# Tobacco Use Among Middle and High School Students — United States, 2011–2016

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Tobacco use is the leading cause of preventable disease and death in the United States; nearly all tobacco use begins during youth and young adulthood (*1*,*2*). Among youths, use of tobacco products in any form is unsafe (*1*,*3*). CDC and the Food and Drug Administration (FDA) analyzed data from the 2011–2016 National Youth Tobacco Surveys (NYTS) to determine recent patterns of current (past 30-day) use of seven tobacco product types among U.S. middle (grades 6–8) and high (grades 9–12) school students. In 2016, 20.2% of surveyed high school students and 7.2% of middle school students reported current tobacco product use. In 2016, among current tobacco product users, 47.2% of high school students and 42.4% of middle school students used ≥2 tobacco products, and electronic cigarettes (e-cigarettes) were the most commonly used tobacco product among high (11.3%) and middle (4.3%) school students. Current use of any tobacco product did not change significantly during 2011–2016 among high or middle school students, although combustible tobacco product use declined. However, during 2015–2016, among high school students, decreases were observed in current use of any tobacco product, any combustible product, ≥2 tobacco products, e-cigarettes, and hookahs. Among middle school students, current use of e-cigarettes decreased. Comprehensive and sustained strategies can help prevent and reduce the use of all forms of tobacco products among U.S. youths (*1*–*3*).

NYTS is a cross-sectional, voluntary, school-based, self-administered, pencil-and-paper questionnaire administered to U.S. middle and high school students. A three-stage cluster sampling procedure was used to generate a nationally representative sample of U.S. students attending public and private schools in grades 6–12. This report uses data from six NYTS waves (2011–2016). Sample sizes and response rates for 2011, 2012, 2013, 2014, 2015, and 2016 were 18,866 (72.7%), 24,658 (73.6%), 18,406 (67.8%), 22,007 (73.3%), 17,711 (63.4%), and 20,675 (71.6%), respectively.

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

Participants were asked about current use of cigarettes, cigars, smokeless tobacco,* e-cigarettes,[†] hookahs (water pipes used to smoke tobacco),[§] pipe tobacco,[¶] and bidis (small imported cigarettes wrapped in a leaf). Current use for each product was

defined as use on ≥1 day during the past 30 days. "Any tobacco product use" was defined as current use of one or more tobacco products, and "≥2 tobacco product use" was defined as current use of two or more tobacco products.** "Any combustible tobacco product use" was defined as current use of cigarettes, cigars, hookahs, pipe tobacco, and/or bidis.

Data were weighted to account for the complex survey design and adjusted for nonresponse; national prevalence estimates, 95% confidence intervals, and population estimates were computed and rounded down to the nearest 10,000. Current use estimates for 2016 are presented for any tobacco product, any combustible tobacco product, ≥2 tobacco products, and each tobacco product individually, by selected demographics for each school type (high school and middle school). Results were assessed for the presence of linear and quadratic trends during 2011–2016, adjusting for race/ethnicity, sex, and school

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* Beginning in 2015, the definition of smokeless tobacco included chewing tobacco/snuff/dip, snus, and dissolvable tobacco because of limited sample sizes for individual products (snus, dissolvable). In figures 1 and 2, this definition was applied across all years (2011–2016) for comparability purposes. The definition of smokeless tobacco in previously published reports (NYTS 2014 and earlier) included only chewing tobacco/snuff/dip, whereas snus and dissolvable tobacco were reported as separate products.

† In 2015 and 2016, current use of e-cigarettes was assessed by the question "During the past 30 days, on how many days did you use electronic cigarettes or e-cigarettes?" E-cigarette questions were preceded by an introductory paragraph. In 2016, this paragraph read: "The next thirteen questions are about electronic cigarettes or e-cigarettes. E-cigarettes are battery-powered devices that usually contain a nicotine-based liquid that is vaporized and inhaled. You may also know them as vape-pens, hookah-pens, e-hookahs, e-cigars, e-pipes, personal vaporizers or mods. Some brand examples are NJOY, Blu, Vuse, MarkTen, Logic, Vapin Plus, eGo, Halo." A similar introductory paragraph preceded e-cigarette questions in 2015. In 2014, current use of e-cigarettes was assessed by the question "During the past 30 days, on how many days did you use e-cigarettes such as Blu, 21st Century Smoke, or NJOY?"; and in 2011 to 2013, e-cigarette use was assessed by the question "In the past 30 days, which of the following products have you used on at least one day?," and the response option for e-cigarettes was "Electronic cigarettes or e-cigarettes such as Ruyan or NJOY."

§ In 2016, current use of hookahs was assessed by the question "In the past 30 days, on how many days did you smoke tobacco in a hookah or waterpipe? Hookah questions were preceded by an introductory statement: "The next eight questions are about smoking tobacco in a hookah, which is a type of waterpipe. Shisha (or hookah tobacco) is smoked in a hookah." From 2011–2015, current hookah use was assessed by the question "In the past 30 days, which of the following products have you used on at least one day?" Hookah was the fourth response option in 2015, the first response option in 2014, and was the fourth or fifth response option from 2011 to 2013.

¶ From 2014 to 2016, current use of tobacco pipes was assessed by the question "In the past 30 days, which of the following products have you used on at least one day?" and the response option for pipe tobacco was "Pipe filled with tobacco (not waterpipe)." Pipe tobacco was the second response option available in 2016, the fifth option in 2015, and the second option available in 2014. From 2011 to 2013, tobacco pipe use was assessed by the question "During the past 30 days, on how many days did you smoke tobacco in a pipe?"

** In 2015 and 2016, the definition of ≥2 tobacco product–use includes the updated definition of smokeless tobacco, thereby analyzing chewing tobacco/snuff/dip, snus, and dissolvable tobacco as a single tobacco product type compared with previously published NYTS reports, which analyzed chewing tobacco/snuff/dip, snus, and dissolvable tobacco as separate products.

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grade.[††] T-tests were performed to examine differences between findings in 2015 and 2016. For all analyses, p-values <0.05 were considered statistically significant.

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[††] A test for linear trend is significant if an overall statistically significant decrease or increase occurs during the study period. Data were also assessed for the presence of quadratic trends; a significant quadratic trend indicates that the rate of change accelerated or decelerated across the study period. Trends were only assessed when statistically stable data were available for all 6 years. A significant positive linear trend and nonsignificant quadratic trend signifies the presence of a linear increase; a significant negative linear trend and nonsignificant quadratic trends signifies the presence of a linear decrease; a significant positive linear trend and significant positive or negative quadratic trend signifies the presence of a nonlinear increase; a significant negative linear trend and significant positive or negative quadratic trend signifies the presence of a nonlinear decrease; a nonsignificant linear trend and significant positive or negative quadratic trend signifies the presence of a nonlinear change.

In 2016, 20.2% of high school students (estimated 3.05 million) reported current use of any tobacco product, including 9.6% (1.44 million; 47.2% of current tobacco product users) who reported current use of ≥2 tobacco products. Among high school students, e-cigarettes were the most commonly used tobacco product (11.3% of current users), followed by cigarettes (8.0%), cigars (7.7%), smokeless tobacco (5.8%), hookahs (4.8%), pipe tobacco (1.4%), and bidis (0.5%) (Table). Males reported higher use of any tobacco product, ≥2 tobacco products, cigars, smokeless tobacco, and pipe tobacco than did females. E-cigarettes were the most commonly used tobacco product among non-Hispanic white (13.7%) and Hispanic

**TABLE. Estimated percentage of middle and high school students who used tobacco products in the past 30 days, by product,* school level, sex, and race/ethnicity — National Youth Tobacco Survey, United States, 2016**

| Tobacco product | Sex % (95% CI) | | Race/Ethnicity % (95% CI) | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Female | Male | White, non-Hispanic | Black, non-Hispanic | Hispanic | Other, non-Hispanic | % (95% CI) | Estimated no. of users[†] |
| **High school students** | | | | | | | | |
| Electronic cigarettes | 9.5 (7.8–11.5) | 13.1 (11.4–14.9) | 13.7 (11.9–15.7) | 6.2 (4.8–7.9) | 10.3 (8.2–12.8) | 5.4 (3.6–8.0) | **11.3 (9.9–12.9)** | **1,680,000** |
| Cigarettes | 6.9 (5.4–8.8) | 9.1 (7.6–11.0) | 9.9 (8.2–11.8) | 3.9 (2.9–5.3) | 6.4 (4.9–8.4) | 4.8 (3.1–7.6) | **8.0 (6.7–9.6)** | **1,180,000** |
| Cigars | 5.6 (4.3–7.2) | 9.0 (8.6–11.2) | 7.9 (6.5–9.6) | 9.5 (7.8–11.5) | 7.2 (5.7–9.1) | 3.7 (2.4–5.7) | **7.7 (6.6–8.9)** | **1,130,000** |
| Smokeless tobacco | 3.3 (2.4–4.4) | 8.3 (6.8–10.1) | 7.4 (6.0–9.1) | 2.1 (1.5–3.1) | 4.4 (3.4–5.7) | 3.8 (2.1–6.8) | **5.8 (4.8–7.0)** | **860,000** |
| Hookah | 5.1 (4.1–6.3) | 4.5 (3.8–5.4) | 4.5 (3.7–5.4) | 4.1 (3.2–5.3) | 6.4 (4.8–8.3) | 3.4 (2.1–5.5) | **4.8 (4.1–5.7)** | **700,000** |
| Pipe tobacco | 0.9 (0.7–1.2) | 1.8 (1.5–2.4) | 1.4 (1.1–1.8) | 1.2 (0.7–2.0) | 1.2 (0.9–1.8) | —[§] | **1.4 (1.1–1.7)** | **190,000** |
| Bidis | 0.3 (0.2–0.6) | 0.7 (0.5–0.9) | 0.4 (0.2–0.7) | — | 0.6 (0.4–1.1) | — | **0.5 (0.3–0.7)** | **70,000** |
| **Any tobacco product[¶]** | 17.0 (14.9–19.3) | 23.5 (21.3–25.8) | 23.0 (20.7–25.6) | 16.4 (14.1–18.9) | 18.3 (15.8–21.0) | 11.3 (8.7–14.5) | **20.2 (18.4–22.3)** | **3,050,000** |
| **≥2 tobacco products**[**] | 7.8 (6.3–9.7) | 11.4 (9.9–13.0) | 11.3 (9.6–13.2) | 6.1 (5.2–7.3) | 8.9 (7.1–11.2) | 5.0 (3.2–7.7) | **9.6 (8.3–11.1)** | **1,440,000** |
| **Any combustible tobacco product[††]** | 12.4 (10.7–14.4) | 15.3 (13.7–17.1) | 15.1 (13.1–17.3) | 12.9 (11.0–15.1) | 12.9 (11.1–14.9) | 8.1 (5.9–11.1) | **13.8 (12.3–15.5)** | **2,080,000** |
| **Middle school students** | | | | | | | | |
| Electronic cigarettes | 3.4 (2.7–4.3) | 5.1 (4.2–6.1) | 3.7 (3.0–4.7) | 4.0 (2.6–6.0) | 5.6 (4.3–7.4) | — | **4.3 (3.7–4.9)** | **500,000** |
| Cigarettes | 1.8 (1.3–2.5) | 2.5 (1.8–3.4) | 1.9 (1.4–2.6) | — | 2.5 (1.8–3.5) | — | **2.2 (1.7–2.7)** | **250,000** |
| Cigars | 1.7 (1.1–2.4) | 2.7 (1.9–3.9) | 1.4 (0.9–2.2) | 4.5 (2.8–7.1) | 2.8 (1.9–4.2) | — | **2.2 (1.7–2.9)** | **260,000** |
| Smokeless tobacco | 1.5 (0.9–2.4) | 3.0 (2.2–4.0) | 2.1 (1.5–3.0) | — | 3.0 (2.1–3.4) | — | **2.2 (1.6–3.1)** | **260,000** |
| Hookah | 1.9 (1.5–2.5) | 2.1 (1.5–2.9) | 0.9 (0.6–1.4) | 2.8 (1.8–4.4) | 3.7 (3.0–4.7) | — | **2.0 (1.6–2.5)** | **230,000** |
| Pipe tobacco | 0.6 (0.3–1.0) | 0.8 (0.5–1.3) | — | — | 1.7 (1.1–2.6) | — | **0.7 (0.5–1.0)** | **70,000** |
| Bidis | — | 0.4 (0.2–0.7) | — | — | 0.6 (0.4–1.1) | — | **0.3 (0.2–0.5)** | **30,000** |
| **Any tobacco product[¶]** | **5.9 (4.9–7.3)** | **8.3 (6.8–9.9)** | **5.9 (4.7–7.3)** | **7.5 (5.5–10.1)** | **9.5 (7.5–11.8)** | — | **7.2 (6.1–8.4)** | **850,000** |
| **≥2 tobacco products**[**] | 2.5 (1.8–3.4) | 3.6 (2.7–4.7) | 2.3 (1.7–3.0) | 3.0 (2.0–4.3) | 4.5 (3.3–6.1) | — | **3.1 (2.5–3.8)** | **360,000** |
| **Any combustible tobacco product[††]** | 3.9 (3.0–5.0) | 4.6 (3.4–6.2) | 2.9 (2.2–3.7) | 5.8 (4.0–8.3) | 6.1 (4.7–7.9) | — | **4.3 (3.5–5.2)** | **510,000** |

**Abbreviation:** CI = confidence interval.
* Past 30-day use of electronic cigarettes was determined by asking, "During the past 30 days, on how many days did you use electronic cigarettes or e-cigarettes?" Past 30-day use of cigarettes was determined by asking, "During the past 30 days, on how many days did you smoke cigarettes?" Past 30-day use of cigars was determined by asking, "During the past 30 days, on how many days did you smoke cigars, cigarillos, or little cigars?" Past 30-day use of hookahs was determined by asking, "During the past 30 days, on how many days did you smoke tobacco in a hookah or waterpipe?" Smokeless tobacco was defined as use of chewing tobacco, snuff, dip, snus, and/or dissolvable tobacco products. Past 30-day use of smokeless tobacco was determined by asking the following question regarding chewing tobacco, snuff, and dip: "During the past 30 days, on how many days did you use chewing tobacco, snuff, or dip?," and the following question for use of snus and dissolvable tobacco products: "In the past 30 days, which of the following products did you use on at least one day: snus, dissolvable tobacco products?." Responses from these questions were combined to derive overall smokeless tobacco use. Past 30-day use of pipe tobacco and bidis were determined by asking, "In the past 30 days, which of the following products have you used on at least one day: pipe filled with tobacco (not waterpipe), bidis (small brown cigarettes wrapped in a leaf)?"
[†] Estimated total number of users is rounded down to the nearest 10,000 persons.
[§] Data are statistically unreliable because samples size was <50 or relative standard error was >0.3.
[¶] Any tobacco product use is defined as use of any tobacco product (electronic cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, and/or bidis) on at least one day in the past 30 days.
[**] ≥2 tobacco product use is defined as use of two or more tobacco products (electronic cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, and/or bidis) on at least one day in the past 30 days.
[††] Any combustible tobacco use defined as use of cigarettes, cigars, hookahs, pipe tobacco, and/or bidis on at least one day in the past 30 days.

(10.3%) high school students, whereas cigars were the most commonly used tobacco product among non-Hispanic black high school students (9.5%).

Among middle school students, 7.2% (0.85 million) reported current use of any tobacco product, and 3.1% (0.36 million; 42.4% of current tobacco users) reported current use of ≥2 tobacco products (Table). Among middle school students, e-cigarettes were the most commonly used tobacco product (4.3%), followed by cigarettes (2.2%), cigars (2.2%), smokeless tobacco (2.2%), hookahs (2.0%), pipe tobacco (0.7%), and bidis (0.3%). Among males, current use of any tobacco product was 8.3%, and among females, was 5.9%. Hispanics reported higher use of any tobacco product, use of ≥2 tobacco products, and use of hookahs than did non-Hispanic whites (Table).

Among all high school students, current use of any tobacco product did not change significantly from 2011 (24.2%) to 2016 (20.2%); however, a nonlinear decrease occurred in current use of any combustible tobacco product (21.8% to 13.8%), and ≥2 tobacco products (12.0% to 9.6%) during this time (Figure 1). By product type, nonlinear increases occurred for current use of e-cigarettes (1.5% to 11.3%) and hookahs (4.1% to 4.8%) (p for trend <0.05); however, a linear decrease occurred in current use of cigarettes (15.8% to 8.0%), cigars (11.6% to 7.7%), and smokeless tobacco (7.9% to 5.8%), and a nonlinear decrease occurred in current use of pipe tobacco (4.0% to 1.4%) and bidis (2.0% to 0.5%) (p<0.05 for trend) (Figure 1). During 2011–2016, among middle school students, a linear decrease occurred in current use of any combustible tobacco products (6.4% to 4.3%), cigarettes (4.3% to 2.2%), cigars (3.5% to 2.2%), and pipe tobacco (2.2% to 0.7%) (p for trend <0.05), whereas no significant linear or quadratic trends were observed for current use of any tobacco product or ≥2 tobacco products (Figure 2). A nonlinear increase occurred in current use of e-cigarettes (0.6% to 4.3%), and a linear increase occurred for current use of hookahs (1.0% to 2.0%) (p for trend <0.05).

During 2015–2016, among high school students, decreases occurred in the use of any tobacco product (25.3% to 20.2%), any combustible tobacco product (17.2% to 13.8%), ≥2 tobacco products (13.0% to 9.6%), e-cigarettes (16.0% to 11.3%), and hookahs (7.2% to 4.8%) (p<0.05). Among middle school students, e-cigarette use decreased from 5.3% in 2015 to 4.3% in 2016 (p<0.05). Among middle and high school students, use of other tobacco products, including cigarettes, cigars, smokeless tobacco, pipe, and bidis, did not change significantly during 2015–2016.

## Discussion

During 2015–2016, the use of any tobacco product, any combustible tobacco product, ≥2 tobacco products, e-cigarettes, and hookahs declined among high school students,

**Summary**

What is already known about this topic?

Tobacco use is the leading cause of preventable disease and death in the United States, and nearly all tobacco use begins during youth and young adulthood. Among youths, use of tobacco products in any form is unsafe.

What is added by this report?

In 2016, one in five high school students and one in 14 middle school students reported current use of a tobacco product on ≥1 of the past 30 days (3.9 million tobacco users). Moreover, 47.2% of high school students and 42.4% of middle school students who used a tobacco product in the past 30 days used ≥2 tobacco products. During 2015–2016, current use of electronic cigarettes (e-cigarettes) decreased among middle school students, and decreases in current use of any tobacco product, any combustible tobacco product, ≥2 tobacco products, e-cigarettes, and hookahs occurred among high school students. However, decreases in cigarette and cigar use during 2011–2016 were offset by increases in hookah and e-cigarette use, resulting in no significant change in any tobacco use. In 2016, e-cigarettes remained the most commonly used tobacco product among high (11.3%) and middle (4.3%) school students.
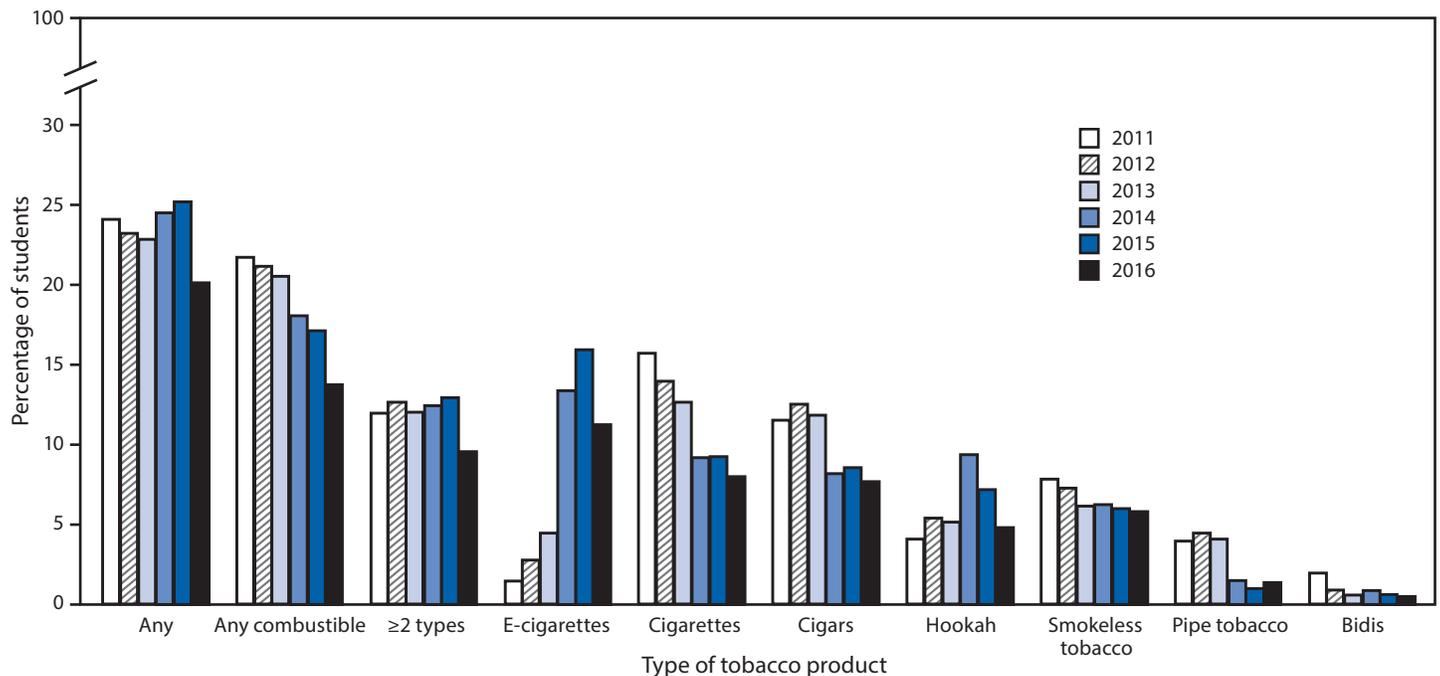
What are the implications for public health practice?

Sustained efforts to implement proven tobacco control strategies focusing on all types of tobacco products are critical to reduce tobacco product use among U.S. youths.

and e-cigarette use declined among middle school students. This is in contrast to prior recent years, when declines in the reported use of cigarettes and cigars occurred alongside increases in the use of other tobacco products, including e-cigarettes and hookahs, resulting in no change in the use of any tobacco product during 2011–2016. In 2016, an estimated 3.9 million U.S. middle and high school students currently used any tobacco product, with 1.8 million reporting current use of ≥2 tobacco products. Among youths, symptoms of nicotine dependence are increased in multiple tobacco product–users compared with single product–users (4).

Tobacco prevention and control strategies at the national, state, and local levels likely have contributed to the reduction in use of certain tobacco products, including e-cigarettes, among youths in recent years (2). Efforts to address youths' use of tobacco products include youth access restrictions, smoke-free policies that include e-cigarettes, and media campaigns warning about the risks of youth tobacco product use. For example, since February 2014, FDA's first national tobacco public education campaign, The Real Cost, has broadcasted tobacco education advertising designed for youths aged 12–17 years; the campaign was associated with an estimated 348,398 U.S. youths who did not initiate cigarette smoking during

**FIGURE 1. Estimated percentage of high school students who currently use any tobacco products,\* any combustible tobacco products,[†] ≥2 tobacco products,[§] and selected tobacco products — National Youth Tobacco Survey, United States, 2011–2016[¶,\*\*,††]**



\* Any tobacco product use is defined as past 30-day use of electronic cigarettes, cigarettes, cigars, hookahs, smokeless tobacco, pipe tobacco and/or bidis.
[†] Any combustible tobacco use is defined as use of cigarettes, cigars, hookahs, pipe tobacco, and/or bidis on at least one day in the past 30 days.
[§] ≥2 tobacco product use is defined as past 30-day use of two or more of the following tobacco products: electronic cigarettes, cigarettes, cigars, hookahs, smokeless tobacco, pipe tobacco, and/or bidis.
[¶] From 2015 to 2016, a significant decrease in use of any tobacco product, any combustible tobacco product, ≥2 tobacco products, electronic cigarettes, and hookahs was observed (p<0.05).
\*\* During 2011–2016, use of electronic cigarettes and hookahs exhibited a nonlinear increase (p<0.05). Use of cigarettes, cigars, and smokeless tobacco exhibited a linear decrease (p<0.05). Any combustible tobacco use, pipe tobacco, and bidis exhibited a nonlinear decrease (p<0.05). There was a nonlinear change during this time in the use of ≥2 types of tobacco products (p<0.05). No significant trend in current use of any tobacco product was observed during 2011–2016.
[††] Beginning in 2015, the definition of smokeless tobacco included chewing tobacco/snuff/dip, snus, and dissolvable tobacco because of limited sample sizes for individual products; this definition was applied across 2011–2016 for comparability purposes. In previous reports (National Youth Tobacco Survey 2014 and earlier) smokeless tobacco included only chewing tobacco/snuff/dip; snus and dissolvable tobacco were reported as separate products.
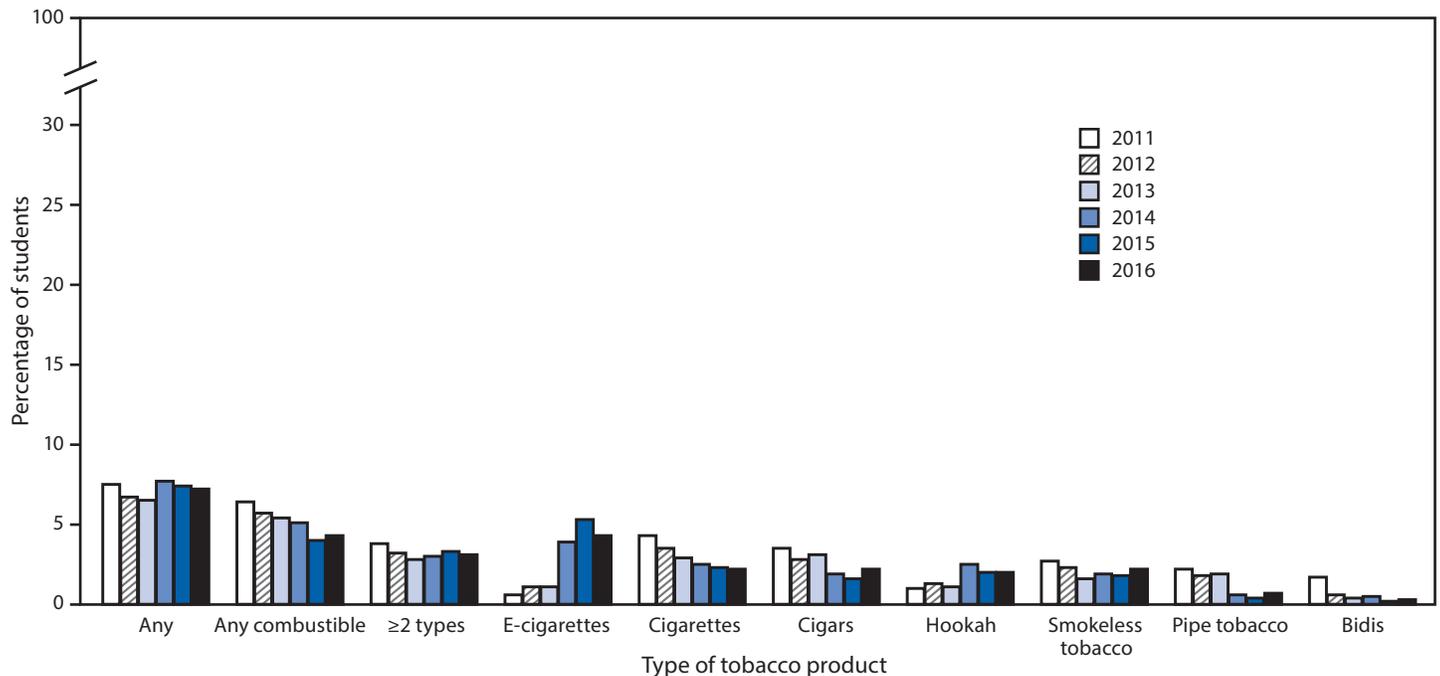
February 2014–March 2016 (*5*). Continued implementation of these strategies can help prevent and further reduce the use of all forms of tobacco product among U.S. youths (*1–3*).

The findings in this report are subject to at least three limitations. First, NYTS only recruited students from public and private schools; therefore, the findings might not be generalizable to youths who are being home-schooled, have dropped out of school, or are in detention centers. Second, data were self-reported; thus, the findings are subject to recall and response bias. Finally, changes in the wording and placement of survey questions about certain products (e.g., e-cigarettes, hookahs, and pipe tobacco) during 2011–2016 might have had an impact on reported use. Despite these limitations, overall trends are generally similar to those found in other nationally representative surveys (*6,7*).

Sustained efforts to implement proven tobacco control policies and strategies are critical to preventing youth use of all tobacco products. Effective August 8, 2016, FDA finalized its deeming rule, which gave FDA jurisdiction over products made or derived from tobacco, including e-cigarettes, cigars, pipe tobacco, and hookah tobacco (*8*). Regulation of the manufacturing, distribution, and marketing of tobacco products by FDA, coupled with full implementation of comprehensive tobacco control and prevention strategies at CDC-recommended funding levels (*9*), could reduce youth tobacco product initiation and use (*1,2,9*). Strategies to reduce youth tobacco product use include increasing the price of tobacco products, protecting people from secondhand exposure to combustible tobacco smoke and e-cigarette aerosol, implementing advertising and promotion restrictions and national public education media campaigns, and raising the minimum age of purchase for tobacco products to 21 years (*9,10*). Continued monitoring of all forms of youth tobacco product use is critical to determine whether current patterns in use persist over time.

**FIGURE 2. Estimated percentage of middle school students who currently use any tobacco products,\* any combustible tobacco product,†
≥2 tobacco products,§ and selected tobacco products — National Youth Tobacco Survey, 2011–2016¶,\*\*,††**



\* Any tobacco product use is defined as past 30-day use of electronic cigarettes, cigarettes, cigars, hookahs, smokeless tobacco, pipe tobacco and/or bidis.
† Any combustible tobacco use is defined as use of cigarettes, cigars, hookahs, pipe tobacco, and/or bidis on at least one day in the past 30 days.
§ ≥2 tobacco product use is defined as past 30-day use of two or more of the following tobacco products: electronic cigarettes, cigarettes, cigars, hookahs, smokeless tobacco, pipe tobacco, and/or bidis.
¶ From 2015 to 2016, a significant decrease in use of electronic cigarettes was observed (p<0.05).
\*\* During 2011–2016, electronic cigarette use exhibited a nonlinear increase (p<0.05). Hookah use exhibited a linear increase (p<0.05). Use of any combustible tobacco, cigarettes, cigars, and pipe tobacco exhibited a linear decrease (p<0.05). Bidi use exhibited a nonlinear decrease (p<0.05). Smokeless tobacco use exhibited a nonlinear change over this time period (p<0.05). No change in current use of any product or ≥2 types of products was observed during 2011–2016.
†† Beginning in 2015, the definition of smokeless tobacco included chewing tobacco/snuff/dip, snus, and dissolvable tobacco because of limited sample sizes for individual products; this definition was applied across 2011–2016 for comparability purposes. In previous reports (National Youth Tobacco Survey 2014 and earlier) smokeless tobacco included only chewing tobacco/snuff/dip; snus and dissolvable tobacco were reported as separate products.

## Conflict of Interest

No conflicts of interest were reported.

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# Electronic Cigarettes as an Introductory Tobacco Product Among Eighth and 11th Grade Tobacco Users — Oregon, 2015

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During 2011–2015, increased electronic cigarette (e-cigarette) and hookah use offset declines in cigarette and other tobacco product use among youths (persons aged <18 years) (*1*). Limited information exists about which tobacco product introduced youths to tobacco product use. Patterns of first use of e-cigarettes among Oregon youths who were tobacco users were assessed in the Oregon Healthy Teens 2015 survey, a cross-sectional survey of eighth and 11th grade students in Oregon. Respondents were asked, "The very first time you used any tobacco or vaping product, which type of product did you use?" Among students who had ever used any tobacco product (ever users), e-cigarettes were the most common introductory tobacco product reported by both eighth (43.5%) and 11th (34.4%) grade students. Among students who used a tobacco product for ≥1 day during the past 30 days (current users), e-cigarettes were the most common introductory tobacco product reported by eighth grade students (44.4%) and the second most common introductory tobacco product reported by 11th grade students (31.0%). Introductory use of e-cigarettes was commonly reported among youths in Oregon who were ever or current tobacco users, underscoring the importance of proven interventions to prevent all forms of tobacco use among youths (*2,3*).

Tobacco use is the leading cause of preventable disease and death in the United States, and the majority of adult cigarette smokers first try smoking before age 18 years (*2*). During the past 3 decades, cigarette smoking among youths has declined substantially, in both Oregon and nationally (*3–5*). However, during 2011–2015, increased electronic cigarette and hookah use offset declines in cigarette and other tobacco product use among youths nationally; in 2014, e-cigarettes surpassed cigarettes as the most commonly used tobacco product among youths (*1*).

Among youths, use of e-cigarettes is strongly associated with use of other tobacco products, including combustible tobacco products (*3,6*). In 2015, the majority of students in U.S. middle and high school who used combustible tobacco (including conventional cigarettes) concurrently used e-cigarettes; however, which type of tobacco product these students are likely to use first remains unknown (*3*). Limited information exists about which product was used as an introduction to tobacco products after e-cigarettes became commonly used among U.S. youths (*7*). Using data from the Oregon Health Teens surveys,

patterns of first use of e-cigarettes were assessed among youths in Oregon who were tobacco users.

Oregon Healthy Teens is a cross-sectional, school-based, biennial survey of health behaviors administered to Oregon eighth and 11th grade students. A statewide representative sample is obtained from a random sample of public high schools and their feeder middle schools, stratified by county. Students' parents are notified before survey administration and can decline participation for their child. Students can opt out of participating at the time of survey administration. Responses are anonymous, and data are weighted based on statewide school enrollment numbers to represent students across Oregon proportionally. During February–May 2015, a total of 16,104 eighth grade and 13,570 11th grade students participated in the surveys; response rate was 83% among 308 schools that were contacted for survey recruitment.

In 2015, respondents were asked, "The very first time you used any tobacco or vaping product, which type of product did you use?" Response options included the following: I have never used any tobacco or vaping product; cigarette; chewing tobacco; small cigar; large cigar; hookah; e-cigarette or other vaping product; and another type of product. The introductory tobacco product used was assessed among ever and current tobacco product users. Respondents were considered ever users if they indicated tobacco product use for the following survey questions: "How old were you when you smoked a whole cigarette for the first time?" or "How old were you when you first used any form of tobacco other than cigarettes?" Respondents were considered current users if they indicated use of a tobacco product ≥1 day during the past 30 days. Tobacco products were categorized as cigarettes, e-cigarettes, hookahs, and other tobacco products (small cigars, large cigars, chewing tobacco, and unspecified tobacco products).

In 2015, among Oregon eighth grade students, 21.9% reported having ever used any tobacco product and 12.3% reported current use; among Oregon 11th grade students, 41.7% reported having ever used any tobacco product, and 23.7% reported current use. E-cigarettes were the most common introductory tobacco product among ever (43.5%) and current (44.4%) eighth grade users (Table). Among 11th grade users of any tobacco product, e-cigarettes were the most commonly reported introductory tobacco product among ever users (34.4%) and the second most commonly reported

**TABLE. Introductory tobacco products used among eighth and 11th grade students who ever used or currently use any tobacco product and cigarettes — Oregon Healthy Teens Survey, 2015**

| School grade | Introductory product | Ever user % (95% CI) | | Current user % (95% CI) | | |
|---|---|---|---|---|---|---|
| | | Any tobacco | Cigarettes | Any tobacco | Cigarettes | Cigarettes and e-cigarettes |
| 8 | E-cigarettes | 43.5 (39.9–47.2) | 25.1 (21.9–28.5) | 44.4 (40.8–48.2) | 22.2 (18.3–26.7) | 30.5 (25.4–36.1) |
| | Cigarettes | 27.2 (23.7–30.9) | 48.7 (43.5–53.9) | 25.0 (21.4–29.0) | 53.9 (47.5–60.3) | 44.1 (37.0–51.4) |
| | Hookah | 16.7 (13.6–20.2) | 11.9 (9.5–14.8) | 16.9 (12.9–21.9) | 9.9 (7.0–13.7) | 12.2 (8.9–16.4) |
| | Other tobacco product* | 12.6 (10.5–15.1) | 14.3 (10.5–19.3) | 13.6 (11.3–16.3) | 14.0 (9.7–19.8) | 13.3 (8.6–20.0) |
| 11 | E-cigarettes | 34.4 (31.9–37.0) | 17.7 (15.4–20.4) | 31.0 (28.2–34.0) | 14.7 (10.6–19.9) | 15.4 (10.7–21.7) |
| | Cigarettes | 29.6 (27.3–32.0) | 52.6 (49.5–55.7) | 31.1 (28.5–33.7) | 57.9 (52.4–63.1) | 57.1 (50.3–63.7) |
| | Hookah | 18.8 (17.1–20.5) | 12.8 (11.1–14.8) | 15.8 (13.7–18.1) | 10.4 (8.4–12.7) | 10.0 (7.8–12.7) |
| | Other tobacco product* | 17.2 (15.4–19.2) | 16.8 (14.8–19.1) | 22.1 (19.5–25.0) | 17.1 (14.2–20.5)[†] | 17.5 (14.2–21.3)[†] |

**Abbreviation:** CI = confidence interval.
* Other tobacco products include cigars, large cigars, chewing tobacco, or unspecified.
[†] Percent reflects total for composite variable (i.e., other tobacco product); however, when examined by individual introductory product, e-cigarettes were the second most common introductory tobacco product among 11th grade students who were current cigarette users, regardless of concurrent e-cigarette use.

introductory product among current users (31.0% of current users reported first using e-cigarettes and 31.1% reported first using conventional cigarettes).

Among eighth and 11th grade students who were conventional cigarette users, e-cigarettes were the second most common introductory tobacco product among ever (25.1% and 17.7%, respectively) and current (22.2% and 14.7%) users (Table). Among current conventional cigarette users who currently also used e-cigarettes, e-cigarettes were the second most common introductory tobacco product for both eighth (30.5%) and 11th grade students (15.4%).

## Discussion

In 2015, e-cigarettes were the most common introductory tobacco product used among Oregon eighth and 11th grade students who had ever tried tobacco products. E-cigarettes were also a common introductory tobacco product for current conventional cigarette users among eighth and 11th grade students in Oregon. Although e-cigarettes were a commonly reported introductory product in both grades, the lower prevalence of introductory use of e-cigarettes among 11th grade students might reflect tobacco use initiation that occurred before the widespread availability of e-cigarettes. This study extends reports on the increases in e-cigarette use by examining introductory tobacco products among youths who were users of tobacco products. However, further studies are needed to establish temporality of e-cigarette and conventional tobacco product use among youths.

The findings in this report are subject to at least four limitations. First, the data were self-reported, and therefore, subject to recall and reporting bias. Second, observational data do not allow for evaluation of a causal link between e-cigarette use and initiation of cigarette smoking. Third, because the survey question of interest was first asked in 2015, it is not possible at this time to report a trend in introductory tobacco products.

### Summary

#### What is already known about this topic?

Electronic cigarette (e-cigarette) use among youths is strongly associated with use of other tobacco products, including combustible tobacco products. Limited information exists about which tobacco product introduced youths to the use of tobacco products after e-cigarettes became widely available in the late 2000s.

#### What is added by this report?

In 2015, e-cigarettes were commonly reported as the introductory tobacco product among youths who had ever used or currently use any tobacco product and cigarette smokers in eighth and 11th grades in Oregon.

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

The findings of this study underscore the importance of proven interventions to prevent all forms of tobacco use, including e-cigarettes, among youths.

Finally, data are only collected from eighth and 11th grade students who attend public schools and are therefore not representative of all Oregon youths.

Introductory use of e-cigarettes was commonly reported among youths in Oregon who were ever or current tobacco users. A 2016 Surgeon General's report concerning e-cigarettes concludes that use of nicotine-containing products in any form, including e-cigarettes, among youths is unsafe (*3*). The report notes that action can be taken at the national, state, local, tribal, and territorial levels to address e-cigarette use among youths and young adults. Public health interventions could include smoke-free policies that include e-cigarettes, restrictions on youths' access to e-cigarettes, pricing strategies, retail licensure, regulation of e-cigarette marketing likely to attract youths, and educational initiatives focused toward youths and young adults (*3*). CDC has issued evidence-based guidelines to establish comprehensive tobacco control programs, and in 2016, the

Food and Drug Administration finalized rules extending its regulatory authority of tobacco products to include e-cigarettes (*8,9*). The findings of this study underscore the importance of proven interventions to prevent all forms of tobacco use, including e-cigarette use, among youths.

## Conflict of Interest

No conflicts of interest were reported.

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# Serious Bacterial Infections Acquired During Treatment of Patients Given a Diagnosis of Chronic Lyme Disease — United States

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The term "chronic Lyme disease" is used by some health care providers as a diagnosis for various constitutional, musculo-skeletal, and neuropsychiatric symptoms (*1,2*). Patients with a diagnosis of chronic Lyme disease have been provided a wide range of medications as treatment, including long courses of intravenous (IV) antibiotics (*3,4*). Studies have not shown that such treatments lead to substantial long-term improvement for patients, and they can be harmful (*1,5*). This report describes cases of septic shock, osteomyelitis, *Clostridium difficile* colitis, and paraspinal abscess resulting from treatments for chronic Lyme disease. Patients, clinicians, and public health practitioners should be aware that treatments for chronic Lyme disease can carry serious risks.

Lyme disease is a well-known condition caused by infection with the spirochete *Borrelia burgdorferi* sensu lato. Features of early infection include erythema migrans (an erythematous skin lesion with a bull's-eye or homogeneous appearance), fever, headache, and fatigue. If left untreated, the spirochete can disseminate throughout the body to cause meningitis, carditis, neuropathy, or arthritis (*5,6*). The recommended treatment for Lyme disease is generally a 2–4-week course of antibiotics (*5*).

Chronic Lyme disease, on the other hand, is a diagnosis that some health care providers use to describe patients with a variety of conditions such as fatigue, generalized pain, and neurologic disorders. Many of these patients have experienced significant debilitation from their symptoms and have not found relief after consultation with conventional medical practitioners. As a result, some seek treatment from practitioners who might identify themselves as Lyme disease specialists ("Lyme literate" doctors) or from complementary and alternative medicine clinics, where they receive a diagnosis of chronic Lyme disease (*3,7*).

A diagnosis of chronic Lyme disease might be based solely on clinical judgment and without laboratory evidence of *B. burgdorferi* infection, objective signs of infection, or a history of possible tick exposure in an area with endemic Lyme disease (*1,7*). There is a belief among persons who support the diagnosis and treatment of chronic Lyme disease that *B. burgdorferi* can cause disabling symptoms even when standard testing is negative, despite evidence that the recommended two-tiered serologic testing is actually more sensitive the longer *B. burgdorferi* infection has been present (*6*). Some practitioners use tests or testing criteria that have not been

validated for the diagnosis of Lyme disease (*1*). A significant concern is that after the diagnosis of chronic Lyme disease is made, the actual cause of a patient's symptoms might remain undiagnosed and untreated (*3,8*).

Patients given a diagnosis of chronic Lyme disease have been prescribed various treatments for which there is often no evidence of effectiveness, including extended courses of antibiotics (lasting months to years), IV infusions of hydrogen peroxide, immunoglobulin therapy, hyperbaric oxygen therapy, electromagnetic frequency treatments, garlic supplements, colloidal silver, and stem cell transplants (*1,3*). At least five randomized, placebo-controlled studies have shown that prolonged courses of IV antibiotics in particular do not substantially improve long-term outcome for patients with a diagnosis of chronic Lyme disease and can result in serious harm, including death (*1,5,9*).*

Clinicians and state health departments periodically contact CDC concerning patients who have acquired serious bacterial infections during treatments for chronic Lyme disease. Five illustrative cases described to CDC over the past several years are presented.

## Patient A

A woman in her late 30s with fatigue and joint pain received a diagnosis of chronic Lyme disease, babesiosis, and *Bartonella* infection by a local physician. Despite multiple courses of oral antibiotics, her symptoms worsened, and a peripherally inserted central catheter (PICC) was placed for initiation of IV antibiotic treatment. After 3 weeks of treatment with IV ceftriaxone and cefotaxime, the patient's joint pain continued, and she developed fever and rash. She became hypotensive and tachycardic and was hospitalized in an intensive care unit, where she was treated with broad spectrum IV antibiotics and required mechanical ventilation and vasopressors. Despite maximal medical support, she continued to worsen and eventually died. The patient's death was attributed to septic shock related to central venous catheter–associated bacteremia.

## Patient B

An adolescent girl sought medical advice regarding years of muscle and joint pain, backaches, headaches, and lethargy. She had received a diagnosis of chronic fatigue syndrome,

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but sought a second opinion from an alternative medicine clinic and was told she had chronic Lyme disease. The patient was treated with oral antibiotics, including rifampin, trimethoprim-sulfamethoxazole, and doxycycline, for 3 months; these were discontinued because of abnormal liver enzyme test results Three months later, a PICC was placed to administer IV antibiotics, including ceftriaxone. After receiving both IV and oral antibiotic therapy for 5 months without improvement, the antibiotics were discontinued, but the PICC was not removed.

One week after antibiotics had been discontinued, the patient developed pallor, chills, and fever to 102.9°F (39.4°C); after consultation with the alternative medicine clinic, she was given another dose of ceftriaxone through the PICC. Later that day she was evaluated in an emergency department with fever to 105.3°F (40.7°C), hypotension, and tachycardia consistent with septic shock. Blood and PICC tip cultures grew *Acinetobacter* spp. She was hospitalized in an intensive care unit and required vasopressors as well as broad-spectrum antibiotics to treat the infection. The PICC was removed, and the patient was eventually discharged after several weeks of hospitalization.

## Patient C

A woman in her late 40s received multiple arthropod bites and subsequently developed a flu-like illness with pain in her arms, legs, and back. One year after her symptoms began, she received a diagnosis of Lyme disease using the recommended two-tiered serologic test (positive enzyme immunoassay test result followed by positive immunoglobulin G Western immunoblot). She was treated with two 4-week courses of oral doxycycline.

The patient developed fatigue, cognitive difficulties, and poor exercise tolerance, and 2 years after her initial diagnosis she received a diagnosis of chronic Lyme disease based on the results of unvalidated tests. She was treated with intramuscular penicillin for approximately 5 weeks without improvement, then IV ceftriaxone for 4 months, followed by IV azithromycin for 6 months administered via a tunneled IV catheter.

One year later, she received additional IV ceftriaxone via a new IV catheter, plus oral doxycycline, tinidazole (an antiparasitic medication), and azithromycin for approximately 4 weeks. The patient developed back pain, shortness of breath, and malaise, and was hospitalized. The catheter was removed, and blood and catheter tip cultures yielded *Pseudomonas aeruginosa*. She was treated with aztreonam for 4 weeks; however, her back pain worsened, and she was readmitted to the hospital. A computed tomography scan indicated destruction of both the 9th and 10th thoracic vertebrae, and magnetic resonance imaging of her spine confirmed osteodiscitis. A bone biopsy and culture grew *P. aeruginosa* with the same antibiotic susceptibility profile

as her previously diagnosed bacteremia. She was treated for osteodiscitis, and her back pain eventually improved.

## Patient D

A woman in her 50s developed progressive weakness, swelling, and tingling in her extremities and received a tentative diagnosis of chronic inflammatory demyelinating polyneuropathy. Despite various treatments over a 5-year period, her symptoms did not substantially improve, and a diagnosis of amyotrophic lateral sclerosis was made.

The patient was subsequently evaluated by another physician and was told she had chronic Lyme disease, babesiosis, and Rocky Mountain spotted fever. Initial treatment with herbs and homeopathic remedies had no effect. She was treated with IV ceftriaxone and oral trimethoprim-sulfamethoxazole, acyclovir, fluconazole, and tinidazole. After 7 months of intensive antimicrobial treatment, her pain improved, but the weakness worsened. She discontinued treatment after developing *C. difficile* colitis that caused severe abdominal cramps and diarrhea. The *C. difficile* infection became intractable, and her symptoms persisted for over 2 years, requiring prolonged treatment. The patient subsequently died from complications of amyotrophic lateral sclerosis.

## Patient E

A woman in her 60s with autoimmune neutropenia, mixed connective tissue disease, and degenerative arthritis received a diagnosis of chronic Lyme disease neuropathy, for which she received IV immunoglobulin every 3 weeks via a tunneled venous catheter with an implanted subcutaneous port. After undergoing treatments for >10 years, she developed fevers and neck pain and was hospitalized; the catheter was removed, and blood and catheter tip cultures yielded methicillin-sensitive *Staphylococcus aureus*. She was treated with IV antibiotics via a newly placed PICC. Although the patient was advised to have the PICC removed once the antibiotic course finished, she chose to keep it for further IV immunoglobulin therapy.

Two months later, she was readmitted for recurrent fevers. The PICC was removed, and cultures of the tip grew coagulase-negative *Staphylococcus*; blood cultures were negative. She was treated with IV antibiotics and discharged.

The patient subsequently received a new implanted subcutaneous venous catheter and restarted IV immunoglobulin therapy, after which she was readmitted for fever and back pain. Blood cultures were positive for methicillin-sensitive *S. aureus*, and magnetic resonance imaging indicated inflammation of the lumbar facet joints, epidural space, and paraspinal muscles, consistent with infection. Despite appropriate antibiotic treatment, her back pain worsened, and she required surgical drainage of a paraspinal abscess.

**Summary**

What is already known about this topic?

"Chronic Lyme disease" is a nonspecific diagnosis without a consistent definition that has been given to patients with various symptoms. Treatments offered for chronic Lyme disease, such as prolonged antibiotic or immunoglobulin therapy, lack data supporting effectiveness and are not recommended.

What is added by this report?

Clinicians, health departments, and patients have contacted CDC with reports of serious bacterial infections resulting from treatment of persons who have received a diagnosis of chronic Lyme disease. Five of these cases are described to illustrate complications resulting from unproven treatments, including septic shock, *Clostridium difficile* colitis, osteodiscitis, abscess, and death.

What are the implications for public health practice?

Clinicians, public health practitioners, and patients should be aware that treatments for chronic Lyme disease lack proof of effectiveness and can result in serious complications. Systematic investigation into the scope and effects of these complications, including the rate and extent of infections and the pathogens associated with these infections, would be helpful to inform clinical practice and fully characterize the risks associated with treatments for chronic Lyme disease.

## Discussion

Antibiotics and immunoglobulin therapies are effective and necessary treatments for many conditions; however, unnecessary antibiotic and immunoglobulin use provides no benefit to patients while putting them at risk for adverse events. When used for extended periods, the risks associated with these treatments increase, so it is important that they be used appropriately.

These cases highlight the severity and scope of adverse effects that can be caused by the use of unproven treatments for chronic Lyme disease. In addition to the dangers associated with inappropriate antibiotic use, such as selection of antibiotic-resistant bacteria, these treatments can lead to injuries related to unnecessary procedures, bacteremia and resulting metastatic infection, venous thromboses, and missed opportunities to diagnose and treat the actual underlying cause of the patient's symptoms (8,10).[†,§] Patients and their health care providers need to be aware of the risks associated with treatments for chronic Lyme disease.

The number of persons who undergo treatments for chronic Lyme disease is unknown, as is the number of complications that result from such treatments. Systematic investigations would be useful to understand the scope and consequences of adverse effects resulting from treatment of persons with a diagnosis of chronic Lyme disease. Data sources to consider include clinician surveys, administrative claims databases, or implementation of state or local reporting systems for adverse outcomes related to these treatments.

[†] https://www.cdc.gov/features/getsmart/.
[§] https://www.cdc.gov/hai/bsi/bsi.html.

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# Trends in Breastfeeding Among Infants Enrolled in the Special Supplemental Nutrition Program for Women, Infants and Children — New York, 2002–2015

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Breastfeeding is widely accepted as the optimal method of infant feeding (1,2). New York Special Supplemental Nutrition Program for Women, Infants and Children (WIC) has prioritized the promotion of breastfeeding. To assess breastfeeding trends among New York WIC infants, indicators for measuring breastfeeding practices reported by the New York Pediatric Nutrition Surveillance System (PedNSS) during 2002–2015 were examined. The prevalence of breastfeeding initiation increased from 62.0% (2002) to 83.4% (2015), exceeding the *Healthy People 2020* (HP2020)* objective of 81.9% in 2014, with improvements among all racial/ethnic groups. The percentage of New York WIC infants who breastfed for ≥6 and ≥12 months increased from 30.2% and 15.0% (2002) to 39.5% and 22.8% (2015), respectively. The prevalence of exclusive breastfeeding for ≥3 and ≥6 months increased from 8.9% and 2.9% (2006) to 14.3% and 8.0% (2015), respectively. Despite improvements in breastfeeding initiation, increasing the duration of breastfeeding and of exclusive breastfeeding among infants enrolled in the New York WIC program remains challenging. Identifying targeted strategies to support continued and exclusive breastfeeding should remain priorities for the New York WIC program.

The New York WIC administrative data contain records for all participants certified by the program. Race/ethnicity of the infant/child and household income are reported by mothers or caregivers at the time of certification. Answers to questions regarding breastfeeding initiation ("Was [the child] ever breastfed or fed breast milk?"), duration ("How old was [the child] when they stopped being breastfed or fed breast milk?"), and exclusivity ("How old was [the child] when they were first fed something other than breast milk?") are assessed and updated at each visit until no longer breastfeeding.

New York WIC administrative data are used to generate New York PedNSS files. Non-Hispanic persons are identified as white, black, Asian, or other; persons identified as Hispanic can be of any race. Income is categorized as a percentage of the Federal Poverty Level for a given year. Infants born during the reporting period and who have valid breastfeeding information are included in the breastfeeding initiation analysis. For each category of breastfeeding duration and exclusivity, analyses include only infants who attained the age of interest during

the reporting period by their date of visit. During 2002–2015, New York PedNSS reports were used to assess the temporal trends of initiation, duration (i.e., ≥1, ≥3, ≥6, and ≥12 months of breastfeeding), and exclusivity (i.e., ≥1, ≥3, and ≥6 months of exclusive breastfeeding).

Breastfeeding estimates were generated using statistical software.† The National Cancer Institute's Joinpoint Regression Program 4.2.0.1§ was used to test for significance of trends using log-linear transformations for ease of interpretation and comparison, because the models directly provide an estimate of a fixed annual percent change (APC). Statistical significance of trend analysis was defined as p<0.05.

Trend analyses indicated that the racial/ethnic composition of the New York PedNSS cohorts changed during 2002–2015, with significant declines in the percentages of blacks and persons of "other" race/ethnicity (e.g., American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, multiracial, and unknown), whereas the percentages of Hispanics, whites and Asians increased significantly (Table 1). The percentage of infants enrolled in WIC in New York who were born into families with household incomes ≤100% of the Federal Poverty Level increased significantly from 64.3% in 2002 to 72.9% in 2015 (Table 1).

Breastfeeding initiation among New York WIC infants increased significantly, from 62.0% in 2002 to 83.4% in 2015, with an APC of 2.4 or an average of 1.7 percentage points per year (Table 2). In 2014, the overall prevalence of initiation reached 82.4%, exceeding the HP2020 goal of 81.9%. The HP2020 goal of breastfeeding initiation was reached by Hispanic WIC infants in 2007 (Figure) and has continued to increase by 0.8 percentage points annually. Even larger improvements have been made by other racial/ethnic groups. Asians had the largest relative increase (80.6%) from 45.8% in 2002 to 82.7% in 2015. As of 2015, white infants were also approaching the HP2020 goal for breastfeeding initiation (79.0%). Overall, the racial/ethnic disparity in breastfeeding initiation rate (i.e., the difference between the highest and the lowest rates among white, black, Hispanic and Asian infants in a particular year) was reduced from 26.5 percentage points in 2002 (Hispanic versus Asian) to 9.2 in 2015 (Hispanic versus white).

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**TABLE 1. Number and demographic distribution (i.e., race/ethnicity and poverty status) of infants born during report year (i.e., included in the breastfeeding initiation analysis) — New York Special Supplemental Nutrition Program for Women, Infants and Children, 2002–2015**

| Year | No. infants | Race/Ethnicity* (%) | | | | | Poverty status |
|------|-------------|----------|-------|-------|-------|--------|----------------|
| | | Hispanic | White | Black | Asian | Other[†] | ≤100% Federal Poverty Level (%) |
| 2002 | 122,852 | 33.0 | 24.5 | 26.9 | 7.5 | 8.1 | 64.3 |
| 2003 | 124,436 | 33.5 | 25.0 | 26.2 | 7.9 | 7.4 | 64.9 |
| 2004 | 124,760 | 34.3 | 25.2 | 26.1 | 8.4 | 5.9 | 67.2 |
| 2005 | 105,698 | 34.7 | 27.4 | 26.0 | 8.9 | 3.1 | 64.9 |
| 2006 | 107,385 | 35.4 | 26.8 | 26.0 | 8.5 | 3.3 | 63.9 |
| 2007 | 129,207 | 36.8 | 26.1 | 25.1 | 9.2 | 2.8 | 65.8 |
| 2008 | 131,145 | 36.5 | 26.5 | 25.3 | 8.8 | 2.8 | 66.0 |
| 2009 | 131,550 | 36.3 | 26.8 | 25.3 | 8.3 | 3.3 | 67.7 |
| 2010 | 125,779 | 36.1 | 27.4 | 24.7 | 8.3 | 3.5 | 71.3 |
| 2011 | 126,686 | 35.7 | 27.4 | 24.3 | 9.2 | 3.4 | 73.5 |
| 2012 | 124,622 | 35.4 | 27.5 | 23.9 | 10.2 | 3.1 | 74.9 |
| 2013 | 119,403 | 35.4 | 27.8 | 24.1 | 9.8 | 3.0 | 75.2 |
| 2014 | 117,578 | 35.7 | 27.4 | 23.7 | 10.2 | 3.1 | 74.2 |
| 2015 | 113,806 | 36.1 | 26.9 | 23.5 | 10.5 | 3.0 | 72.9 |

* Persons identified as Hispanic might be of any race. Persons identified as white, black, Asian, or other race are non-Hispanic. The five racial/ethnic categories are mutually exclusive.
[†] Includes American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, multiracial, and unknown.

**TABLE 2. Percentages of enrolled infants who initiated breastfeeding, continued for ≥1, ≥3, ≥6, or ≥12 months, and who were exclusively breastfed for ≥1, ≥3, or ≥6 months — New York Special Supplemental Nutrition Program for Women, Infants and Children, 2002–2015**

| Year | Initiation (%) | Duration (%) | | | | Exclusivity (%)* | | |
|------|---------------|--------|--------|--------|---------|--------|--------|--------|
| | | ≥1 mon | ≥3 mon | ≥6 mon | ≥12 mon | ≥1 mon | ≥3 mon | ≥6 mon |
| 2002 | 62.0 | 56.9 | 40.6 | 30.2 | 15.0 | —[†] | — | — |
| 2003 | 64.6 | 59.6 | 43.4 | 33.1 | 17.3 | — | — | — |
| 2004 | 66.5 | 61.5 | 47.4 | 38.6 | 22.7 | — | — | — |
| 2005 | 66.0 | 60.7 | 46.9 | 39.4 | 25.1 | — | — | — |
| 2006 | 67.2 | 57.3 | 42.2 | 35.5 | 23.2 | 15.6 | 8.9 | 2.9 |
| 2007 | 72.0 | 63.6 | 48.8 | 39.7 | 23.4 | 15.1 | 8.1 | 3.3 |
| 2008 | 73.8 | 64.6 | 50.0 | 41.2 | 26.1 | 16.4 | 8.6 | 3.8 |
| 2009 | 74.4 | 64.9 | 49.0 | 38.8 | 22.8 | 17.8 | 9.7 | 4.9 |
| 2010 | 76.9 | 66.9 | 50.6 | 38.2 | 19.7 | 19.0 | 10.5 | 5.8 |
| 2011 | 78.7 | 68.2 | 50.5 | 38.3 | 20.6 | 20.4 | 11.3 | 6.4 |
| 2012 | 80.1 | 69.2 | 51.7 | 38.0 | 20.4 | 20.7 | 10.9 | 5.8 |
| 2013 | 81.2 | 69.3 | 52.0 | 39.2 | 21.4 | 21.2 | 11.0 | 6.3 |
| 2014 | 82.4 | 70.2 | 52.9 | 39.9 | 22.1 | 22.1 | 13.0 | 7.3 |
| 2015 | 83.4 | 71.7 | 53.9 | 39.5 | 22.8 | 23.2 | 14.3 | 8.0 |

* Breastfeeding exclusivity information was not collected by New York State Special Supplemental Nutrition Program for Women, Infants and Children before 2006.
[†] Data not available for these years.

There was a significant increase in the crude prevalence of breastfeeding duration during 2002–2015 for infants who breastfed for ≥1 month (APC = 1.7) and ≥3 months (APC = 1.9) (Table 2). Joinpoint regression analysis of breastfeeding prevalence for ≥6 months indicated two segments. During 2002–2004 (APC = 13.2), the increase was not significant at the p<0.05 level but would have been at the 0.06 level; and during 2004–2005 (APC = 0.3), the prevalence leveled off. Similarly, the percentage of infants who breastfed for ≥12 months increased from 2002–2005 (APC = 17.2), and then leveled off from 2005–2015 (p = 0.90). Further examination of all breastfeeding duration trends by race/ethnicity demonstrated significant improvements among all racial/ethnic group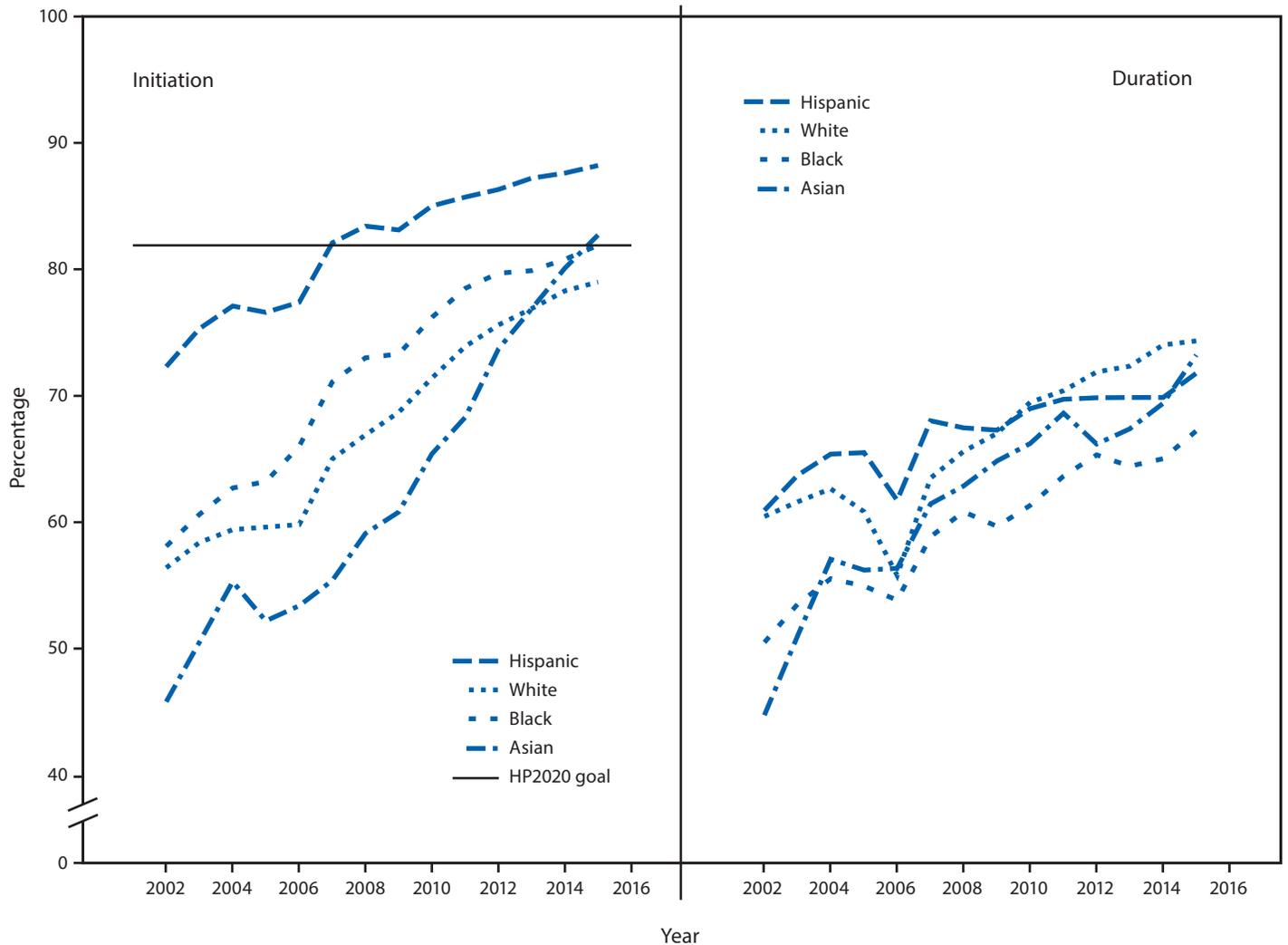s only for breastfeeding duration of ≥1 month, with the largest increase occurring among Asians (Figure). Overall, 71.7% of these infants were breastfed for ≥ 1 month in 2015.

Exclusive breastfeeding status among WIC infants was not monitored by PedNSS until 2006 (Table 2). During 2006–2015, exclusive breastfeeding (≥1 and ≥3 months) increased significantly, with an APC of 5.0 and 5.8, respectively. The percentage of infants exclusively breastfed for ≥6 months increased significantly during 2006–2010 (APC = 18.9), and again during 2010–2015 (APC = 6.2).

## Discussion

The New York WIC program reached the HP2020 breastfeeding initiation goal of 81.9% 6 years ahead of target, with substantial increases in all racial/ethnic groups during 2002–2015.

**FIGURE. Breastfeeding initiation and duration for ≥1 month among Hispanic, white, black, and Asian infants\* — New York Special Supplemental Nutrition Program for Women, Infants and Children, 2002–2015**



**Abbreviation:** HP2020 = *Healthy People 2020*.
\* Persons identified as Hispanic might be of any race. Persons identified as white, black, Asian, or other race are non-Hispanic. The five racial/ethnic categories are mutually exclusive.

Despite considerable progress in breastfeeding duration over time, the New York WIC program was still 21.1 percentage points below the HP2020 objectives for breastfeeding duration ≥6 months (60.6%) and 11.3 percentage points below the HP2020 objectives for breastfeeding duration ≥12 months (34.1%) in 2015. The crude prevalence of exclusive breastfeeding for ≥3 months (14.3%) and ≥6 months (8.0%) in 2015 were less than one-third of the 46.2% and 25.5% HP2020 objectives, respectively. If the current pace continues, the New York WIC program will not achieve the HP2020 goals for duration and exclusivity during the next 5 years.

At the national level, the U.S. Department of Agriculture and the U.S. Department of Health and Human Services have led efforts to promote breastfeeding through signature initiatives (e.g., the *Loving Support* program,¶ the *Surgeon General's Call to Action to Support Breastfeeding*,\*\* and the *Healthy People* objectives.) The New York WIC program has a long history of promoting breastfeeding as a strategy to prevent childhood obesity.†† Moreover, New York and local governments enacted legislation (*3*) and the *Latch-On*§§ initiative to improve support of breastfeeding. The substantial progress in breastfeeding

¶ https://lovingsupport.fns.usda.gov/.
\*\* https://www.surgeongeneral.gov/library/calls/breastfeeding/index.html.
†† https://www.health.ny.gov/prevention/nutrition/resources/eat_well_play_hard/.
§§ https://www1.nyc.gov/site/doh/health/health-topics/breastfeeding-latch-on.page.

measures among New York WIC infants likely reflects the collective efforts at national, state and local levels. However, the observed trends indicate that among New York WIC infants these efforts might be more effective at improving initiation rather than duration and exclusivity, and that breastfeeding practices might vary by race or ethnicity.

WIC provides multiple services (including supplemental foods when applicable) to all infants, children, and mothers enrolled in the program. In 2009, the economic value of the food packages issued to fully breastfeeding mothers was enhanced (4). However, a recent study, using 2004–2010 data from multiple sources, demonstrated little effect of these changes on various breastfeeding measures (5). The analyses presented here, with an additional 5 years of New York PedNSS data, support those findings. In particular, the annual increase in breastfeeding initiation remains steady among different racial/ethnic groups. Joinpoint regression analyses of breastfeeding duration and exclusivity trends showed no inflection point at 2009 (or 2010 if there was a delayed response), suggesting little or no association with the 2009 food package changes as well.

The trends of breastfeeding initiation (2004–2011) and duration (≥4 weeks, 2004–2011) illustrated by the New York PedNSS are similar to those among "on-WIC during pregnancy"–participants residing in New York reported by the Pregnancy Risk Assessment Monitoring System¶¶ (PRAMS). In addition to a higher response rate and shorter recall interval, timely dissemination of breastfeeding statistics of infants living in low income households and participating in WIC is one advantage of the PedNSS over the PRAMS. This is of particular importance, because a prompt program evaluation is an integral part in the adaptive and iterative design of any quality improvement project. Nevertheless, these two surveillance systems were developed with distinct objectives and thus collect data from different sources. The complementary information provided by the PedNSS and the PRAMS strengthens the surveillance efforts related to improving infant health.

The findings in this report are subject to at least two limitations. First, the observed improvements in breastfeeding outcomes could not be attributed to any particular exposure(s) (e.g., a specific breastfeeding promotion initiative). Second, because this analysis was conducted among New York WIC participants, the findings might not be generalizable to populations enrolled in other programs or in other parts of the country.

The decision to continue breastfeeding is influenced by a combination of demographic, socioeconomic, psychosocial,

¶¶ https://www.health.ny.gov/statistics/prams/.

**Summary**

What is already known about this topic?

Breastfeeding is widely accepted as the optimal method of infant feeding. Collective efforts at national, state, and local levels have been made to promote breastfeeding initiation, duration and exclusivity among low-income families.

What is added by this report?

Breastfeeding initiation among New York infants enrolled in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) exceeded the 81.9% *Healthy People 2020 (*HP2020) objective in 2014. The racial/ethnic disparity in initiation declined from 26.5 percentage points in 2002 to 9.2 in 2015. Although significant progress has been made regarding breastfeeding duration and exclusivity (e.g., 39.5% breastfeeding for ≥6 months and 14.3% exclusively breastfeeding for ≥3 months in 2015, respectively), the New York WIC program is not on target to meet the HP2020 objectives of 60.6% (≥6 months duration) and 46.2% (≥3 months exclusively), respectively. Improvements in breastfeeding measures vary by race/ethnicity.

What are the implications for public health practice?

Current interventions are effective in promoting breastfeeding initiation and helpful in improving duration of breastfeeding among some racial/ethnic groups of New York WIC participants. In addition to known best practices, future breastfeeding promotion strategies should explore these limitations and focus on implementation with high fidelity.

cultural, and environmental factors (3,6–8). The findings in this study indicate potential conceptual or methodological limitations in existing initiatives to promote duration and exclusivity. The challenge for the New York WIC program, which might be applicable to WIC programs in other states, is to identify those elements that might be influential to a majority of mothers in low-income households regarding breastfeeding duration and exclusivity from participants' perspectives; design theory-based interventions that optimize the existing resources available in the program itself, communities, and the health care system (9); implement the interventions with high fidelity (i.e., measured and assessed in terms of adherence and competence) (10); and evaluate the efficacy of the interventions regularly using mixed-method approaches.

## Conflict of Interest

No conflicts of interest were reported.

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# Pregnancy Outcomes After Maternal Zika Virus Infection During Pregnancy — U.S. Territories, January 1, 2016–April 25, 2017

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Pregnant women living in or traveling to areas with local mosquito-borne Zika virus transmission are at risk for Zika virus infection, which can lead to severe fetal and infant brain abnormalities and microcephaly (*1*). In February 2016, CDC recommended 1) routine testing for Zika virus infection of asymptomatic pregnant women living in areas with ongoing local Zika virus transmission at the first prenatal care visit, 2) retesting during the second trimester for women who initially test negative, and 3) testing of pregnant women with signs or symptoms consistent with Zika virus disease (e.g., fever, rash, arthralgia, or conjunctivitis) at any time during pregnancy (*2*). To collect information about pregnant women with laboratory evidence of recent possible Zika virus infection* and outcomes in their fetuses and infants, CDC established pregnancy and infant registries (*3*). During January 1, 2016–April 25, 2017, U.S. territories† with local transmission of Zika virus reported

2,549 completed pregnancies§ (live births and pregnancy losses at any gestational age) with laboratory evidence of recent possible Zika virus infection; 5% of fetuses or infants resulting from these pregnancies had birth defects potentially associated with Zika virus infection¶ (*4,5*). Among completed pregnancies with positive nucleic acid tests confirming Zika infection identified in the first, second, and third trimesters, the percentage of fetuses or infants with possible Zika-associated birth defects was 8%, 5%, and 4%, respectively. Among liveborn infants, 59% had Zika laboratory testing results reported to the pregnancy and infant registries. Identification and follow-up of infants born to women with laboratory evidence of recent possible Zika virus infection during pregnancy permits timely and appropriate clinical intervention services (*6*).

To characterize pregnancies with laboratory evidence of recent possible Zika virus infection and outcomes of completed pregnancies, data were abstracted from prenatal, delivery, and birth hospitalization records. These abstracted data were included in the Zika pregnancy and infant registries,** which

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* Maternal laboratory evidence of recent possible Zika virus infection was defined as 1) Zika virus infection detected by a Zika virus RNA nucleic acid test (NAT) (e.g., reverse transcription–polymerase chain reaction [RT-PCR]) on any maternal, placental, fetal, or infant specimen (referred to as NAT-confirmed) or 2) detection of recent Zika virus infection or recent unspecified flavivirus infection by serologic tests on a maternal, fetal, or infant specimen (i.e., either positive or equivocal Zika virus immunoglobulin M [IgM] and Zika virus plaque reduction neutralization test [PRNT] titer ≥10, regardless of dengue virus PRNT value; or negative Zika virus IgM, and positive or equivocal dengue virus IgM, and Zika virus PRNT titer ≥10, regardless of dengue virus PRNT titer). Infants with positive or equivocal Zika virus IgM are included, provided a confirmatory PRNT has been performed on a maternal or infant specimen. The use of PRNT for confirmation of Zika virus infection, including in pregnant women and infants, is not routinely recommended in Puerto Rico; dengue virus is endemic and cross-reactivity is likely to occur in most cases (https://www.cdc.gov/zika/laboratories/lab-guidance.html). In Puerto Rico, detection of a positive Zika IgM result in a pregnant woman, fetus or infant (within 48 hours after delivery) was considered sufficient to indicate recent possible Zika virus infection.

† Pregnancies reported to the registries in this report included births or pregnancy losses occurring in the U.S. territories of American Samoa, Puerto Rico, and U.S. Virgin Islands and the U.S. freely associated states of Federated States of Micronesia and Marshall Islands. Outcomes from multiple gestation pregnancies were counted once.

§ Completed pregnancies included live births and pregnancy losses at any gestational age with maternal, placental, fetal, or infant laboratory evidence of recent possible Zika virus infection during pregnancy.

¶ "Birth defects potentially associated with Zika virus infection during pregnancy" refers to the birth defects included in the CDC Zika surveillance case definition (November 2016). The definition covers all birth defects that have been reported as being potentially related to Zika virus infection and includes brain abnormalities, microcephaly (confirmed and possible), neural tube defects and other early brain malformations; eye abnormalities; and consequences of central nervous system dysfunction, such as joint contractures and congenital sensorineural deafness (https://www.cdc.gov/zika/geo/pregnancy-outcomes.html).

** The Zika Pregnancy and Infant Registries include the U.S. Zika Pregnancy Registry (USZPR) and the Puerto Rico Zika Active Pregnancy Surveillance System (PR ZAPSS). The USZPR and PR ZAPSS are both enhanced surveillance systems that collect data on pregnancy and infant outcomes in pregnancies with laboratory evidence of possible Zika virus infection and use similar methods. All U.S. states, the District of Columbia, and all U.S. territories except Puerto Rico are collaborating in the USZPR. Because Puerto Rico has the largest population among U.S. territories, CDC and the Puerto Rico Department of Health established a separate Zika pregnancy registry, called Puerto Rico Zika Active Pregnancy Surveillance System.

were established by CDC in collaboration with state, territorial, tribal, and local health departments. The number of completed pregnancies with laboratory evidence of recent possible Zika virus infection and a subset with positive nucleic acid tests (NAT)[††] confirming Zika virus infection (NAT-confirmed) from the registries were analyzed. Pregnancies were included in this analysis if the pregnancy was completed in the U.S. territories on or before April 25, 2017, and reported to the registries on or before May 24, 2017, and if there was laboratory evidence of possible Zika virus infection during pregnancy.

Clinical birth defects experts reviewed abstracted registry data to identify each fetus or infant with birth defects meeting the standard CDC surveillance criteria for possible Zika-associated birth defects (4,5) and divided them into two mutually exclusive categories: 1) brain abnormalities and/or microcephaly and 2) neural tube defects, eye abnormalities, or consequences of central nervous system dysfunction among fetuses or infants without evidence of other brain abnormalities or microcephaly (4,5). Analyses were stratified by maternal symptom status[§§] and trimester of maternal symptom onset or laboratory specimen collection date.[¶¶] The percentage (with 95% confidence intervals [CI]) of fetuses or infants with possible Zika-associated birth defects was calculated for a binomial proportion using the Wilson score interval.

To describe infant testing and screening (6) reported to the Zika pregnancy and infant registries, the percentages of liveborn infants with 1) laboratory testing results for Zika virus infection at birth, 2) postnatal neuroimaging (cranial ultrasound, computed tomography, magnetic resonance imaging, or radiograph) findings, and 3) hearing screening results were calculated. Information about infant testing and screening during birth hospitalization was based on data reported to the registries for births on or before April 25, 2017.

The U.S. territories reported 3,930 pregnancies with laboratory evidence of recent possible Zika infection to the registries during January 1, 2016–May 24, 2017, including 2,549 (65%) pregnancies completed on or before April 25, 2017, which resulted in 2,464 (97%) liveborn infants and 85 (3%) pregnancy losses. Among women with completed pregnancies, 1,561 (61%) reported signs or symptoms compatible

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[††] Pregnancies with nucleic acid tests (NAT) confirming Zika infection include those with a maternal, placental, fetal, or infant specimen in which the presence of Zika virus RNA was documented by a positive NAT.

[§§] A pregnant woman is considered symptomatic if one or more signs or symptoms consistent with Zika virus disease (acute onset of fever, rash, arthralgia, or conjunctivitis) is reported. A pregnant woman is considered asymptomatic if these signs or symptoms are not reported.

[¶¶] Gestational timing of Zika virus infection was calculated using the earliest date of maternal serum, urine, or whole blood collection that tested positive for Zika virus infection by NAT or serologic testing or symptom onset date if symptomatic. Gestational age dating was based on first trimester ultrasound. If ultrasound was unavailable, dating was based on the last menstrual period. If ultrasound and last menstrual period were unavailable, gestational age was based on information provided on the laboratory requisition form.

with Zika virus infection during pregnancy, 966 (38%) were asymptomatic, and symptom information was missing for 22 (1%). Maternal symptoms or positive laboratory test results were identified in the first, second, and third trimesters for 21%, 43%, and 34% of women, respectively; timing of infection was missing or occurred periconceptionally for 41 pregnancies (2%) (Table 1).

Among the 2,549 completed pregnancies, 122 (5%) resulted in a fetus or infant with possible Zika-associated birth defects (5% among symptomatic and 4% among asymptomatic women) (Table 1). The same percentage of birth defects (5%) was observed among the subset of 1,508 (59%) pregnancies with NAT-confirmed Zika virus infections (5% among symptomatic and 7% among asymptomatic women). Among the 122 fetuses or infants that met the surveillance case definition for possible Zika-associated birth defects, 108 (89%) were classified as having brain abnormalities and/or microcephaly. Possible Zika-associated birth defects were reported among pregnant women with symptom onset or positive maternal laboratory test results identified during all trimesters. Among women with symptoms or a positive test result identified during the first, second, and third trimesters, 6%, 5%, and 4% of infants or fetuses, respectively, were reported with possible Zika-associated birth defects. Among pregnancies with NAT-confirmed maternal infections, possible Zika-associated birth defects were reported in 8%, 5%, and 4% of infants or fetuses with maternal symptoms or positive laboratory results identified during the first, second, and third trimesters, respectively.

Among liveborn infants, 59% had Zika laboratory testing results reported to the pregnancy and infant registries. Of the infants, 52% had postnatal neuroimaging findings reported, and 79% had hearing screening results reported during birth hospitalization (Table 2).

## Discussion

Among completed pregnancies with laboratory evidence of recent possible maternal Zika virus infection in the U.S. territories, about one in 20 fetuses or infants had a possible Zika-associated birth defect. When analysis was restricted to NAT-confirmed Zika virus infection in the first trimester, about one in 12 fetuses or infants had a possible Zika-associated birth defect. Zika-associated birth defects were reported after identification of maternal symptoms or positive test results in each trimester.

The overall estimate of 5% of fetuses or infants with possible Zika-associated birth defects among completed pregnancies with NAT-confirmed infections might be affected by the smaller proportion of total completed pregnancies with symptom onset or a positive test result during the first trimester (18%) than during the second or third trimesters (81%).

**TABLE 1. Pregnancy outcomes\* for 2,549 completed pregnancies† with laboratory evidence of recent possible maternal Zika virus infection, by symptom status and timing of symptom onset or specimen collection date — Zika Pregnancy and Infant Registries,§ U.S. territories, January 1, 2016–April 25, 2017**

| Characteristic | No. with brain abnormalities and/or microcephaly¶ | No. with NTDs and early brain malformations, eye abnormalities, or consequence of CNS dysfunction without brain abnormalities or microcephaly | Total no. with ≥1 birth defect | Total no. of completed pregnancies | Percentage with Zika virus–associated birth defect, (95% CI\*\*) |
|---|---|---|---|---|---|
| **Any laboratory evidence of recent possible Zika virus infection††** | | | | | |
| Total | 108 | 14 | 122 | 2,549 | 5 (4–6) |
| **Maternal symptom status§§** | | | | | |
| Symptoms of Zika virus infection reported | 68 | 11 | 79 | 1,561 | 5 (4–6) |
| No symptoms of Zika virus infection reported | 38 | 3 | 41 | 966 | 4 (3–6) |
| **Timing¶¶ of symptoms or specimen collection date\*\*\*** | | | | | |
| First trimester††† | 27 | 5 | 32 | 536 | 6 (4–8) |
| Second trimester§§§ | 46 | 5 | 51 | 1,096 | 5 (4–6) |
| Third trimester¶¶¶ | 31 | 4 | 35 | 876 | 4 (3–6) |
| **Recent NAT-confirmed Zika virus infection in maternal, placental, fetal, or infant specimen\*\*\*\*** | | | | | |
| Total | 71 | 9 | 80 | 1,508 | 5 (4–7) |
| **Maternal symptom status††††** | | | | | |
| Symptoms of Zika virus infection reported | 54 | 9 | 63 | 1,279 | 5 (4–6) |
| No symptoms of Zika virus infection reported | 16 | 0 | 16 | 225 | 7 (4–11) |
| **Timing§§§§ of symptoms or specimen collection date\*\*\*** | | | | | |
| First trimester††† | 18 | 4 | 22 | 276 | 8 (5–12) |
| Second trimester§§§ | 34 | 2 | 36 | 726 | 5 (4–7) |
| Third trimester¶¶¶ | 17 | 3 | 20 | 494 | 4 (3–6) |

**Abbreviations:** CI = confidence interval; CNS = central nervous system; IgM = immunoglobulin M; NAT = nucleic acid test; NTD = neural tube defect; RT-PCR = reverse transcription–polymerase chain reaction.

\* Outcomes for multiple gestation pregnancies are counted once.

† Includes 2,464 live births and 85 pregnancy losses.

§ U.S. Zika Pregnancy Registry and Puerto Rico Zika Active Pregnancy Surveillance System.

¶ Microcephaly was defined as head circumference at delivery <3rd percentile for infant sex and gestational age regardless of birthweight. When multiple head circumference measurements were available, the majority of those measurements had to be <3rd percentile for a designation of microcephaly. A clinical diagnosis of microcephaly or mention of microcephaly or small head in the medical record was not required. (https://www.cdc.gov/zika/geo/pregnancy-outcomes.html).

\*\* 95% CI for a binomial proportion using Wilson score interval.

†† Includes maternal, placental, fetal, or infant laboratory evidence of recent possible Zika virus infection based on presence of Zika virus RNA by a positive NAT (e.g., RT-PCR), serologic evidence of a recent Zika virus infection, or serologic evidence of a recent unspecified flavivirus infection.

§§ Maternal symptom (i.e., fever, rash, arthralgia, or conjunctivitis) status was unknown for 22 completed pregnancies; of these, two resulted in fetuses or infants with brain abnormalities with or without microcephaly.

¶¶ Maternal Zika virus infection was reported in the periconceptional period (i.e., the 8 weeks before conception [6 weeks before and 2 weeks after the first day of the last menstrual period]) in 21 completed pregnancies; of these, one resulted in a fetus or infant with brain abnormalities with or without microcephaly. Timing of maternal Zika virus infection was unknown for 20 completed pregnancies; of these, three resulted in fetuses or infants with brain abnormalities with or without microcephaly.

\*\*\* Gestational timing of Zika virus infection was calculated using the earliest date of maternal serum, urine, or whole blood collection that tested positive for Zika virus infection by NAT or serologic testing or symptom onset date if symptomatic.

††† First trimester is defined as 2 weeks after last menstrual period to 13 weeks, 6 days gestational age based on estimated date of delivery.

§§§ Second trimester is defined as 14 weeks to 27 weeks, 6 days gestational age based on estimated date of delivery.

¶¶¶ Third trimester is defined as 28 weeks gestational age or later based on estimated date of delivery.

\*\*\*\* Includes maternal, placental, fetal, or infant laboratory evidence of Zika virus infection based on the presence of Zika virus RNA by a positive NAT (e.g., RT-PCR).

†††† Maternal symptom status was unknown for four completed pregnancies; of these, one resulted in a fetus or infant with brain abnormalities with or without microcephaly.

§§§§ Maternal Zika virus infection was reported in the periconceptional period (i.e., the 8 weeks before conception [6 weeks before and 2 weeks after the first day of last menstrual period]) in six pregnancies; of these, one resulted in a fetus or infant with brain abnormalities with or without microcephaly. Timing of maternal Zika virus infection was unknown for six pregnancies; of these, two resulted in fetuses or infants with brain abnormalities with or without microcephaly.

**TABLE 2. Infant Zika virus testing and screening at birth for 2,464 live-born infants from completed pregnancies with laboratory evidence of recent possible Zika virus infection — Zika Pregnancy and Infant Registries,\* U.S. territories, January 1, 2016–April 25, 2017**

| Testing and screening | Live-born infants | | |
|---|---|---|---|
| | With birth defects[†] No. (%) | Without birth defects No. (%) | Total No. (%) |
| **Total** | 116 (5) | 2,348 (95) | 2,464 (100) |
| **Infant Zika virus testing** | | | |
| ≥1 infant specimen[§] test result reported to Zika pregnancy and infant registries | 64 (55) | 1,381 (59) | 1,445 (59) |
| **Infant screening at birth** | | | |
| Postnatal neuroimaging[¶] conducted and findings reported to Zika pregnancy and infant registries | 69 (59) | 1,219 (52) | 1,288 (52) |
| Hearing screening conducted and results reported to Zika pregnancy and infant registries | 105 (91) | 1,840 (78) | 1,945 (79) |

\* U.S. Zika Pregnancy Registry and Puerto Rico Zika Active Pregnancy Surveillance System.
[†] Includes infants with one or more of the following birth defects potentially associated with Zika virus infection: brain abnormality and/or microcephaly or possible microcephaly, neural tube defect and other early brain malformation, eye abnormality, or consequence of central nervous system dysfunction.
[§] Infant specimens include serum, urine, and cerebrospinal fluid.
[¶] Neuroimaging includes any imaging of the infant head, including cranial ultrasound, computed tomography, magnetic resonance imaging, or radiograph reported to the Zika pregnancy registries based on neuroimaging guidance published August 19, 2016. (Russell K, Oliver SE, Lewis L, et al. Update: interim guidance for the evaluation and management of infants with possible congenital Zika virus infection—United States, August 2016. MMWR Morb Mortal Wkly Rep 2016;65:870–8).

Because available data suggest that the risk for birth defects is higher when infection occurs early in pregnancy (*5,7*) and there are ongoing pregnancies with infection in the first trimester, it will be important to continue to monitor pregnancy outcomes to determine the impact of infection early in pregnancy on the percentage of infants with possible Zika-associated birth defects. Possible Zika-associated birth defects were identified in pregnancies with symptoms or laboratory evidence of recent possible maternal Zika virus infection in each trimester of pregnancy. Challenges with determining the exact timing of infection limit interpretation; however, adverse outcomes following infection throughout pregnancy are consistent with adverse outcomes associated with some other congenital infections (*8*). For example, severe central nervous system sequelae (hearing loss, seizures, or chorioretinitis) have been reported following congenital cytomegalovirus infection later in pregnancy, with the highest risk following first trimester infection (*8*). The continued follow-up of infants is critical to elucidating the impact of Zika virus infection during pregnancy beyond abnormalities detected at birth. Monitoring of ongoing pregnancies with laboratory evidence of possible recent Zika virus infection and the continued follow-up of infant status beyond birth hospitalization can inform public health recommendations for testing, evaluation, and care. Additional information about the full spectrum of outcomes can improve access to early intervention (https://www2.ed.gov/programs/osepeip/index.html) and services for children with special health care needs (https://mchb.hrsa.gov/maternal-child-health-topics/children-and-youth-special-health-needs).

Consistent with previously reported data from the 50 U.S. states regarding primarily travel-associated Zika virus infections in pregnancy, about one in 20 fetuses or infants had possible Zika-associated birth defects (*5*). However, the report from U.S. states included a larger percentage of pregnancies with imprecise timing of infection, thereby limiting any direct comparison of the percentage of affected pregnancies by trimester of infection. This report from the territories, with more robust late pregnancy data, suggests a risk for birth defects throughout pregnancy; further study is needed to confirm this finding. The percentage of infants with possible Zika-associated birth defects after infection identified in the first trimester was 8% (95% CI = 5%–12%) in the U.S. territories compared with 15% (95% CI = 8%–26%) in the U.S. states (*5*); the confidence intervals for these estimates overlap and both are based on relatively small numbers. In addition, for the analysis of the U.S. territories data, a more restrictive definition of confirmed infection, limited to NAT-confirmed infection, was used.

The findings in this report are subject to at least seven limitations. First, the actual number of infants who had Zika virus testing and postnatal screenings might be underestimated because of delays in reporting results to medical records and changes to clinical guidance for infants in August 2016 (*6*). Second, misclassification of microcephaly might have occurred because of imprecise measurements of head circumference at birth and difficulties with consistent surveillance for microcephaly, which could result in overascertainment or underascertainment of microcephaly (*9*). Third, other potential etiologies for these birth defects (e.g., genetic or other infectious causes) were not assessed in this analysis. Fourth, lack of postnatal neuroimaging might have led to underascertaining brain abnormalities; just over half of infants had postnatal neuroimaging reported at birth, despite recommendations that all infants born to mothers with laboratory evidence of possible Zika infection receive such imaging (*6*). Some infants might have additional imaging in the outpatient setting; planned efforts to follow these infants at 2 months and beyond might provide additional data. Fifth, the actual number

of Zika virus infections among pregnant women in the U.S. territories might be underestimated. Investigation of a 2007 Zika virus disease outbreak in Yap, Federated States of Micronesia, suggested that up to 80% of Zika virus infections might be asymptomatic or mildly symptomatic (*10*). The percentage of asymptomatic infections in the U.S. territories (38%) was much lower than that reported from Yap and lower than that suggested by data from the Zika pregnancy and infant registries from the U.S. states (62%) (*5,10*). However, in the U.S. territories, Zika virus testing of women during pregnancy was recommended regardless of symptom status, whereas a household survey of the general population was conducted in Yap. Sixth, because of limitations in the specificity of current serologic testing, some pregnant women who were reported to the Zika pregnancy and infant registries might have had other flavivirus infections. However, rates of dengue virus transmission were low in Puerto Rico and the U.S. Virgin Islands during 2016 (https://disease-maps.usgs.gov/mapviewer/), and dengue virus infection is not known to cause birth defects. Finally, some women who were infected with Zika virus before pregnancy might have a persistent immunologic response resulting in a positive immunoglobulin M test detectable during pregnancy. Analyses restricted to pregnancies with NAT-confirmed Zika virus infection indicated a similar proportion of infants with birth defects. However, even with NAT testing, timing of maternal infection might be inexact, especially given that Zika virus RNA might persist during pregnancy (https://www.cdc.gov/zika/laboratories/lab-guidance.html), and because most Zika virus infections are asymptomatic or have mild, nonspecific symptoms.

This report adds information about the number of possible Zika-associated birth defects with laboratory evidence of recent possible or NAT-confirmed Zika virus infection during pregnancy among women living in the U.S. territories and supplements findings from the U.S. states. It also provides new estimates for the proportion of infants with a birth defect after identification of maternal Zika virus infection in the first, second, and third trimesters of pregnancy, and provides evidence that birth defects might occur following documentation of symptom onset or positive laboratory testing during any trimester. Moreover, based on data reported to the pregnancy and infant registries, this report highlights potential gaps in testing and screening of infants with possible congenital Zika virus infection in U.S. territories at birth. Identification and follow-up of infants born to mothers with laboratory evidence of recent possible Zika virus infection during pregnancy can facilitate timely and appropriate clinical intervention services and assessment of future needs (*2,6*). Information about adherence to the recommended newborn testing and screening can improve monitoring and care of infants affected by Zika.

## Summary

### What is already known on this topic?

Zika virus infection during pregnancy causes serious brain abnormalities and/or microcephaly and has been associated with other severe birth defects. Local transmission of Zika virus was reported in U.S. territories in 2016.

### What is added by this report?

Overall, about 5% of fetuses and infants born to women with laboratory evidence of recent possible Zika virus infection in the U.S. territories had possible Zika-associated birth defects, the same as the percentage reported in the 50 U.S. states during 2016. Possible Zika-associated birth defects including brain abnormalities and/or microcephaly were reported following Zika virus infection during every trimester of pregnancy. Among completed pregnancies with positive nucleic acid tests confirming Zika virus infection identified in the first, second, and third trimesters, the percentages of fetuses or infants with possible Zika-associated birth defects was 8%, 5%, and 4%, respectively.

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

Current data suggest that Zika virus infection during any trimester of pregnancy might result in Zika-associated birth defects. Identification and follow-up of infants born to women with laboratory evidence of recent possible Zika virus infection during pregnancy can facilitate timely and appropriate clinical intervention services and assessment of future needs. Information about adherence to the recommended newborn testing and screening can improve monitoring and care of infants affected by Zika.

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### Conflict of Interest

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## Notes from the Field

### Evaluation of a Perceived Cluster of Plasma Cell Dyscrasias Among Workers at a Natural Gas Company — Illinois, 2014

Marie A. de Perio, MD[1]; Jayesh Mehta, MD[2]

In 2014, CDC received a request from workers at a natural gas company in Illinois for a health hazard evaluation. The request concerned a perceived cluster of amyloidosis and multiple myeloma among workers. The company delivers natural gas to residential and business customers and employs approximately 1,300 persons. Employees are classified into three job groups: administrative, service, and distribution. Plasma cell dyscrasias, characterized by the monoclonal growth of plasma cells, include multiple myeloma, Waldenstrom macroglobulinemia (WM), monoclonal gammopathy of undetermined significance (MGUS), and amyloidosis. Using a standard approach (1), CDC investigated this suspected cluster. Investigators obtained information from the company's two health insurance providers to identify current and former employees with these diagnoses from January 2008–January 2014 using *International Classification of Diseases, Ninth Revision* codes. Diagnoses were confirmed by contacting health care providers or reviewing medical records. Demographic and work information was obtained from the company.

Thirteen workers with confirmed plasma cell disorders were identified, including two active and 11 retired employees. Diagnoses included MGUS (five persons), myeloma (four), WM (three), and immunoglobulin light chain amyloidosis (one). All affected employees were men; eight were white, and five were black. The median age at diagnosis was 72 years (range = 38–90 years). Four employees received their diagnoses while they were active employees; nine diagnoses were made during retirement. Years of hire ranged from 1946 to 1995; years of retirement or termination ranged from 1982 to 2014. The median time worked at the company before diagnosis or retirement (whichever was earlier) was 31 years (range = 15–50 years). Job categories included distribution (five persons), service (five), and administrative (three). Work locations included five different shops and office locations. Each affected employee had one or more demographic risk factors for plasma cell dyscrasias, including male sex (myeloma, MGUS, and WM), older age (all diagnoses), and black race (myeloma and MGUS).

Company representatives estimated that 30,000–50,000 persons had worked for the company since 1946. It was not possible to calculate crude or adjusted incidence rates among employees because the cumulative number of company employees could not be determined. Therefore, statistical comparisons between employees and the general Illinois population were not possible and might not be appropriate. Also, disease or tumor rates are highly variable in small populations and rarely match the overall rate for a larger area such as an entire state. Nonetheless, available national information was used to crudely estimate rates.

Using published estimates for the lifetime risk for developing multiple myeloma (1 in 125),* four multiple myeloma cases did not appear unusual. Using the reported prevalence of MGUS (1%–3% in persons aged ≥50 years) (2), five MGUS cases also did not appear unusual. However, WM is rare, with an incidence of three cases per 1 million per year nationwide.† Therefore, the occurrence of three cases among persons working for the same employer did appear unusual. They might be a coincidental occurrence, or the cases might represent exposures to an unproven causative agent.

No environmental or occupational exposures have been definitively established as causes for any plasma cell disorder. However, benzene, pesticides, coal dust, and organic solvent exposures have been associated with myeloma, WM, and MGUS (3–5). According to company representatives, it was unlikely that employees were exposed to these substances. Also, the three employees with WM worked in three different areas (one each in administrative, service, and distribution) and therefore likely had different exposures.

This investigation highlights the difficulty of elucidating whether clusters of plasma cell dyscrasias result from chance or if they have a common occupational or environmental cause. This difficulty is partly a consequence of the lack of occupation and industry information in most disease registries, including cancer registries. By disseminating information about clusters such as this one, more accurate reporting of usual (or longest held) occupation and industry data in medical records can be encouraged, so that surveillance systems and registries can be used to stimulate research on occupational causes of cancer.

* https://seer.cancer.gov/statfacts/html/mulmy.html.
† https://www.cancer.org/cancer/waldenstrommacroglubulinemia/detailedguide/waldenstrom-macroglobulinemia-key-statistics-w-m.

#### Conflict of Interest

Jayesh Mehta reports speaking fees from Celgene Corporation and Millennium Pharmaceuticals outside the submitted work. No other conflicts of interest were reported.

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# *Announcement*

## Community Preventive Services Task Force Recommendation for Team-Based Care for Patients with Type 2 Diabetes

The Community Preventive Services Task Force recently posted new information on its website: "Diabetes Management: Team-Based Care for Patients with Type 2 Diabetes." The information is available at https://www.thecommunityguide.org/findings/diabetes-management-team-based-care-patients-type-2-diabetes.

Established in 1996 by the U.S. Department of Health and Human Services, the task force is an independent, nonfederal panel of public health and prevention experts who are appointed by the director of CDC. The task force provides information for a wide range of persons who make decisions about programs, services, and other interventions to improve population health. Although CDC provides administrative, scientific, and technical support for the task force, the recommendations developed are those of the task force and do not undergo review or approval by CDC.

## QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

### Percentage* of Children and Teens Aged 4–17 Years Ever Diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD),† by Sex and Urbanization§ of County of Residence — National Health Interview Survey,¶ 2013–2015



* With 95% confidence intervals indicated with error bars.
† Based on responses to the question, "Has a doctor or health professional ever told you that [child] had attention-deficit/hyperactivity disorder (ADHD) or attention deficit disorder (ADD)?"
§ Counties were classified into urbanization levels based on a classification scheme developed by the National Center for Health Statistics that considers metropolitan/nonmetropolitan status, population, and other factors. https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf.
¶ Estimates are based on household interviews of a sample of the noninstitutionalized U.S. civilian population and are derived from the National Health Interview Survey Sample Child component.

During 2013–2015, the percentage of children and teens aged 4–17 years who had ever received a diagnosis of ADHD was significantly higher among boys than among girls within all urbanization levels. Among boys, those living in small metro and nonmetro micropolitan areas were more likely to have received a diagnosis of ADHD (17.4% and 16.4%, respectively) than were those living in large central (11.4%) and large fringe (12.7%) metropolitan areas. Among girls, those living in large central areas were less likely to have received a diagnosis of ADHD (4.4%) than those living in each of the other five types of urban/rural areas.

**Source:** National Center for Health Statistics. National Health Interview Survey, 2013–2015. https://www.cdc.gov/nchs/nhis.htm.

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