indicated that they might not have agreed that accreditation caused a specific change if the question related to an area in which they were already strong before applying.

This evaluation is the first to examine the impacts of the national public health accreditation program on quality improvement, management processes, and accountability. However, the findings are consistent with an earlier evaluation of PHAB's pilot test in 30 health departments (*6*) and with evaluation findings from a state-based public health accreditation program (*7*). Those studies found that health departments participating in accreditation activities experienced benefits related to quality improvement and collaboration. In addition, a series of case studies by applicant health departments highlights many of the same findings from the current evaluation, particularly the connection between accreditation and advancements in quality improvement (*8*).

The findings in this report are subject to at least three limitations. First, all survey data are self-reported and have not been verified independently. Social desirability bias could result in respondents overreporting their quality improvement activities. Second, survey respondents are among the early adopters of accreditation. Although the health departments included in this study were diverse in size, geographic location, and structure, they might not be representative of all health departments. Finally, because accreditation is a voluntary program, selection bias might apply. For example, health departments are required to provide examples of quality improvement activities to demonstrate conformity with the PHAB standards. Therefore, health departments that were already active in this area might be more likely to apply, particularly in the first few years of the accreditation program. As a growing number of health departments are accredited, future studies can use other quantitative techniques to study the effects of accreditation.

The 2003 Institute of Medicine report that recommended that the public health field explore accreditation also described the need for governmental public health agencies to have strong organizational capabilities. Strengthening health departments' cross-cutting capacities and infrastructure (*9*) might allow health departments to partner more effectively with community organizations, health care organizations, and other stakeholders to improve the public's health. The initial evaluation findings reported in this study suggest that health departments that have participated in the accreditation process have experienced these intended benefits.

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Outbreak of Plague in a High Malaria Endemic Region — Nyimba District, Zambia, March–May 2015

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Outbreaks of plague have been recognized in Zambia since 1917 (*1*). On April 10, 2015, Zambia's Ministry of Health was notified by the Eastern Provincial Medical Office of possible bubonic plague cases in Nyimba District. Eleven patients with acute fever and cervical lymphadenopathy had been evaluated at two rural health centers during March 28–April 9, 2015; three patients died. To confirm the outbreak and develop control measures, the Zambia Ministry of Health's Field Epidemiology Training Program (ZFETP) conducted epidemiologic and laboratory investigations in partnership with the University of Zambia's schools of Medicine and Veterinary Medicine and the provincial and district medical offices. Twenty-one patients with clinically compatible plague were identified, with symptom onset during March 26–May 5, 2015. The median age was 8 years, and all patients were from the same village. Blood specimens or lymph node aspirates from six (29%) patients tested positive for *Yersinia pestis* by polymerase chain reaction (PCR). There is an urgent need to improve early identification and treatment of plague cases. PCR is a potential complementary tool for identifying plague, especially in areas with limited microbiologic capacity. Twelve (57%) patients, including all six with PCR-positive plague and all three who died, also tested positive for malaria by rapid diagnostic test (RDT). Plague patients coinfected with malaria might be misdiagnosed as solely having malaria, and appropriate antibacterial treatment to combat plague might not be given, increasing risk for mortality. Because patients with malaria might be coinfected with other pathogens, broad spectrum antibiotic treatment to cover other pathogens is recommended for all children with severe malaria, until a bacterial infection is excluded.

Epidemiologic Investigation

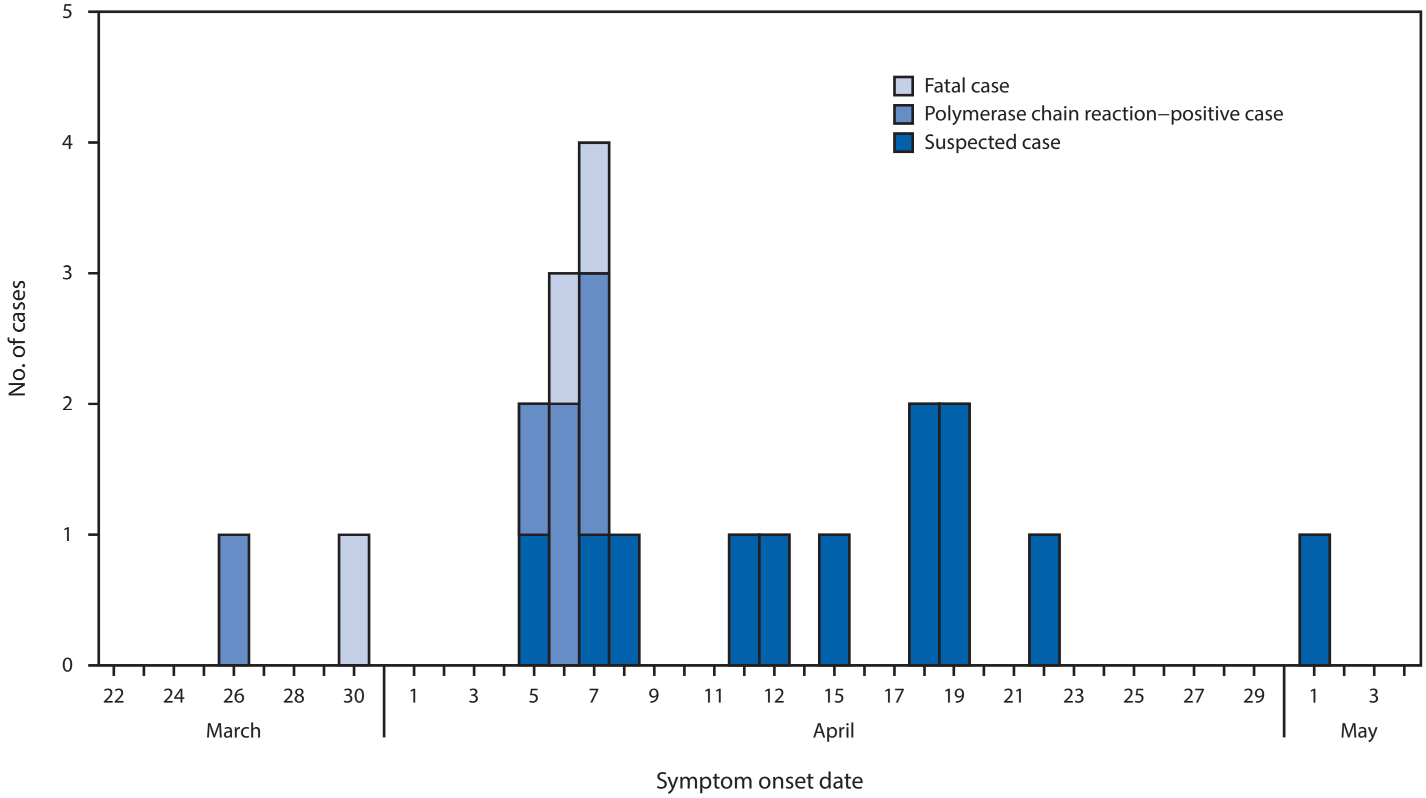
After the initial report of possible plague cases, the Nyimba District Medical Office began active case finding in the health center catchment areas. During March 26–May 5, 2015, a total of 111 patients with fever or recent history of fever, and swollen lymph nodes were identified and evaluated for possible plague; 82 (75%) patients were admitted to the health centers, treated with intravenous gentamycin and benzyl penicillin, and observed for at least one night. The remaining 29 patients received oral doxycycline and cotrimoxazole as outpatients.

The ZFETP investigation team arrived on April 29 to support the local response. Illness clinically compatible with plague was defined as temperature ≥100.4°F (≥38°C) or history of recent fever, and at least one of the following signs or symptoms: 1) painful, visibly enlarged cervical, axillary, or inguinal lymph nodes; 2) evidence of sepsis (prostration, reduced responsiveness, or hypotension); or 3) severe pneumonia (cough with respiratory distress or hemoptysis). A suspected case of plague was defined as a clinically compatible illness in a resident of Nyimba District, with symptom onset during March 15–May 5.

Among the 82 patients who had been hospitalized, 25 (not including any of the 21 identified with clinically compatible plague with symptom onset during March 26–May 5, 2015) were available for physical examination. None had lymph node enlargement consistent with buboes, and none met the case definition. Based on medical record review, among all 82 hospitalized patients, 21 (26%) from the same village met the suspected plague case definition. Among these patients, the earliest reported symptom onset was March 26, and the number of cases peaked during April 6–7 (Figure). The median age was 8 years (range = 3–18 years), and 95% were aged <15 years. Eleven (52%) patients were male. After fever, the most common signs and symptoms were swollen cervical lymph nodes (90%), cough (38%), and headache (33%) (Table 1). Two patients who died lacked documentation of enlarged nodes, although both had reported neck pain.

Among the 21 suspected cases, blood specimens were collected from 11 (52%) patients, and lymph node aspirates were collected from three (14%) patients for culture. Both blood and lymph node aspirates were obtained from two patients (Table 2). Specimens were stored at the district hospital laboratory at 39°F–46°F (4°C–8°C) before being transported to the University Teaching Hospital reference laboratory in Lusaka, a process that took 3–17 days. Blood from four patients was placed in ethylenediaminetetraacetic acid (EDTA)–containing tubes, making these specimens unsuitable for culture. The remaining seven blood specimens remained negative for *Y. pestis* after 7 days, including one that likely grew a contaminant. All three lymph node aspirates were culture-negative. Five blood specimens and two lymph node aspirates (six patients) tested positive for *Y. pestis* by PCR targeting a 478-base pair region of the *Y. pestis* plasminogen activator gene (*2*) (Table 2).

FIGURE. Symptom onset date, outcome, and epidemiologic and laboratory confirmation status of 21 plague cases — Nyimba District, Zambia, March–May, 2015



Among 18 (86%) suspected plague patients tested for malaria during initial evaluation by RDT (SD-Bioline Malaria Ag, Standard Diagnostic Incorporation, St. Ingbert, Germany), 12 (57%) tested positive, including all six who tested PCR-positive for plague. All of the first (according to date of symptom onset) four suspected plague patients tested positive for malaria and were treated with antimalarials (coartem and arteminisin combination therapy) on their first visit. However three of the four patients had antibiotics added to their treatment regimen on their second visits to the health center. Two of the three patients who experienced this delayed initiation of antibiotic therapy died.

Structured interviews conducted with suspected plague patients or their caretakers and families of the decedents revealed that all 21 cases slept on reed mats on the floors of their huts, which was the practice among children in the village. Although no comparison group was interviewed, village elders reported that adults generally slept on beds or mats elevated off the ground.

In response to the outbreak, indoor spraying of 1,303 (96%) households in the two rural health center catchment areas was conducted using organophosphates (fenitrothion and pirimiphos-methyl), aimed at reducing the flea population, and recommendations were made to local leaders regarding risks for plague transmission, including that no one should sleep on the floor. Heightened surveillance for possible plague cases was initiated in this catchment area.

Discussion

The first recorded outbreak of bubonic plague in Nyimba District, Zambia resulted in 21 suspected cases and three deaths, primarily among children, during March 26–May 5, 2015. Although no cases were confirmed by culture (the gold standard), six patients tested positive for *Y. pestis* by PCR. The median age of cases in this outbreak was much lower than that in previous outbreaks in Africa (*3*,*4*). One possible explanation for the younger age distribution and absence of cases among adults was the practice of children sleeping on the floor, which might have brought children into closer contact with fleas, whereas adults generally slept on beds elevated off the floor. The identification of exclusively cervical buboes was unexpected, but it is not clear that examination of inguinal or axillary areas was performed consistently. A higher frequency of cervical buboes in plague cases in children compared with adults has been reported,

TABLE 1. Demographic and clinical characteristics of 21 suspected plague cases — Nyimba District, Zambia, March–May, 2015

Characteristic	No. (%)
Sex	
Male	11 (52)
Female	10 (48)
Age group (yrs)	
1–4	6 (29)
5–9	6 (29)
10–14	8 (38)
15–20	1 (4)
Clinical characteristics	
History of fever	21 (100)
Temperature ≥38°C	14 (67)
Swollen cervical lymph nodes	19 (90)
Cough	8 (38)
Headache	7 (33)
Neck ache	4 (19)
Abdominal pain	3 (14)
Sore throat	3 (14)
Vomiting	3 (14)
Diarrhea	2 (9)
Malaria rapid diagnostic test	
Positive	12 (57)

although the inguinal region was the most common bubo location in all age groups (*3*).

A large proportion (57%) of cases, including all three fatal cases and all six PCR-positive plague cases, also tested positive for malaria. Malaria positivity might have delayed diagnosis and initiation of antibiotic treatment in some early cases in this outbreak, which might have contributed to poor outcomes. Malaria is often overdiagnosed in regions of Africa with endemic malaria, potentially delaying appropriate therapy for other bacterial illnesses (*5*). In areas where malaria is highly endemic, parasitemic patients can be acutely coinfected with another pathogen (*6*), including *Y. pestis* (*7*). Malaria parasitemia in Nyimba is high (21.2%) (*8*), so testing of febrile patients for malaria is routine. The availability of malaria RDTs in health facilities might influence a health provider to treat an RDT-positive patient for only malaria without considering bacterial coinfections. Malaria treatment guidelines published by the Zambia Ministry of Health* and the World Health Organization† recommend antibiotics for all patients with severe disease. This recommendation could be strengthened by explicit guidance that antibiotic treatment of severely ill patients should be administered even if the patient tests positive for malaria. The antibiotic regimens that were given to the suspected cases were appropriate for the treatment of plague and might have reduced the possibility of developing worse outcomes.

PCR supported the plague diagnosis in Nyimba, because *Y. pestis* was not isolated from blood specimens or lymph node aspirates obtained from suspected cases. Bacterial isolation is difficult in rural Zambia because of the lack of local microbiology capacity, inexperience with specimen collection and handling, and transport delays to the reference microbiology and PCR laboratory, 217 miles (350 kilometers) away. Blood specimens from the first cases were improperly collected, and at least one culture was contaminated with skin flora, suggesting breaches in sterile specimen collection technique. *Y. pestis* grows on general nutrient-rich media, but at 98.6°F (37°C), its growth rate is slower than that of most other bacteria; therefore, organisms that replicated faster (*9*) might have masked its presence. Further, it is likely that most patients received antibiotics before specimen collection, although this was not documented. Under these challenging conditions, PCR testing might be more sensitive than culture, because it does not rely on detection of viable organisms. Microbiologic confirmation has been lacking in previous plague outbreaks in Zambia (*10*) and elsewhere in Africa (*4*). However, PCR is not considered

Summary

What is already known about this topic?

Plague is a bacterial disease of rodents caused by *Yersinia pestis*, and approximately 90% of cases are reported from Africa. Sporadic plague outbreaks have occurred in Zambia since 1917. Plague is transmitted to humans through the bite of an infected flea. Case fatality rates for untreated plague range from 66%–93%; prompt treatment with antimicrobials can be lifesaving.

What is added by this report?

During a plague outbreak in the Eastern Province of Zambia during March–May 2015, 21 patients with illnesses clinically compatible with plague were identified, three of whom died. Six patients tested positive for *Y. pestis* by polymerase chain reaction (PCR); 11 blood specimens and two lymph node aspirates tested for *Y. pestis* by culture were negative. Thirteen of 21 suspected plague patients also tested positive for malaria. Most plague patients were children aged <15 years, and children typically slept on floors in huts.

What are the implications for public health practice?

Delayed recognition of plague in an area where malaria is prevalent might have resulted in delayed treatment and poorer outcomes. PCR testing might improve detection of plague in settings with limited microbiologic capacity. Efforts should be made to increase awareness of plague and its associated risk factors among clinicians and frontline health workers to improve prevention, early case recognition, and treatment. Children with severe malaria should also be treated with antibiotics until bacterial infection is excluded.

* Government of the Republic of Zambia, Ministry of Health. Guidelines for the Diagnosis and Treatment of Malaria in Zambia. http://apps.who.int/medicinedocs/documents/s22367en/s22367en.pdf.

† World Health Organization. http://apps.who.int/iris/bitstream/10665/162441/1/9789241549127_eng.pdf.

TABLE 2. Summary of laboratory results for suspected plague cases — Nyimba District, Zambia, March–May, 2015 (N = 21)

Case no.	Age (yrs)	WBC (x1000) on admission (field test)	Malaria RDT result (field test)	Specimens collected for transport to reference laboratory	Culture result (reference laboratory)	PCR result for *Y. pestis* (reference laboratory)	Outcome
1	6	11.3	Positive	Blood	Unsuitable for culture†	Positive	Alive
2	13	—*	Positive	None	—*	—*	Dead
3	11	—*	Positive	None	—*	—*	Dead
4	4	12.4	Positive	Blood	Unsuitable for culture†	Positive	Alive
		—*	—*	Lymph node aspirate	No growth	Positive	Alive
5	13	—*	Positive	None	—*	—*	Dead
6	3	—*	Positive	None	—*	—*	Alive
7	10	5.5	Positive	Blood	No growth	Positive	Alive
8	14	12.5	Positive	Lymph node aspirate	No growth	Positive	
9	3	—*	Positive	None	—*	—*	Alive
10	4	8.1	Positive	Blood	Unsuitable for culture†	Positive	Alive
11	5	—*	—*	None	—*	—*	Alive
12	8	7.9	Positive	Blood	Unsuitable for culture†	Positive	Alive
13	11	—*	Positive	Blood	No growth	—*	Alive
14	10	—*	Negative	Blood	No growth	—*	Alive
15	3	—*	Negative	None	—*	—*	Alive
16	8	—*	Negative	None	—*	—*	Alive
17	5	—*	Negative	Blood	No growth	—*	Alive
18	10	—*	Negative	Blood	No growth	—*	Alive
19	8	—*	Negative	Blood	No growth	—*	Alive
20	4	—*	—*	None	—*	—*	Alive
21	18	—*	—*	Blood	Coagulase-negative staphylococcus	—*	Alive
		—*	—*	Lymph node aspirate	No growth	—*	Alive

Abbreviations: PCR = polymerase chain reaction; RDT = rapid diagnostic test; WBC = white blood cell.
* Test not done.
† Blood specimens were unsuitable for culture because they were incorrectly collected in ethylenediaminetetraacetic acid (EDTA) containers instead of blood culture bottles.

the gold standard for plague, because false-positive results can occur with specimen cross-contamination.

The findings in this report are subject to at least three limitations. First, among 111 patients identified through active case finding, medical records of 29 (26%) were unavailable for review, which might have resulted in underascertainment of cases. Second, only 25 patients were available for examination during their acute illness, leaving investigators to rely on review of medical records to classify cases. Although follow-up interviews with patients or their parents allowed investigators to confirm symptoms, the number of actual cases might have been underestimated because of missing and incomplete data. Finally, the lack of a control group limited the ability to assess risk factors for illness compatible with plague.

Plague is probably underdetected in Zambia because of limited clinical recognition and laboratory capacity. Had the multiple subsequent cases not raised alarm, the initial cases in Nyimba would likely have been attributed to severe malaria, and plague might not have been recognized. PCR might improve detection, but will not influence clinical management given the long diagnostic delays. A point-of-care diagnostic test could improve early diagnosis and guide appropriate therapy. Efforts to increase awareness of plague among frontline health workers can improve early case recognition and treatment. Broad spectrum antibiotic treatment to cover other pathogens is recommended for all children with severe malaria, until a bacterial infection is excluded.

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Notes from the Field

Shigellosis Outbreak Among Men Who Have Sex with Men and Homeless Persons — Oregon, 2015–2016

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In July 2015, *Shigella sonnei* infections with a specific pulsed-field gel electrophoresis (PFGE) pattern linked to a multistate outbreak were recognized among men who have sex with men (MSM) in the Portland metropolitan area, and an outbreak investigation was initiated. During November 2015, isolates with PFGE patterns indistinguishable from the outbreak strain were identified in cases reported in four women, none of whom had epidemiologic links to other affected persons; however, three reported homelessness. In the ensuing months, additional *S. sonnei* infections were reported among homeless persons in the Portland area.

Shigella is the third most common cause of bacterial gastroenteritis in the United States, resulting in approximately 500,000 infections, 100,000 hospitalizations, and 500 deaths annually (*1*); *S. sonnei* is most commonly reported. *Shigella* is transmitted by the fecal-oral route and is highly infectious, highlighting the importance of hygiene in outbreak control (*2*). In high-income countries, children, travelers to low-income countries, and MSM are groups at increased risk for infection (*3*); in low-income countries, groups with inadequate access to hygiene and sanitation are at increased risk (*4*).

During July 1, 2015–June 30, 2016, a total of 103 *Shigella* infections with indistinguishable PFGE patterns were reported in Oregon. All cases occurred in adults aged ≥18 years; 77 (75%) were men, 38 (49%) of whom self-identified as MSM. Homelessness was self-reported by three (8%) MSM and 41 (63%) of 65 persons who did not self-identify as MSM. Twelve (12%) persons, including two MSM, reported connections to homeless persons (e.g., volunteer work) during their incubation period. During July–October, 2015, 18 (82%) *Shigella* cases occurred in MSM, compared with 20 (25%) during November 2015–June, 2016 (prevalence ratio [PR] = 3.3; 95% confidence interval [CI] = 2.2–5.1); Before November 2015, only three (14%) *Shigella* patients were homeless, including one who self-identified as MSM. After November 1, 2015, 41 (51%) were homeless (PR = 3.7; 95% CI = 1.3–10.9) (Figure).

When the increase in the proportion of *Shigella* infections occurring among homeless persons was recognized in December 2015, outbreak investigation questionnaires were updated to gather information about risk factors in this population. However, contacting these persons for interviews was difficult; only 36% of homeless patients were interviewed compared with 86% of persons who were not homeless (chi-square p<0.01). Alternative data collection strategies included auditing electronic medical records and querying homeless outreach workers. The focus of outreach efforts expanded from prevention of sexual transmission among MSM to addressing access to hygiene and sanitation among homeless persons, including distribution of hand sanitizing wipes, site visits to shelters and encampments, and alerts to safety-net providers.

Information about antimicrobial susceptibility was available for 48 (47%) isolates; all were sensitive to ciprofloxacin, the first-line therapy for adults with *Shigella* infection in the United States, and resistant to ampicillin and trimethoprim-sulfamethoxazole. All 13 isolates tested by CDC were resistant to azithromycin. Overall, 46 (45%) persons were hospitalized, including 30 (68%) homeless persons and 16 (27%) who were not homeless (PR = 2.5; 95% CI = 1.6–4.0); none died.

As the outbreak progressed, the percentage of *Shigella* infections among MSM declined, while infections among homeless persons increased. Continuing infections among MSM with no connection to the homeless community indicate ongoing transmission in both populations. In retrospect, reports of illnesses among women were the first indication of *Shigella* infections in homeless persons. Early detection of new populations at risk is important because outbreak investigation and control measures might require revision. Adding questions about sexual practices and housing status to routine *Shigella* questionnaires might help identify outbreaks in these groups.

Although homeless persons experience high rates of tuberculosis, human immunodeficiency virus, and hepatitis C (*5*), shigellosis has rarely been described (*6*). However, in high-income countries, homeless persons face conditions associated with *Shigella* infections among displaced populations in low-income countries, including inadequate access to hygiene and sanitation, overcrowding, and potential exposure to contaminated food and water. Preventing similar outbreaks will require mitigating these risk factors and educating providers who care for homeless persons.

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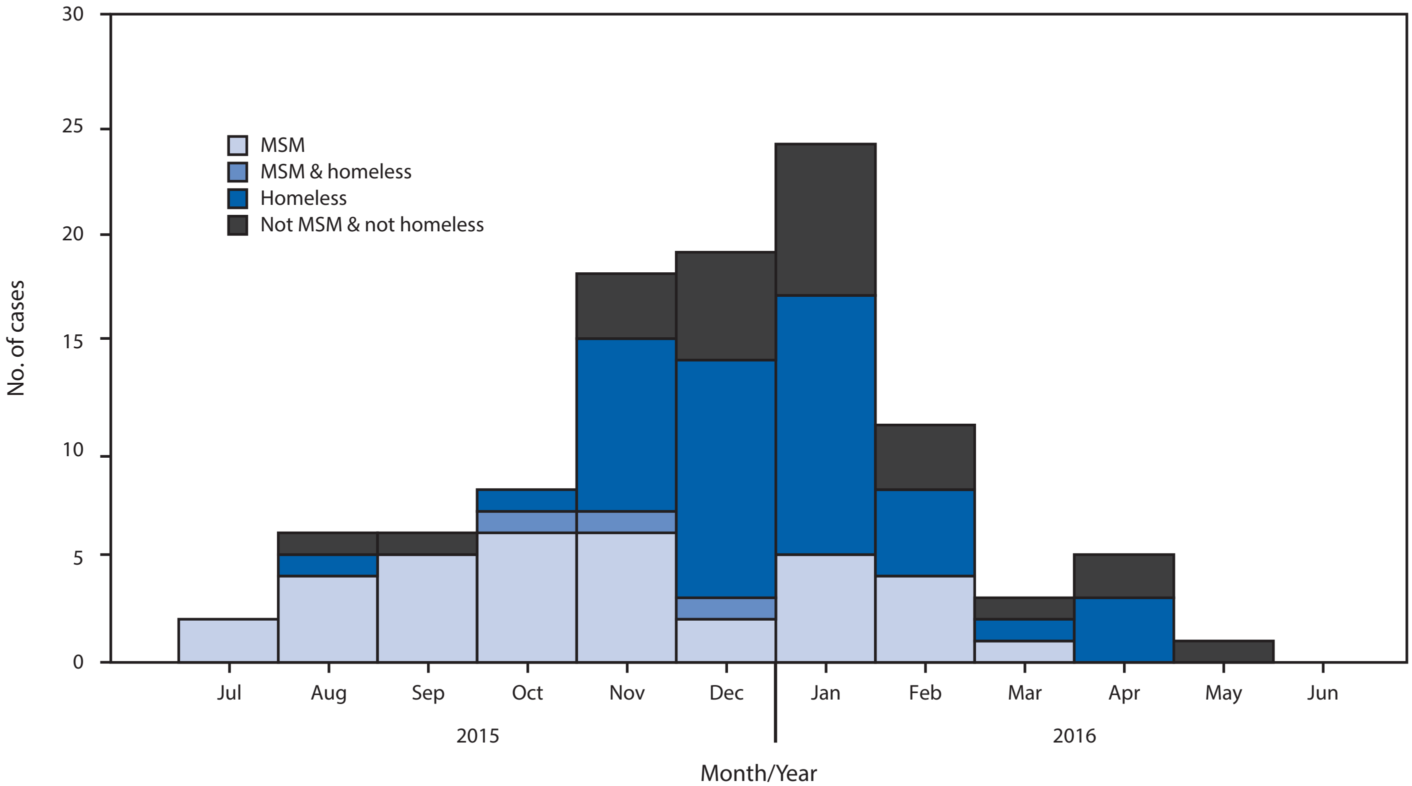
FIGURE. Number of *Shigella* cases by month and year of onset, and percentage of cases in MSM and homeless persons* — Oregon, July 2015–June 2016



Abbreviation: MSM = men who have sex with men.
* Three cases occurred in both MSM and homeless; 24 cases occurred in persons who were neither MSM nor homeless.

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Errata

Vol. 65, No. SS-8

In the Surveillance Summary, "Prevalence of Amyotrophic Lateral Sclerosis — United States, 2012–2013," an error occurred on the cover. No continuing education examination is available for this report.

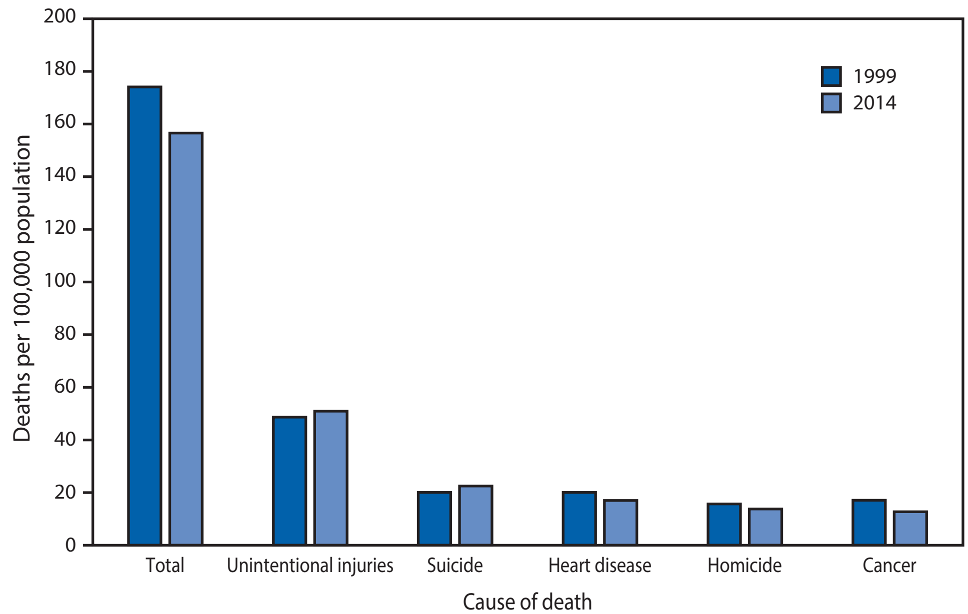
Vol. 65, No. 28

In the *MMWR* report, "Projected Zika Virus Importation and Subsequent Ongoing Transmission after Travel to the 2016 Olympic and Paralympic Games — Country-Specific Assessment, July 2016," an error occurred throughout in reporting the number of countries participating in the 2016 Olympic and Paralympic Games without evidence of past Zika transmission: 18 countries (not 19 as stated) met this criterion. Thus, the fourth sentence of the fourth paragraph should have read, "For **14** of these countries, estimated aviation travel from Rio de Janeiro in August 2016 compared with total aviation travel from all countries with local Zika virus transmission in 2015 was 0.01%–**3.04%** (Table 2)." In addition, in Table 2, Angola should not have been listed, and the title should have read, "Participating countries currently not reporting Zika outbreaks **(n = 18)** that met risk criteria for Zika virus importation and subsequent ongoing transmission attributed to travel to the Olympic and Paralympic Games, ranked by aviation travel volume* from Rio de Janeiro, Brazil — August 2016."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Death Rates* for Males Aged 15–44 Years, by the Five Leading Causes of Death† — United States, 1999 and 2014



* All differences in rates were statistically significant (p<0.05). Age-adjusted rates are per 100,000 standard population.
† Unintentional injuries are identified with *International Classification of Diseases, 10th revision* codes V01–X59, Y85–Y86; U03, X60–X84, Y87.0 for suicide; I00–I09, I11, I13, I20–I51 for heart disease; U01–U02, X85–Y09,Y87.1 for homicide; and C00–C97 for cancer.

The age-adjusted death rate for males aged 15–44 years was 10% lower in 2014 (156.6 per 100,000 population) than in 1999 (174.1). Among the five leading causes of death, the age-adjusted rates for three were lower in 2014 than in 1999: cancer (from 17.1 to 12.8; 25% decline), heart disease (20.1 to 17.0; 15% decline), and homicide (15.7 to 13.8; 12% decline). The age-adjusted death rates for two of the five causes were higher in 2014 than in 1999: suicide (20.1 to 22.5; 12% increase), and unintentional injuries (from 48.7 to 51.0; 5% increase).

Source: CDC/NCHS, National Vital Statistics System, 1999 and 2014, Mortality. CDC Wonder online database. http://wonder.cdc.gov/ucd-icd10.html.

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