

## Prevalence of Excess Sodium Intake in the United States — NHANES, 2009–2012

Sandra L. Jackson, PhD<sup>1,2</sup>; Sallyann M. Coleman King, MD<sup>2</sup>; Lixia Zhao, PhD<sup>2,3</sup>; Mary E. Cogswell, DrPH<sup>2</sup>

Hypertension, a major risk factor for cardiovascular diseases, occurs among 29% of U.S. adults, and lowering excess sodium intake can reduce blood pressure (1–3). The *2015–2020 Dietary Guidelines for Americans* recommend consuming less than 2,300 mg dietary sodium per day for persons aged  $\geq 14$  years and less for persons aged 2–13 years.\* To examine the current prevalence of excess sodium intake among Americans overall, and among hypertensive adults, CDC analyzed data from 14,728 participants aged  $\geq 2$  years in the 2009–2012 National Health and Nutrition Examination Survey (NHANES). Eighty-nine percent of adults and over 90% of children exceeded recommendations for sodium intake. Among hypertensive adults, 86% exceeded 2,300 mg dietary sodium per day. To address the high prevalence of excess sodium consumption in the U.S. population, the Institute of Medicine (IOM) recommended reducing sodium in the food supply, as excess sodium added to foods during commercial processing and preparation represents the main source of sodium intake in U.S. diets (4).

NHANES is a nationally representative, multistage survey of noninstitutionalized persons in the United States. The survey includes an in-person examination with a 24-hour dietary recall, and a second 24-hour dietary recall administered by telephone 3–10 days later. This cross-sectional study used data from NHANES years 2009–2012 (N = 20,293). For children aged 2–5 years, dietary intake was reported by a proxy, and for children aged 6–11 years, by the participant assisted by a proxy. The unweighted response rate of the examined sample was 77.3% in 2009–2010 and 69.5% in 2011–2012. This study included participants aged  $\geq 2$  years who completed two 24-hour dietary recalls (n = 14,900), but excluded pregnant

women and women whose pregnancy status was unknown (n = 161), as well as respondents with unreliable dietary recalls (n = 11), yielding 14,728 respondents eligible for analysis.

Normal blood pressure was defined as a mean systolic blood pressure  $< 120$  mm Hg and mean diastolic blood pressure  $< 80$  mm Hg. Hypertension was defined as mean systolic blood pressure  $\geq 140$  mm Hg, mean diastolic blood pressure  $\geq 90$  mm Hg, or self-reported use of antihypertensive medication. Among persons who did not meet this definition of hypertension, prehypertension was defined as a mean systolic blood pressure of 120–139 mm Hg or a mean diastolic blood pressure of 80–89 mm Hg. An average of up to three brachial systolic and diastolic blood pressure readings was used for determination of blood pressure values. The majority of study participants had at least two complete blood pressure measurements, but for participants with only one, the single measurement was used. Race/ethnicity was categorized as non-Hispanic white (white), non-Hispanic black (black), and Hispanic. In sensitivity analyses, respondents who self-identified as Mexican-Americans were analyzed separately, and

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\*Additional information available at <http://health.gov/dietaryguidelines>.



little difference was observed between Mexican-Americans and “other Hispanic” groups.

Estimated mean usual daily sodium intake and caloric intake (continuous variables) were calculated, as well as sodium density (mg of sodium per 1,000 kilocalories consumed). The proportion of persons with excess sodium intake was estimated by sex, age group, and racial/ethnic subpopulation, and among adults (aged  $\geq 19$  years), by hypertension status. Recommendations for sodium intake among persons aged  $< 14$  years are adjusted downward for age-specific calorie intake (Table 1). Statistical software was used to account for day-to-day variation in sodium intake to estimate usual intake from two 24-hour dietary recalls.<sup>†</sup> All analyses used survey sample weights (Dietary two-day sample) in statistical software for complex surveys.

The majority of persons in the United States in 2009–2012 exceeded recommendations for dietary sodium (Table 1). Among adults aged  $\geq 19$  years, 89% consumed excess sodium. A larger proportion of adult men (98%) than women (80%) consumed more than 2,300 mg of dietary sodium per day ( $p < 0.001$ ), as did a larger proportion of adult whites (90%) than blacks (85%) ( $p = 0.02$ ). Among children aged 2–18 years, 92%–94% consumed excess sodium.

Sodium intake was typically higher among persons consuming more kilocalories (kcal), and estimated sodium consumed

was highest among persons aged 19–50 years (Table 2). Sodium density, which captures milligrams of sodium per 1000 kcal consumed, was highest among adults aged 19–50 years (mean = 1,730 mg/1,000 kcal) and lowest among children aged 2–3 years (mean = 1,466 mg/1,000 kcal). Total sodium intake was higher among males than females ( $p < 0.001$ ), but sodium density did not differ significantly between sexes ( $p = 0.50$ ).

Among adults with hypertension, 86% consumed dietary sodium in excess of 2,300 mg, which is statistically significantly less than the prevalence for adults with prehypertension (91%,  $p < 0.001$ ) and adults without hypertension (90%,  $p = 0.01$ ) (Figure). Adults with hypertension had the lowest mean sodium intake (Table 2).

## Discussion

Most adults and children in the United States exceed the 2015–2020 *Dietary Guidelines for Americans* recommendation for dietary sodium. Even among groups at higher risk for cardiovascular disease, including adults aged  $\geq 51$  years, blacks, and adults with prehypertension and hypertension, at least three out of four consumed more than 2,300 mg daily, increasing their potential risk of stroke and coronary heart disease mortality (2).

The high prevalence of excess sodium intake and the amount of sodium consumed per calorie in this report are generally consistent with previous reports including one that examined trends in sodium consumption during 2003–2010 in relation to the IOM Dietary Reference Intakes (DRIs) (5–7). This

<sup>†</sup> Additional information available at <http://epi.grants.cancer.gov/diet/usualintakes/method.html>.

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**TABLE 1. Prevalence of U.S. population aged  $\geq 2$  years with usual sodium intake in excess of 2015–2020 Dietary Guidelines for Americans limits, by sex, age group, and racial/ethnic subpopulation\* — National Health and Nutrition Examination Survey, 2009–2012**

Subpopulation (limit)	No. in sample (unweighted)	% with intake $\geq$ limit (95% CI)
<b>Age 2–3 yrs (1,500 mg)</b>	<b>793</b>	<b>93.5 (87.4–99.6)</b>
Male	403	95.4 (90.0–100)
Female	390	91.4 (84.1–98.8)
White, non-Hispanic	219	93.9 (87.6–100)
Black, non-Hispanic	190	96.1 (91.0–100)
Hispanic	273	92.0 (83.2–100)
<b>Age 4–8 yrs (1,900 mg)</b>	<b>1,639</b>	<b>92.2 (88.6–95.7)</b>
Male	861	95.1 (92.4–97.8)
Female	778	89.0 (83.4–94.5)
White, non-Hispanic	470	91.8 (86.9–96.6)
Black, non-Hispanic	367	94.3 (90.3–98.4)
Hispanic	595	91.6 (87.2–95.9)
<b>Age 9–13 yrs (2,200 mg)</b>	<b>1,526</b>	<b>93.7 (89.9–97.6)</b>
Male	742	97.0 (93.6–100)
Female	784	90.7 (85.8–95.7)
White, non-Hispanic	443	93.4 (89.1–97.7)
Black, non-Hispanic	364	92.0 (85.5–98.4)
Hispanic	536	94.5 (89.5–99.6)
<b>Age 14–18 yrs (2,300 mg)</b>	<b>1,330</b>	<b>92.8 (86.8–98.8)</b>
Male	682	99.0 (97.1–100)
Female	648	87.1 (76.8–97.4)
White, non-Hispanic	378	94.6 (89.0–100)
Black, non-Hispanic	345	86.6 (76.2–97.0)
Hispanic	438	91.9 (83.2–100)
<b>Age <math>\geq 19</math> yrs (2,300 mg)</b>	<b>9,440</b>	<b>89.0 (87.0–90.9)</b>
Male <sup>†</sup>	4,613	98.4 (97.6–99.2)
Female	4,827	79.9 (76.7–83.0)
White, non-Hispanic <sup>§</sup>	4,210	89.8 (87.9–91.8)
Black, non-Hispanic	2,061	84.6 (80.9–88.3)
Hispanic	2,266	88.6 (84.5–92.8)
<b>Age 19–50 yrs (2,300 mg)</b>	<b>5,025</b>	<b>92.1 (89.4–94.7)</b>
Male	2,459	99.3 (98.5–100)
Female	2,566	84.5 (79.8–89.2)
White, non-Hispanic	2,037	93.1 (90.7–95.5)
Black, non-Hispanic	1,049	88.1 (82.6–93.5)
Hispanic	1,338	91.3 (86.8–95.8)
<b>Age <math>\geq 51</math> yrs (2,300 mg)</b>	<b>4,415</b>	<b>85.0 (82.2–87.9)</b>
Male	2,154	96.6 (95.0–98.2)
Female	2,261	74.8 (70.2–79.4)
White, non-Hispanic	2,173	86.2 (83.1–89.3)
Black, non-Hispanic	1,012	78.3 (72.8–83.8)
Hispanic	928	80.5 (73.8–87.3)

**Abbreviation:** CI = confidence interval.

\* The proportion of persons with excess sodium intake was estimated by sex, age group, and racial/ethnic subpopulation. Statistical software was used to account for day-to-day variation in sodium intake to estimate usual intake from two 24-hour dietary recalls. All other analyses used survey sample weights (Dietary two-day sample) in statistical software for complex surveys. Respondents with "other" race/ethnicity are not shown. Age categories were defined according to Institute of Medicine Dietary Reference Intake age categories. Age-specific tolerable upper intake levels (UL) for sodium were defined as the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects. Age-appropriate ULs for sodium were 1,500 mg/day for children aged 2–3 years, 1,900 mg/day for children aged 4–8 years, 2,200 mg/day for children and adolescents aged 9–13 years, and 2,300 mg/day for persons aged  $\geq 14$  years.

<sup>†</sup> Prevalence of excess sodium among adult men versus women ( $p < 0.001$ ).

<sup>§</sup> Prevalence of excess sodium among adult non-Hispanic whites versus non-Hispanic blacks ( $p = 0.02$ ); non-Hispanic whites versus Hispanics ( $p = 0.61$ ); non-Hispanic blacks versus Hispanics ( $p = 0.16$ ).

**TABLE 2. Mean usual daily sodium intake, calorie intake, and sodium density for persons aged  $\geq 2$  years\* — National Health and Nutrition Examination Survey, 2009–2012**

Subpopulation	Mean sodium intake, mg/day (SE)	Mean calorie intake, kcal (SE)	Mean usual sodium density, mg/1,000 kcal (SE)
<b>Age 2–3 yrs</b>	<b>2,154 (31.4)</b>	<b>1,481 (21.6)</b>	<b>1,466 (22.5)</b>
Male	2,227 (47.2)	1,536 (28.8)	1,465 (30.4)
Female	2,074 (63.8)	1,421 (45.2)	1,471 (28.8)
White, non-Hispanic	2,160 (46.6)	1,507 (33.1)	1,441 (27.0)
Black, non-Hispanic	2,270 (88.7)	1,491 (43.8)	1,554 (71.4)
Hispanic	2,099 (66.4)	1,450 (40.1)	1,457 (28.2)
<b>Age 4–8 yrs</b>	<b>2,754 (61.7)</b>	<b>1,785 (26.8)</b>	<b>1,555 (23.1)</b>
Male	2,883 (73.3)	1,856 (35.1)	1,570 (27.1)
Female	2,617 (68.1)	1,709 (32.2)	1,542 (29.8)
White, non-Hispanic	2,734 (89.6)	1,803 (43.9)	1,525 (32.7)
Black, non-Hispanic	2,858 (78.6)	1,812 (44.1)	1,592 (29.3)
Hispanic	2,728 (70.7)	1,746 (34.4)	1,577 (26.5)
<b>Age 9–13 yrs</b>	<b>3,126 (84.5)</b>	<b>1,926 (41.8)</b>	<b>1,657 (20.8)</b>
Male	3,312 (112.5)	2,053 (69.9)	1,645 (28.2)
Female	2,961 (98.4)	1,812 (46.8)	1,668 (29.5)
White, non-Hispanic	3,111 (115.8)	1,925 (54.0)	1,650 (36.3)
Black, non-Hispanic	3,037 (123.2)	1,859 (71.4)	1,678 (36.7)
Hispanic	3,176 (97.6)	1,961 (55.2)	1,652 (28.4)
<b>Age 14–18 yrs</b>	<b>3,538 (108.8)</b>	<b>2,099 (50.9)</b>	<b>1,722 (36.0)</b>
Male	4,018 (150.3)	2,367 (79.7)	1,735 (46.1)
Female	3,084 (109.1)	1,844 (61.5)	1,709 (38.0)
White, non-Hispanic	3,634 (130.4)	2,143 (71.6)	1,738 (51.5)
Black, non-Hispanic	3,205 (158.2)	1,987 (94.2)	1,639 (37.2)
Hispanic	3,463 (171.7)	2,057 (81.3)	1,715 (42.7)
<b>Age <math>\geq 19</math> yrs</b>	<b>3,552 (32.2)</b>	<b>2,114 (20.2)</b>	<b>1,727 (9.9)</b>
Male	4,143 (46.3)	2,458 (30.2)	1,735 (12.2)
Female	2,978 (29.2)	1,779 (17.4)	1,719 (13.8)
White, non-Hispanic	3,594 (37.9)	2,149 (25.0)	1,719 (10.1)
Black, non-Hispanic	3,325 (65.4)	2,032 (40.3)	1,683 (20.9)
Hispanic	3,524 (94.4)	2,074 (57.5)	1,745 (28.1)
Hypertensive	3,379 (46.0)	2,110 (24.8)	1,722 (9.3)
Prehypertensive	3,705 (34.8)	2,189 (22.8)	1,729 (9.7)
Normotensive	3,581 (39.3)	2,069 (22.3)	1,729 (10.8)

See table footnotes on page 1396.

suggests that overall sodium consumption and the concentration of sodium in foods consumed have not changed over the past decade. The top sources of sodium in the U.S. diet include breads and rolls, deli meats, pizza, poultry, soups, sandwiches, cheese, pasta dishes, meat mixed dishes, such as meatloaf with tomato sauce, and savory snacks.<sup>§</sup>

During 2009–2012, despite some differences by age, sex, race/ethnicity, and hypertension status, the vast majority of Americans across all subpopulations exceeded recommendations for sodium intake. Compared with adults without hypertension, adults with hypertension consumed slightly less dietary sodium, which might indicate efforts to reduce sodium consumption among this group. However, 86% of adults with hypertension still consumed too much sodium. Compared

<sup>§</sup> Additional information available at <http://www.cdc.gov/vitalsigns/sodium/index.html>.

**TABLE 2. (Continued) Mean usual daily sodium intake, calorie intake, and sodium density for persons aged  $\geq 2$  years\* — National Health and Nutrition Examination Survey, 2009–2012**

Subpopulation	Mean sodium intake, mg/day (SE)	Mean calorie intake, kcal (SE)	Mean usual sodium density, mg/1,000 kcal (SE)
<b>Age 19–50 yrs</b>	<b>3,744 (35.8)</b>	<b>2,227 (22.8)</b>	<b>1,730 (11.2)</b>
Male	4,374 (67.1)	2,595 (41.7)	1,736 (14.9)
Female	3,090 (37.9)	1,846 (18.9)	1,723 (14.9)
White, non-Hispanic	3,816 (47.5)	2,274 (28.5)	1,728 (12.1)
Black, non-Hispanic	3,480 (91.7)	2,161 (56.1)	1,653 (27.1)
Hispanic	3,674 (98.1)	2,173 (64.1)	1,736 (30.4)
Hypertensive	3,793 (87.7)	2,265 (52.3)	1,719 (9.5)
Prehypertensive	3,932 (40.6)	2,340 (24.1)	1,731 (10.9)
Normotensive	3,628 (39.4)	2,159 (23.4)	1,730 (12.0)
<b>Age <math>\geq 51</math> yrs</b>	<b>3,293 (48.3)</b>	<b>1,960 (26.3)</b>	<b>1,724 (14.2)</b>
Male	3,812 (76.6)	2,262 (40.2)	1,733 (19.5)
Female	2,837 (46.4)	1,695 (26.5)	1,716 (18.1)
White, non-Hispanic	3,346 (61.5)	2,005 (31.5)	1,710 (17.6)
Black, non-Hispanic	3,057 (79.8)	1,818 (43.5)	1,730 (24.3)
Hispanic	3,129 (117.5)	1,817 (66.1)	1,771 (34.9)
Hypertensive	3,228 (52.5)	1,921 (26.3)	1,724 (14.2)
Prehypertensive	3,411 (71.1)	2,029 (40.0)	1,726 (15.9)
Normotensive	3,350 (67.5)	2,002 (38.9)	1,717 (17.3)

**Abbreviation:** SE = standard error.

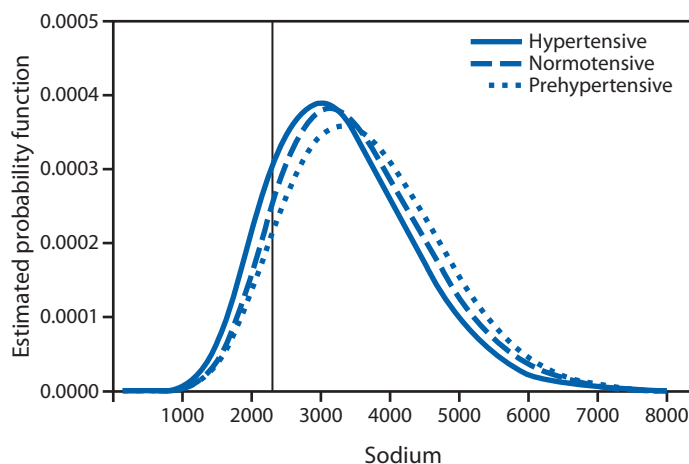
\* Mean usual daily sodium intake (continuous variable) was calculated, as well as sodium density (mg of sodium per calorie consumed). Statistical software was used to account for day-to-day variation in sodium intake to estimate usual intake from two 24-hour dietary recalls. All other analyses used survey sample weights (Dietary Day 2 sample) in statistical software for complex surveys. Overall mean sodium intake was higher for males compared to females ( $p < 0.001$ ). Overall mean sodium density did not differ significantly for males versus females ( $p = 0.50$ ). Overall mean sodium intake was higher for non-Hispanic whites compared to non-Hispanic blacks ( $p < 0.001$ ), and did not differ for non-Hispanic whites versus Hispanics ( $p = 0.06$ ) or non-Hispanic blacks versus Hispanics ( $p = 0.07$ ). Overall mean sodium density did not differ for non-Hispanic whites versus non-Hispanic blacks ( $p = 0.06$ ), non-Hispanic whites versus Hispanics ( $p = 0.71$ ), or non-Hispanic blacks versus Hispanics ( $p = 0.12$ ). Mean sodium intake was lower for adults with hypertension (hypertensive) compared to adults with prehypertension (prehypertensive) ( $p < 0.001$ ) or adults without hypertension (normotensive) ( $p < 0.001$ ), and was higher for adults with prehypertension compared to adults without hypertension ( $p = 0.02$ ).

with persons without hypertension, persons with hypertension can benefit even more from reduced sodium consumption (2). Physicians and other health care professionals can counsel their patients to lower sodium intake through following a healthy dietary pattern. One example is the Dietary Approaches to Stop Hypertension eating plan,<sup>§</sup> which emphasizes fruits, vegetables, and low-fat dairy products.

The findings in this report are subject to at least three limitations. First, NHANES data are subject to response bias, although the data are weighted for some nonresponse. Second, dietary data are subject to both recall bias and bias because of underreporting of foods or portion sizes. Finally, sodium intake estimates excluded salt added at the table and from dietary

<sup>§</sup> Additional information available at <https://www.nhlbi.nih.gov/health/health-topics/topics/dash>.

**FIGURE. Distribution of estimated usual intake of sodium (mg/day) among U.S. adults, by hypertension status\* — National Health and Nutrition Examination Survey, 2009–2012**



\* The vertical line indicates the 2015–2020 Dietary Guidelines for Americans recommendation for sodium intake (2,300 mg per day for adults). Overall, 86% of adults with hypertension (hypertensive), 90% of adults without hypertension (normotensive), and 91% of adults with prehypertension (prehypertensive) exceeded 2,300 mg per day sodium intake.

supplements and antacids, which account for about 5%–6% of sodium intake (4).

Given that the majority of the population consumes excess dietary sodium and one third of adults have hypertension (8), sodium reduction is an integral part of initiatives to prevent cardiovascular diseases, such as Million Hearts, which aims to prevent a million heart attacks and strokes by 2017,\*\* CDC's Sodium Reduction in Communities Program,<sup>††</sup> and the National Sodium Reduction Initiative, coordinated by New York City, in which some corporations have pledged to reduce sodium content to meet targets for specific food categories.<sup>§§</sup> Other initiatives to help consumers lower sodium intake include the U.S. Department of Agriculture Nutrition Standards for school meals and competitive foods, and the Department of Health and Human Services Health and Sustainability Guidelines for Federal Concessions and Vending Operations. Reducing sodium added to foods by food manufacturers and restaurants is a fundamental public health strategy for reducing the intake of sodium to levels consistent with the 2015–2020 Dietary Guidelines for Americans (4). Globally, 36 countries have engaged industry to lower sodium intake through the setting of voluntary sodium targets for foods and meals (9). In the United Kingdom, reduction in sodium intake with this approach was associated with substantial

\*\* Additional information available at <http://millionhearts.hhs.gov>.

†† Additional information available at [http://www.cdc.gov/dhdsp/programs/sodium\\_reduction.htm](http://www.cdc.gov/dhdsp/programs/sodium_reduction.htm).

§§ Additional information available at <http://www.nyc.gov/html/doh/html/diseases/salt.shtml>.

**Summary****What is already known about this topic?**

Excess sodium intake is a modifiable risk factor for hypertension and cardiovascular disease. However, according to data from the National Health and Nutrition Examination Survey 2005–2008, 88%–99% of Americans consumed dietary sodium in excess of *2010 Dietary Guidelines for Americans*.

**What is added by this report?**

During 2009–2012, most Americans, including 89% of adults and over 90% of children, consumed dietary sodium in excess of *2015–2020 Dietary Guidelines for Americans* recommendations. Adults with hypertension consumed slightly less sodium than other adults, but 86% still exceeded 2,300 mg per day.

**What are the implications for public health practice?**

To address the continued widespread overconsumption of sodium, a multifaceted strategy is needed, including changes in individual lifestyles and how foods are produced. Reducing sodium added to foods by food manufacturers and restaurants is a key strategy for lowering population-wide dietary sodium intake.

reductions in hypertension and cardiovascular disease deaths (10). Cardiovascular diseases remain the number one killer in the United States (8), and a multifaceted strategy, including changes in individual lifestyles and how foods are produced, might contribute to the reduction of sodium consumption by Americans of all ages.

<sup>1</sup>Epidemic Intelligence Service, CDC; <sup>2</sup>Division for Heart Disease and Stroke Prevention, National Center for Chronic Disease Prevention and Health Promotion, CDC; <sup>3</sup>IHRC, Inc., Atlanta, Georgia.

Corresponding author: Sandra L Jackson, SLJackson@cdc.gov, 770-488-4221.

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## Diagnosis of Tuberculosis in Three Zoo Elephants and a Human Contact — Oregon, 2013

Amy Zlot, MPH<sup>1</sup>; Jennifer Vines, MD<sup>1</sup>; Laura Nystrom, MPH<sup>1</sup>; Lindsey Lane, MPH<sup>2</sup>; Heidi Behm, MPH<sup>2</sup>; Justin Denny, MD<sup>1</sup>; Mitch Finnegan, DVM<sup>3</sup>; Trevor Hostetler<sup>4</sup>; Gloria Matthews<sup>4</sup>; Tim Storms, DVM<sup>3</sup>; Emilio DeBess, DVM<sup>2</sup>

In 2013, public health officials in Multnomah County, Oregon, started an investigation of a tuberculosis (TB) outbreak among elephants and humans at a local zoo. The investigation ultimately identified three bull elephants with active TB and 118 human contacts of the elephants. Ninety-six (81%) contacts were evaluated, and seven close contacts were found to have latent TB infection. The three bulls were isolated and treated (elephants with TB typically are not euthanized) to prevent infection of other animals and humans, and persons with latent infection were offered treatment. Improved TB screening methods for elephants are needed to prevent exposure of human contacts.

In May 2013, a routine annual culture of a sample from a trunk washing on elephant A, an Asian elephant aged 20 years at a zoo in Oregon's Multnomah County, yielded *Mycobacterium tuberculosis*, indicating active, potentially infectious disease. Bidirectional transmission of *M. tuberculosis* between elephants and humans has been documented (1). Assuming that elephant A was not infectious at the time of his previous negative trunk wash sample culture, the infectious period was defined as the 12 months preceding the positive results of the May 2013, trunk wash sample (May 2012–May 2013) (2). The Multnomah County Health Department (MCHD) investigated close and casual contacts of elephant A. Close contacts were defined as persons with any presence in the 8,300-square-foot elephant barn or who had been within 15 feet (4.6 m) of any of the eight elephants in the enclosed outdoor area at least weekly during the past 12 months. Casual contacts included zoo employees or volunteers who might have been exposed to elephant trunk secretions or fecal matter (3), but who had not had close contact with elephant A. Human contacts were evaluated with either a tuberculin skin test (TST) or interferon gamma release assay (IGRA). For close contacts, TST conversions were defined as indurations of  $\geq 5$  mm (rather than  $\geq 10$  mm used in TB screening) (4) within 2 years of the most recent negative TB screening test, and were considered indicative of infection with *M. tuberculosis*. Historical annual TB screening test results for close contacts were obtained from the zoo's occupational health providers. Historical test results were unavailable for other contacts. TB test results reported for contacts were documented at the initial evaluation and at  $\geq 8$  weeks after the last known exposure. Contacts whose first

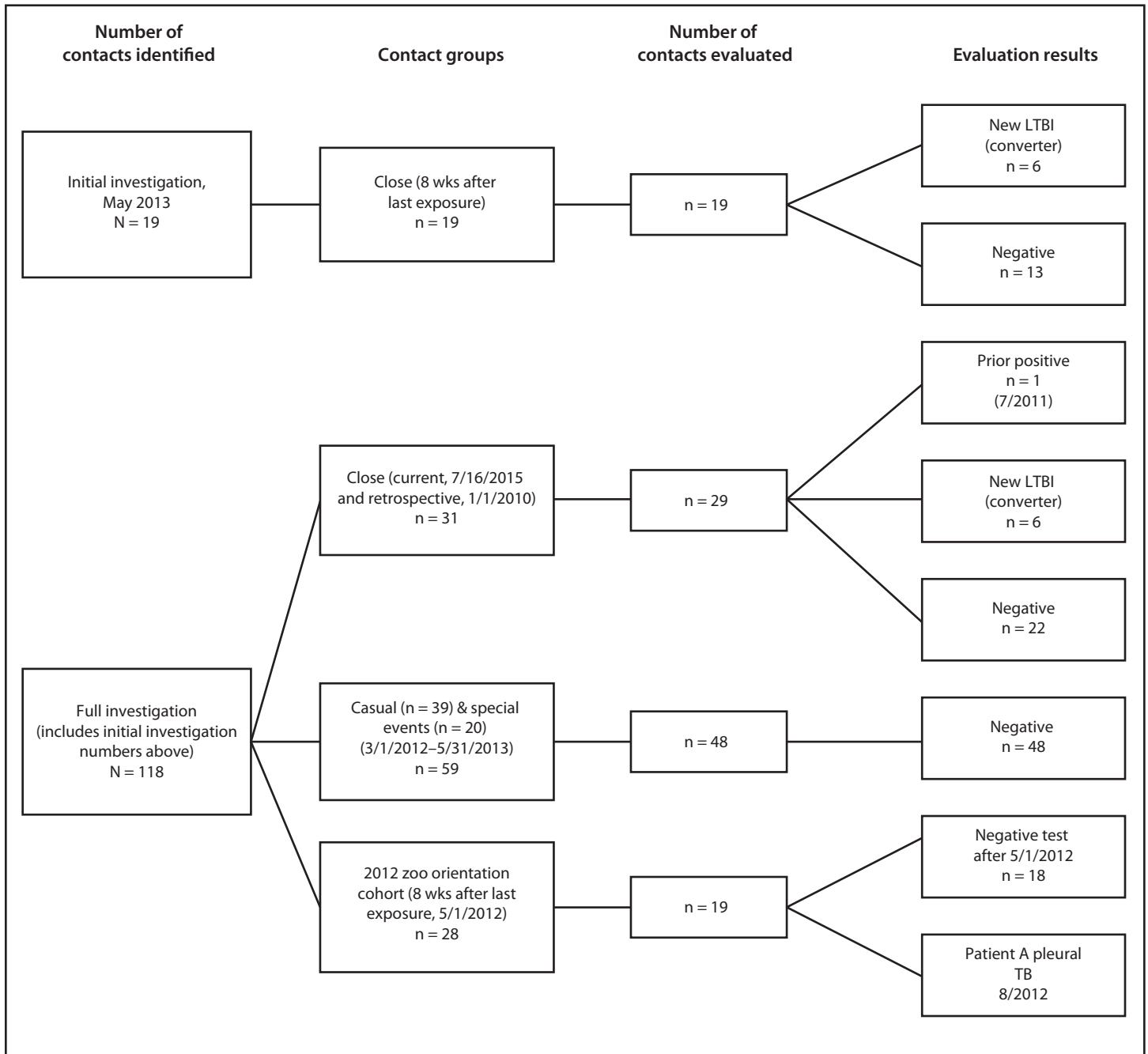
test occurred at least 8 weeks following the last exposure had only one TST or IGRA.

The zoo identified 19 close contacts, all of whom had TSTs at  $\geq 8$  weeks after exposure; 13 were negative. Six persons with no previous positive TST and at least one negative TST during the past 2 years had positive TSTs (Figure 1). None of the contacts with positive TSTs had spent time in TB-endemic countries, or had other risk factors for TB, such as a history of homelessness or injection-drug use or diagnosis of human immunodeficiency virus. All had chest radiographs and were evaluated for symptoms; none had active disease. Among close contacts, the number and percentage of conversions from negative TST to positive within 2 years (31.6%) was higher than expected, given the baseline of 4% of the U.S. population having latent infection on the basis of a single  $\geq 10$  mm skin test result (5).

Because of the positive test results among close contacts, MCHD expanded the investigation to identify 39 casual contacts. A third group of 20 contacts was identified among persons who had attended special events at which elephant A sprayed paint with his trunk onto canvases behind attendees, potentially exposing them to aerosolized *M. tuberculosis*. Among all 59 casual and special event contacts, exposure to elephant A was approximately  $< 30$  minutes and at a distance of  $\geq 25$  feet. Among the 59 casual and special event contacts identified, 48 (81%) were fully evaluated; none had a positive TST or IGRA (Figure 1).

Before diagnosis of TB in elephant A, elephants were routinely screened for TB by annual cultures of samples collected from trunk washings, with samples collected from each elephant on 3 consecutive days. Following diagnosis of TB in elephant A, the zoo increased the frequency of trunk washings to once a month for infected elephants and once every 3 months for uninfected elephants. Serologic screenings were conducted once or twice a year to identify infected, but culture-negative, elephants. During the course of the investigation, antibodies to *M. tuberculosis* were detected in the serum of elephant A's father (elephant B), aged 51 years. Subsequently, in October 2013, culture of a trunk wash sample from elephant B was positive. The other seven elephants in the herd, including elephant A, had negative trunk washings at that time. Elephant B's close human contacts were identical to

FIGURE 1. Investigation of contacts of elephants with tuberculosis at a zoo — Oregon, 2013



Abbreviations: LTBI = latent tuberculosis infection; TB = tuberculosis.

those of elephant A, with the exception of one new employee, whose TB screen was negative when he began employment.

In October 2013, another local public health department discovered that patient A, who had completed treatment for culture-confirmed pleural TB in the fall of 2012, had also been a casual contact of elephant A. Upon receiving notification for routine annual TB screening from the zoo, patient A had sought guidance from the health department

regarding documentation of TB status. Patient A had worked at the zoo intermittently during 2012, but had limited contact with elephants (1 hour cumulative presence in the elephant barn). Given the pleural (sputum-culture-negative) nature of patient A's disease, patient A was most likely noninfectious.

The Oregon Health Authority had reviewed patient A's *M. tuberculosis* isolate's genotype in 2012, and found no matches in Oregon. When patient A's zoo work history was

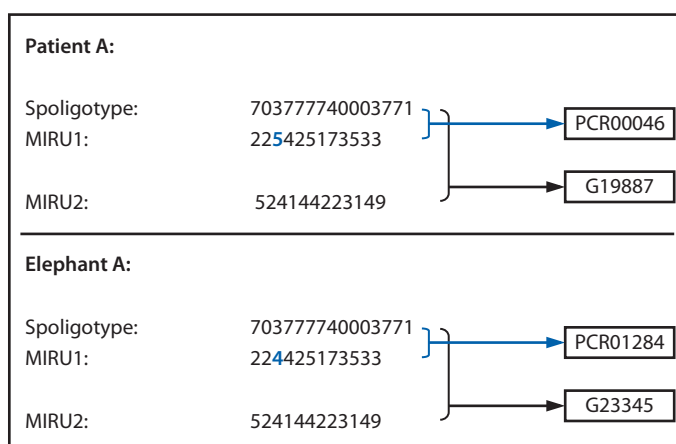
revealed in October 2013, well into the contact investigation for elephant A, the Oregon Health Authority reviewed the genotypes of the isolates of patient A and elephant A, and found that they differed by only one locus in the 24-locus mycobacterial interspersed repetitive units (MIRU) pattern (Figure 2). Isolates from patient A and elephant A were analyzed at CDC using whole genome sequencing. Comparison of the assembled genomes from the two isolates identified no differences. Although this result is consistent with transmission, it does not indicate direction of transmission, and does not provide information about how patient A or the elephant contracted TB. Elephant B's isolate was genotyped, and spacer oligonucleotide typing (spoligotype) from this isolate matched those of patient A and elephant A (Figure 2).

In May 2014, a third bull elephant, elephant C, aged 44 years, was found to be infected with *M. tuberculosis* by a positive culture from a trunk washing sample. Elephant C's isolate was not whole genome sequenced; all of this elephant's human contacts were the same as those of elephant B. None of the three elephants had shown signs of illness, although elephant B had experienced temporary weight loss. All three elephants' isolates were susceptible to first-line *M. tuberculosis* drugs. Each bull has received different and changing regimens; treatment is ongoing and guided by drug levels and tolerance.

Because the strain isolated from patient A matched that from elephant A, MCHD personnel searched for an unidentified, common human source and explored the possibility that the elephants might have been previously transmitting TB despite negative trunk washings. During the summer of 2014, the investigation was expanded to include two additional groups: 1) all current and former employees who had worked at the zoo since January 1, 2010, and who met the definition of close contacts, and 2) persons who participated in the same February 2012 zoo orientation as patient A, which was the time when patient A had the most contact with elephants (Figure 1, Figure 3). Among the 28 persons who participated in the 2012 zoo orientation (including patient A), 18 had a negative TST; nine persons no longer worked at the zoo and could not be reached. MCHD concluded that persons who participated in the same orientation as patient A were likely not infected with TB in the course of their orientation. MCHD uncovered no evidence of a previously unidentified human case in the zoo orientation cohort that could have infected other humans or elephant A during this time. As of April 2015, reports from CDC's TB Genotyping Information Management System revealed that the isolates from elephant A and from patient A have unique genotypes (spoligotype + 24-locus MIRU), not matched locally or nationally.

Final results of the investigation of all 31 close contacts since 2010 identified one additional positive TST result from

**FIGURE 2. Genotyping analysis of *M. tuberculosis* isolates from patient A and elephant A\* — Oregon, 2013**



\* Patient A and elephant A have slightly different genotypes (spoligotype+MIRU1+MIRU2), differing by only one locus.

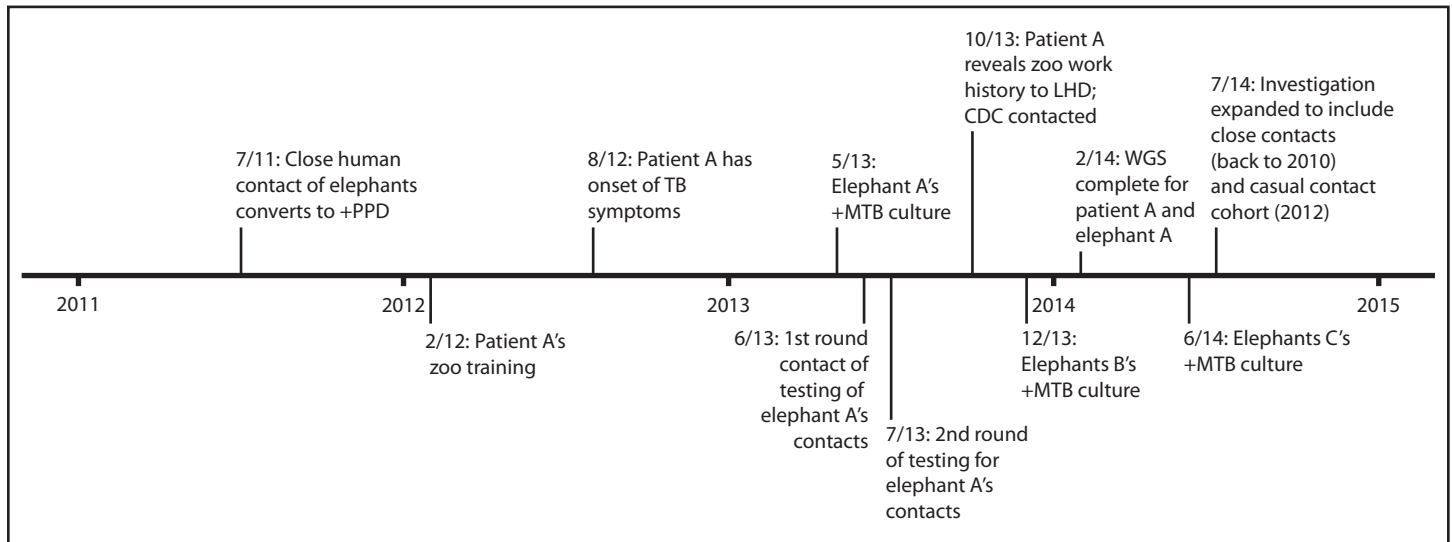
July 2011 (induration = 19 mm); this is close to the zoo's baseline of 0–1 conversions per year (Figure 1). On the basis of these findings, shedding of *M. tuberculosis* by elephants before elephant A's diagnosis was deemed unlikely.

Throughout the investigation, MCHD worked with the zoo and the Oregon Health Authority to ensure the safety of staff members, animals, and the public. Close and prolonged contact, including spending multiple hours indoors with infected elephants, was associated with TB transmission in this investigation. Continuing routine protocols for annual TB screening of humans who work with elephants is warranted, as is a heightened screening recommendation for the closest contacts until summer 2016. In addition to other administrative and environmental controls, all current close contacts wear a fit-tested N-95 respirator or higher level of protection when in the elephant barn or in contact with any potentially infectious elephant. Close contacts will continue to receive a TST every 6 months until summer 2016, at which point the exposure control plan will be reevaluated. Close contacts with previous positive test results will have a periodic TB symptom screen rather than a TST.

Once all elephants complete treatment for active TB, the Oregon Health Authority, MCHD, and the zoo veterinarians will decide whether to modify the exposure control plan. The elephants will continue to be screened at regular intervals according to Department of Agriculture guidelines (2). Because of the absence of guidance on determining when an elephant is no longer infectious, the zoo and state and local public health professionals defined an infectious elephant as one that 1) has had *M. tuberculosis* isolated from a culture of a trunk washing sample, 2) has not received at least 2 months of adequate TB treatment, and 3) has not had at least three



FIGURE 3. Timeline of tuberculosis diagnoses in three elephants and a casual contact at a zoo — Oregon, 2013\*



**Abbreviations:** LHD = local health department; +Mtb = positive for *Mycobacterium tuberculosis*; +PPD = positive purified protein derivative test (tuberculin skin test); TB = tuberculosis; WGS = whole genome sequencing.

\* Current contacts (as of May 2013) of Elephant A during March 1, 2012–May 13, 2013 were initially investigated; in July 2014, the investigation was expanded to include close contacts back to January 1, 2012 and a casual (zoo orientation) cohort in February 2012.

consecutive negative findings from cultures of monthly trunk washing samples; or that is not responding to treatment, has a worsening serologic picture,\* or might otherwise pose a risk to the herd, zoo personnel, or the public. On the basis of the contact investigation results, MCHD has advised that outdoor contact with infectious elephants for <30 minutes and at a distance of  $\geq 25$  feet posed minimal risk for TB transmission.

MCHD also worked with zoo veterinarians and the state public health veterinarian to develop guidelines for safe public elephant viewing. Although the contact investigation suggested minimal risk, all infectious elephants were removed from general display and public viewing within 100 feet. Routine indoor and outdoor public viewing of noninfectious elephants is considered safe.

## Discussion

In North America, approximately 5% of captive Asian elephants are infected with *M. tuberculosis*, on the basis of positive cultures of trunk washing samples or necropsy results (6). The U.S. Department of Agriculture's Animal and Plant Health Inspection Service has developed guidelines for the screening and diagnosis of TB in captive elephants, including annual trunk wash samples for mycobacterial culture (2). However, trunk-wash sample cultures, the standard for diagnosing active TB in elephants, are insensitive, and some cases of TB might be missed. Serologic screening is used in

\*Serologic tests can be used as indicators of active infection in elephants or to assess an elephant's response to infection and treatment.

some settings to identify elephants with TB infection (7), but is controversial among elephant veterinarians and is subject to false-positive results (7).

Although MCHD's investigation did not suggest previously unrecognized shedding of *M. tuberculosis* by the elephants, annual personnel screening is an important component of occupational safety, given the potential risk for TB exposure to staff members as well as the risk to elephants of transmission from humans with undiagnosed TB. Organizations that conduct TB testing for employees should have a mechanism for tracking results and investigating when TST conversions are elevated above the annual baseline. In addition, better understanding of modes of TB transmission between humans, elephants, and other animals might lead to more comprehensive guidelines for prevention of TB transmission in high-risk settings (8). Genotyping surveillance, in conjunction with epidemiologic investigation, might also be effective in linking human and non-human TB cases and evaluating unrecognized transmission, especially if the strains are rare. Collaboration between public health, veterinary medicine, and occupational health experts would allow for better understanding of the risks for and prevention of zoonotic transmission of *M. tuberculosis*.

## Acknowledgments

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## References

## Summary

## What is already known on this topic?

In North America, approximately 5% of captive Asian elephants are infected with *Mycobacterium tuberculosis*. Bidirectional spread of *M. tuberculosis* between elephants and humans has been documented.

## What is added by this report?

Investigation of a tuberculosis (TB) outbreak among three elephants at an Oregon zoo identified multiple close, casual, and spectator contacts. One hundred and eighteen contacts were identified, 96 of these contacts were screened, and seven close contacts (six recent conversions and one earlier positive test) were found to have latent, noninfectious TB. Whole-genome sequencing revealed that one elephant's *M. tuberculosis* isolate identically matched the isolate of a person with pleural TB who attended a zoo orientation in 2012. The lack of guidance about how to manage captive, TB-infected elephants complicated the decision-making process for protection of zoo contacts, other animals at the zoo, and the general public.

## What are the implications for public health practice?

Collaboration between public health, veterinary medicine, and occupational health experts could lead to better understanding about associated risks, and could help prevent zoonotic transmission of *M. tuberculosis*. The development of improved TB screening methods for elephants is needed to prevent exposure to humans with close and prolonged contact.

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<sup>1</sup>Multnomah County Health Department, Oregon; <sup>2</sup>Public Health Division, Oregon Health Authority; <sup>3</sup>Oregon Zoo; <sup>4</sup>Washington County Department of Health and Human Services, Oregon.

Corresponding author: Amy Zlot, amy.zlot@multco.us, 503-988-3406.

# Vital Signs: Exposure to Electronic Cigarette Advertising Among Middle School and High School Students — United States, 2014

Tushar Singh, MD, PhD<sup>1,2</sup>; Kristy Marynak, MPP<sup>1</sup>; René A. Arrazola, MPH<sup>1</sup>; Shanna Cox, MSPH<sup>1</sup>; Italia V. Rolle, PhD<sup>1</sup>; Brian A. King, PhD<sup>1</sup>

On January 5, 2016, this report was posted as an MMWR Early Release on the MMWR website (<http://www.cdc.gov/mmwr>).

## Abstract

**Introduction:** Electronic cigarette (e-cigarette) use has increased considerably among U.S. youths since 2011. Tobacco use among youths in any form, including e-cigarettes, is unsafe. Tobacco product advertising can persuade youths to start using tobacco. CDC analyzed data from the 2014 National Youth Tobacco Survey to estimate the prevalence of e-cigarette advertisement exposure among U.S. middle school and high school students.

**Methods:** The 2014 National Youth Tobacco Survey, a school-based survey of middle school and high school students in grades 6–12, included 22,007 participants. Exposure to e-cigarette advertisements (categorized as “sometimes,” “most of the time,” or “always”) was assessed for four sources: retail stores, Internet, TV and movies, and newspapers and magazines. Weighted exposure estimates were assessed overall and by school type, sex, race/ethnicity, and grade.

**Results:** In 2014, 68.9% of middle and high school students (18.3 million) were exposed to e-cigarette advertisements from at least one source. Among middle school students, exposure was highest for retail stores (52.8%), followed by Internet (35.8%), TV and movies (34.1%), and newspapers and magazines (25.0%). Among high school students, exposure was highest for retail stores (56.3%), followed by Internet (42.9%), TV and movies (38.4%), and newspapers and magazines (34.6%). Among middle school students, 23.4% reported exposure to e-cigarette advertising from one source, 17.4% from two sources, 13.7% from three sources, and 11.9% from four sources. Among high school students, 21.1% reported exposure to e-cigarette advertising from one source, 17.0% from two sources, 14.5% from three sources, and 18.2% from four sources.

**Conclusions and Implications for Public Health Practice:** Approximately seven in 10 U.S. middle and high school students were exposed to e-cigarette advertisements in 2014. Exposure to e-cigarette advertisements might contribute to increased use of e-cigarettes among youths. Multiple approaches are warranted to reduce youth e-cigarette use and exposure to e-cigarette advertisements, including efforts to reduce youth access to settings where tobacco products, such as e-cigarettes, are sold, and regulation of youth-oriented e-cigarette marketing.

## Introduction

Electronic cigarettes (e-cigarettes) are battery-powered devices capable of delivering nicotine and other additives (e.g., flavorings) to the user in an aerosol form. E-cigarette use has increased considerably among U.S. youths in recent years. During 2011–2014, past-30-day e-cigarette use increased from 0.6% to 3.9% among middle school students and from 1.5% to 13.4% among high school students; in 2014, e-cigarettes became the most commonly used tobacco product among middle school and high school students (1). Youth use of tobacco in any form (combustible, noncombustible, or electronic) is unsafe (2,3). E-cigarettes typically deliver nicotine derived from tobacco, which is highly addictive, might harm brain development, and could lead to sustained tobacco product use among youths (2). In April 2014, the Food and Drug Administration

(FDA) issued a proposed rule to deem all products made or derived from tobacco subject to FDA jurisdiction (4).

In the United States, e-cigarette sales have increased rapidly since entering the U.S. marketplace in 2007, reaching an estimated \$2.5 billion in sales in 2014 (5,6). Corresponding increases have occurred in e-cigarette advertising expenditures, which increased from \$6.4 million in 2011 to an estimated \$115 million in 2014 (7,8). Tobacco product advertising is causally related to tobacco product initiation among youths (9). Many of the themes used in conventional tobacco product advertising, including independence, rebellion, and sexual attractiveness, also are used to advertise e-cigarettes (9,10). Moreover, almost all tobacco use begins before age 18 years, during which time there is great vulnerability to social

influences, such as youth-oriented advertisements and youth-generated social media posts (9). This report assesses exposure to e-cigarette advertisements among U.S. middle school and high school students.

## Methods

Data from the 2014 National Youth Tobacco Survey (NYTS) were analyzed to assess exposure to e-cigarette advertisements from four sources: retail stores (convenience stores, supermarkets, or gas stations); Internet; TV and movies; and newspapers and magazines. NYTS is a cross-sectional, school-based, self-administered, pencil-and-paper questionnaire administered to U.S. middle school (grades 6–8) and high school (grades 9–12) students.\* A three-stage cluster sampling procedure was used to generate a nationally representative sample of U.S. students who attend public and private schools in grades 6–12. In 2014, 207 of 258 selected schools (80.2%) participated, yielding a sample of 22,007 participants (91.4%) among 24,084 eligible students; the overall response rate was 73.3%.

Sources of exposure to e-cigarette advertisements were assessed by participants' responses to the following four questions: 1) Internet: "When you are using the Internet, how often do you see advertisements or promotions for electronic cigarettes or e-cigarettes?" 2) Newspapers and magazines: "When you read newspapers or magazines, how often do you see advertisements or promotions for electronic cigarettes or e-cigarettes?" 3) Retail stores: "When you go to a convenience store, supermarket, or gas station, how often do you see advertisements or promotions for electronic cigarettes or e-cigarettes?" 4) TV and movies: "When you watch TV or go to the movies, how often do you see advertisements or promotions for electronic cigarettes or e-cigarettes?" For each question, respondents could select the following options: they do not use the specific source (e.g., "I do not read newspapers or magazines"), "never," "rarely," "sometimes," "most of the time," or "always." Respondents who said they saw promotions or advertisements "sometimes," "most of the time," or "always" were considered to have been exposed to advertisements from the source; those who selected "never" or "rarely" were considered not exposed. Respondents who did not use a source were also classified as not exposed.† Data were weighted to account for the complex survey design and adjusted for nonresponse. National prevalence estimates with 95% confidence intervals and population estimates were computed; population estimates

were rounded down to the nearest tenth of a million. Estimates of exposure for each source were assessed overall and by school type, sex, race/ethnicity, and grade. T-tests were used to calculate differences between groups; a p-value <0.05 was considered statistically significant. The number of exposure sources were summed for each student and reported as the proportion who were exposed to one, two, three, or four sources.

## Results

**All students.** Overall, 68.9% of participants (an estimated 18.3 million students) were exposed to e-cigarette advertisements from  $\geq 1$  source (Figure). Retail stores were the most frequently reported exposure source (54.8% of respondents, or an estimated 14.4 million students), followed by the Internet (39.8%, 10.5 million), TV and movies (36.5%, 9.6 million), and newspapers and magazines (30.4%, 8.0 million) (Table). Exposure to e-cigarette advertisements on the Internet and in newspapers and magazines was reported more frequently by females than males. Exposure in retail stores was higher among non-Hispanic whites (whites) than non-Hispanic blacks (blacks) and students of other non-Hispanic races/ethnicities. Exposure from TV and movies was higher among blacks and Hispanics than whites. Exposure was higher among students in higher grade levels for all sources. Overall, 22.1% of participants (5.8 million students) reported exposure to e-cigarette advertising from one source, 17.2% (4.5 million) from two sources, 14.1% (3.7 million) from three sources, and 15.4% (4.1 million) from four sources (Figure).

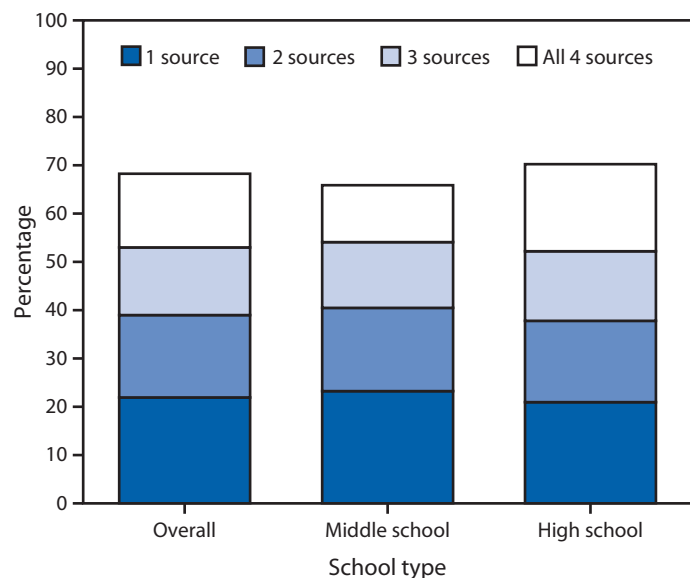
**Middle school students.** Among middle school students, 66.4% (7.7 million) were exposed to e-cigarette advertisements from at least one source (Figure). Retail stores were the most frequently reported source of exposure (52.8% of respondents, or an estimated 6.0 million middle school students), followed by the Internet (35.8%, 4.1 million), TV and movies (34.1%, 3.9 million), and newspapers and magazines (25.0%, 2.8 million) (Table). Exposure to e-cigarette advertisements on the Internet was higher among female than male middle school students. Exposure in retail stores was higher among whites than blacks and other non-Hispanic race/ethnicities. Exposure from TV or movies was higher among blacks than whites. A single source of exposure was reported by 23.4% of participants (2.7 million middle school students); two sources by 17.4% (2.0 million), three sources by 13.7% (1.5 million), and four sources by 11.9% (1.3 million) (Figure).

**High school students.** Among high school students, 70.9% of respondents (an estimated 10.5 million high school students) reported exposure to e-cigarette advertisements from at least one source (Figure). Similar to middle school students, more than half of reported e-cigarette advertising exposures (56.3%, 8.3 million) occurred in retail stores, followed by the Internet

\* Additional information available at [http://www.cdc.gov/tobacco/data\\_statistics/surveys/nyts/index.htm](http://www.cdc.gov/tobacco/data_statistics/surveys/nyts/index.htm).

† Respondents who indicated that they did not use the specified source, and who were reclassified as not exposed, included 717 (3.3%) who did not visit retail stores, 715 (3.3%) who did not use the Internet, 697 (3.2%) who did not watch TV/movies, and 5,567 (25.3%) who did not read newspapers/magazines.

**FIGURE. Proportion of U.S. students exposed to electronic cigarette (e-cigarette) advertisements, by school type and number of exposure sources\* — National Youth Tobacco Survey, 2014**



\* The four sources were retail stores, Internet, TV and movies, and newspapers and magazines.

(42.9%, 6.3 million), TV and movies (38.4%, 5.6 million), and newspapers and magazines (34.6%, 5.1 million) (Table). Exposure in retail stores was higher among whites than blacks and other non-Hispanic race/ethnicities. Exposure from TV and movies was higher among blacks than whites. One source of exposure was reported by 21.1% of participants (3.1 million high school students), two sources by 17.0% (2.5 million), three sources by 14.5% (2.1 million), and four sources by 18.2% (2.7 million) (Figure).

## Conclusions and Comments

In 2014, nearly seven in 10 (18.3 million) U.S. middle school and high school students were exposed to e-cigarette advertisements from at least one source, and approximately 15%, or 4.1 million students, were exposed to e-cigarette advertisements from all four sources. Approximately half were exposed to e-cigarette advertisements in retail stores, whereas approximately one in three were exposed on the Internet, on TV or at the movies, or while reading newspapers or magazines. Although there were slight variations by sex and race/ethnicity, the magnitude of exposure was consistent across groups. Implementation of comprehensive efforts to reduce youth exposure to e-cigarette advertising and promotion is critical to reduce e-cigarette experimentation and use among youths.

Retail store exposure to e-cigarette advertising in this study (54.8%) was lower than levels of exposure to conventional cigarette and other tobacco product advertising reported in the NYTS in 2014 (80.6%), but comparable to exposure on the

Internet (39.8% versus 46.8%, respectively) and in newspapers and magazines (30.4% versus 34.3%, respectively) (11).<sup>§</sup> Advertising for conventional tobacco products, such as cigarettes, has been shown to prompt experimentation as well as increase and maintain tobacco product use among youths (9). Similarly, according to a recent randomized controlled study, adolescents who were exposed to e-cigarette advertisements on TV were 54% more likely to say they would try an e-cigarette soon, and 43% more likely to say they would try an e-cigarette within the next year, compared with adolescents who were not exposed to e-cigarette advertisements (12). The study also determined that youths exposed to e-cigarette advertisements were more likely to agree that e-cigarettes can be used in places where smoking is not allowed (12). This is consistent with findings that certain e-cigarette marketers are using advertising tactics similar to those used in the past to market conventional cigarettes, including youth-oriented themes, and promoting e-cigarette use as an alternative in places where smoking is not allowed (2,9,10). An analysis of 57 online e-cigarette vendors determined that 70.2% of vendors used more than one social network service to market e-cigarettes (13). Moreover, 61.4% of vendors only required users to click a pop-up or dialog box to self-verify age, and 35.1% of vendors had no detectable age verification process. This unrestricted marketing of e-cigarettes, coupled with rising use of these products among youths (1), has the potential to compromise decades of progress in preventing tobacco use and promoting a tobacco-free lifestyle among youths (2,9).

Research supports the importance of a multifaceted approach to youth tobacco prevention involving multiple levels of government (2,9,14). Local, state, and federal efforts to reduce youth access to the settings where tobacco products, including e-cigarettes, are sold could reduce youth e-cigarette initiation and consumption, as well as advertising exposure. Potential strategies include requiring that tobacco products, including e-cigarettes, be sold only in facilities that never admit youths; limiting tobacco outlet density or proximity to schools; and requiring that e-cigarette purchases be made only through face-to-face transactions. Adding e-cigarettes and other tobacco products to the list of current tobacco products prohibited from being sent through U.S. mail and requiring age verification for online sales at purchase and delivery could also prevent sales to youths. In addition, potential strategies at the federal or state level include regulation of e-cigarette advertising in media, Internet, and retail settings that are demonstrated to appeal to youths or are viewed by a substantial number of youths. The evidence base for restricting advertisements for conventional

<sup>§</sup> A question assessing exposure to advertisements for cigarettes and other tobacco products from TV and movies is not available for the 2014 NYTS.

**TABLE. Electronic cigarette (e-cigarette) advertisement exposure among U.S. middle school and high school students, by sources of exposure — National Youth Tobacco Survey, 2014**

Characteristic	Retail stores		Internet		TV and movies		Newspapers and magazines	
	% (95% CI)	Population estimate (millions)*	% (95% CI)	Population estimate (millions)	% (95% CI)	Population estimate (millions)	% (95% CI)	Population estimate (millions)
<b>Overall</b>								
<b>Total</b>	<b>54.8 (53.6–56.0)</b>	<b>14.4</b>	<b>39.8 (38.5–41.1)</b>	<b>10.5</b>	<b>36.5 (35.3–37.7)</b>	<b>9.6</b>	<b>30.4 (29.3–31.6)</b>	<b>8.0</b>
<b>Sex</b>								
Female (referent)	54.9 (53.5–56.3)	7.2	41.1 (39.4–42.9)	5.4	36.4 (34.8–38.0)	4.7	32.1 (30.2–34.1)	4.2
Male	54.6 (52.9–56.4)	7.1	38.5 <sup>†</sup> (37.1–39.8)	5.0	36.7 (35.2–38.2)	4.8	28.7 <sup>†</sup> (27.6–29.9)	3.7
<b>Race/Ethnicity</b>								
Non-Hispanic white (referent)	56.7 (55.0–58.4)	8.4	40.2 (38.5–42.0)	5.9	35.2 (33.7–36.6)	5.2	31.1 (29.7–32.5)	4.6
Non-Hispanic black	51.7 <sup>§</sup> (49.4–53.9)	1.9	41.3 (38.5–44.2)	1.5	42.2 <sup>§</sup> (40.0–44.3)	1.5	32.2 (30.0–34.5)	1.2
Hispanic	55.6 (53.8–57.4)	3.0	39.4 (37.8–41.1)	2.1	37.4 <sup>§</sup> (35.6–39.4)	2.0	29.2 (27.1–31.3)	1.5
Other (non-Hispanic)	44.4 <sup>§</sup> (39.2–49.7)	0.5	32.6 <sup>§</sup> (28.3–37.2)	0.3	29.9 <sup>§</sup> (26.1–33.9)	0.3	25.3 <sup>§</sup> (22.1–28.7)	0.2
<b>Grade</b>								
6	50.6 <sup>¶</sup> (47.2–54.0)	1.8	32.8 <sup>¶</sup> (30.8–34.8)	1.1	31.8 <sup>¶</sup> (29.4–34.3)	1.1	24.1 <sup>¶</sup> (22.1–26.2)	0.8
7	55.0 (51.7–58.3)	2.1	36.7 <sup>¶</sup> (34.4–39.0)	1.4	35.6 (32.8–38.5)	1.4	25.9 <sup>¶</sup> (24.0–28.0)	1.0
8	52.6 (48.9–56.3)	2.0	37.6 <sup>¶</sup> (34.7–40.5)	1.4	34.6 (32.2–37.1)	1.3	25.0 <sup>¶</sup> (21.5–28.9)	0.9
9	54.7 (52.1–57.2)	2.1	39.2 <sup>¶</sup> (37.0–42.8)	1.5	37.2 (32.2–37.1)	1.4	32.0 <sup>¶</sup> (30.1–34.0)	1.2
10	56.2 (53.6–58.8)	2.1	43.4 (40.9–45.8)	1.6	38.9 (36.5–41.3)	1.4	34.0 <sup>¶</sup> (31.6–36.5)	1.2
11	57.8 (54.9–60.6)	2.0	45.5 (43.3–47.6)	1.6	39.9 (37.1–42.7)	1.4	35.9 (33.7–38.1)	1.2
12 (referent)	56.8 (54.2–59.3)	1.9	44.1 (41.7–46.6)	1.5	37.8 (34.5–41.3)	1.3	37.1 (34.7–39.5)	1.2
<b>Middle School</b>								
<b>Total</b>	<b>52.8 (50.9–54.7)</b>	<b>6.0</b>	<b>35.8 (34.2–37.4)</b>	<b>4.1</b>	<b>34.1 (32.3–35.8)</b>	<b>3.9</b>	<b>25.0 (23.8–26.3)</b>	<b>2.8</b>
<b>Sex</b>								
Female (referent)	52.1 (50.0–54.1)	2.9	37.6 (35.4–39.8)	2.1	33.3 (31.4–35.3)	1.8	26.2 (23.8–28.8)	1.4
Male	53.5 (50.8–56.2)	3.1	34.0 <sup>§</sup> (32.1–36.0)	1.9	34.9 (32.4–37.4)	2.0	24.0 (22.4–25.6)	1.4
<b>Race/Ethnicity</b>								
Non-Hispanic white (referent)	55.1 (52.7–57.5)	3.4	36.5 (34.4–38.5)	2.3	32.6 (30.2–35.2)	2.0	25.7 (23.9–27.5)	1.6
Non-Hispanic black	50.6 <sup>§</sup> (47.6–53.5)	0.7	36.4 (33.2–39.7)	0.5	40.4 <sup>§</sup> (36.8–44.1)	0.6	26.5 (23.6–29.7)	0.4
Hispanic	53.7 (50.9–56.5)	1.3	36.0 (33.9–38.2)	0.9	35.1 (33.1–37.1)	0.8	24.5 (22.3–26.9)	0.6
Other (non-Hispanic)	41.2 <sup>§</sup> (32.9–50.1)	0.2	28.8 <sup>§</sup> (23.7–34.6)	0.1	30.3 (24.8–36.6)	0.1	21.0 <sup>§</sup> (16.9–25.8)	0.1
<b>High School</b>								
<b>Total</b>	<b>56.3 (54.7–57.9)</b>	<b>8.3</b>	<b>42.9 (41.4–44.4)</b>	<b>6.3</b>	<b>38.4 (36.8–40.1)</b>	<b>5.6</b>	<b>34.6 (33.3–36.0)</b>	<b>5.1</b>
<b>Sex</b>								
Female (referent)	57.1 (55.0–59.1)	4.2	43.8 (41.5–46.1)	3.2	38.8 (36.6–41.0)	2.8	36.7 (34.7–38.7)	2.7
Male	55.5 (53.5–57.5)	4.0	42.0 (40.4–43.6)	3.0	38.1 (36.0–40.2)	2.7	32.5 <sup>§</sup> (42.2–45.5)	2.3
<b>Race/Ethnicity</b>								
Non-Hispanic white (referent)	57.8 (55.6–60.0)	4.9	43.0 (40.7–45.4)	3.6	37.1 (35.2–39.1)	3.1	35.2 (33.8–36.6)	3.0
Non-Hispanic black	52.4 <sup>§</sup> (49.4–55.4)	1.1	44.6 (41.0–48.4)	0.9	43.3 <sup>§</sup> (39.7–46.9)	0.9	36.1 (32.8–39.5)	0.8
Hispanic	57.3 (54.9–59.7)	1.6	42.3 (40.1–44.5)	1.2	39.5 (36.4–42.7)	1.1	33.1 (30.0–36.4)	0.9
Other (non-Hispanic)	46.6 <sup>§</sup> (41.6–51.5)	0.3	35.2 <sup>§</sup> (29.8–40.9)	0.2	29.5 <sup>§</sup> (25.9–33.4)	0.1	28.7 <sup>§</sup> (24.6–33.2)	0.1

**Abbreviation:** CI = confidence interval.

\* Population estimate (rounded down to the nearest 0.1 million).

<sup>†</sup> Statistically significant difference from referent (female) (p-value <0.05).

<sup>§</sup> Statistically significant difference from referent (non-Hispanic white) (p-value <0.05).

<sup>¶</sup> Statistically significant difference from referent (12th grade) (p-value <0.05).

tobacco products indicates that these interventions would be expected to contribute to reductions in e-cigarette advertisement exposure and use among youths as well (2,9). To effectively implement these strategies, there is a need for fully funded and sustained comprehensive state tobacco control programs that address all forms of tobacco use, including e-cigarettes (14). These programs are critical to support the

implementation and maintenance of proven population-based interventions to reduce tobacco use among youths, including tobacco price increases, comprehensive smoke-free laws, and high impact mass media campaigns (14). However, in 2015, states appropriated only 1.9% (\$490.4 million) of combined revenues of \$25.6 billion from settlement payments and tobacco taxes for all states on comprehensive tobacco control

**Key Points**

- E-cigarette advertising expenditures have increased dramatically in the United States in recent years, from approximately \$6.4 million in 2011 to \$115 million in 2014.
- Approximately 18.3 million U.S. middle school and high school students were exposed to at least one source of e-cigarette advertising in 2014.
- Approximately half of all middle school and high school students (an estimated 14.4 million students) were exposed to e-cigarette advertisements in retail stores.
- Approximately one third of middle school and high school students were exposed to e-cigarette advertisements on the Internet (10.5 million), on TV or at the movies (9.6 million), or while reading newspapers or magazines (8.0 million).
- Tobacco product advertising can entice youth to start using tobacco. Comprehensive efforts to reduce youth exposure to e-cigarette marketing would be expected to reduce this burden, and consequently reduce youth use of these products.
- Additional information is available at <http://www.cdc.gov/vitalsigns>.

programs,<sup>‡</sup> representing <15% of the CDC-recommended level of funding (\$3.3 billion) for all states combined (14). Only two states (Alaska and North Dakota) currently fund tobacco control programs at CDC-recommended levels. Additionally, parents, caregivers, and health care providers can talk to children about the dangers of tobacco use, encourage or set limits on media use, and teach children critical media viewing skills to increase their resistance to pro-tobacco messages (15).

These findings are subject to at least three limitations. First, advertising exposure was self-reported and is subject to recall bias. Second, data were collected only from students who attended public or private schools and might not be generalizable to middle school- and high school-aged youths who are being homeschooled, youths who have dropped out of school, or youths in detention centers. However, data from the Current Population Survey indicate that 97.5% of U.S. youths aged 10–13 years and 95.4% of those aged 14–17 years were enrolled in a traditional school in 2014.\*\* Finally, exposure to

e-cigarette advertisements might have been underestimated, as survey questions asked only about exposure from four sources, and did not assess exposure from other potential sources such as sporting events, radio, or billboards.

This report highlights youth exposure to e-cigarette advertisements, which might be contributing to increasing youth experimentation with and use of e-cigarettes in recent years. Multiple approaches are warranted to reduce youth e-cigarette use and exposure to e-cigarette advertisements, including efforts to reduce youth access to the settings where tobacco products, including e-cigarettes, are sold, and regulation of youth-oriented e-cigarette marketing. The implementation of these approaches, in coordination with fully funded and sustained comprehensive state tobacco control programs, has the potential to reduce all forms of tobacco use among youths, including e-cigarette use.

<sup>1</sup>Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; <sup>2</sup>Epidemic Intelligence Service, CDC.

Corresponding author: Tushar Singh, [TSingh@cdc.gov](mailto:TSingh@cdc.gov), 770-488-4252.

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## Announcement

### National Birth Defects Prevention Month and Folic Acid Awareness Week — January 2016

Birth defects are common, costly, and critical conditions that affect one in every 33 U.S. newborns annually (1). Women can reduce their risk of having a baby born with a birth defect by making healthy choices and adopting healthy habits before and during pregnancy.

Health care providers can encourage parents-to-be to make a PACT for birth defects prevention by taking the following steps: Planning ahead for pregnancy; Avoiding harmful substances like chemicals in the home or workplace (2); Choosing a healthy lifestyle, including eating a healthy diet (3); and Talking with their health care provider before and during pregnancy, particularly about medication use. Additional information about medication use in pregnancy is available at CDC's Treating for Two initiative website (<http://www.cdc.gov/treatingfortwo>).

CDC encourages health care providers to become active participants in National Birth Defects Prevention Month by joining the nationwide effort to raise awareness of birth defects, their causes, and their impact. Additional information is available at <http://www.cdc.gov/ncbddd/birthdefects/prevention-month.html>.

January 10–16, 2016, is National Folic Acid Awareness Week. CDC urges all women of childbearing age who can become pregnant to get 400  $\mu\text{g}$  of folic acid every day to help reduce the risk for neural tube defects. Health care providers should encourage women of childbearing age to consume folic acid in fortified foods or supplements, or a combination of the two, in addition to a diet rich in folate. Additional information about folic acid is available at <http://www.cdc.gov/ncbddd/folicacid/index.html>.

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## Erratum

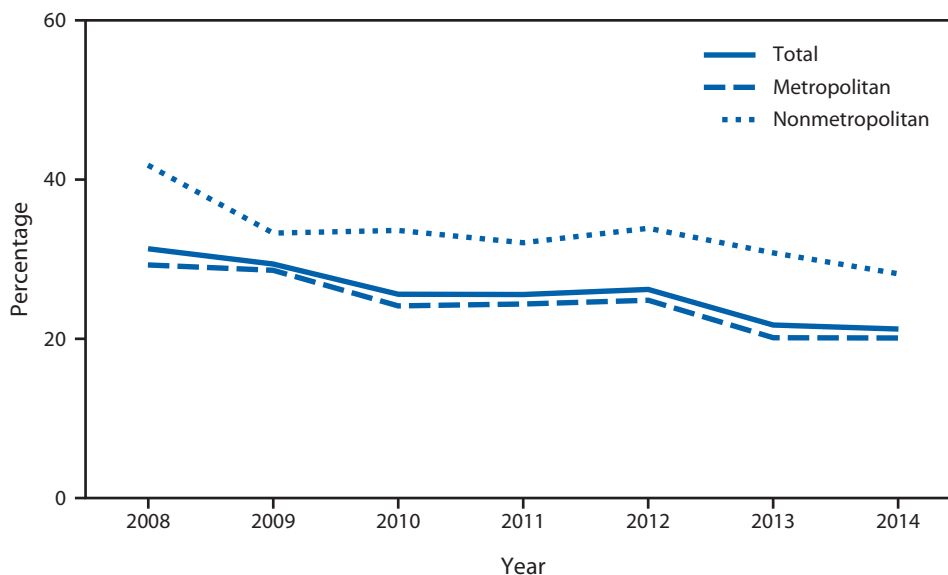
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The report, “Notes from the Field: Increase in Human Cases of Tularemia — Colorado, Nebraska, South Dakota, and Wyoming, January–September 2015,” contained an error. The last two sentences of the first paragraph should have read as follows: “As of September 30, a total of 100 tularemia cases were reported in 2015 among residents of Colorado (n = 43), Nebraska (n = 21), South Dakota (n = 20), and Wyoming (n = 16) (Figure). This represents a substantial increase in the annual mean number of four (975% increase), seven (200%), seven (186%) and two (700%) cases, respectively, reported in each state during 2004–2014 (2).”

## QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

### Percentage of Youths Aged 10–17 Years Who Did Not Receive a Well-Child Checkup in the Past 12 Months,\* by Metropolitan Status of Residence<sup>†</sup> — National Health Interview Survey, United States, 2008–2014<sup>§</sup>



\* Data on well-child visits are based on the response to the question, "During the past 12 months did (sample child) receive a well-child checkup — that is, a general checkup when (he/she) was not sick or injured?"

<sup>†</sup> Based on the household residence location. Metropolitan residences are located within a metropolitan statistical area, defined as a county or group of contiguous counties containing at least one urbanized area with a population  $\geq 50,000$ ; surrounding counties with strong economic ties to the urbanized area also are included. Nonmetropolitan areas do not include a large urbanized area and are generally more rural.

<sup>§</sup> Estimates are based on household interviews of a sample of the U.S. noninstitutionalized civilian population and are derived from the National Health Interview Survey sample child component.

From 2008 to 2014, the percentage of youths aged 10–17 years who had not received a well-child checkup in the past 12 months decreased overall (31.3% to 21.2%) and in both metropolitan (29.3% to 20.1%) and nonmetropolitan (41.8% to 28.2%) areas. In 2014, youths aged 10–17 years residing in nonmetropolitan areas were more likely to have not received a well-child checkup in the past 12 months compared with those residing in metropolitan areas.

**Source:** National Health Interview Survey, 2008–2014 data. Available at <http://www.cdc.gov/nchs/nhis.htm>.

**Reported by:** Lindsey I. Black, MPH, [LBlack1@cdc.gov](mailto:LBlack1@cdc.gov), 301-458-4548; Anjel Vahratian, PhD.



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