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National HIV Testing Day — June 27, 2018

National HIV Testing Day, June 27, highlights the importance of testing in detecting, treating, and preventing human immunodeficiency virus (HIV) infection. Awareness of HIV infection through HIV testing is the first step to prevention, health care, and social services that improve life quality and length of survival (*1*).

Health care providers and others providing HIV testing can reduce HIV-related adverse health outcomes and risk for HIV transmission by implementing routine and targeted testing to decrease diagnosis delays (*2*). In this issue, an analysis of national population-based survey data collected during 2006–2016 found that persons with higher risk for HIV in the past year did not achieve CDC's recommended frequency of at least annual screening and the median time between tests did not change (*3*). Health care providers and public health practitioners need to intensify efforts to routinely screen all patients for HIV infection, and to identify persons with ongoing risk and ensure that they are engaged in annual screening for HIV infection.

Additional information on National HIV Testing Day is available at https://www.cdc.gov/features/HIVtesting. Basic testing information for the public is available at https://www.cdc.gov/hiv/basics/testing.html. Additional information on HIV testing for health professionals is available at https://www.cdc.gov/hiv/testing. CDC's guidelines for HIV testing of serum and plasma specimens are available at https://www.cdc.gov/hiv/guidelines/testing.html.

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Interval Since Last HIV Test for Men and Women with Recent Risk for HIV Infection — United States, 2006–2016

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Since 2006, CDC has recommended routine screening of all persons aged 13–64 years for human immunodeficiency virus (HIV) and at least annual rescreening of persons at higher risk (*1*). However, national surveillance data indicate that many persons at higher risk for HIV infection are not screened annually, and delays in diagnosis persist (*2*). CDC analyzed 2006–2016 data from the General Social Survey (GSS)* and estimated that only 39.6% of noninstitutionalized U.S. adults had ever tested for HIV. Among persons ever tested, the estimated median interval since last test was 1,080 days or almost 3 years. Only 62.2% of persons who reported HIV-related risk behaviors in the past 12 months were ever tested for HIV, and the median

* Conducted by the National Opinion Research Center at the University of Chicago. http://www.gss.norc.org/.

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interval since last test in this group was 512 days (1.4 years). The percentage of persons ever tested and the interval since last test remained largely unchanged during 2006–2016. More frequent screening of persons with ongoing HIV risk is needed to achieve full implementation of CDC's screening recommendations and to prevent new infections. Integration of routine screening as standard clinical practice through existing strategies, such as electronic medical record prompts (*3*), or through new, innovative strategies might be needed to increase repeat screening of persons with ongoing risk.

In 2006, CDC recommended one-time HIV screening of all persons aged 13–64 years and annual rescreening of persons at higher risk for HIV, including persons who inject drugs and their sex partners, persons who exchange sex for money or drugs, sex partners of HIV-infected persons, sexually active gay, bisexual, and other men who have sex with men (MSM), and heterosexual persons who themselves or whose sex partners have had more than one sex partner since their most recent HIV test (*1*). In 2017, CDC reiterated this annual screening recommendation for sexually active MSM based on a systematic literature review (*4*,*5*) that found that HIV incidence could be reduced significantly if MSM were screened annually (*6*,*7*). Despite this recommendation, a recent analysis of National HIV Surveillance System (NHSS) and National HIV Behavioral Surveillance (NHBS) data demonstrated that many persons at higher risk are not screened annually and that HIV diagnosis delays persist (*2*). Because NHSS data are based on reported diagnoses of HIV and do not include persons who test HIV-negative, and NHBS samples only persons at higher risk for HIV who reside in urban areas, these findings are not generalizable to the entire U.S. population (*2*). Population-based surveys such as the Behavioral Risk Factor Surveillance System (BRFSS) can be used to evaluate national HIV screening coverage, but BRFSS and most other population-based surveys lack sufficient information about HIV-related risk behaviors.

GSS is a biennial, household-based, multistage probability survey of noninstitutionalized U.S. adults aged ≥18 years that, since 2006, has included questions about HIV-related risk behaviors and HIV testing.[†] During 2006–2016, overall survey response rates ranged from 61.3% to 71.4%.[§] In this analysis, respondents were divided into four mutually exclusive HIV risk groups based on self-report of recent HIV-related risk behaviors: 1) men who had a male sex partner in the past 12 months; 2) men who did not have a male sex partner in the past 12 months but had multiple female sex partners, injected drugs, or paid or were paid for sex with a female sex partner in

[†] Time since last HIV test was assessed during the interview by asking respondents for the month and year of their last test. In this analysis, the number of days since last test was estimated by randomly assigning a day in the month of last test and subtracting that date from the date of interview. If the respondent was last tested in the same month as the interview, the number of days since last test was randomly assigned to between 1 and 31 days.

[§] http://www.gss.norc.org/documents/codebook/GSS_Codebook_AppendixA.pdf.

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the past 12 months; 3) women who had multiple sex partners (male or female), injected drugs, or paid or were paid for sex in the past 12 months; and 4) respondents who did not have any of these risks. The first three groups were aggregated and categorized as persons with recent HIV risk. Data collected from the six biennial surveys were aggregated and used to estimate the weighted prevalence and 95% confidence interval (CI) of ever testing for HIV and the median number and interquartile range (IQR) of days since last test, stratified by demographics and HIV risk group. The median number of days since last test was also compared by survey year. Questions about HIV testing and risk behaviors were part of a computer-assisted self-interview module administered to a randomly selected subset of each survey sample. This analysis was limited to respondents who were asked if they were ever tested for HIV infection and provided a "yes" or "no" response. All estimates were weighted to account for the multistage sampling design.

Among 15,956 total respondents, 11,896 (74.6%) were asked if they had ever tested for HIV. Of these, 208 (1.7%) provided a response of "don't know" or refused to answer, yielding an analytic sample of 11,688 respondents. Overall, 39.6% had ever tested, and the median estimated time since last test was 1,080 days or almost 3 years (Table 1). The percentages ever tested were highest among persons aged 25–34 years (54.4%) and 35–44 years (55.1%), non-Hispanic African American or black (black) persons (57.4%), and persons with recent HIV risk (62.2%). The median estimated number of days since last test was fewest among blacks (534 days), persons aged 18–24 years (332 days), persons with an annual household income of <$35,000 (767 days), and persons with recent HIV risk (512 days). Among persons with recent HIV risk, the median number of days exceeded 365 days (i.e., annual screening) in every survey year (Figure), and the percentage ever tested ranged from 60.0% to 66.7% across years (data not shown). The percentage ever tested was highest for men who had a male sex partner (71.0%) and women with HIV risk in the past 12 months (65.9%) (Table 2). Median interval since last test was shorter among persons in all three HIV risk groups (men who had a male sex partner [459 days], other at-risk men [610 days], and women [416 days]) compared with persons with no recent HIV risk (1,360 days).

Discussion

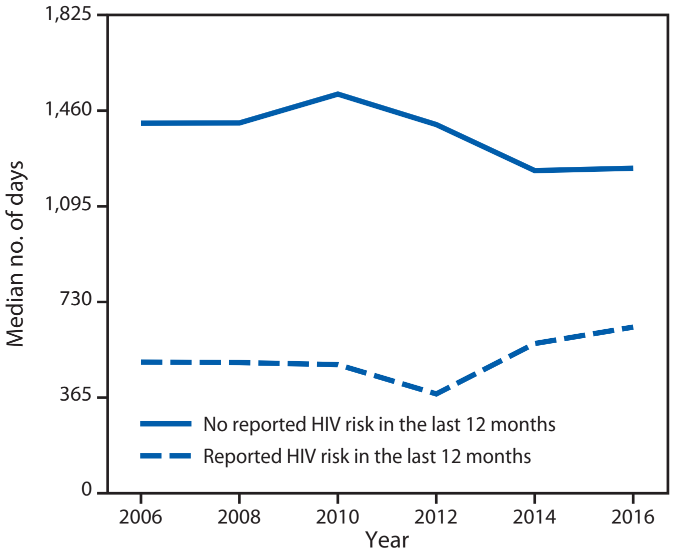
In this analysis, the median estimated interval since last HIV test for persons with recent HIV risk was 512 days (1.4 years). Although persons with recent HIV risk were more likely to have ever tested and to have tested more recently than those without recent risk, during 2006–2016 the median estimated interval since last test remained consistently longer than 1 year for all three risk groups defined in this analysis. Although longer than annual screening, the median estimated interval since last test was shorter among women with recent risk than among men with recent risk; this likely reflects the contribution of prenatal screening, which is commonly reported as the main reason for testing among women (*8*). These findings suggest that persons with HIV risk in the past year are not testing as frequently as recommended, consistent with findings from NHSS, which reported that the median interval from infection to diagnosis was ≥2 years for all risk groups (*2*). NHBS data from the same report indicated that 71% of MSM but only 41% of heterosexual men and women had tested in the past year. In this analysis, the percentage of all groups with recent HIV risk who tested in the past year was less than 50%, which is comparable to testing estimates among MSM sampled by

TABLE 1. Percentage of persons ever tested for human immunodeficiency virus (HIV) infection and median number of days since last HIV test by demographic characteristics and recent HIV risk — General Social Survey, United States, 2006–2016

Characteristic	No.	Ever tested: Weighted % (95% CI)	Days since last test: Median (IQR)
Total	**11,688**	**39.6 (38.4–40.8)**	**1,080 (325–3,023)**
Sex			
Male	5,202	38.1 (36.5–39.8)	1,116 (331–2,886)
Female	6,486	40.8 (39.3–42.3)	1,047 (320–3,097)
Age group (yrs)			
18–24	1,033	34.4 (31.1–37.9)	332 (122–730)
25–34	2,224	54.4 (52.1–56.7)	657 (248–1,645)
35–44	2,214	55.1 (52.7–57.5)	1,403 (384–3,428)
45–64	4,154	35.9 (34.2–37.7)	2,235 (645–5,105)
≥65	2,032	13.1 (11.5–14.7)	2,332 (614–5,613)
Race/Ethnicity			
White, non-Hispanic	8,153	35.2 (33.9–36.5)	1,545 (454–3,757)
Black, non-Hispanic	1,668	57.4 (54.5–60.3)	534 (192–1,575)
Hispanic/Latino	1,371	47.1 (43.5–50.8)	792 (290–2,092)
Other, non-Hispanic	496	31.3 (26.5–36.4)	702 (173–1,903)
Education			
<High school	1,619	40.1 (37.3–43.1)	844 (273–2,290)
High school	3,172	34.6 (32.5–36.7)	1,033 (285–3,241)
Some college	3,184	44.6 (42.5–46.7)	954 (301–2,736)
College or above	3,701	39.2 (37.3–41.2)	1,388 (425–3,592)
Annual household income			
<$35,000	4,084	44.1 (42.3–46.0)	767 (260–2,236)
≥$35,000	6,553	39.1 (37.6–40.6)	1,356 (391–3,448)
U.S. census region			
Northeast	1,939	38.3 (35.5–41.1)	862 (292–2,901)
Midwest	2,751	32.9 (30.7–35.1)	1,203 (356–3,461)
South	4,281	41.8 (39.9–43.7)	998 (305–2,859)
West	2,717	43.2 (40.6–45.9)	1,226 (351–3,112)
Recent HIV risk*			
Yes	1,693	62.2 (59.2–65.1)	512 (172–1,357)
No	9,995	36.1 (34.9–37.3)	1,360 (401–3,510)

Abbreviations: CI = confidence interval; IQR = interquartile range.
* Had male sex partner (male respondents only), had multiple sex partners, injected drugs, paid or was paid for sex in past 12 months.

FIGURE. Median interval in days since last HIV test among men and women with and without recent HIV risk in past 12 months, by survey year — General Social Survey, United States, 2006–2016



Abbreviation: HIV = human immunodeficiency virus.

Summary

What is already known about this topic?

CDC recommends routine human immunodeficiency virus (HIV) screening of persons aged 13–64 years and annual rescreening of persons at higher risk. Many persons at higher risk are not screened annually.

What is added by this report?

Analysis of 2006–2016 national population-based data found that the percentage of persons ever tested and median interval since last test remained unchanged. The median interval since last test among persons with recent HIV risk was shorter than that of other persons tested but exceeded 1 year.

What are the implications for public health practice?

Efforts to identify persons at higher risk and ensure that they receive annual HIV screening can reduce morbidity, mortality, and transmission to others. Integration of routine screening as standard clinical practice through existing strategies, such as electronic medical record prompts, or new, innovative strategies might be needed to increase repeat screening of persons with ongoing risk.

other population-based surveys such as BRFSS (*9*) and the National Survey of Family Growth (*8*) as well as national web-based surveys of MSM (*10*). GSS is the only national population-based survey that provides enough risk information to stratify testing estimates by HIV risk while also providing single-year testing estimates.

The findings in this report are subject to at least four limitations. First, because the proportion of respondents reporting specific HIV-related risk behaviors in the past 12 months (e.g., injecting drugs) was small, trends in the interval since last test could not be evaluated by individual risk group, which could have obscured meaningful differences between risk groups. Second, self-reported data might be compromised by social desirability and recall biases, which might have led to overestimates of testing among persons with HIV risk. Third, because GSS is a household-based survey, important subgroups of persons with recent HIV risk, such as persons who inject drugs or homeless persons, were likely undersampled. Finally, to the extent that those who answered "don't know" or refused to answer the HIV testing question were at higher risk for HIV infection and were not being tested frequently, the median interval since last test among persons at risk could have been underestimated.

Early diagnosis and effective treatment that suppresses HIV replication not only reduces individual morbidity and mortality but also reduces the risk for transmission to others.¶ Delayed diagnosis limits the benefits of early treatment initiation to minimize immune system damage and prevent HIV transmission. HIV screening is a critical entry point to a range of HIV prevention and treatment options. For persons with ongoing risk for HIV infection, annual screening also offers the opportunity to discuss options to reduce risk, including HIV preexposure prophylaxis.** Findings from this analysis suggest that HIV screening frequency for persons with recent HIV risk is suboptimal and has not improved substantially

¶ https://www.cdc.gov/hiv/risk/art/index.html.
** https://www.cdc.gov/hiv/risk/prep/index.html.

TABLE 2. Percentage of persons tested for human immunodeficiency virus (HIV) infection and median number of days since last HIV test, by HIV risk group, General Social Survey — United States, 2006–2016

		Ever tested	Tested in past 12 months	No. of days since last test
HIV risk group*	**No. (%)**	**Weighted % (95% CI)**	**Weighted % (95% CI)**	**Median (IQR)**
Men with recent male sex partner	180 (1.5)	71.0 (62.1–78.5)	42.2 (32.7–52.4)	459 (172–2,143)
Men with other recent risk	849 (7.3)	58.0 (53.9–61.9)	37.0 (31.7–42.7)	610 (202–1,434)
Women with recent risk	664 (5.7)	65.9 (61.1–70.4)	45.6 (39.9–51.4)	416 (139–1,169)
Men and women with no recent risk	9,995 (85.5)	36.1 (34.9–37.3)	23.6 (22.0–25.3)	1,360 (400–3,510)

Abbreviations: CI = confidence interval; IQR = interquartile range.
* Recent risk includes having a male sex partner (male respondents only), having multiple sex partners, injecting drugs, and paying or being paid for sex in the past 12 months. Risk groups are mutually exclusive. Male respondents with a male sex partner were classified as having a male sex partner regardless of any additional reported risks.

since 2006. Continuing efforts are needed to achieve full implementation of annual screening recommendations and prevent new infections. It is important that health care providers and public health practitioners intensify efforts to identify persons with ongoing risk and ensure they are engaged in annual screening for HIV infection. Strategies that have been shown to be effective for increasing one-time screening, such as integration of routine screening as standard clinical practice through supportive institutional policy changes, electronic health record prompts, and staff member education (*3*) could be used to ensure repeat screening for persons with ongoing risk. Expanding access to HIV screening in nonclinical settings and through strategies such as social network strategy, couples HIV testing and counseling,[††] and home testing[§§] can reduce barriers to accessing screening. New, innovative approaches might also be needed to increase repeat screening of persons with ongoing risk.

[††] https://effectiveinterventions.cdc.gov/en/HighImpactPrevention/PublicHealthStrategies/HIVTesting.aspx.
[§§] https://www.cdc.gov/hiv/testing/hometests.html.

Conflict of Interest

No conflicts of interest were reported.

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Self-Reported Concussions from Playing a Sport or Being Physically Active Among High School Students — United States, 2017

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Increased susceptibility to concussions and longer recovery times among high school athletes compared with older athletes (*1*) make concussions among youths playing a sport or being physically active an area of concern. Short-term and long-term sequelae of concussions can include cognitive, affective, and behavioral changes (*1*). Surveillance methods used to monitor concussions among youths likely underestimate the prevalence. Estimates assessed from emergency departments miss concussions treated outside hospitals, those generated using high school athletic trainer reports miss concussions sustained outside of school-based sports (*2*), and both sources miss medically untreated concussions. To estimate the prevalence of concussions among U.S. high school students related to playing a sport or being physically active, CDC analyzed data from the 2017 national Youth Risk Behavior Survey (YRBS). Overall, 15.1% of students (approximately 2.5 million*) reported having at least one of these concussions during the 12 months before the survey, and 6.0% reported two or more concussions. Concussion prevalence was significantly higher among male students than among female students and among students who played on a sports team than among students who did not. Among all sex, grade, and racial/ethnic subgroups, the odds of reporting a concussion increased significantly with the number of sports teams on which students played. These findings underscore the need to 1) foster a culture of safety in which concussion prevention and management is explicitly addressed; 2) expand efforts to educate students, parents, coaches, and health care providers regarding the risk for concussion; and 3) identify programs, policies, and practices that prevent concussions.

YRBS is a biennial, cross-sectional, school-based survey that uses a three-stage cluster sampling design to produce nationally representative samples of public and private school students in grades 9–12 (*3*). In accordance with local parent permission procedures, students voluntarily completed an anonymous, self-administered questionnaire during one class period and recorded their responses on a computer-scannable answer sheet. An institutional review board at CDC approved the protocol for the national YRBS. In 2017, the school response rate was 75%, the student response rate was 81%, the overall response rate was 60%,[†] and the sample size was 14,765.

In 2017, CDC included a question about concussions on the national YRBS questionnaire for the first time. Following a definition of concussion ("when a blow or a jolt to the head causes problems such as headaches, dizziness, being dazed or confused, difficulty remembering or concentrating, vomiting, blurred vision, or being knocked out"), students were asked, "During the past 12 months, how many times did you have a concussion from playing a sport or being physically active?" Response options were: "0 times, 1 time, 2 times, 3 times, and 4 or more times." Sports team participation was assessed with the question, "During the past 12 months, on how many sports teams did you play? (Count any teams run by your school or community groups.)" Response options were "0 teams, 1 team, 2 teams, and 3 or more teams." Prevalence estimates were computed overall and by sex (female or male), grade (9, 10, 11, or 12), the number of sports teams on which students played (0, 1, 2, or ≥3), and race/ethnicity (non-Hispanic white [white], non-Hispanic black [black], or Hispanic). The number of students in other racial/ethnic subgroups was too small for meaningful analysis.

Sampling weights were applied to each student record to adjust for nonresponse and the oversampling of black and Hispanic students. For all analyses, statistical software was used that took into account the complex sampling design and sampling weights. Chi-square tests were used to identify associations between student characteristics and having had 0, 1, 2, 3, or ≥4 concussions. T-tests were used for pairwise comparisons when a chi-square test result was significant. Among students who played on at least one sports team, the association between the number of teams on which students played and concussion was evaluated for each demographic subgroup using unadjusted logistic regression models. First, number of sports teams was treated as a categorical variable and then, to test for a linear association, as a continuous variable.

Overall, 9.1% of high school students reported one concussion, 3.0% reported two, 1.0% reported three, and 2.0% reported four or more concussions related to sports or physical activity during the 12 months before the survey (Table 1). Thus, 15.1% of students reported having at least one concussion, and 6.0% reported having two or more. Male students

* The National Center for Education Statistics estimated that in 2017, a total of 16,451,000 youths were enrolled in public and private high schools. This number was multiplied by the estimated prevalence of one or more and then two or more concussions related to sports or physical activity found in this study.

† Overall response rate = school response rate x student response rate.

TABLE 1. Percentage of high school students who reported having a concussion from playing a sport or being physically active,* by number of concussions† and selected characteristics — Youth Risk Behavior Survey, United States, 2017§

	No. of concussions reported				
	0	1	2	3	≥4
Characteristic	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Total	**84.9 (83.3–86.4)**	**9.1 (8.2–10.2)**	**3.0 (2.5–3.5)**	**1.0 (0.8–1.3)**	**2.0 (1.6–2.4)**
Sex					
Female	87.0 (85.3–88.6)	8.0 (6.8–9.5)	2.6 (2.1–3.2)	0.8 (0.6–1.1)	1.5 (1.2–1.9)
Male	82.9 (81.1–84.4)	10.2 (9.2–11.3)	3.3 (2.6–4.1)	1.2 (0.9–1.6)	2.4 (1.9–3.1)
p-value	0.000	0.002	0.044	0.054	0.006
Grade					
9	83.0 (80.8–84.9)	11.3 (9.7–13.2)	3.0 (2.3–4.0)	0.9 (0.6–1.3)	1.8 (1.2–2.5)
10	84.8 (82.6–86.8)	8.5 (7.2–10.1)	3.2 (2.4–4.3)	1.4 (1.1–1.9)	2.0 (1.4–2.8)
11	84.7 (82.4–86.7)	9.6 (8.1–11.3)	3.0 (2.2–4.2)	0.9 (0.6–1.5)	1.8 (1.3–2.6)
12	87.8 (85.6–89.7)	6.8 (5.5–8.5)	2.5 (1.9–3.2)	0.7 (0.5–1.2)	2.1 (1.5–3.0)
p-value	0.001¶	0.001**	0.529	0.103	0.867
Race/Ethnicity					
White, non-Hispanic	85.4 (83.2–87.4)	9.7 (8.5–11.2)	2.6 (2.0–3.5)	0.9 (0.7–1.3)	1.3 (0.9–1.7)
Black, non-Hispanic	83.0 (80.7–85.1)	8.2 (6.7–10.0)	3.3 (2.6–4.2)	1.7 (1.1–2.8)	3.7 (2.1–6.3)
Hispanic	85.1 (83.2–86.8)	8.2 (7.3–9.3)	3.4 (2.6–4.6)	0.9 (0.6–1.3)	2.4 (1.7–3.4)
p-value	0.183	0.060	0.347	0.210	0.014††
Played on at least one sports team§§					
Yes	78.6 (76.3– 80.7)	13.1 (11.7–14.6)	4.2 (3.5–5.1)	1.5 (1.2–2.0)	2.6 (2.0–3.2)
No	92.4 (91.2–93.5)	4.5 (3.7–5.4)	1.4 (1.0–1.9)	0.4 (0.3–0.6)	1.3 (1.0–1.7)
p-value	0.000	0.000	0.000	0.000	0.001

Abbreviation: CI = confidence interval.
* During the 12 months before the survey.
† 15.1% of high school students reported at least one concussion.
§ Weighted percentages are presented. Weighted percentages might not add to 100 because of rounding.
¶ Prevalence among 12th grade students was significantly higher than among 9th, 10th, and 11th grade students.
** Prevalence among 12th grade students was significantly lower than among 9th, 10th, and 11th grade students; prevalence among 9th grade students was significantly higher than among 10th grade students.
†† Prevalence among non-Hispanic white students was significantly lower than among non-Hispanic black and Hispanic students.
§§ Run by their school or community groups during the 12 months before the survey.

were more likely to report one, two, and four or more concussions than were female students. Students in grades 9, 10, and 11 were more likely to report a single concussion than were students in grade 12, and students in grade 9 were more likely to report a single concussion than were students in grade 10. Black and Hispanic students were more likely to report four or more concussions than were white students. Students who played on at least one sports team were more likely to report one, two, three, and four or more concussions than were those who did not play on any teams.

Among students who played on one, two, and three or more sports teams, the prevalence of reporting having had at least one concussion was 16.7%, 22.9%, and 30.3%, respectively (Table 2). Among students who played on at least one sports team, for all demographic subgroups, the odds of reporting a concussion increased with an increasing number of teams on which students played (Table 3).

Discussion

In 2017, an estimated 2.5 million high school students reported having at least one concussion related to sports or physical activity during the year preceding the YRBS, and an estimated 1.0 million students reported having two or more concussions during the same time frame. The findings suggest that students who played on a sports team had a significantly higher risk for one or more concussions than did students who did not play on a team. Furthermore, concussions were significantly more common among students who played on two and three or more sports teams than among those who played on one team. The prevalence of having one or more concussions (15.1%) is comparable to the findings of an analysis of 2013 YRBS data from three states that added different questions to their survey to assess sports-related concussions among high school athletes. In that study, the prevalence ranged from 17.6% to 20.1% (*4*). The prevalence of concussions in the current study is higher than estimates based on emergency department data (e.g., 622.5 visits per 100,000 population aged 10–14 years) (*5*) and athletic trainer reports (e.g., 1.8 per 100 high school and college athletes for an average season) (*6*). Emergency department data miss concussions treated elsewhere, and athletic trainer reports miss concussions sustained outside of school-based sports; both sources miss medically untreated concussions (*2*).

TABLE 2. Percentage of high school students who reported having a concussion from playing a sport or being physically active,* by number of sports teams on which students played† and selected characteristics — Youth Risk Behavior Survey, United States, 2017§

	No. of sports teams on which students played			
	0	1	2	≥3
Characteristic	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**
Total	**7.6 (6.5–8.8)**	**16.7 (14.8–18.9)**	**22.9 (19.7–26.4)**	**30.3 (26.6–34.1)**
Sex				
Female	6.9 (5.5–8.7)	15.2 (13.3–17.4)	21.1 (18.1–24.5)	29.1 (23.7–35.2)
Male	8.3 (6.8–10.1)	18.3 (15.7–21.2)	23.9 (20.0–28.4)	30.9 (26.4–35.9)
Grade				
9	9.6 (7.5–12.4)	18.2 (14.5–22.7)	23.0 (18.5–28.3)	28.4 (23.3–34.1)
10	8.6 (6.9–10.7)	17.4 (13.8–21.6)	21.1 (16.4–26.9)	29.3 (23.0–36.4)
11	6.3 (4.6–8.7)	16.6 (12.1–22.3)	25.1 (20.0–31.0)	34.9 (29.1–41.2)
12	5.6 (4.2–7.3)	14.4 (11.7–17.5)	21.1 (16.7–26.4)	28.4 (21.2–36.9)
Race/Ethnicity				
White, non-Hispanic	6.6 (5.1–8.4)	15.7 (13.4–18.3)	22.9 (18.7–27.8)	30.8 (25.7–36.4)
Black, non-Hispanic	8.2 (6.4–10.5)	18.2 (14.5–22.5)	26.1 (20.1–33.2)	30.4 (23.0–38.9)
Hispanic	9.4 (7.6–11.7)	17.4 (13.8–21.8)	21.6 (17.9–25.7)	26.5 (21.2–32.5)

Abbreviation: CI = confidence interval.
* One or more times during the 12 months before the survey.
† Run by their school or community groups during the 12 months before the survey.
§ Weighted percentages are presented. Weighted percentages might not add to 100 because of rounding.

Although increased awareness and recognition might result in higher rates of reported concussions (*1*), underreporting of concussions among athletes remains an important issue. A study of high school athletes found that among athletes with concussions, 40% reported that their coach was unaware of their symptoms (*7*). Students might not always recognize or remember that they have experienced a concussion, or they might not want to report having experienced a concussion. In this study, the opportunity to anonymously self-report a concussion, without negative consequences, such as a loss of playing time, might have aided in including concussions missed by other data sources. However, this study might overestimate the prevalence of concussions related to sports or physical activity if students reported concussions occurring before the 12-month reference period (*8*) or mistakenly thought that they had a concussion because some symptoms of a concussion, such as a headache, also occur in the absence of a concussion (*9*).

The findings in this report are subject to at least four limitations. First, these concussions, self-reported by students, were not validated (e.g., through medical record review). Second, these data apply only to high school students who attend school and are not representative of all youths in this age group or in other age groups. Nationwide, in 2013, approximately 5% of persons aged 16–17 years were not enrolled in high school and lacked a high school credential.§ Third, continuing to play sports or be physically active with a concussion that is symptomatic increases the risk for a subsequent, more serious concussion (*10*). YRBS data found that 6% of students

Summary

What is already known about this topic?

A concussion is a type of traumatic brain injury. Surveillance efforts likely miss some concussions related to sports and physical activity among youths.

What is added by this report?

The 2017 Youth Risk Behavior Survey found that 15.1% of students reported having at least one concussion related to sports or physical activity, and 6.0% reported having two or more. Playing on more than one sports team was found to further increase the risk for concussion.

What are the implications for public health practice?

It is important to expand education about the risk for concussion, the signs and symptoms of concussion, the need to remove athletes with a suspected concussion from play, the evaluation of concussions, and the protocol for athletes' safe return to school and play.

reported two or more concussions, but YRBS data do not allow for determining the proportion of concussions that might have been related to a previous concussion that had not fully healed. Finally, it is not known what proportion of concussions occurred during team sports participation versus other types of physical activity.

A 2014 National Academy of Sciences report concluded that, in light of the limitations of existing surveillance systems, more comprehensive estimates of youth sports concussions are needed (*1*). This study, and state-level YRBS data (*4*), support this conclusion by suggesting that many concussions among

§ https://nces.ed.gov/pubs2016/2016117rev.pdf.

TABLE 3. Association between the number of sports teams on which high school students played* and having reported a concussion from playing a sport or being physically active,†,§ by selected characteristics — Youth Risk Behavior Survey, United States, 2017

	No. of sports teams on which students played			
	1	2	≥3	
Characteristic	OR (95% CI)	OR (95% CI)	OR (95% CI)	Linear trend¶ p-value
Total	**Referent**	**1.5 (1.2–1.8)**	**2.2 (1.8–2.6)**	**<0.001**
Sex				
Female	Referent	1.5 (1.2–1.9)	2.3 (1.7–3.0)	<0.001
Male	Referent	1.4 (1.1–1.8)	2.0 (1.5–2.6)	<0.001
Grade				
9	Referent	1.3 (0.9–1.9)	1.8 (1.3–2.5)	0.001
10	Referent	1.3 (0.9–1.9)	2.0 (1.2–3.1)	0.007
11	Referent	1.7 (1.2–2.5)	2.7 (1.7–4.4)	<0.001
12	Referent	1.6 (1.1,2.3)	2.4 (1.6–3.6)	<0.001
Race/Ethnicity				
White, non-Hispanic	Referent	1.6 (1.2–2.1)	2.4 (1.8–3.1)	<0.001
Black, non-Hispanic	Referent	1.6 (1.1–2.4)	2.0 (1.3–2.9)	<0.001
Hispanic	Referent	1.3 (1.0–1.7)	1.7 (1.0–2.8)	0.027

Abbreviations: CI = confidence interval; OR = odds ratio.
* Run by their school or community groups during the 12 months before the survey.
† Among students who played on at least one sports team during the 12 months before the survey.
§ One or more times during the 12 months before the survey.
¶ Logistic regression models tested a linear association between the number of sports teams on which students played and the odds of reporting having a concussion from playing a sport or being physically active.

youths are not being counted and might also indicate that similar comprehensive estimates below the high school level are needed. To that end, CDC is working toward developing a National Concussion Surveillance System to determine the incidence and identify the circumstances of concussions, and all traumatic brain injuries, across the lifespan (*2*).

The findings in this report support the need to continue education efforts addressing concussion risk associated with sports and physical activity, and indicate a need for messaging targeted toward students who play on multiple sports teams. Additionally, black and Hispanic students were more likely to report four or more concussions than were white students; targeted messaging might be needed to educate these groups in particular about the risks associated with sustaining multiple concussions. In addition, coaches and parents can encourage athletes to follow the rules of play for their sport with an emphasis on player safety, which might reduce the incidence and severity of concussions (*1*,*10*). It is important that any athlete with a suspected concussion be removed from practice and competition and not return to play without the clearance of a health care provider (*10*). Continuing to play with a concussion might worsen symptoms (*1*) and increase the risk for a second concussion; therefore, it is crucial to talk with athletes about the importance of reporting their concussion symptoms (*10*). Among recreational activities, bicycle helmets have been shown to reduce head injuries (*1*). There is a need to expand programs, policies, and practices, tailored to specific audiences, to ensure that all students, parents, coaches, teachers, and health care providers know how to prevent, recognize, and manage concussions. It is critical that these stakeholders know how to safely return students to school and to play following a concussion.

Conflict of Interest

No conflicts of interest were reported.

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Smoke-Free and Tobacco-Free Policies in Colleges and Universities — United States and Territories, 2017

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Each year in the United States, cigarette smoking causes an estimated 480,000 deaths, including approximately 41,000 deaths from secondhand smoke exposure among nonsmoking adults (*1*). Smoke-free policies protect nonsmokers from secondhand smoke exposure, reduce the social acceptability of smoking, help in preventing youth and young adult smoking initiation, and increase smokers' efforts to quit smoking (*1*,*2*). Given that 99% of adult cigarette smokers first start smoking before age 26 years and many smokers transition to regular, daily use during young adulthood (*2*),* colleges and universities represent an important venue for protecting students, faculty, staff members, and guests from secondhand smoke exposure through tobacco control policies (*3*). To assess smoke-free and tobacco-free policies in U.S. colleges and universities, CDC and the American Nonsmokers' Rights Foundation (ANRF) determined the number of campuses nationwide that completely prohibit smoking (smoke-free) or both smoking and smokeless tobacco product use (tobacco-free) in all indoor and outdoor areas. As of November 2017, at least 2,082 U.S. college and university campuses had smoke-free policies. Among these campuses, 1,743 (83.7%) were tobacco-free; 1,658 (79.6%) specifically prohibited electronic cigarette (e-cigarette) use; and 854 (41.0%) specifically prohibited hookah smoking. Smoke-free and tobacco-free policies on college and university campuses can help reduce secondhand smoke exposure, tobacco use initiation, and the social acceptability of tobacco use (*1*–*3*).

Data on smoke-free and tobacco-free policies enacted as of November 2017 were obtained from ANRF's College Campus Tobacco Policy Database,† the only national repository of tobacco restrictions on college campuses in the United States. The database is compiled using a daily news digest from Internet searches, as well as direct communication with state and local health departments, university officials, students, and alumni.§ The policies then are analyzed using standardized criteria and entered into the database. Campuses eligible for consideration are located in all 50 U.S. states, the District of Columbia, commonwealths, territories, and in tribal entities.

College and university campuses were considered smoke-free if they completely prohibited smoking in all indoor and outdoor areas, and tobacco-free if they prohibited both smoking and smokeless tobacco product use in all indoor and outdoor areas.¶ In addition, those that explicitly prohibited use of e-cigarettes and hookah smoking were also assessed.** For institutions comprising multiple physical learning sites with or without distinct policies, each site was evaluated as a separate campus. Campuses without smoke-free or tobacco-free policies were not included in the database, and data on the total number of U.S. college and university campuses as defined in the context of this report were unavailable. Therefore, it was not possible to summarize the number of smoke-free campuses as a percentage of total U.S. campuses. Findings were reported overall and by state and campus type (public; private; community college; historically black college or university; and tribal).†† Campus type categories were not mutually exclusive, and campuses could be categorized as multiple types.

As of November 2017, at least 2,082 U.S. college and university campuses were smoke-free (Table 1). Among these campuses, 1,743 (83.7%) were tobacco-free; 1,658 (79.6%) specifically prohibited e-cigarette use; and 854 (41.0%) specifically prohibited hookah smoking.

* https://www.ncbi.nlm.nih.gov/books/n/nap18997/pdf.
† https://no-smoke.org/colleges-universities-list-criteria/.
§ Information on school policies is also gathered by ANRF program personnel providing technical assistance in this area. Details are confirmed by reviewing a copy of the final policy, either on the institution's website or via an institution contact with access to the policy documentation.

¶ For smoke-free campuses, the law or institutional policy prohibits smoking of combustible tobacco products on the entire campus property, both indoors and out, including remote parking lots, stadiums, theater performances, and residential housing (where applicable). For tobacco-free campuses, the law or institutional policy prohibits smoking of combustible tobacco products and the use of smokeless tobacco products on the entire campus property, both indoors and out, including remote parking lots, stadiums, theater performances, and residential housing (where applicable). The only possible exemptions for smoke-free and tobacco-free campuses include one's personal vehicle, research in a controlled lab setting, or religious ceremonial purposes.
** Coverage of hookah smoking is not consistently addressed under smoke-free policies for college or university campuses. Therefore, subsequent analyses determined the proportion of smoke-free policies that contain language specifically prohibiting hookah (e.g. "hookah," "shisha," or "water pipe") use anywhere on campus.
†† A public college or university was defined as a campus funded by government means. A private college or university was defined as a campus not funded by government means. A community college was defined as a campus with "community college" in the name or that described itself as one in the documentation encountered during analysis, confirmed via a reliable source familiar with the entity or via Internet research. A historically black college or university was defined as a campus that described itself as one in the documentation encountered during analysis, confirmed via a reliable source familiar with the entity, or via Internet research. A tribal college or university was defined as a campus on American Indian/Alaska Native sovereign land.

TABLE 1. College and university campuses* with smoke-free policies,† tobacco-free policies,§ and policies specifically prohibiting e-cigarette use and hookah smoking, by campus type — United States and territories, 2017

Type of campus¶	No. of smoke-free campuses	Campuses with additional policies**		
		Tobacco-free no. (%)	E-cigarettes no. (%)	Hookah no. (%)
Public	1,616	1,375 (85.1)	1,373 (85.0)	692 (42.8)
Community college	1,209	1,066 (88.2)	1,018 (84.2)	459 (38.0)
Private	448	350 (78.1)	283 (63.2)	159 (35.5)
Historically black	58	42 (72.4)	37 (63.8)	28 (48.3)
Tribal	18	18 (100.0)	2 (11.1)	3 (16.7)
Total	**2,082**	**1,743 (83.7)**	**1,658 (79.6)**	**854 (41.0)**

* Institutions comprising multiple campuses or sites, with or without distinct policies, are counted separately.

† As of November 2017, the campus is covered by a law or policy that prohibits smoking (at minimum) in all indoor and outdoor areas. The only exemptions include one's personal vehicle, research in a controlled laboratory setting, or religious ceremonial purposes. Smoke-free campuses covered by state law are not indicated separately from campuses covered by institutional policies.

§ As of November 2017, the campus is covered by a law or policy that prohibits smoking and smokeless tobacco use in all indoor and outdoor areas. The only exemptions include one's personal vehicle, research in a controlled laboratory setting, or religious ceremonial purposes. Tobacco-free campuses covered by state law are not indicated separately from campuses covered by institutional policies.

¶ College and university campus types were not mutually exclusive. Campuses could be categorized as multiple campus types and counted more than once (e.g., private and community college) and therefore could sum to more than the total. A public college or university was defined as a campus funded by government means. A private college or university was defined as a campus not funded by government means. A community college was defined as a campus with "community college" in the name, or described itself as one in the documentation encountered during analysis, or a reliable source confirmed this status. A historically black college or university was defined as a campus that described itself as one in the documentation encountered during analysis or a reliable source has confirmed this status. A tribal college or university was defined as a campus on American Indian/Alaska Native sovereign land.

** Indicated as a subset or percentage of smoke-free campuses.

A total of 1,616 public college and university campuses were smoke-free. Among these public campuses, 1,375 (85.1%) were tobacco-free; 1,373 (85.0%) specifically prohibited e-cigarette use; and 692 (42.8%) specifically prohibited hookah smoking. Among the 448 private campuses with smoke-free policies, 350 (78.1%) were tobacco-free; 282 (63.2%) specifically prohibited e-cigarette use; and 159 (35.5%) specifically prohibited hookah smoking. Among the 1,209 community college campuses with smoke-free policies, 1,066 (88.2%) were tobacco-free; 1,018 (84.2%) specifically prohibited e-cigarette use; and 459 (38.0%) specifically prohibited hookah smoking. Among the 58 historically black college or university campuses with smoke-free policies, 42 (72.4%) were tobacco-free; 37 (63.8%) specifically prohibited e-cigarette use; and 28 (48.3%) specifically prohibited hookah smoking. Among the 18 tribal campuses with smoke-free policies, all 18 were tobacco-free; two (11.1%) specifically prohibited e-cigarette use; and three (16.7%) specifically prohibited hookah smoking. By state or territory, the number of college and university campuses with a smoke-free policy ranged from one in Hawaii and the Northern Mariana Islands to 108 in California and North Carolina (Table 2).

Discussion

In September 2012, the U.S. Department of Health and Human Services, the University of Michigan, and the American College Health Association collaboratively launched the Tobacco-Free College Campus Initiative to promote and support the voluntary adoption and implementation of tobacco-free policies at universities, colleges, and other institutions of higher learning across the United States. At the time, 774 colleges and universities were identified as having a smoke-free campus policy, 562 (72.6%) of which were tobacco-free.§§ The findings from this study indicate that, as of November 2017, the number of campuses with smoke-free or tobacco-free policies had risen to 2,082 and 1,743, respectively, suggesting that the number of U.S. college and university campuses with such policies has more than doubled over the past half-decade. Smoke-free and tobacco-free policies at colleges and universities can help reduce secondhand smoke exposure, tobacco use initiation, and the social acceptability of tobacco use (*1–3*).

These results include campuses that might be smoke-free or tobacco-free because of policies at the institutional, local, state, or territorial levels. *Healthy People 2020* objective TU-13.17 monitors the number of states and the District of Columbia that have enacted laws that prohibit smoking on college and university campuses.¶¶ As of 2017, four states (Arkansas, Illinois, Iowa, and Louisiana) and the Northern Mariana Islands have enacted laws requiring smoke-free policies that prohibit smoking in all indoor and outdoor areas of public college campuses (*4,5*). Among these smoke-free laws, Arkansas's law specifically prohibits e-cigarettes, Illinois's law specifically prohibits e-cigarettes and hookahs, and the Northern Mariana Islands' law specifically prohibits e-cigarettes and smokeless

§§ http://no-smoke.org/wp-content/uploads/pdf/smokefreecollegesuniversities-Jul-1-2012.pdf.

¶¶ http://www.healthypeople.gov/2020/topics-objectives/topic/tobacco-use/objectives.

TABLE 2. Distribution of college and university campuses* with smoke-free policies† and tobacco-free policies§ — United States and territories, 2017

State/Territory	Campus type: Smoke-free no.	Campus type: Tobacco-free¶ no. (%)
Alabama	45	39 (86.7)
Alaska	6	6 (100.0)
Arizona	42	42 (100.0)
Arkansas**	60	26 (43.3)
California	108	85 (78.7)
Colorado	11	8 (72.7)
Connecticut	6	3 (50.0)
Delaware	9	9 (100.0)
Florida	85	70 (82.4)
Georgia	60	58 (96.7)
Hawaii	1	1 (100.0)
Idaho	13	8 (61.5)
Illinois**	95	23 (24.2)
Indiana	71	65 (91.5)
Iowa**	104	58 (55.8)
Kansas	30	20 (66.7)
Kentucky	92	87 (94.6)
Louisiana**	91	86 (94.5)
Maine	26	26 (100.0)
Maryland	24	22 (91.7)
Massachusetts	29	16 (55.2)
Michigan	71	69 (97.2)
Minnesota	30	29 (96.7)
Mississippi	38	34 (89.5)
Missouri	55	50 (90.9)
Montana	8	8 (100.0)
Nebraska	19	19 (100.0)
Nevada	3	0 (0.0)
New Hampshire	6	4 (66.7)
New Jersey	36	27 (75.0)
New Mexico	2	1 (50.0)
New York	98	81 (82.7)
North Carolina	108	104 (96.3)
North Dakota	12	12 (100.0)
Ohio	46	44 (95.7)
Oklahoma	56	56 (100.0)
Oregon	32	27 (84.4)
Pennsylvania	68	57 (83.8)
Rhode Island	2	2 (100.0)
South Carolina	68	63 (92.6)
South Dakota	25	21 (84.0)
Tennessee	40	33 (82.5)
Texas	89	86 (96.6)
Utah	3	3 (100.0)
Vermont	25	25 (100.0)
Virginia	4	4 (100.0)
Washington	21	20 (95.2)
West Virginia	16	16 (100.0)
Wisconsin	90	87 (96.7)
Wyoming	NI	NI
American Samoa	NI	NI
Guam	2	2 (100.0)
Marshall Islands	NI	NI
Micronesia	NI	NI
Northern Mariana Islands**	1	1 (100.0)
Palau	NI	NI
Puerto Rico	NI	NI
Virgin Islands	NI	NI
Total	**2,082**	**1,743**

Abbreviation: NI = none identified.

* Institutions comprising multiple campuses or sites, with or without distinct policies, are counted separately.

† As of November 2017, the campus is covered by a law or policy that prohibits smoking (at minimum) in all indoor and outdoor areas. The only exemptions include one's personal vehicle, research in a controlled laboratory setting, or religious ceremonial purposes. Campuses that do not qualify as smoke-free under these definitions are not assessed.

§ As of November 2017, the campus is covered by a law or policy that prohibits smoking and smokeless tobacco use in all indoor and outdoor areas. The only exemptions include one's personal vehicle, research in a controlled laboratory setting, or religious ceremonial purposes.

¶ Indicated as a subset or percentage of smoke-free campuses.

** Four states (Arkansas, Illinois, Iowa, and Louisiana) and the Northern Mariana Islands have enacted laws requiring comprehensive smoke-free indoor and outdoor public campuses. Iowa's smoke-free campus provision applies to both public and private institutions. Campuses covered by state law are not indicated separately from campuses covered by institutional policies.

tobacco.*** Iowa's smoke-free campus law is the only state law that extends to campuses at both public and private institutions.††† Given the evolving U.S. tobacco product landscape, addressing the diversity of tobacco products available on the market is important in the development of tobacco-free policies, including emerging products such as e-cigarettes and hookahs.

Because nearly all adult cigarette smokers begin smoking by young adulthood (*2*), colleges and universities can serve an important role in preventing tobacco product use initiation among nonusers, while also protecting students, faculty, staff members, and guests from secondhand smoke exposure. In 2015, approximately 40% of U.S. adults aged 18–24 years (12.6 million) were enrolled in 4,562 degree-granting postsecondary institutions (*6*),§§§ and a substantial proportion of young adults currently use at least one tobacco product: in 2015, one in five adults aged 18–24 years (21.4%) reported using a tobacco product some days or every day (*7*). Moreover, 23.8% of adults who attained some college education, but received no diploma, reported current use of at least one tobacco product (*7*).

*** Arkansas Clean Air on Campus Act 734 of 2009 (effective August 1, 2010), subsequently amended effective July 22, 2015, and Arkansas Medical Marijuana Amendment of 2016 (effective March 29, 2017); Illinois Smoke-Free Campus Act, 110 ILCS 64/1-99 (effective January 1, 2015); Commonwealth of the Northern Mariana Islands Smoke-free Air, PL 16-46, Act of 2008 (effective September 29, 2009).

††† Iowa Smoke-Free Air Act of 2008, Iowa Code Chapter 142 D (effective July 1, 2008).

§§§ Includes only institutions reporting enrollment data in Fall 2015. The number of degree-granting postsecondary institutions reported by the National Center for Education Statistics is not directly comparable to the number of smoke-free campuses identified in this report.

Summary

What is already known about this topic?

Cigarette smoking causes an estimated 480,000 U.S. deaths annually, including 41,000 from secondhand smoke exposure. Nearly all adult cigarette smokers start smoking before age 26 years, making smoke-free and tobacco-free policies at colleges and universities important.

What is added by this report?

As of November 2017, at least 2,082 U.S. colleges and universities had smoke-free policies, twice as many as in 2012. Among these campuses, 1,743 (83.7%) had tobacco-free policies and some specifically prohibited electronic cigarette use (1,658 [79.6%]) and hookah smoking (854 [41.0%]).

What are the implications for public health practice?

Efforts to monitor, promote, implement, and enforce smoke-free and tobacco-free policies in U.S. colleges and universities can help reduce the prevalence of tobacco product use and secondhand smoke exposure among those who learn, live, work, and gather in these environments.

Given the trajectories of tobacco product use and initiation among young adults, interventions targeted toward this population, including tobacco-free and smoke-free policies in colleges and universities, might help accelerate efforts to reduce tobacco product use among young persons (*1*,*2*).

This study is subject to at least four limitations. First, these data might include policies that have been formally adopted but are not yet in effect. Second, whereas ANRF's database is the only national repository of smoke-free campus policies, these policies are not collected systematically from all campuses in the United States and therefore might not contain all policies that currently exist. Third, ANRF's database does not capture the total number of U.S. college and university campuses; comparable data would be needed to present the percentage of U.S. campuses with smoke-free or tobacco-free policies and to estimate the percentage of students protected. Finally, there is no uniform method for ascertaining how rigorously these policies are enforced. Previous research suggests that although tobacco-free campuses have increased in recent years, policy restrictiveness, implementation, and enforcement vary (*8*).

The U.S. Surgeon General has concluded that there is no risk-free level of secondhand smoke (*9*), and the public health benefits of smoke-free policies are well established in the scientific literature (*1*). Smoke-free and tobacco-free campuses can promote the health and well-being of a diverse intersection of students, faculty, staff members, and guests by protecting nonusers from the harmful effects of secondhand tobacco product emissions, reducing the social acceptability of tobacco product use, preventing tobacco use initiation, and promoting cessation (*1*,*2*,*9*). Continued efforts to monitor, promote, implement, and enforce smoke-free and tobacco-free policies in U.S. colleges and universities, in coordination with continued implementation of proven population-based interventions and tobacco product regulation (*10*), can help reduce the burden of tobacco product use among those who learn, live, work, and gather in these environments (*1*,*2*,*9*).

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Conflict of Interest

No conflicts of interest were reported.

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Strategic Response to an Outbreak of Circulating Vaccine-Derived Poliovirus Type 2 — Syria, 2017–2018

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Since the 1988 inception of the Global Polio Eradication Initiative (GPEI), progress toward interruption of wild poliovirus (WPV) transmission has occurred mostly through extensive use of oral poliovirus vaccine (OPV) in mass vaccination campaigns and through routine immunization services (*1*,*2*). However, because OPV contains live, attenuated virus, it carries the rare risk for reversion to neurovirulence. In areas with very low OPV coverage, prolonged transmission of vaccine-associated viruses can lead to the emergence of vaccine-derived polioviruses (VDPVs), which can cause outbreaks of paralytic poliomyelitis. Although WPV type 2 has not been detected since 1999, and was declared eradicated in 2015,* most VDPV outbreaks have been attributable to VDPV serotype 2 (VDPV2) (*3*,*4*). After the synchronized global switch from trivalent OPV (tOPV) (containing vaccine virus types 1, 2, and 3) to bivalent OPV (bOPV) (types 1 and 3) in April 2016 (*5*), GPEI regards any VDPV2 emergence as a public health emergency (*6*,*7*). During May–June 2017, VDPV2 was isolated from stool specimens from two children with acute flaccid paralysis (AFP) in Deir-ez-Zor governorate, Syria. The first isolate differed from Sabin vaccine virus by 22 nucleotides in the VP1 coding region (903 nucleotides). Genetic sequence analysis linked the two cases, confirming an outbreak of circulating VDPV2 (cVDPV2). Poliovirus surveillance activities were intensified, and three rounds of vaccination campaigns, aimed at children aged <5 years, were conducted using monovalent OPV type 2 (mOPV2). During the outbreak, 74 cVDPV2 cases were identified; the most recent occurred in September 2017. Evidence indicates that enhanced surveillance measures coupled with vaccination activities using mOPV2 have interrupted cVDPV2 transmission in Syria.

Context for VDPV2 Emergence in Syria

The ongoing civil war in Syria, which began in 2011, has had a deleterious impact on its health care system, leading to a steep decline in routine vaccination coverage and population immunity. Before the war (during 2001–2010), national 3-dose OPV (OPV3) coverage estimates by age 1 year consistently exceeded 80%. By 2016, estimated OPV3 coverage had decreased from 83% in 2010 to 48% (*8*).

Multiple rounds of supplementary immunization activities (SIAs), implemented in response to a WPV outbreak during 2013–2014 (*9*), mitigated the poor quality of routine immunization services in parts of the country; however, the frequency and quality of these activities lessened after the outbreak was declared over. In 2016, the year after the response to the WPV outbreak officially concluded, six SIAs were conducted in Deir-ez-Zor governorate; two used tOPV, with reported administrative coverage† of 7% and 23%.

The vaccination status of patients aged 6–59 months with nonpolio AFP (NPAFP) can be used as a proxy for OPV vaccination coverage. Among children born during the war, the estimated proportion of unvaccinated children with NPAFP increased from 3% in 2015 to 6% nationally by the end of 2016. In Deir-ez-Zor governorate, the proportion of children aged 6–59 months with NPAFP who had not received OPV rose from 0% in 2015 to 10% in 2016, coinciding with a decline in SIA quality in the governorate. Intermittent bans on vaccination campaigns were also imposed by local authorities in control of the governorate during this period.

Detection of poliovirus circulation depends on prompt identification and investigation of AFP cases. During 2016–2017, national NPAFP rates (assessing surveillance sensitivity) and the proportion of adequate stool specimens collected from AFP patients (assessing quality of case investigation) exceeded the performance targets of ≥2 cases per 100,000 persons aged <15 years and ≥80%, respectively. However, subnational AFP surveillance gaps were noted for both indicators; the proportion of AFP cases in Deir-ez-Zor governorate with adequate stool specimens declined from 84% in 2015 to 61% in 2016.

Outbreak Epidemiology

The earliest identified cVDPV2 outbreak case occurred in a girl aged 22 months from Mayadeen district, Deir-ez-Zor governorate, (paralysis onset March 3, 2017) and the most recent occurred in an infant aged 5 months from Boukamal district, Deir-ez-Zor governorate (paralysis onset September 21, 2017).

* http://polioeradication.org/news-post/global-eradication-of-wild-poliovirus-type-2-declared/.

† Administrative vaccination coverage is obtained by dividing the total number of vaccine doses administered by the estimated target population group.

The cVDPV2 isolate identified in the index case differed from Sabin vaccine virus by 22 nucleotides in the VP1 coding region (903 nucleotides). Among 74 cases reported as of June 17, 2018 (Figure 1) (Figure 2), 46 (62%) occurred in females. The median patient age was 15 months, with 26 (35%) aged <12 months, 35 (47%) aged 12–23 months, 11 (15%) aged 24–59 months, and two (3%) aged ≥5 years. Thirty cases (41%) occurred in children who had never received a dose of OPV, 32 (43%) in 1–2 dose recipients, and 12 (16%) in children who had received ≥3 OPV doses.

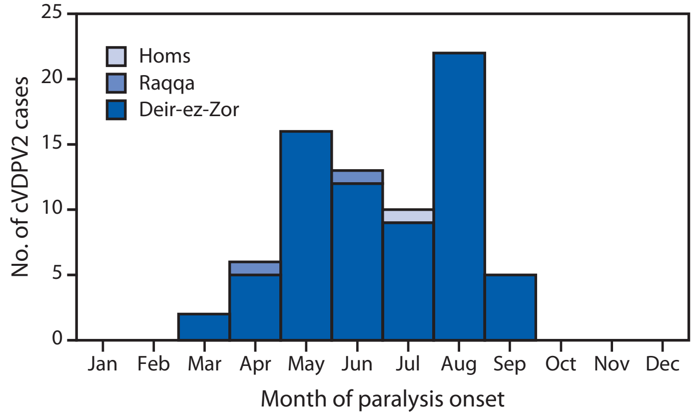
Geographically, 71 (96%) cases were reported from Deir-ez-Zor governorate, including 58 (78%) from Mayadeen district, 12 (16%) from Boukamal district, and one (1%) from Deir-ez-Zor district. The three remaining cases were reported (one case each) from Tell Abyad and Thawra districts in Raqqa governorate and Tadmour district in Homs governorate, which borders Mayadeen district, the epicenter of both the current cVDPV2 and the 2013–2014 WPV outbreaks.

Outbreak Response Activities

Active searches for AFP cases were intensified in districts reporting cVDPV2 cases and in surrounding areas. AFP cases were promptly investigated, and stool specimens were also collected from close patient contacts for testing; the cVDPV2 cases in Raqqa governorate were confirmed through the testing of stool specimens obtained from contacts. In addition, stool specimens were collected from healthy children in affected areas of Deir-ez-Zor governorate and from children arriving in other governorates from outbreak-affected areas. To facilitate early detection of poliovirus circulation, six environmental surveillance sites were established in five governorates (Deir-ez-Zor, Raqqa, Homs, Damascus, and Aleppo) beginning in December 2017. To date, no cVDPV2 has been isolated from sewage samples collected from these sites.

In response to the outbreak, SIAs were implemented in two distinct phases (Table). The first phase took place from July to October 2017, during which time two mOPV2 vaccination campaigns were conducted, targeting children aged <5 years in Deir-ez-Zor and Raqqa governorates. Inactivated poliovirus vaccine (IPV) was also administered to children aged 2–23 months in both governorates during the second mOPV2 round, except in Tell Abyad district of Raqqa governorate. In Deir-ez-Zor governorate, the first mOPV2 vaccination campaign was implemented during July 22–27, 2017. Based on administrative data, approximately 79% of 328,000 targeted children were vaccinated, whereas estimated coverage from postcampaign monitoring data (based on parental recall) was 88%. The second mOPV2 vaccination campaign in Deir-ez-Zor governorate, which was held 1 month later, achieved an estimated 77% administrative and postcampaign

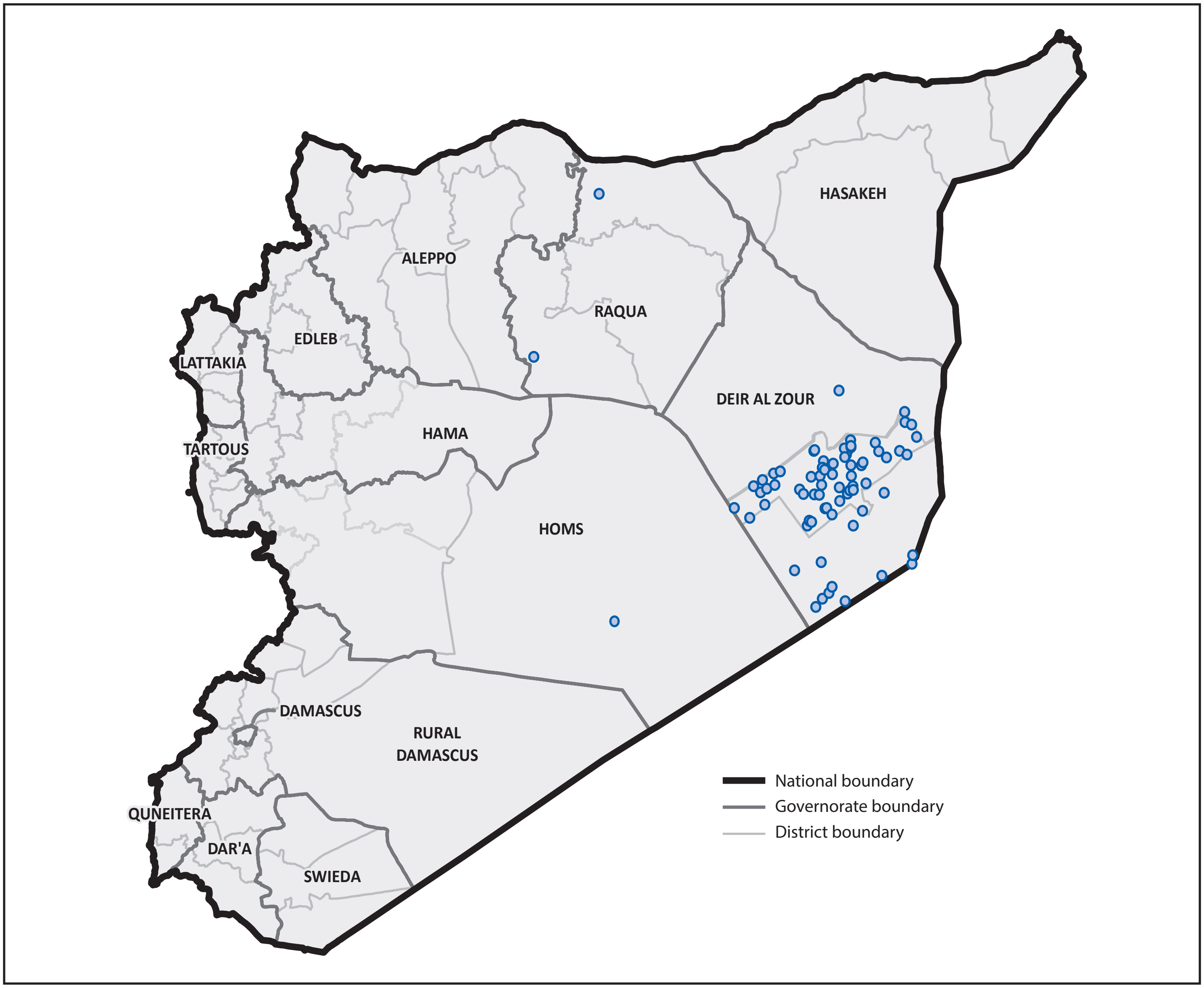
FIGURE 1. Distribution of cases of circulating vaccine-derived poliovirus type 2 (cVDPV2), by governorate and month of paralysis onset (n = 74) — Syria, 2017



monitoring coverage. In Raqqa governorate, the commencement of both mOPV2 campaigns was delayed because of protracted negotiations with multiple local authorities in control of different parts of the governorate. The first mOPV2 vaccination campaign was implemented during August 12–18, 2017. Although administrative data indicated that 86% of 120,000 targeted children were vaccinated, postcampaign monitoring estimated coverage at only 57%. Administrative vaccination coverage was 114% after the second mOPV2 vaccination campaign in Raqqa, implemented in early October 2017; however, estimated coverage from postcampaign monitoring data was 84%.

In January 2018, the second phase of response vaccination activities was initiated because of evidence of ongoing cVDPV2 transmission after the first phase of vaccination activities in Deir-ez-Zor governorate. A third mOPV2 vaccination campaign was implemented in Deir-ez-Zor, Raqqa, and Hasakeh governorates as well as in Tadmour district of Homs governorate. IPV was also administered to children aged 2–23 months among groups at high risk in Damascus, Aleppo, and Hasakeh governorates during a separate round of vaccination activities in February 2018. Estimated mOPV2 coverage based on postcampaign monitoring ranged from 84% in Raqqa governorate to 91% in Hasakeh governorate. Fewer than 1,000 children were vaccinated in the sparsely populated district of Tadmour in Homs governorate. Whereas estimating the target population of eligible children in Tadmour district was challenging because of population migration, the number of children vaccinated was seen as reflective of those present in the governorate at the time of the campaign. IPV was also administered to internally displaced children in Syria throughout the second half of 2017, as well as to refugees and groups at high risk in neighboring communities in Lebanon,

FIGURE 2. Geographic distribution of cases* (n = 74) of circulating vaccine-derived poliovirus type 2 — Syria, 2017



Sources: World Health Organization; Office of Public Health Preparedness and Response, CDC.
* Each dot represents one case. Dots are randomly placed within the district boundary.

Iraq, and Turkey, to bolster protection of children in high-risk areas outside the immediate outbreak-affected area.

In line with GPEI protocol for containment of type 2 polioviruses, a principal focus of the response was ensuring proper management and disposal of mOPV2 vaccine vials. Nearly all mOPV2 vaccine vials were successfully retrieved at the end of each round of vaccination activities. Unused vials were returned to national stockpiles, whereas partially used or empty vials were consolidated and destroyed at designated locations. Another crucial element of the response was the tailoring of social mobilization and communication strategies to foster positive perceptions of vaccines while dispelling misconceptions.

Discussion

A longstanding humanitarian crisis precipitated by war and political unrest has left much of Syria's population vulnerable to recurrent disease outbreaks (*10*). The 2017 cVDPV2 outbreak followed a WPV outbreak during 2013–2014 and occurred against the backdrop of declining routine vaccination coverage since the onset of the war (*8*) and the poor quality of tOPV SIAs implemented in conflict-affected areas such as Deir-ez-Zor before the 2016 global tOPV-to-bOPV switch.

Given VDPVs' propensity for emerging in settings of low OPV coverage, the worsening poliovirus type 2 immunity profile among children in Deir-ez-Zor governorate created

TABLE. Vaccination activities in response to an outbreak of circulating vaccine-derived poliovirus type 2 — Syria, 2017–2018

		Outbreak response phase 1				Outbreak response phase 2	
		Round 1		Round 2		Round 3	
Governorate/ Vaccine type	Target age group (mos)	Administrative coverage* (%)	PCM† (recall) (%)	Administrative coverage* (%)	PCM† (recall) (%)	Administrative coverage* (%)	PCM† (recall) (%)
Deir-ez-Zor							
mOPV2	<60	79	88	77	77	79	90
IPV	2–23	—	—	71	80	—	—
Raqqa							
mOPV2	<60	86	57	114	84	86	84
IPV	2–23	—	—	50	50	—	—
Hasakeh§							
mOPV2	<60	—	—	—	—	77	91
IPV	2–23	—	—	—	—	95	85

Abbreviations: IPV = inactivated poliovirus vaccine (contains types 1, 2, and 3); mOPV2 = monovalent oral poliovirus vaccine type 2; PCM = postcampaign monitoring.
* Administrative coverage was calculated using denominators for the target age group provided by official sources. These denominators might not have reflected the actual target population because of frequent population movement to and from the outbreak-affected area.
† Postcampaign monitoring is often considered a more accurate measure of vaccination coverage than administrative data and was estimated using cluster and market surveys administered by independent monitors to parents of children within the target age group.
§ Although no case was identified in Hasakeh governorate, it was included in response activities because of its geographic proximity to the outbreak-affected area.

the conditions for emergence and rapid spread of VDPV2 within the governorate. According to genomic sequence analysis, the viral strain responsible for the outbreak differed by 22 nucleotides from Sabin vaccine virus and was circulating for approximately a year before isolation of VDPV2 in the index case. The delay in detecting circulation of the virus could have contributed to the size and scope of the outbreak, one of the largest documented cVDPV2 outbreaks. Subnational gaps in AFP surveillance performance, as well as delays in receiving laboratory results because of difficulties transporting stool specimens, occasioned by the complex humanitarian emergency, contributed to the inability to detect the outbreak earlier.

Despite immense operational and security constraints, the response by the Syrian national polio eradication program to the outbreak appears to have been effective. Evidence indicates that institution of environmental sewage sampling to supplement intensified AFP surveillance activities and vaccination campaigns with mOPV2 successfully interrupted the transmission of cVDPV2 in Syria.

Summary

What is already known about this topic?

Oral poliovirus vaccine (OPV) contains live attenuated viruses, which rarely revert to neurovirulence. These vaccine-derived polioviruses (VDPVs) tend to emerge in populations with low OPV coverage and are capable of causing paralysis.

What is added by this report?

In 2017, an outbreak of circulating VDPV type 2 (cVDPV2) occurred in Syria, causing 74 cases. Implementation of three rounds of monovalent OPV type 2 campaigns coupled with intensified surveillance interrupted the outbreak.

What are the implications for public health practice?

The outbreak in Syria underscores the risk for emergence of vaccine-derived polioviruses in settings of low OPV coverage. High-quality surveillance and targeted vaccination using monovalent OPV type 2 are effective in controlling cVDPV2 outbreaks.

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Conflict of Interest

No conflicts of interest were reported.

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Erratum

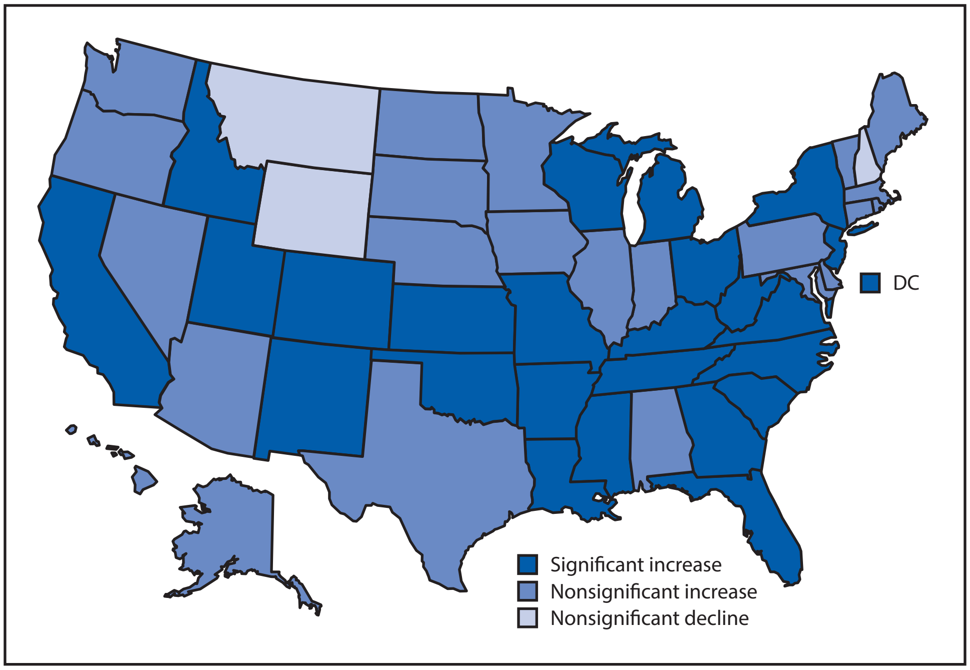
Vol. 67, No. 18

In the report "Access to Syringe Services Programs — Kentucky, North Carolina, and West Virginia, 2013–2017," on page 529, the second sentence should have read "**In combination with medication-assisted treatment**, syringe services programs (SSPs) providing sufficient access to safe injection equipment can reduce **the risk for hepatitis C acquisition by 74%** (*2*)."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Changes* in Late Preterm Birth Rates,† by State — National Vital Statistics System, United States, 2014 and 2016



* Increases and declines; significant at $p<0.05$.

† Late preterm birth rate is the number of births delivered at 34 to 36 completed weeks of gestation per 100 total births.

The late preterm birth (34 to 36 weeks of gestation) rate rose 4.0% in the United States, from 6.82% in 2014 to 7.09% in 2016. Increases in late preterm birth rates occurred in 24 states and the District of Columbia during 2014–2016. Increases in an additional 23 states were not statistically significant. Nonsignificant declines in late preterm births were observed in three states.

Source: National Vital Statistics System, Natality, 2014 and 2016. https://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_12.pdf and https://www.cdc.gov/nchs/data/nvsr/nvsr67/nvsr67_01.pdf.

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