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Great American Smokeout — November 21, 2019

The American Cancer Society's Great American Smokeout is an annual event that encourages smokers to make a plan to quit smoking (https://www.cancer.org/healthy/stay-away-from-tobacco/great-american-smokeout.html). The 44th annual Great American Smokeout will occur on November 21, 2019.

In the more than 50 years since the first Surgeon General's report on the health consequences of smoking, cigarette smoking among U.S. adults has declined by approximately two thirds (*1*). A report in this issue of *MMWR* documented that in 2018, 13.7% of U.S. adults were current cigarette smokers, which is the lowest prevalence recorded since monitoring began in 1965 (*2*). However, the report also found that 34.2 million adults still smoke cigarettes and that marked disparities in tobacco use persist across population groups (*2*).

Smoking remains the leading preventable cause of disease, disability, and death in the United States (*1*); however, smokers can and do quit smoking, and today there are more former smokers than current smokers (*1*,*2*). Among current U.S. adult smokers, nearly 70% want to quit smoking, and approximately half made a quit attempt in the past year (*2*,*3*). Using counseling and medications increases the chances of quitting (*3*). Support for quitting smoking is available at 800-QUIT-NOW (800-784-8669). CDC's Tips From Former Smokers campaign (https://www.cdc.gov/tips) and the National Cancer Institute's smokefree.gov (https://smokefree.gov) offer additional resources.

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Tobacco Product Use and Cessation Indicators Among Adults — United States, 2018

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Cigarette smoking is the leading cause of preventable disease and death in the United States (*1*). The prevalence of adult cigarette smoking has declined in recent years to 14.0% in 2017 (*2*). However, an array of new tobacco products, including e-cigarettes, has entered the U.S. market (*3*). To assess recent national estimates of tobacco product use among U.S. adults aged ≥18 years, CDC, the Food and Drug Administration (FDA), and the National Cancer Institute analyzed data from the 2018 National Health Interview Survey (NHIS). In 2018,

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an estimated 49.1 million U.S. adults (19.7%) reported currently using any tobacco product, including cigarettes (13.7%), cigars (3.9%), e-cigarettes (3.2%), smokeless tobacco (2.4%), and pipes* (1.0%). Most tobacco product users (83.8%) reported using combustible products (cigarettes, cigars, or pipes), and 18.8% reported using two or more tobacco products. The prevalence of any current tobacco product use was higher in males; adults aged ≤65 years; non-Hispanic American Indian/Alaska Natives; those with a General Educational Development certificate (GED); those with an annual household income <$35,000; lesbian, gay, or bisexual adults; uninsured adults; those with a disability or limitation; and those with serious psychological distress. The prevalence of e-cigarette and smokeless tobacco use increased during 2017–2018. During 2009–2018, there were significant increases in all three cigarette cessation indicators (quit attempts, recent cessation, and quit ratio). Implementing comprehensive population-based interventions in coordination with regulation of the manufacturing, marketing, and distribution of all tobacco products can reduce tobacco-related disease and death in the United States (*1*,*4*).

NHIS is an annual, nationally representative, household survey of the noninstitutionalized U.S. civilian population.† The 2018 NHIS Sample Adult component included 25,417 adults aged ≥18 years; the response rate was 53.1% (*5*). Data were weighted to provide nationally representative estimates, adjusting for differences in selection probability and nonresponse. Use of five tobacco products was assessed: cigarettes, cigars (cigars, cigarillos, or filtered little cigars), pipes (regular pipes, water pipes, or hookahs), e-cigarettes, and smokeless tobacco (chewing tobacco, snuff, dip, snus, or dissolvable tobacco). Current cigarette smokers reported having smoked ≥100 cigarettes during their lifetime and smoked every day or some days at the time of survey. Current users of all other tobacco products reported using these products every day or some days at the time of survey. Prevalence estimates for current use of any tobacco product, any combustible tobacco product, and ≥2 tobacco products§ were calculated. Estimates were calculated overall and separately by sex, age, race/ethnicity, U.S. Census region, education (for adults aged ≥25 years), marital status, annual household income, sexual orientation, health insurance coverage, disability, and presence of serious psychological distress. T-tests were performed to assess overall differences in tobacco product use from 2017 to 2018.¶ Daily and nondaily use of each product

*The use of regular pipe, water pipe, or hookah was assessed together using a single question.

† https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm.

§ Use of two or more of the following tobacco products: cigarettes (≥100 cigarettes during lifetime); cigars, cigarillos, or filtered little cigars; pipes, water pipes, or hookahs; electronic cigarettes; or smokeless tobacco products every day or on some days.

¶ NHIS 2017 data were incorporated to inform statistically significant differences ($p<0.05$) during 2017–2018 for the use of any tobacco product, any combustible tobacco product, ≥2 tobacco products, cigarettes, cigars, pipes, e-cigarettes, and smokeless tobacco. The 2017 Sample Adult component included 26,742 adults aged ≥18 years; the response rate was 53.0%.

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was assessed. Three cigarette smoking cessation indicators were assessed: past-year quit attempts,** recent successful cessation,†† and quit ratio.§§ Linear and nonlinear (quadratic) trends were assessed for each cigarette smoking cessation indicator during 2009–2018. Statistical significance was defined as p<0.05 for differences and trends. SAS-Callable SUDAAN software (version 11.0.3; Research Triangle Institute) was used to conduct all analyses; all analyses were weighted and accounted for the complex survey design.

Among U.S. adults in 2018, 19.7% (estimated 49.1 million) currently used any tobacco product, 16.5% (41.2 million; 83.8% of current tobacco users) used any combustible tobacco product, and 3.7% (9.3 million; 18.8% of current tobacco users) used ≥2 tobacco products (Table). Cigarettes were the most commonly used tobacco product (13.7%; 34.2 million). Prevalence estimates of use of the other tobacco products in 2018 were as follows: cigars (3.9%; 9.6 million); e-cigarettes (3.2%; 8.1 million); smokeless tobacco (2.4%; 5.9 million); and pipes (1.0%; 2.6 million). During 2017–2018, the prevalence of e-cigarette use increased from 2.8% to 3.2% (p = 0.029), and the prevalence of smokeless tobacco use increased from 2.1% to 2.4% (p = 0.047). No significant changes occurred in the use of the other tobacco products included in this study. Among current tobacco product users, daily use was reported by 74.6% of cigarette smokers, 59.1% of smokeless tobacco users, 42.6% of e-cigarette users, and 15.8% of cigar smokers (Figure 1).¶¶

The prevalence of any current tobacco product use was higher among males (25.8%) than among females (14.1%) and among persons aged 25–44 years (23.8%), 45–64 years (21.3%), and 18–24 years (17.1%) than among those aged ≥65 years (11.9%) (Table). Current tobacco product use was also higher among non-Hispanic American Indian/Alaska Native adults (32.3%), non-Hispanic multiracial adults (25.4%), non-Hispanic whites (21.9%), non-Hispanic blacks (19.3%), and Hispanic adults (13.8%) than among non-Hispanic Asian adults (10.0%), as well as among those who lived in the Midwest (23.6%) or the South U.S. Census regions (21.4%) than among those who lived in the West (15.3%) or the Northeast (17.5%). The prevalence of current tobacco product use was also higher among persons who had a GED (41.4%) than among those with other levels of education and among those who were divorced, separated, or widowed (22.6%) or single, never married, or not living with a partner (21.1%) than among those married or living with a partner (18.4%). Current tobacco product use was higher among persons with an annual household income <$35,000 (26.2%) than those in higher income groups, as well as among lesbian, gay, or bisexual adults (29.2%) than among those who were heterosexual (19.5%). Prevalence also was higher among adults who were uninsured (29.9%), insured by Medicaid (27.8%), or had some other public insurance (23.0%) than among those with private insurance (17.2%) or Medicare only (12.6%); among those who had a disability/limitation (24.3%); and those who had serious psychological distress (36.7%).

Significant linear increases occurred for all three cigarette cessation indicators. Among adult cigarette smokers, the prevalence of making a quit attempt in the past 12 months increased from 52.8% in 2009 to 55.1% in 2018 (p<0.001) (Figure 2). Recent successful smoking cessation increased from 6.3% in 2009 to 7.5% in 2018 (p<0.001). The quit ratio for cigarette smoking increased from 51.7% in 2009 to 61.7% in 2018 (p<0.001).

Discussion

The approximate two thirds decline in adult cigarette smoking prevalence that has occurred since 1965 represents a major public health success (*1*). In 2018, 13.7% of U.S. adults aged ≥18 years currently smoked cigarettes, the lowest prevalence recorded since 1965. However, no significant change in cigarette smoking prevalence occurred during 2017–2018. Most cigarette smokers and smokeless tobacco users reported daily use, whereas most e-cigarette and cigar users reported nondaily use. Even nondaily use of cigarettes has been linked to increased mortality risk (*6*).

Quitting smoking at any age is beneficial for health (*1*,*4*). During 2009–2018, significant linear increases occurred in quit attempts, recent successful cessation, and quit ratio. Population-based tobacco control interventions, including high-impact tobacco education campaigns like CDC's Tips From Former Smokers (https://www.cdc.gov/tobacco/campaign/tips/index.html) campaign and FDA's Every Try Counts campaign (https://www.fda.gov/tobacco-products/every-try-counts-campaign), combined with barrier-free access to evidence-based cessation treatments, can both motivate persons who use tobacco products to try to quit and help them succeed in quitting.

The prevalence of adult e-cigarette use increased from 2.8% in 2017 to 3.2% in 2018 but was much lower than the 20.8% (*7*) of U.S. high school students reporting past 30-day e-cigarette use in 2018. The prevalence of e-cigarette use

** Current cigarette smokers who reported they stopped smoking for >1 day during the past 12 months because they were trying to quit smoking and former smokers who quit during the past year.

†† Former cigarette smokers who quit smoking for ≥6 months during the past year, among current smokers who smoked for ≥2 years and former smokers who quit during the past year.

§§ The percentage of ever smokers (≥100 cigarettes during lifetime) who have quit smoking.

¶¶ Daily estimates of pipe use were statistically unstable (relative standard error>30%) and not presented.

TABLE. Percentage of persons aged ≥18 years who reported tobacco product use "every day" or "some days," by tobacco product and selected characteristics — National Health Interview Survey, United States, 2018

Demographic	% (95% CI)							
	Any tobacco product*	Any combustible product†	Cigarettes§	Cigars/ Cigarillos/ Filtered little cigars¶	Pipe/ Water pipe/ Hookah**	E-cigarettes††	Smokeless tobacco§§	≥2 Tobacco products¶¶
Overall	**19.7 (19.0–20.4)**	**16.5 (15.9–17.2)**	**13.7 (13.1–14.3)**	**3.9 (3.5–4.2)**	**1.0 (0.9–1.2)**	**3.2 (3.0–3.5)**	**2.4 (2.1–2.6)**	**3.7 (3.4–4.0)**
Sex								
Men	25.8 (24.7–26.9)	20.6 (19.6–21.5)	15.6 (14.8–16.5)	6.8 (6.2–7.4)	1.5 (1.3–1.8)	4.3 (3.8–4.8)	4.7 (4.2–5.1)	5.9 (5.3–6.4)
Women	14.1 (13.3–14.9)	12.8 (12.0–13.5)	12.0 (11.2–12.7)	1.1 (0.8–1.3)	0.6 (0.4–0.7)	2.3 (2.0–2.6)	—***	1.7 (1.5–2.0)
Age group (yrs)								
18–24	17.1 (14.8–19.3)	11.2 (9.3–13.1)	7.8 (6.2–9.4)	4.1 (2.9–5.3)	—	7.6 (6.1–9.1)	—	4.1 (3.0–5.2)
25–44	23.8 (22.5–25.0)	20.0 (18.9–21.2)	16.5 (15.4–17.6)	5.0 (4.4–5.6)	1.5 (1.1–1.8)	4.3 (3.7–4.8)	3.2 (2.7–3.6)	5.5 (4.9–6.1)
45–64	21.3 (20.2–22.4)	18.7 (17.6–19.7)	16.3 (15.3–17.3)	3.7 (3.2–4.2)	0.6 (0.4–0.8)	2.1 (1.8–2.5)	2.4 (2.0–2.8)	3.3 (2.8–3.7)
≥65	11.9 (11.0–12.8)	10.3 (9.5–11.1)	8.4 (7.7–9.2)	2.1 (1.7–2.5)	—	0.8 (0.6–1.1)	1.4 (1.0–1.7)	1.3 (1.0–1.6)
Race/Ethnicity†††								
White	21.9 (21.1–22.8)	17.9 (17.1–18.6)	15.0 (14.3–15.7)	4.1 (3.7–4.5)	1.0 (0.8–1.2)	3.7 (3.3–4.1)	3.3 (2.9–3.6)	4.2 (3.8–4.6)
Black	19.3 (17.3–21.3)	18.2 (16.3–20.1)	14.6 (12.8–16.3)	4.9 (3.8–5.9)	—	—	—	3.5 (2.7–4.3)
Asian	10.0 (8.0–12.0)	8.2 (6.3–10.0)	7.1 (5.2–8.9)	—	—	—	—	—
AI/AN	32.3 (19.1–45.5)	25.2 (14.4–35.9)	22.6 (12.0–33.3)	—	—	—	—	—
Hispanic	13.8 (12.2–15.4)	12.3 (10.8–13.8)	9.8 (8.4–11.2)	2.8 (2.0–3.5)	—	2.5 (1.8–3.3)	—	2.2 (1.4–3.0)
Multiracial	25.4 (19.8–30.9)	21.3 (16.2–26.3)	19.1 (14.3–24.0)	—	—	—	—	—
U.S. Census region§§§								
Northeast	17.5 (15.8–19.1)	15.7 (14.2–17.2)	12.5 (11.1–13.8)	4.5 (3.6–5.4)	–	2.2 (1.7–2.7)	1.3 (0.8–1.8)	3.4 (2.5–4.2)
Midwest	23.6 (22.0–25.1)	19.7 (18.3–21.1)	16.2 (15.0–17.5)	4.8 (3.9–5.6)	1.1 (0.7–1.4)	4.0 (3.3–4.6)	3.0 (2.4–3.5)	4.5 (3.8–5.2)
South	21.4 (20.1–22.7)	17.5 (16.4–18.7)	14.8 (13.7–15.9)	3.8 (3.3–4.3)	1.0 (0.7–1.2)	3.5 (3.1–4.0)	2.9 (2.5–3.4)	3.9 (3.4–4.4)
West	15.3 (13.9–16.6)	12.7 (11.5–13.8)	10.7 (9.6–11.8)	2.6 (2.2–3.1)	1.1 (0.7–1.5)	2.9 (2.2–3.5)	1.7 (1.3–2.1)	3.0 (2.4–3.6)
Education (adults aged ≥25 years)								
0–12 yrs (no diploma)	25.9 (23.7–28.0)	23.1 (21.1–25.1)	21.8 (19.9–23.8)	2.8 (2.1–3.5)	—	2.5 (1.8–3.3)	2.9 (2.0–3.8)	4.2 (3.4–5.1)
GED	41.4 (36.2–46.7)	38.6 (33.5–43.8)	36.0 (31.3–40.7)	—	—	—	—	9.7 (6.9–12.4)
High school diploma	25.2 (23.6–26.9)	21.7 (20.1–23.2)	19.7 (18.3–21.1)	4.0 (3.3–4.7)	—	2.7 (2.2–3.3)	3.6 (2.9–4.2)	4.9 (4.0–5.7)
Some college, no degree	24.7 (23.0–26.3)	21.2 (19.6–22.8)	18.3 (16.7–19.8)	4.4 (3.7–5.2)	—	4.1 (3.3–4.9)	2.8 (2.2–3.4)	5.0 (4.2–5.8)
Associate degree	21.3 (19.6–23.1)	18.0 (16.4–19.6)	14.8 (13.3–16.3)	4.3 (3.4–5.2)	—	3.0 (2.3–3.6)	3.1 (2.3–3.8)	3.9 (3.0–4.8)
Undergraduate degree	13.0 (11.8–14.1)	10.6 (9.6–11.6)	7.1 (6.2–7.9)	3.7 (3.1–4.4)	1.1 (0.7–1.4)	2.2 (1.7–2.6)	1.5 (1.1–1.9)	2.0 (1.6–2.5)
Graduate degree	8.2 (7.1–9.4)	7.0 (5.9–8.0)	3.7 (3.0–4.4)	3.1 (2.4–3.8)	—	—	—	—
Marital status								
Married/Living with partner	18.4 (17.5–19.2)	15.3 (14.5–16.1)	12.5 (11.7–13.2)	3.7 (3.3–4.1)	0.8 (0.7–1.0)	2.6 (2.2–2.9)	2.6 (2.3–3.0)	3.3 (2.9–3.7)
Divorced/ Separated/ Widowed	22.6 (21.2–24.0)	20.2 (19.0–21.4)	18.1 (16.9–19.4)	3.3 (2.7–3.8)	0.8 (0.5–1.1)	2.4 (2.0–2.9)	2.3 (1.8–2.8)	3.5 (3.0–4.0)
Single/Never married/Not living with a partner	21.1 (19.7–22.6)	17.2 (15.9–18.6)	13.9 (12.7–15.1)	4.8 (4.0–5.5)	1.7 (1.3–2.1)	5.5 (4.6–6.3)	1.7 (1.4–2.0)	4.9 (4.2–5.6)
Income (USD)¶¶¶								
<35,000	26.2 (24.8–27.6)	23.2 (22.0–24.5)	21.3 (20.0–22.5)	3.8 (3.3–4.3)	1.7 (1.3–2.1)	4.0 (3.4–4.5)	2.1 (1.7–2.6)	5.5 (4.8–6.1)
35,000–74,999	21.0 (19.8–22.3)	17.8 (16.7–19.0)	14.9 (13.8–16.0)	4.1 (3.5–4.7)	0.9 (0.7–1.2)	3.5 (2.9–4.0)	2.6 (2.1–3.1)	4.1 (3.6–4.7)
75,000–99,999	20.2 (18.5–21.9)	16.5 (15.0–18.1)	13.3 (11.8–14.8)	3.9 (3.1–4.6)	—	3.7 (2.8–4.6)	2.9 (2.2–3.6)	3.7 (2.8–4.5)
≥100,000	14.3 (13.1–15.5)	10.8 (9.8–11.8)	7.3 (6.5–8.2)	4.2 (3.5–4.8)	—	2.7 (2.2–3.3)	2.4 (1.9–2.9)	2.4 (1.9–2.8)
Sexual orientation								
Heterosexual/ Straight	19.5 (18.8–20.3)	16.3 (15.7–17.0)	13.5 (12.9–14.1)	3.8 (3.5–4.2)	1.0 (0.8–1.1)	3.1 (2.8–3.4)	2.5 (2.2–2.7)	3.6 (3.3–4.0)
Lesbian, gay, or bisexual	29.2 (24.7–33.7)	24.9 (20.7–29.1)	20.6 (16.7–24.5)	—	—	—	—	—

See table footnotes on the next page.

TABLE. (*Continued*) Percentage of persons aged ≥18 years who reported tobacco product use "every day" or "some days," by tobacco product and selected characteristics — National Health Interview Survey, United States, 2018

Demographic	% (95% CI)							
	Any tobacco product*	Any combustible product†	Cigarettes§	Cigars/ Cigarillos/ Filtered little cigars¶	Pipe/ Water pipe/ Hookah**	E-cigarettes††	Smokeless tobacco§§	≥2 Tobacco products¶¶
Health insurance coverage**								
Private insurance	17.2 (16.4–18.0)	13.7 (13.0–14.4)	10.5 (9.9–11.1)	3.9 (3.5–4.3)	0.9 (0.7–1.1)	3.0 (2.7–3.4)	2.5 (2.2–2.8)	3.1 (2.7–3.4)
Medicaid	27.8 (25.6–30.0)	25.3 (23.2–27.5)	23.9 (21.8–26.0)	3.8 (3.0–4.5)	—	4.2 (3.2–5.1)	—	5.5 (4.5–6.5)
Medicare only (≥65 yrs)	12.6 (11.0–14.1)	10.9 (9.5–12.4)	9.4 (8.1–10.8)	—	—	—	—	—
Other public insurance	23.0 (20.5–25.5)	20.4 (17.9–22.8)	17.4 (15.1–19.8)	4.2 (3.2–5.3)	—	3.3 (2.3–4.3)	—	4.7 (3.5–5.9)
Uninsured	29.9 (27.4–32.4)	26.4 (24.1–28.8)	23.9 (21.7–26.1)	5.1 (4.0–6.2)	—	5.0 (3.9–6.1)	2.8 (2.0–3.7)	7.1 (5.9–8.4)
Disability/Limitation†††								
Yes	24.3 (22.4–26.3)	20.9 (19.0–22.7)	19.2 (17.3–21.0)	3.6 (2.7–4.4)	—	3.6 (2.9–4.4)	2.9 (2.1–3.7)	4.9 (4.0–5.9)
No	19.3 (18.5–20.0)	16.1 (15.4–16.7)	13.1 (12.5–13.7)	3.9 (3.6–4.3)	1.0 (0.9–1.2)	3.2 (2.9–3.5)	2.3 (2.1–2.6)	3.6 (3.3–3.9)
Serious psychological distress§§§§								
Yes	36.7 (32.7–40.6)	33.0 (29.0–37.0)	31.6 (27.9–35.4)	—	—	6.2 (4.6–7.8)	—	8.4 (6.2–10.6)
No	19.1 (18.4–19.8)	15.9 (15.2–16.5)	13.0 (12.4–13.6)	3.8 (3.5–4.2)	1.0 (0.9–1.2)	3.1 (2.8–3.4)	2.4 (2.1–2.6)	3.5 (3.2–3.8)

Abbreviations: AI/AN = American Indian/Alaska Native; CI = confidence interval; GED = General Educational Development certificate.

* Any tobacco product use was defined as use "every day" or "some days" of at least one tobacco product (for cigarettes, users were defined as persons who reported use either "every day" or "some days" and had smoked ≥100 times during their lifetime).

† Any combustible tobacco product use was defined as use "every day" or "some days" of at least one combustible tobacco product: cigarettes; cigars, cigarillos, filtered little cigars; pipes, water pipes, or hookahs (for cigarettes, users were defined as persons who reported use either "every day" or "some days" and had smoked ≥100 times during their lifetime).

§ Current cigarette smokers were defined as persons who reported smoking ≥100 cigarettes during their lifetime and now smoked cigarettes "every day" or "some days."

¶ Reported smoking cigars, cigarillos, or little filtered cigars at least once during their lifetime and now smoked at least one of these products "every day" or "some days."

** Reported smoking tobacco in a regular pipe, water pipe, or hookahs at least once during their lifetime and now smoked at least one of these products "every day" or "some days."

†† Reported using electronic cigarettes at least once during their lifetime and now used e-cigarettes "every day" or "some days."

§§ Reported using chewing tobacco, snuff, dip, snus, or dissolvable tobacco at least once during their lifetime and now used at least one of these products "every day" or "some days."

¶¶ Multiple tobacco product use was defined as use either "every day" or "some days" for at least two or more of the following tobacco products: cigarettes (≥100 times during lifetime); cigars, cigarillos, or filtered little cigars; pipes, water pipes, or hookahs; electronic cigarettes; or smokeless tobacco products.

*** Dashes indicate prevalence estimates with a relative standard error >30% that are not presented.

††† Hispanic persons could be of any race. All other racial/ethnic groups were non-Hispanic.

§§§ *Northeast:* Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *Midwest:* Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *South:* Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; *West:* Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

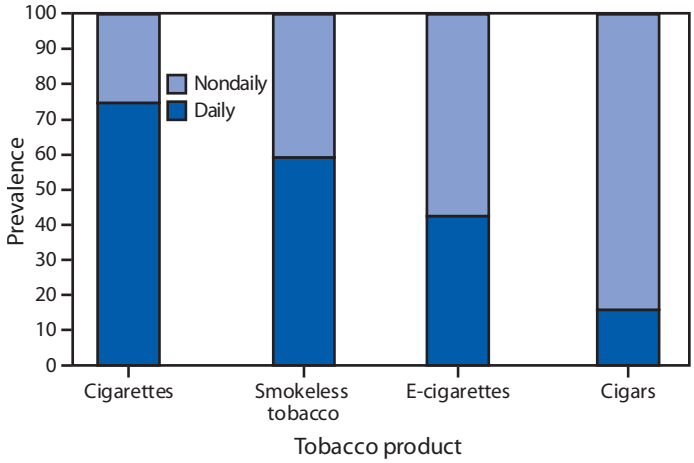
¶¶¶ Based on income variables from the family file (n = 8,310 missing valid income data). Imputed income files were not used in this analysis.

**** *Private coverage*: includes adults who have any comprehensive private insurance plan (including health maintenance organizations and preferred provider organizations). *Medicaid*: for adults aged <65 years, includes adults who do not have private coverage, but who have Medicaid or other state-sponsored health plans including Children's Health Insurance Program (CHIP); for adults aged ≥65 years, includes those who do not have any private coverage but have Medicare and Medicaid or other state-sponsored health plans including CHIP. *Medicare only*: includes adults aged ≥65 years who only have Medicare coverage. *Other coverage*: includes adults who do not have private insurance, Medicaid, or other public coverage, but who have any type of military coverage, coverage from other government programs, or Medicare. *Uninsured*: includes adults who have not indicated that they are covered at the time of the interview under private health insurance, Medicare, Medicaid, CHIP, a state-sponsored health plan, other government programs, or military coverage. Insurance coverage is "as of time of survey."

†††† Disability was defined based on self-reported presence of selected limitations including vision, hearing, mobility, remembering, self-care, and communication. Respondents who answered "A lot of difficulty" or "Cannot do at all/unable to do" to one of the following questions "Do you have difficulty seeing, even when wearing glasses?," "Do you have difficulty hearing, even when using a hearing aid?," "Do you have any difficulty walking or climbing steps?," "Using your usual language, do you have difficulty communicating, for example, understanding or being understood?," "Do you have difficulty remembering or concentrating?," "Do you have difficulty with self-care, such as washing all over or dressing?" to be coded as having a disability; those who responded "no difficulty" or "some difficulty" to all six questions were coded to not have a disability. These six questions are based on the short set of questions recommended by the Washington Group on Disability Statistics (https://www.cdc.gov/nchs/washington_group/index.htm).

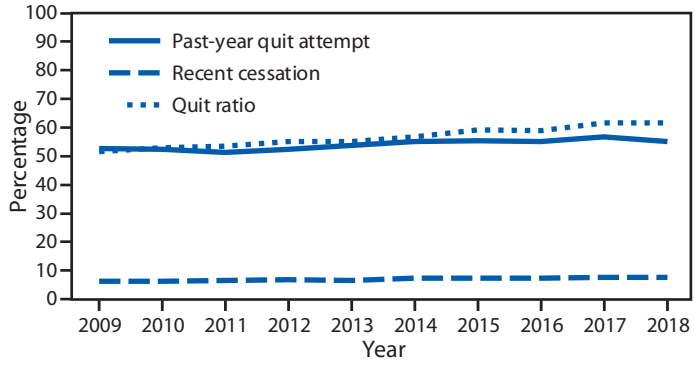
§§§§ The Kessler psychological distress scale is a series of six questions that ask about feelings of sadness, nervousness, restlessness, worthlessness, and feeling like everything is an effort in the past 30 days. Participants were asked to respond on a Likert scale ranging from "None of the time" (score = 0) to "All of the time" (score = 4). Responses were summed over the six questions; persons with a score of ≥13 were coded as having serious psychological distress, and respondents with a score <13 were coded as not having serious psychological distress.

FIGURE 1. Prevalence of daily* and nondaily† use of selected tobacco products§ among adults aged ≥18 years who currently use each tobacco product — National Health Interview Survey, United States, 2018



* Smoking cigarettes every day at the time of the survey among persons who reported having smoked ≥100 cigarettes during their lifetime or use of e-cigarettes, cigars, or smokeless tobacco every day at the time of survey.
† Smoking cigarettes on some days at the time of survey among persons who reported having smoked ≥100 cigarettes during their lifetime or use of e-cigarettes, cigars, or smokeless tobacco on some days at the time of survey.
§ Daily use estimates for pipe use were unstable (relative standard error >30%); neither daily use nor nondaily use is presented.

FIGURE 2. Prevalence of past-year quit attempts* and recent cessation† and quit ratio§ among cigarette smokers aged ≥18 years — National Health Interview Survey, United States, 2009–2018



* Percentage of current cigarette smokers who reported they stopped smoking for >1 day during the past 12 months because they were trying to quit smoking and former smokers who quit during the past year.
† Percentage of former cigarette smokers who quit smoking for ≥6 months during the past year, among current smokers who smoked for ≥2 years and former smokers who quit during the past year.
§ Percentage of persons who ever smoked (≥100 cigarettes during lifetime) who have quit smoking.

among persons aged 18–24 years is higher than that among other adult age groups, and e-cigarette use in this age group increased from 5.2% in 2017 (*2*) to 7.6% in 2018. During 2014–2017 there had been a downward trajectory of adult e-cigarette use (*2,8*), but during 2017–2018 a significant increase in adult e-cigarette use was detected for the first time. This increase might be related to the emergence of new types of e-cigarettes, especially "pod-mod" devices, which frequently use nicotine salts as opposed to the free-base nicotine used in other e-cigarettes and tobacco products. Sales of JUUL, a pod-mod device, increased by approximately 600% from 2016 to 2017, making it the dominant e-cigarette product in the United States by the end of 2017 (*9*). Further research is needed to monitor patterns of e-cigarette use and the relationship between use of e-cigarettes and other tobacco products (e.g., cigarette smoking).

The findings in this report are subject to at least three limitations. First, responses were self-reported and were not validated by biochemical testing. However, self-reported smoking status correlates highly with serum cotinine levels (*10*). Second, because NHIS is limited to the noninstitutionalized U.S. civilian population, the results are not generalizable to institutionalized populations and persons in the military. Finally, the NHIS Sample Adult response rate of 53.1% might have resulted in nonresponse bias.

Coordinated efforts at the local, state, and national levels are needed to continue progress toward reducing tobacco-related disease and death in the United States. Proven strategies include implementation of tobacco price increases, comprehensive smoke-free policies, high-impact antitobacco media campaigns, barrier-free cessation coverage, and comprehensive state tobacco control programs, combined with regulation of the manufacturing, marketing, and distribution of all tobacco products (*1,4*).

Summary

What is already known about this topic?

Cigarette smoking is the leading cause of preventable disease and death in the United States. Adult cigarette smoking prevalence has declined; however, new tobacco products, including e-cigarettes, have entered the U.S. market.

What is added by this report?

In 2018, approximately 20% of U.S. adults currently used any tobacco product; cigarette smoking reached an all-time low (13.7%). During 2009–2018, significant increases in three cigarette cessation indicators occurred. During 2017–2018, e-cigarette and smokeless tobacco product use prevalence increased.

What are the implications for public health practice?

Continued surveillance is critical to informing tobacco control efforts at the national, state, and local levels. Coordinated efforts and regulation of all tobacco products are needed to reduce tobacco-related disease and death in the United States.

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Disparities in Receipt of Eye Exams Among Medicare Part B Fee-for-Service Beneficiaries with Diabetes — United States, 2017

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Approximately 30 million persons in the United States have diabetes.* Persons with diabetes are at risk for vision loss from diabetic retinopathy and other eye diseases (*1*). Diabetic retinopathy, the most common diabetes-related eye disease, affects 29% of U.S. adults aged ≥40 years with diabetes (*2*) and is the leading cause of incident blindness among working-age adults (*1*). It is caused by chronically high blood glucose damaging blood vessels in the retina.† Annual dilated eye exams are recommended for persons with diabetes because early detection and timely treatment of diabetic eye diseases can prevent irreversible vision loss§,¶ (*3*,*4*). Studies have documented prevalence of annual eye exams among U.S. adults with diabetes (*5*,*6*); however, a lack of recent state-level data limits identification of geographic disparities in adherence to this recommendation. Medicare claims from the 50 states, the District of Columbia (DC), Puerto Rico, and U.S. Virgin Islands (USVI) were examined to assess the prevalence of eye exams in 2017 among beneficiaries with diabetes who were continuously enrolled in Part B fee-for-service insurance, which covers annual eye exams for beneficiaries with diabetes.** This report also examines disparities, by state and race/ethnicity, in receipt of eye exams. Nationally, 54.1% of beneficiaries with diabetes had an eye exam in 2017. Prevalence ranged from 43.9% in Puerto Rico to 64.8% in Rhode Island. Fewer than 50% of beneficiaries received an eye exam in seven states (Alabama, Alaska, Kentucky, Louisiana, Nevada, West Virginia, and Wyoming) and Puerto Rico. Non-Hispanic white (white) beneficiaries had a higher prevalence of receiving an eye exam (55.6%) than did non-Hispanic blacks (blacks) (48.9%) and Hispanics (48.2%). Barriers to receiving eye care (e.g., suboptimal clinical care coordination and referral, low health literacy, and lack of perceived need for care) might limit Medicare beneficiaries' ability to follow this preventive care recommendation. Understanding and addressing these barriers might prevent irreversible vision loss among persons with diabetes.

This analysis was performed using 100% of the Centers for Medicare & Medicaid Services research identifiable files but was restricted to claims for Medicare beneficiaries continuously enrolled in Part B fee-for-service for all of 2017.†† Part B covers outpatient services, including ophthalmologic services. This analysis includes Medicare beneficiaries aged ≥65 years, as well as those aged <65 years who qualify through disability or disease status, in the 50 U.S. states, DC, Puerto Rico, and USVI. Analyses were conducted using SAS Enterprise Guide (version 9.4; SAS Institute).

The outcome measure was the prevalence among Medicare Part B fee-for-service beneficiaries with diabetes of receiving an eye exam during January–December 2017. Beneficiaries received a diagnosis of diabetes if they had at least one diagnosis code (*International Classification of Diseases*, *Tenth Revision*) or procedure code (Current Procedural Terminology [CPT] and Healthcare Common Procedure Coding System) defined in the Chronic Conditions Data Warehouse diabetes algorithm on at least one claim during 2016–2017.§§ Prevalence was calculated as the number of continuously enrolled beneficiaries with diabetes who had an eye exam claim in 2017 divided by the number of continuously enrolled beneficiaries with diabetes in that year. Eye exams were defined using CPT codes 92002, 92004, 92014, and 92014 and other evaluation and management visit CPT codes if the provider taxonomy codes indicated an eye care provider.¶¶ Unadjusted percentages are presented nationally and by state and race/ethnicity (white, black, Hispanic, Asian/Pacific Islander, American Indian/Alaska Native, and other). Age-standardized estimates, using direct standardization, were similar, and these data are not presented. Statistical testing was not performed because these data represent 100% of Medicare beneficiaries who met the inclusion criteria.

Among the 30,238,300 continuously enrolled Medicare Part B fee-for-service beneficiaries in 2017, a total of 8,341,000 (28%) had a diabetes diagnosis. The majority (72.4%) of these beneficiaries with a diabetes diagnosis were aged 65–84 years, with fewer aged 40–64 years (14.6%) or ≥85 years (12.1%). Overall, 73.3% of these beneficiaries were white, 13.0% were black, 8.3% were Hispanic, 3.5% were Asian/Pacific Islander,

* https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf.
† https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/diabetic-retinopathy.
§ https://www.aao.org/eye-health/tips-prevention/top-five-diabetes-steps.
¶ http://aoa.uberflip.com/i/374890-evidence-based-clinical-practice-guideline-diabetes-mellitus.
** https://www.medicare.gov/coverage/eye-exams-for-diabetes.
†† https://www.cdc.gov/visionhealth/vehss/data/claims/medicare.html.
§§ https://www2.ccwdata.org/web/guest/condition-categories.
¶¶ http://www.norc.org/PDFs/VEHSS/VEHSSClaimsRegistryAnalysisPlan.pdf.

0.8% were American Indian/Alaska Native, and 1.0% were other racial/ethnic groups.

Nationally, 54.1% of beneficiaries with diabetes had an eye exam in 2017 (Table). The prevalence ranged from 43.9% in Puerto Rico to 64.8% in Rhode Island. In seven states (Alabama, Alaska, Kentucky, Louisiana, Nevada, West Virginia, and Wyoming) and Puerto Rico, <50% of beneficiaries with diabetes received an eye exam (Table) (Figure 1). In nine states (Connecticut, Delaware, Hawaii, Iowa, Maine, Massachusetts, Nebraska, North Dakota, and Rhode Island) ≥60% of beneficiaries with diabetes had an eye exam in 2017.

Nationally, the prevalence of having an eye exam was lower among Hispanic (48.2%) and black (48.9%) beneficiaries with diabetes than it was among whites (55.6%). This was also observed in 46 states and DC. Prevalence was higher among beneficiaries aged ≥85 years (58.6%) and 65–84 years (56.9%) than among those aged 40–64 years (38.0%) or 18–39 years (31.7%) (Figure 2).

Discussion

This report of recent state-level prevalence of receiving an eye exam among Medicare Part B fee-for-service beneficiaries with diabetes found that, although Medicare covers annual eye exams for beneficiaries with diabetes, only 54.1% of these beneficiaries received an eye exam in 2017. Among Hispanic and black beneficiaries and those in seven states, <50% of beneficiaries received an eye exam.

These findings are consistent with those from other studies. An analysis of the 2005–2008 National Health and Nutrition Examination Survey data found that 51.2% of adults aged ≥40 years with diabetes had an eye exam in the past year (*5*). A study of claims for U.S. patients aged 10–64 years with commercial or employer-sponsored health insurance found that among persons with diabetes and no diabetic retinopathy, 48.1% had not received an eye exam during the 5-year study period and 15.3% had an annual or biennial exam (*6*).

Dilated eye exams are an important preventive care practice for early detection of diabetic retinopathy. Seventy-three percent of persons with diabetic retinopathy are unaware of their disease (*7*). Early detection and timely treatment can prevent irreversible vision loss. The efficacy and cost-effectiveness of diabetic retinopathy screening among persons with diabetes is well established (*4*), and professional organizations recommend annual screening. The American Diabetes Association recommends that persons with diabetes have annual eye exams, with consideration of biennial exams if there is no evidence of retinopathy on at least one annual eye exam and blood glucose is controlled (*3*).

Studies have documented enablers and barriers to obtaining regular eye exams. A study using a small sample of Medicare beneficiaries aged ≥65 years found that 37% had an eye exam at least once every 15 months during a 5-year period (*8*). Factors associated with more frequent eye exams included older age, being married, higher educational attainment, and a higher score on the Charleson Comorbidity Index (which predicts mortality for a patient with a range of comorbid conditions) (*8*). Factors associated with lower frequency of eye exams included being male, living ≥20 miles from an ophthalmologist, low cognitive function, and limitations in instrumental activities of daily living (skills and abilities needed to perform certain day-to-day tasks associated with living independently). A study of adults with diabetes in 22 states found that the factors most commonly cited for not seeking annual eye care were not perceiving a need for care and cost or lack of insurance; other factors included a lack of transportation, distance to an eye doctor, and not having or knowing of an eye doctor (*9*). These findings highlight a lack of perception of the need for eye care and geographic and transportation barriers. Telemedicine might be a promising health care innovation to address geographic barriers in accessing eye care professionals for diabetic retinopathy screenings (*10*). Through following evidence-based recommendations and providing patient education, health care providers can play an important role in improving the rate of receipt of annual eye exams among persons with diabetes. In addition, optimizing systems for eye care referrals and reminders (e.g., clinical decision support tools in electronic health records) and improving care coordination between clinicians managing diabetes and those providing eye care might address barriers attributable to low patient awareness.

The findings in this report are subject to at least four limitations. First, some beneficiaries who had eye exams might be nonadherent with recommendations; claims provide insufficient detail to identify dilated eye exams. Second, patients might have multiple insurers, and services reimbursed by a supplemental plan would not be recorded in Medicare claims, thereby underestimating eye exam prevalence. Third, Medicare data do not include care provided by the Indian Health Service; therefore, the data presented are likely not representative of the American Indian/Alaska Native population. Finally, this analysis excluded the 33.9% of Medicare beneficiaries enrolled in Medicare managed care plans.***

Although annual eye exams are covered for all Medicare Part B fee-for-service beneficiaries with diabetes, only approximately half of these beneficiaries received an eye exam in 2017. Geographic and racial/ethnic disparities in adherence to this preventive care practice were identified. This low prevalence of receipt of annual eye exams could have significant implications

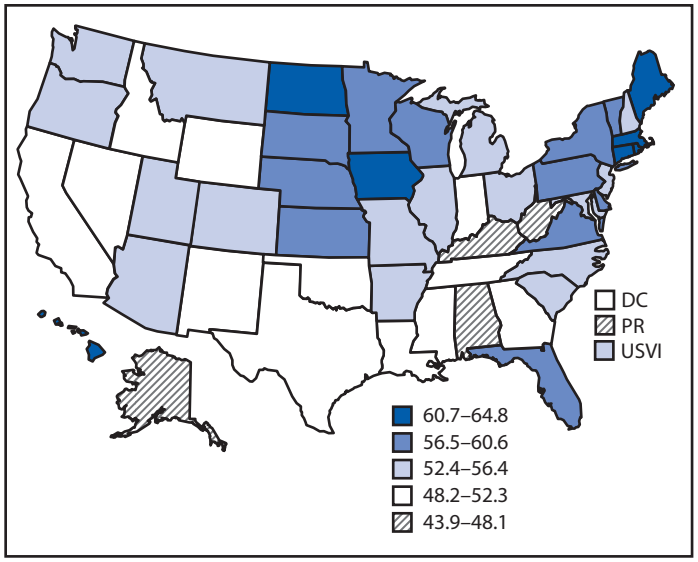
*** https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/CMSProgramStatistics/2017/Downloads/MDCR_ENROLL_AB/2017_CPS_MDCR_ENROLL_AB_1.pdf.

TABLE. Percentage of Medicare Part B fee-for-service beneficiaries with diagnosed diabetes who had an eye exam in 2017, by state and race/ethnicity* — Medicare Part B fee-for-service claims data, 2017

State	No.	Racial/Ethnic group, %						
		All	White	Black	Hispanic	Asian/ Pacific Islander	American Indian/ Alaska Native	Other
Alabama	159,300	**47.1**	48.5	43.0	41.2	49.8	54.0	48.3
Alaska	15,500	**47.5**	47.8	50.2	45.0	46.2	46.3	47.3
Arizona	137,000	**55.6**	56.9	49.3	48.6	56.0	56.2	58.3
Arkansas	103,200	**52.4**	53.4	47.2	46.0	51.8	52.2	52.2
California	707,600	**51.5**	52.8	44.6	47.1	56.8	45.5	54.8
Colorado	77,000	**52.5**	54.5	47.5	44.2	53.0	48.9	54.1
Connecticut	93,400	**62.3**	63.9	57.6	54.6	59.9	58.9	59.6
Delaware	42,800	**60.4**	61.2	58.2	55.4	61.2	58.3	65.5
District of Columbia	16,100	**51.6**	56.7	50.7	49.9	56.6	—†	55.7
Florida	569,900	**56.6**	58.5	50.2	49.3	54.9	53.0	58.9
Georgia	238,600	**50.4**	52.1	46.4	43.2	50.3	35.2	54.8
Hawaii	27,100	**63.1**	58.8	50.2	57.2	65.1	54.2	64.2
Idaho	38,900	**51.7**	52.3	40.0	45.7	50.4	44.7	52.6
Illinois	356,500	**54.2**	55.4	49.5	49.9	58.7	45.0	58.2
Indiana	207,200	**51.6**	52.4	45.3	44.3	53.1	50.4	54.6
Iowa	101,200	**64.7**	65.3	53.9	53.8	55.5	45.1	69.1
Kansas	92,000	**59.3**	60.5	50.8	48.8	56.9	49.1	61.5
Kentucky	156,400	**47.7**	47.6	48.9	44.0	52.0	42.3	51.9
Louisiana	136,000	**49.2**	49.9	47.8	47.9	45.5	44.8	52.4
Maine	44,000	**60.7**	60.8	51.2	61.7	59.9	50.9	59.2
Maryland	205,800	**53.4**	55.4	49.6	50.6	56.0	43.0	56.5
Massachusetts	183,400	**64.4**	65.2	61.5	60.2	60.8	55.8	65.1
Michigan	303,000	**53.3**	54.9	46.6	49.5	55.2	46.0	54.9
Minnesota	66,300	**58.1**	59.5	47.9	52.0	49.4	53.4	51.2
Mississippi	127,300	**50.3**	51.8	47.7	47.4	44.0	51.0	53.2
Missouri	175,500	**53.4**	54.1	48.4	50.0	53.1	39.7	52.3
Montana	27,500	**54.9**	56.2	47.3	47.1	58.0	43.0	55.1
Nebraska	55,700	**60.1**	61.2	52.4	48.7	56.0	38.8	57.7
Nevada	62,500	**48.8**	50.1	43.4	44.3	50.8	51.6	53.9
New Hampshire	45,200	**55.6**	55.7	55.0	50.2	55.8	50.0	54.4
New Jersey	305,000	**53.9**	55.7	48.0	47.2	55.8	42.8	57.3
New Mexico	53,600	**50.9**	52.8	49.4	45.2	58.4	60.3	50.9
New York	513,800	**58.5**	59.9	54.7	52.5	59.2	50.4	59.5
North Carolina	314,400	**54.4**	55.9	51.0	50.0	52.8	45.7	55.3
North Dakota	20,000	**64.3**	65.3	52.5	53.5	60.0	53.1	66.7
Ohio	303,100	**52.7**	53.1	49.3	47.9	57.3	38.5	57.2
Oklahoma	136,900	**50.9**	50.8	47.7	43.2	49.2	55.5	54.2
Oregon	74,500	**54.2**	54.5	55.8	50.0	55.1	50.5	59.2
Pennsylvania	320,100	**57.1**	58.5	47.9	47.3	53.6	40.8	57.8
Rhode Island	21,400	**64.8**	65.9	59.5	53.9	59.8	56.4	64.7
South Carolina	173,900	**53.5**	55.2	49.0	48.2	54.2	43.2	55.8
South Dakota	24,700	**58.3**	60.1	43.6	50.2	56.6	43.1	67.0
Tennessee	190,400	**50.5**	51.5	45.2	46.3	46.3	44.2	49.3
Texas	582,200	**51.1**	53.6	45.2	47.5	51.9	54.2	55.1
Utah	44,400	**53.7**	54.7	46.7	44.9	47.7	45.4	50.9
Vermont	21,300	**57.3**	57.4	44.0	54.0	53.5	64.3	60.3
Virginia	260,600	**56.9**	58.3	53.2	50.0	55.9	46.9	61.3
Washington	156,000	**54.9**	55.8	49.0	48.6	54.5	45.5	57.5
West Virginia	79,100	**46.2**	46.2	45.2	42.8	51.8	44.4	47.3
Wisconsin	126,400	**58.0**	59.1	47.9	50.0	49.5	53.9	59.4
Wyoming	16,700	**49.7**	50.6	46.4	46.4	44.6	29.3	48.8
Puerto Rico	25,200	**43.9**	49.5	—†	43.9	—†	—†	—†
U.S. Virgin Islands	5,500	**54.9**	49.0	56.6	44.6	56.4	—†	52.9
Total	**8,341,000**	**54.1**	**55.6**	**48.9**	**48.2**	**56.3**	**51.9**	**57.2**

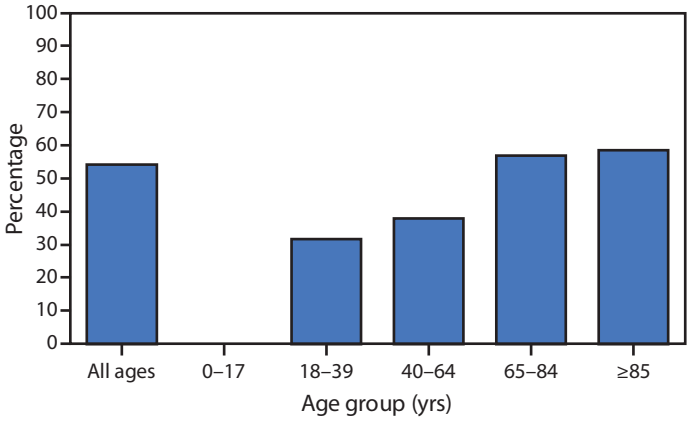
* Whites, blacks, Asian/Pacific Islanders, American Indians/Alaska Natives, and Others were non-Hispanic; Hispanic persons could be of any race.
† Data were suppressed because of small sample size, defined as either 1) a denominator <11 or 2) a numerator <3 and denominator <30.

FIGURE 1. Percentage of Medicare Part B fee-for-service beneficiaries with diabetes who had an eye exam, by state — United States, 2017



Abbreviations: DC = District of Columbia; PR = Puerto Rico; USVI = U.S. Virgin Islands.

FIGURE 2. Percentage of Medicare Part B fee-for-service beneficiaries with diabetes who had an eye exam, by age group* — United States, 2017



* Data for beneficiaries aged 0–17 years were suppressed because of small sample size (≤100).

for vision loss from diabetes-related eye diseases. CDC's Vision and Eye Health Surveillance System, which provides data on U.S. vision and eye health conditions and use of eye care, is an important tool to identify trends and assess eye health disparities among persons with diabetes.[†††] These data can be used to inform strategies and interventions to prevent vision loss among Medicare beneficiaries with diabetes.

[†††] https://www.cdc.gov/visionhealth/vehss/index.html.

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David Rein, PhD, National Opinion Research Center, University of Chicago, Illinois.

Summary

What is already known about this topic?

Annual eye exams are an important preventive care practice for persons with diabetes. Early detection and treatment of diabetic retinopathy and other eye diseases can prevent irreversible vision loss.

What is added by this report?

Nationally, 54.1% of Medicare Part B fee-for-service beneficiaries with diabetes had an eye exam in 2017. Disparities by state and race/ethnicity were identified.

What are the implications for public health practice?

Although Medicare covers annual eye exams for beneficiaries with diabetes, the prevalence of receipt of exams is low. Interventions are needed to improve adherence to annual eye exams to prevent irreversible vision loss among persons with diabetes.

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Update on Vaccine-Derived Poliovirus Outbreaks — Worldwide, January 2018–June 2019

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Certification of global eradication of indigenous wild poliovirus type 2 occurred in 2015 and of type 3 in 2019. Since the launch of the Global Polio Eradication Initiative (GPEI) in 1988 and broad use of live, attenuated oral poliovirus vaccine (OPV), the number of wild poliovirus cases has declined >99.99% (*1*). Genetically divergent vaccine-derived poliovirus* (VDPV) strains can emerge during vaccine use and spread in underimmunized populations, becoming circulating VDPV (cVDPV) strains, and resulting in outbreaks of paralytic poliomyelitis.† In April 2016, all oral polio vaccination switched from trivalent OPV (tOPV; containing vaccine virus types 1, 2, and 3) to bivalent OPV (bOPV; containing types 1 and 3) (*2*). Monovalent type 2 OPV (mOPV2) is used in response campaigns to control type 2 cVDPV (cVDPV2) outbreaks. This report presents data on cVDPV outbreaks detected during January 2018–June 2019 (as of September 30, 2019). Compared with January 2017–June 2018 (*3*), the number of reported cVDPV outbreaks more than tripled, from nine to 29; 25 (86%) of the outbreaks were caused by cVDPV2. The increase in the number of outbreaks in 2019 resulted from VDPV2 both inside and outside of mOPV2 response areas. GPEI is planning future use of a novel type 2 OPV, stabilized to decrease the likelihood of reversion to neurovirulence. However, all countries must maintain high population immunity to decrease the risk for cVDPV emergence. Cessation of all OPV use after certification of polio eradication will eliminate the risk for VDPV emergence.

Detection of cVDPV1

During January 2018–June 2019, cVDPV type 1 (cVDPV1) circulation was detected in three countries (Indonesia, Myanmar, and Papua New Guinea), compared with one country (Papua New Guinea) during the previous reporting period (*3*). cVDPV1 isolates from acute flaccid paralysis (AFP) cases and environmental surveillance (testing of sewage samples for poliovirus) continued to be detected from the previously reported Papua New Guinea outbreak (*4*) (Table); the AFP patient with the latest case had paralysis onset in October 2018. A new cVDPV1 outbreak was reported in Myanmar; the first patient had paralysis onset in May 2019, and the most recent case occurred in August 2019. A new cVDPV1 outbreak of one case was reported in Indonesia with paralysis onset in November 2018.

Detection of cVDPV2

During January 2018–June 2019, 25 cVDPV2 outbreaks were reported in 13 countries (Table). Twelve of the 13 countries were in Africa (Figure 1), and one outbreak occurred in China. During the reporting period, 124 (77%) of the 161 cVDPV cases were cVDPV2, a profile continuing the trend of type 2 dominance that has been observed for the past decade (Figure 2).

Western Africa. A single cVDPV2 emergence (designated JIS-1§) first detected by environmental surveillance in Jigawa State (Nigeria) in January 2018 was later detected in 12 other states in Nigeria and internationally throughout the reporting period. During the first half of 2019, isolates genetically linked to JIS-1 were detected from AFP cases and environmental surveillance samples initially in Niger, and subsequently in Benin, Cameroon, and Ghana (*5*). Five other independent cVDPV2 emergences were detected in Nigeria: two in Kogi State (KGS-1 and KGS-2) and three in Sokoto (SOS-3, SOS-4, and SOS-5) and Niger (SOS-3) states. During the reporting period, multiple mOPV2 outbreak response activities were conducted in Nigeria (*5*) and in neighboring countries where JIS-1 cVDPV2 was detected.

Central Africa. During the reporting period, nine cVDPV2 emergences were detected among 42 AFP cases in five provinces in the Democratic Republic of the Congo (DRC); six of these emergences were detected during the first half of 2019. The previously reported cVDPV2 emergences first detected in Haut Lomami (HLO-1) and Mongala (MON-1) provinces (*6*) and a new 2018 emergence in Haut Katanga (HKA-1) were apparently interrupted (as of September 30, it has been 11–15 months since the latest detection). During January–June 2019, three additional independent cVDPV2 emergences were detected in Kasai (KAS-1–KAS-3) province, and three

* Vaccine-derived poliovirus strains are >1% divergent (for poliovirus types 1 and 3) or >0.6% divergent (for poliovirus type 2) in VP1 sequences from the corresponding OPV strain.

† GPEI guidelines for classification and reporting of vaccine-derived polioviruses. http://polioeradication.org/wp-content/uploads/2016/09/Reporting-and-Classification-of-VDPVs_Aug2016_EN.pdf.

§ Names designate the location of the emergence and the number of emergences in a geographic region; names have been shortened to exclude the country code.

TABLE. Number of circulating vaccine-derived poliovirus (cVDPV) isolates detected, by serotype, source, and other selected characteristics — worldwide, January 2018–June 2019

Country	Year(s) detected*	Emergence designation†	Serotype	No. of isolatesfrom AFP cases	No. of isolates from other human sources (non-AFP)§	No. of isolates from environmental (sewage) surveillance	Capsid protein VP1 divergence from Sabin OPV strain¶ (%)	2018 estimated national bOPV-3 coverage (%)**	Date of latest outbreak case, healthy child sample, or environmental sample
Angola	2019	HUI-1	2	2	12	0	0.7–1.2	56	Aug 13, 2019
Angola	2019	LNO-1	2	1	1	0	0.8–1.1	56	May 14, 2019
Angola	2019	LNO-2	2	1	0	0	1.1	56	Jul 29, 2019
Benin	2019	JIS-1	2	1	0	0	3.2	75	Jul 11, 2019
Cameroon	2019	JIS-1	2	0	0	1	2.8	78	Apr 20, 2019
CAR	2019	BAM-1	2	2	9	0	1.1–1.3	47	Jun 23, 2019
CAR	2019	BAM-2	2	0	3	0	0.7	47	May 27, 2019
CAR	2019	BIM-1	2	2	1	0	1.0–1.2	47	Jun 29, 2019
CAR	2019	BIM-2	2	0	13	0	1.0–2.0	47	Jun 28, 2019
China	2018–2019	XIN-1	2	1	2	1	1.4–3.7	99	Jun 27, 2019
DRC	2017–2018	HLO-1	2	7	3	0	2.2–3.2	79	Jun 8, 2018
DRC	2018	MON-1	2	11	10	0	2.0–2.9	79	Oct 29, 2018
DRC	2018	HKA-1	2	2	0	0	0.8–0.9	79	Oct 18, 2018
DRC	2019	HLO-2	2	7	1	0	0.9–1.3	79	Sept 9, 2019
DRC	2019	KAS-1	2	1	2	0	0.7–0.8	79	Mar 17, 2019
DRC	2019	KAS-2	2	4	1	0	0.7–1.2	79	Jun 22, 2019
DRC	2019	KAS-3	2	3	0	0	0.9–1.3	79	Jul 13, 2019
DRC	2019	SAN-1	2	6	2	0	0.7–1.4	79	Aug 30, 2019
DRC	2019	TPA-1	2	1	1	0	0.8	79	Aug 14, 2019
Ethiopia	2019	BAN-1	2	1	4	0	5.6	67	Aug 1, 2019
Ghana	2019	JIS-1	2	0	0	1	3.0	98	Sep 3, 2019
Indonesia	2018	PAP-1	1	1	2	0	6.4–6.6	80	Feb 13, 2019
Kenya	2018	BAN-1	2	0	0	2	5.0–5.2	81	Mar 21, 2018
Mozambique	2018	ZAM-2	2	1	2	0	0.7–1.1	80	Dec 17, 2018
Myanmar	2019	KAY-1	1	3	2	0	2.7–3.4	91	Aug 9, 2019
Nigeria	2018–2019	JIS-1	2	45	61	80	1.4–3.7	57	Aug 27, 2019
Nigeria	2019	KGS-1	2	1	0	0	0.9	57	Jul 22, 2019
Nigeria	2019	KGS-2	2	1	0	0	1.1	57	Aug 17, 2019
Nigeria	2018–2019	SOS-3	2	1	0	17	0.7–1.6	57	Mar 24, 2019
Nigeria	2019	SOS-4	2	0	0	3	1.8–2.2	57	Jun 10, 2019
Nigeria	2019	SOS-5	2	1	1	0	1.6–1.7	57	Jun 20, 2019
Niger	2018–2109	JIS-1	2	11	11	0	2.2–2.9	79	Apr 18, 2019
PNG	2018	MOR-1	1	26	8	7	1.4–2.7	67	Nov 4, 2018
Somalia	2017–2019	BAN-1	2	10	1	24	4.2–6.1	47	May 25, 2019
Somalia	2018	BAN-2	3	7	5	12	1.6–2.5	47	Sep 7, 2018
Total cVDPVs	—	—	—	**161**	**158**	**148**	—	—	—

Abbreviations: AFP = acute flaccid paralysis; bOPV = bivalent oral poliovirus vaccine; CAR = Central African Republic; DRC = Democratic Republic of the Congo; PNG = Papua New Guinea.

* Total years detected for previously reported cVDPV outbreaks (Democratic Republic of the Congo, Kenya, Nigeria, Papua New Guinea, and Somalia).

† Outbreaks list total cases clearly associated with cVDPVs. Emergences indicate independent cVDPV outbreaks and designate the location of the emergence and the number of emergences in a geographic region.

§ Contacts and healthy child sampling.

¶ Percentage of divergence is estimated from the number of nucleotide differences in the VP1 region from the corresponding parental OPV strain.

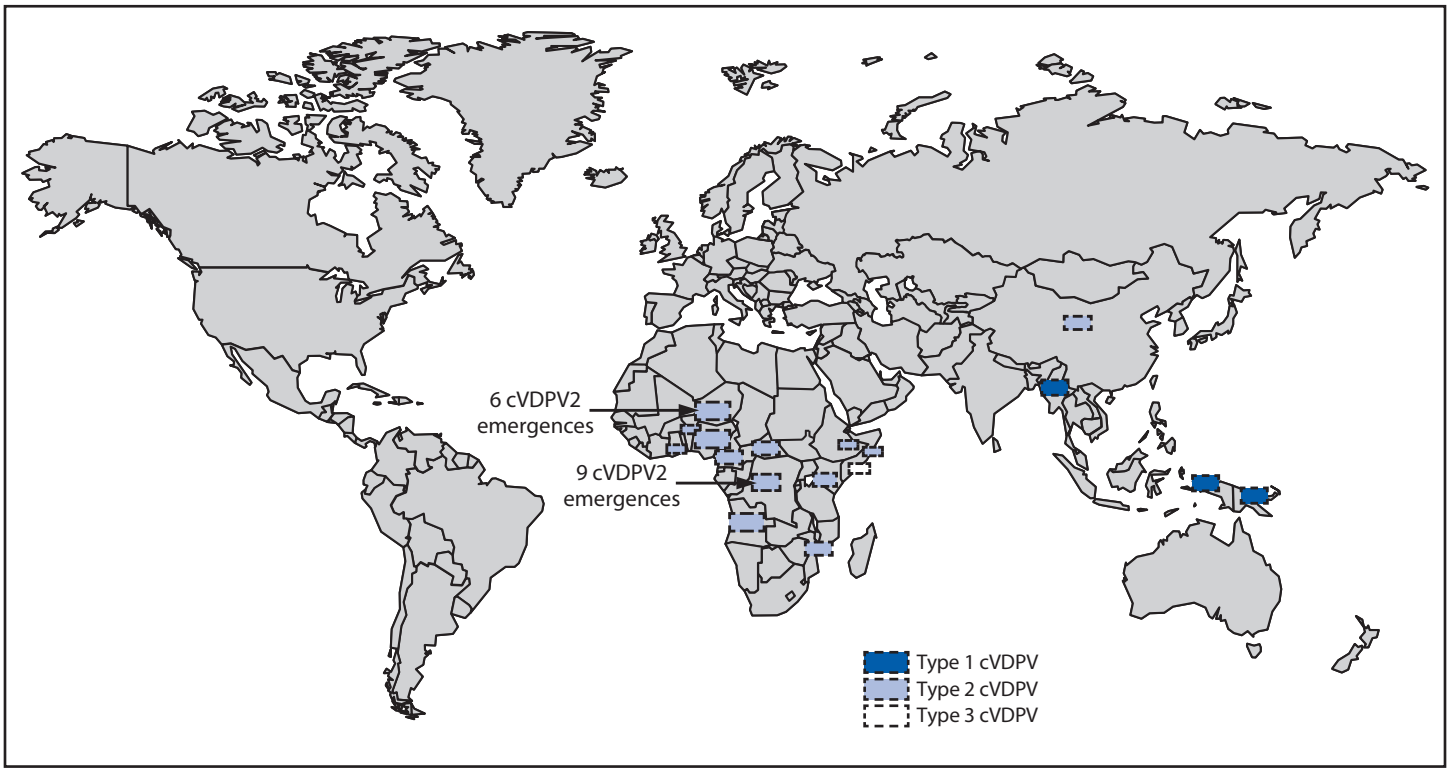
** Coverage with 3 doses of OPV, based on 2018 data from the World Health Organization (WHO) Vaccine Preventable Diseases Monitoring System (2018 global summary) and WHO-United Nations Children's Fund coverage estimates, https://www.who.int/gho/immunization/poliomyelitis/en/. National data might not reflect weaknesses at subnational levels.

new cVDPV2 emergences were detected in Haut Lomami (HLO-2), Tshuapa (TPA-1), and Sankuru (SAN-1) provinces.

During the reporting period, four new cVDPV2 emergences were detected in southern districts of Central African Republic (CAR); two were first reported in Bimbo District (BIM-1 and BIM-2) and two were first reported in Bambari District (BAM-1 and BAM-2). As of September 30, six AFP cases were associated with these four cVDPV2 emergences; the first patient had paralysis onset in May 2019. Estimated OPV coverage in CAR both before and after the tOPV-to-bOPV switch has been chronically low (<50%).

Three new cVDPV2 emergences were detected in Angola; two were first detected in Lunda Norte Province (LNO-1 and LNO-2), and one was first detected in Huila (HUI-1) Province. The first cVDPV2 isolate was detected in Lunda Norte from a patient with AFP who had paralysis onset in April 2019.

FIGURE 1. Circulating vaccine-derived poliovirus (cVDPV) outbreaks* — worldwide, January 2018–June 2019



Abbreviations: cVDPV2 = circulating type 2 VDPV.
* All of the cVDPV outbreaks were confirmed by genetic sequence data and evolutionary analyses.

cVDPV2 isolates genetically related to these Angola emergences were later detected from AFP cases in Lunda Sul and Huambo provinces.

Horn of Africa. During January 2018–June 2019, cVDPV2 genetically related to the emergence first detected in Somalia in October 2017 (BAN-1) (*6*) was isolated from 10 patients with AFP in Somalia and one in Ethiopia, and from 26 environmental surveillance samples (24 collected in Mogadishu, Somalia, and two in Nairobi, Kenya). BAN-1 cases were detected in provinces in South-Central and Puntland zones of Somalia (Banadeer, Bari, Gedo, Hiran, Lower Juba, Sool, and Togdheer) and in the Somali region of Ethiopia.

Southern Africa. During October–December 2018, cVDPV2 was isolated from one AFP patient and two contacts in the Molumbo District of Zambezia Province (Mozambique).

China. cVDPV2 was isolated from one environmental surveillance sample collected in Xinjiang province in April 2018 and from one AFP patient and two patient contacts in Sichuan province during May–June 2019. The cVDPV2 sequences from this emergence were 1.4%–3.7% divergent from parental Sabin 2, indicating prolonged circulation.

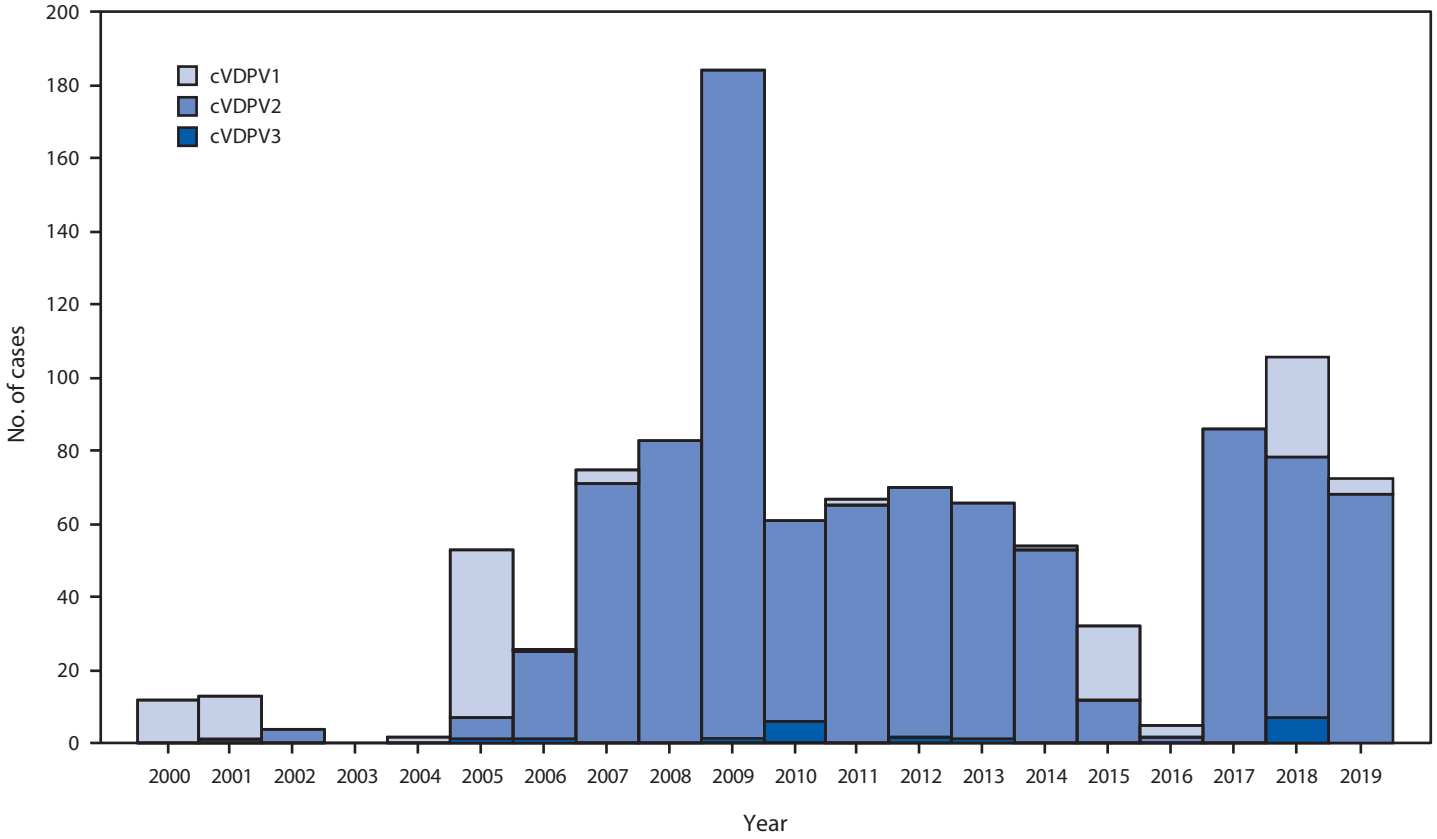
Detection of cVDPV3

During 2018, cVDPV3 was isolated from seven patients with AFP (one was coinfected with cVDPV2) and 12 environmental surveillance samples collected in four provinces of Somalia (BAN-2) (Table). The latest patient with AFP had onset of paralysis on September 7, 2018 (*6*).

Discussion

The number of cVDPV outbreaks detected worldwide increased from nine in six countries during the January 2017–June 2018 reporting period (*3*) to 29 in 15 countries during January 2018–June 2019; 25 (86%) outbreaks were cVDPV2 emergences, 18 (72%) of which were detected during the first half of 2019 in Central and Western Africa. cVDPV2 cases primarily occurred in type 2-naïve children who were born after the switch from tOPV to bOPV and who were therefore at high risk because they were born in areas with chronically low routine and supplementary polio immunization coverage. Seven new cVDPV2 outbreaks were detected in Angola and CAR, countries with no mOPV2 use after the withdrawal of type 2 OPV, but which border DRC, where mOPV2 was used in outbreak responses. Similarly, new cVDPV emergences have

FIGURE 2. Number of circulating vaccine-derived poliovirus (cVDPV) cases detected, by serotype — worldwide, 2000–2019*



Abbreviations: cVDPV1 = circulating type 1 VDPV; cVDPV2 = circulating type 2 VDPV; cVDPV3 = circulating type 3 VDPV.
* Number of cases detected and reported as of September 10, 2019.

occurred in areas of countries that were not part of the mOPV2 response areas (Angola, DRC, and Nigeria). This reflects the increasing susceptibility to type 2 infection and cVDPV2 outbreaks because >3 years have passed since OPV2 cessation. International cVDPV2 spread of JIS-1 from Nigeria to Benin, Cameroon, Ghana, and Niger, and of BAN-1 from Somalia to Ethiopia suggests that multiple mOPV2 responses after detection in each of the countries were of insufficient quality, delayed, or too limited in scope to prevent further spread that, in some cases, led to international transmission.

cVDPV1 and cVDPV3 outbreaks can emerge in countries with suboptimal routine and supplementary immunization coverage; at the subnational level, areas with very wide gaps in immunity carry a higher risk for VDPV emergence and circulation. bOPV campaigns in response to cVDPV1 and cVDPV3 emergences effectively controlled outbreaks in Papua New Guinea (cVDPV1) and Somalia (cVDPV3). cVDPV2 outbreak control requires the use of mOPV2, the release of which depends on the decision of the Director-General of the World Health Organization with the advice from the mOPV2 Advisory Group. Early cVDPV2 detection and timeliness of response are key in addressing circulating VDPV2s; a geographically limited scale mOPV2 campaign should be conducted within 14 days after laboratory cVDPV2 confirmation before larger scale rounds are implemented.

Since April 2016, approximately 300 million mOPV2 doses have been administered in response to cVDPV2 outbreaks (*7*). Although the effective means to stop cVDPV2 outbreaks is mOPV2, the risks associated with its use include seeding of new VDPV2 emergences with the potential for further circulation. The increase in the frequency of new emergences of cVDPV2 outbreaks outside of mOPV2 response areas has led to enhanced surveillance activities and scaling the geographic distribution of mOPV2 campaigns to 1–4 million persons aged <5 years. GPEI partners are providing a surge in technical assistance staffing to outbreak countries to improve the timeliness and quality of mOPV2 responses to aid in more rapid control of outbreaks and limit new emergences. A novel OPV type 2 vaccine, stabilized to decrease the likelihood of reversion to neurovirulence during replication, is in clinical trials (*8*) and, if found to be safe and effective, could be available in limited supply for emergency use as early as mid-2020, and in larger

Summary

What is already known about this topic?

Circulating vaccine-derived polioviruses (cVDPVs) can emerge in settings with low population immunity and cause paralysis.

What is added by this report?

Following the synchronized switch from trivalent oral poliovirus vaccine (tOPV, types 1, 2, and 3) to bivalent oral poliovirus vaccine (bOPV, types 1 and 3 only) in 2016, transmission of type 2 cVDPVs was detected in 12 countries in Africa and also in China. Type 1 cVDPVs were identified in Indonesia, Myanmar, and Papua New Guinea, and type 3 cVDPVs were identified in Somalia.

What are the implications for public health practice?

All countries must maintain high population immunity. Cessation of all OPV use after certification of polio eradication will eliminate the risk for VDPV emergence.

supply at a later date. Expansion of environmental surveillance provides critical indicators for early VDPV detection (*9*); for example, environmental surveillance detection in Cameroon and Ghana in 2019 confirmed circulation of the cVDPV2 emergence of JIS-1 outside Nigeria in the absence of detection of AFP (Cameroon) or before detection (Ghana) of AFP cases.

Since 2000, 1,085 cases of paralysis caused by cVDPV have been reported, 932 (86%) of which were type 2. During the same period, approximately 12 million cases of paralytic polio have been averted through polio eradication efforts. Vaccine-associated paralytic polio can occur in children who receive the vaccine, usually after the first dose, or in their susceptible close contacts, totaling about 2–4 cases per birth cohort of 1,000,000 children before the switch from tOPV to bOPV. Since the switch, an estimated 160–240 cases per year of type 2 vaccine-associated paralytic polio have been averted. In addition, there have been no new cases of VDPV2 excretion identified in persons with primary immunodeficiency (iVDPV) since the switch from tOPV-to-bOPV. Cessation of all OPV use after certification of polio eradication will eliminate the risk for VDPV emergence and spread.

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Progress Toward Poliomyelitis Eradication — Pakistan, January 2018–September 2019

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Afghanistan and Pakistan are the only countries that continue to confirm ongoing wild poliovirus type 1 (WPV1) transmission (*1*). During January 2018–September 2019 the number of WPV1 cases in Pakistan increased, compared with the number during the previous 4 years. This report updates previous reports on Pakistan's polio eradication activities, progress, and challenges (*2*,*3*). In 2018, Pakistan reported 12 WPV1 cases, a 50% increase from eight cases in 2017, and a 31% increase in the proportion of WPV1-positive sites under environmental surveillance (i.e., sampling of sewage to detect poliovirus). As of November 7, 2019, 80 WPV1 cases had been reported, compared with eight cases by the same time in 2018. An intensive schedule of supplementary immunization activities (SIAs)* implemented by community health workers in the core reservoirs (i.e., Karachi, Peshawar, and Quetta) where WPV1 circulation has never been interrupted, and by mobile teams, has failed to interrupt WPV1 transmission in core reservoirs and prevent WPV1 resurgence in nonreservoir areas. Sewage samples have indicated wide WPV1 transmission in nonreservoir areas in other districts and provinces. Vaccine refusals, chronically missed children, community campaign fatigue, and poor vaccination management and implementation have exacerbated the situation. To overcome challenges to vaccinating children who are chronically missed in SIAs and to attain country and global polio eradication goals, substantial changes are needed in Pakistan's polio eradication program, including continuing cross-border coordination with Afghanistan, gaining community trust, conducting high-quality vaccination campaigns, improving oversight of field activities, and improving managerial processes to unify eradication efforts.

Immunization Activities

Routine immunization. The World Health Organization (WHO) and the United Nations Children's Fund estimated national coverage with 3 doses of oral poliovirus vaccine (OPV) received through the routine immunization program by age 1 year in Pakistan to be 75% each year during 2016–2018 (*4*). Reported 3-dose (OPV3) administrative coverage (calculated by dividing the number of doses administered by the estimated target population) is highly variable among provinces; the highest reported administrative coverage rates in 2018 were in Azad Jammu and Kashmir province (95%) and Islamabad Capital Territory (91%); the lowest were in Khyber Pakhtunkhwa (68%) and Balochistan (35%) provinces. Variation in coverage among districts is similarly high.

History of doses of OPV received (according to vaccination cards and parental recall) by children aged 6–23 months with acute flaccid paralysis (AFP) who tested negative for poliovirus (nonpolio AFP [NPAFP][†]) is a surrogate estimate of OPV coverage in the population, with particular focus on the proportion of children who have never received OPV during SIAs or through routine immunization services (zero-dose children). Provinces and areas with the highest proportion of zero-dose children in 2018 were Gilgit-Baltistan (2.7%), Islamabad (1.2%), and Balochistan (0.9%).

Supplementary immunization activities. During January 2018–September 2019, seven national SIAs and nine subnational SIAs were conducted using bivalent OPV (bOPV), which contains polio vaccine virus types 1 and 3. Small-scale SIAs were implemented in response to isolation of WPV1 from environmental surveillance or from persons with AFP, using bOPV and monovalent (type 1) OPV. SIA quality was assessed in subdistricts (union councils) by intracampaign monitoring surveys and lot quality assurance sample surveys.[§] Both methods have indicated a decline in SIA quality during 2018–2019, compared with those in previous years, with substantial numbers of children missed in union councils (up to 20% missed in Punjab and up to 17% missed in Sindh). SIA rounds using a single dose of injectable inactivated poliovirus vaccine were

* Mass campaigns conducted for a brief period (days to weeks) in which 1 dose of oral poliovirus vaccine is administered to all children aged <5 years, regardless of vaccination history. Campaigns can be conducted nationally or subnationally (i.e., in portions of the country).

† Vaccination histories of children aged 6–23 months with acute flaccid paralysis who do not test positive for WPV are used to estimate OPV coverage of the overall target population and to corroborate national reported routine vaccination coverage estimates.

§ Lot quality assurance sampling is a rapid method used to assess the quality of vaccination activities after SIAs in predefined areas such as health districts (referred to as "lots"), using a small sample size. Lot quality assurance sampling involves dividing the population into lots and ascertaining receipt of vaccination by randomly selected persons within each lot. If the number of unvaccinated persons in the sample exceeds a predetermined value, then the lot is classified as having an unsatisfactory level of vaccination coverage, and mop-up activities are recommended.

implemented serially in high-risk districts of Balochistan, Gilgit-Baltistan, Khyber Pakhtunkhwa, and Sindh.

Community-based vaccination and permanent transit points. Locally recruited community health workers in districts of core reservoirs (i.e., areas where WPV1 circulation has never been interrupted) are responsible for increasing vaccine coverage within their communities during and between SIAs through engagement with local leaders and community members. As of August 2019, a total of 19,274 community health workers had been deployed in 15 districts in Balochistan, Khyber Pakhtunkhwa, and Sindh; 85% are women, who, because of cultural and religious customs, can more easily enter homes in these areas. To identify and vaccinate children in mobile populations at high risk, 1,106 permanent transit posts (i.e., small vaccination clinics) were placed at the official border crossings with Afghanistan, along major domestic migration routes, and at railroad and bus transport hubs in all provinces.

Surveillance Activities

AFP surveillance. In 2018, all provinces exceeded the target NPAFP rate of 2 per 100,000 population aged <15 years (sufficiently sensitive surveillance to detect a case of polio) and the 80% target proportion of AFP cases with collection of adequate stool specimens¶ (Table). During January 2018–September 2019, the national NPAFP rate was 15.9 per 100,000, ranging from 14.6 to 27.7 among provinces; the percentage of AFP cases with adequate stool specimens was 89% nationally, ranging from 86% to 92% among provinces.

Environmental surveillance. Environmental surveillance supplements AFP surveillance through systematic sewage sampling (currently at 60 sites) and testing for poliovirus. During January 2018–September 2019, in addition to core reservoirs, poliovirus was detected continually from multiple nonreservoir sites, particularly those in Khyber Pakhtunkhwa (Bannu and South Waziristan), Punjab (Islamabad, Lahore, and Rawalpindi), and Sindh (Hyderabad and Sukkur) (Table). Among the same 51 sites sampled during January 2018–September 2019, 70 of 457 specimen (15%) were WPV1-positive in 2017, 74 of 459 (16%) in 2018 and 209 of 468 (45%) in 2019. Approximately 45% of all environmental sites tested positive in 2019, compared with 15% during the same period in 2018 and 16% in 2017.

Epidemiology of WPV1 Cases

Twelve WPV1 cases were reported in Pakistan during 2018, a 50% increase from eight in 2017 (Figure 1). Seventy-two WPV1 cases have been reported during January–September 2019 among 22 districts in four provinces, compared with four during the same period in 2018 among four districts in two provinces. Of the 84 WPV1 cases with onset during January 2018–September 2019, 61 (73%) were from Khyber Pakhtunkhwa, nine (11%) from Balochistan, nine (11%) from Sindh, and five (6%) from Punjab (Table) (Figure 2). Among these 84 cases, ages of patients ranged from 2 to 144 months (median = 18 months). According to parental recall, nine (11%) patients had received zero OPV doses, 12 (14%) had received 1–3 doses, and 59 (70%) had received ≥4 doses. Four (5%) patients had unknown vaccination histories or are still being investigated. Among those who received ≥1 dose, two (2%) received only routine immunization and 49 (58%) only SIA doses.

Several viral genetic lineages persisted through the 2018–2019 low season (November–April) and, concomitant with the increase in the number of detected WPV1 cases, markedly expanded during 2019, particularly in Khyber Pakhtunkhwa. Among the five genetically distinct clusters (i.e., groups of polioviruses sharing ≥95% sequence identity in the viral capsid protein VP1) associated with AFP cases, during the reporting period, four were detected in Khyber Pakhtunkhwa.

Discussion

Observations based on the geography of WPV1-positive environmental surveillance sites and viral genomic sequence diversity indicate that the Pakistan polio eradication program made substantial progress during 2015–2016 but, despite slight decreases in case numbers, progress stalled during 2017–2018 (*2*). The number of cases in 2019 to date has increased approximately fifteenfold from the same period in 2018, and the geographic distribution of WPV1-positive environmental surveillance specimens has expanded beyond the core reservoirs. The proportion of positive environmental surveillance specimens began to increase in mid-2017, heralding the subsequent increase in the number of paralytic cases in late 2018. The current status of polio eradication in Pakistan has serious global implications: the increased risk for WPV1 spreading beyond Pakistan's borders is high; if transmission in Pakistan is not quickly controlled and back on track toward interruption, success of the Global Polio Eradication Initiative is threatened.

¶ AFP surveillance quality is monitored by performance indicators that include 1) the detection rate of NPAFP cases and 2) the percentage of AFP cases with adequate stool specimens. WHO operational targets for countries with endemic poliovirus transmission are NPAFP detection rates of ≥2 cases per 100,000 population aged <15 years and adequate stool specimen collected from ≥80% of AFP cases. Adequate stool specimens are defined as two stool specimens of sufficient quality for laboratory analysis, collected ≥24 hours apart, both within 14 days of paralysis onset, and arriving in good condition at a World Health Organization–accredited laboratory with reverse cold chain maintained, without leakage or desiccation, and with proper documentation.

TABLE. Acute flaccid paralysis (AFP) surveillance indicators and number of reported cases of wild poliovirus (WPV) and number and proportion of WPV-positive environmental surveillance samples, by region and period — Pakistan, January 2018–September 2019

Characteristic	Area							
	Pakistan total	Azad Jammu and Kashmir	Gilgit-Baltistan	Islamabad	Khyber Pakhtunkhwa	Punjab	Balochistan	Sindh
2018 AFP surveillance indicators								
No. of AFP cases	**12,276**	266	112	145	3,216	5,514	580	2,443
Nonpolio AFP rate*	**14.0**	12.8	17.1	21.2	20.6	12.2	14.2	12.7
% with adequate specimens†	**87**	88	85	80	86	88	87	88
2019 AFP surveillance indicators								
No. of AFP cases	**10,800**	273	115	140	2,400	5,207	465	2,200
Nonpolio AFP rate*	**16.2**	17.1	23.5	27.1	20	15.3	14.9	15
% with adequate specimens†	**88**	92	86	90	86	88	89	90
Reported WPV cases								
Jan–Jun 2018	**3**	—§	—	—	—	—	3	—
Jul–Dec 2018	**9**	—	—	—	8	—	—	1
Jan–Sep 2019	**72**	—	—	—	53	5	6	8
Total Jan 2018–Sep 2019	**84**	**0**	**0**	**0**	**61**	**5**	**9**	**9**
Environmental surveillance no. of samples (%)								
Jan–Jun 2018	**43 (13)**	NA	NA	2 (33)	13 (21)	6 (6)	6 (10)	16 (16)
Jul–Dec 2018	**96 (27)**	NA	NA	5 (83)	30 (39)	23 (23)	18 (30)	20 (19)
Jan–Sep 2019	**250 (43)**	NA	NA	3 (25)	31 (26)	63 (35)	45 (46)	108 (65)
Total Jan 2018–Sep 2019	**389**	**NA**	**NA**	**10**	**74**	**92**	**69**	**144**

Abbreviation: NA = not available.

* Per 100,000 children aged <15 years.

† Adequate stool specimens are defined as two stool specimens of sufficient quality for laboratory analysis, collected ≥24 hours apart, both within 14 days of paralysis onset, and arriving in good condition at a World Health Organization–accredited laboratory with reverse cold chain maintained, without leakage or desiccation, and with proper documentation.

§ A dash indicates that no cases were reported in the area during the given period.

FIGURE 1. Cases of wild poliovirus type 1, by month — Pakistan, January 2015–September 2019

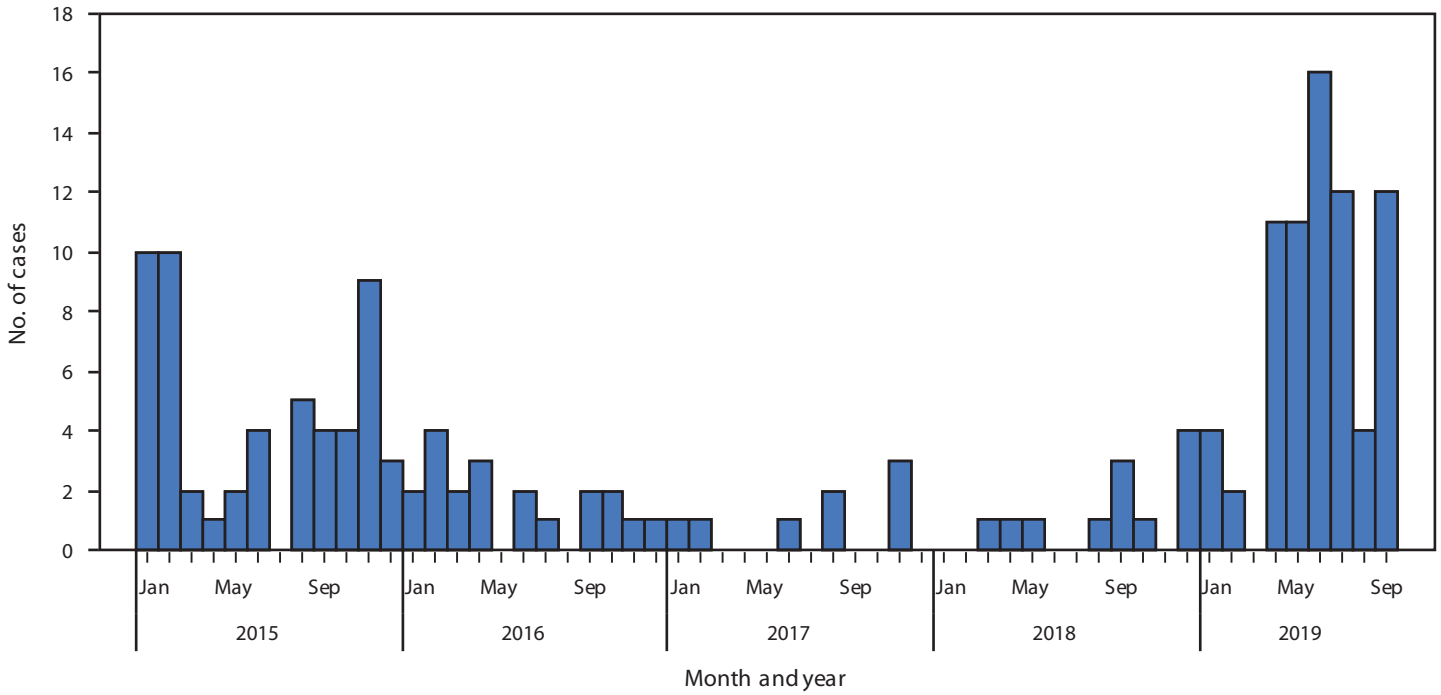
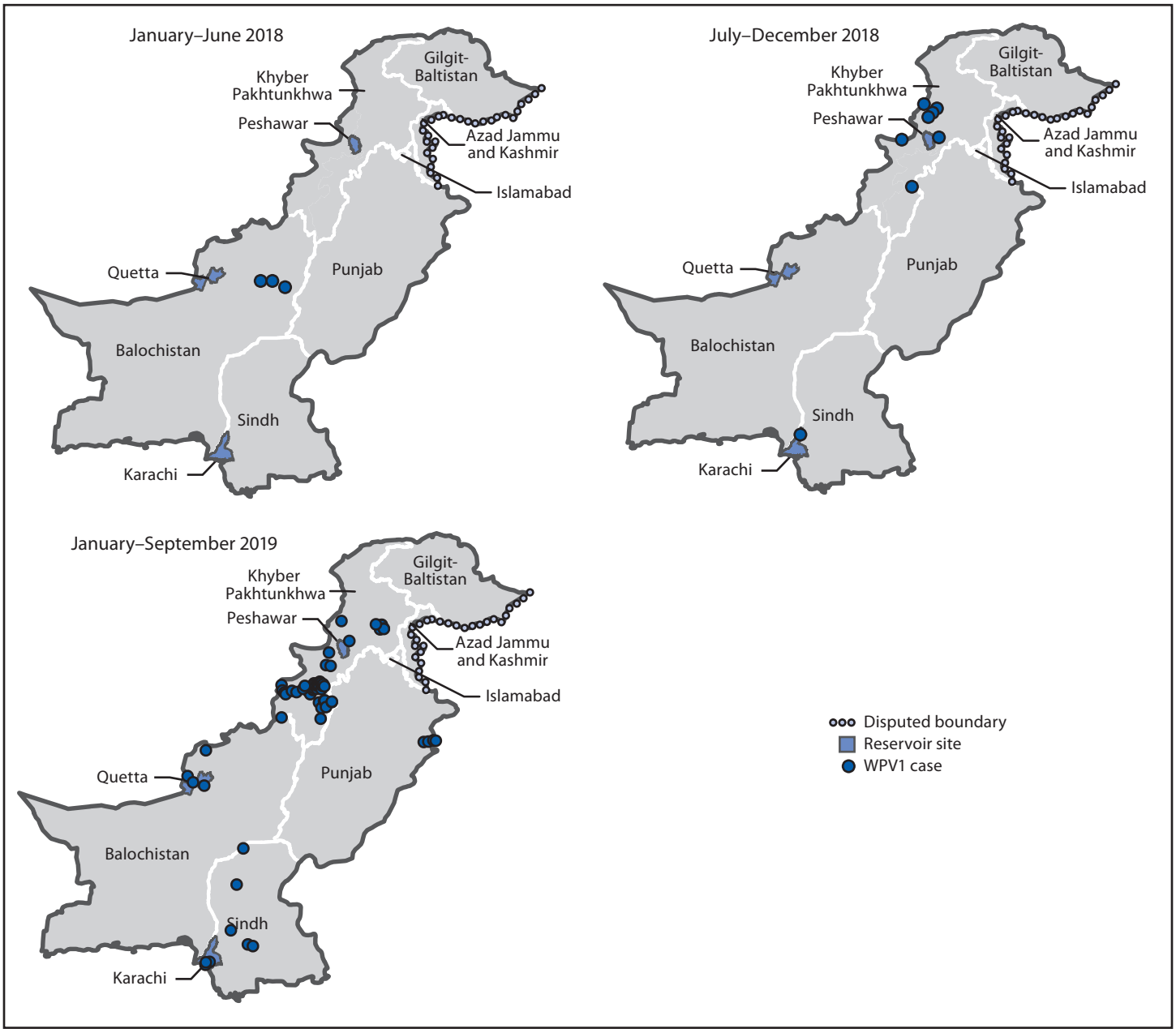


FIGURE 2. Location of reported wild poliovirus type 1 (WPV1) cases, by province and period — Pakistan, January 2018–September 2019



The Pakistan program's failure in progress toward polio eradication is related to both community and program management challenges. Community challenges are increasingly strident refusals to vaccinate and children chronically missed by immunization activities. Because national and subnational SIAs have been occurring every 4–6 weeks, and there are frequent response campaigns after identification of polio cases and WPV1-positive environmental samples as well, campaign-fatigued communities are complaining that the government is not addressing other public health needs (e.g., nutrition and clean water) or other public services (*5*). The spread of false information, particularly through social media (e.g., that OPV contains pork products or causes sterility) has increased community resistance to vaccination (*6*). It is essential that the program counters false information, informs communities of the importance of vaccination, and engages and listens to communities to reestablish trust in the vaccination program. While starting to address these issues, the program has suspended SIAs in core reservoirs until December 2019. The Technical Advisory Group, an expert polio group comprising internal and external partners from a variety of backgrounds (e.g., virology, vaccines and vaccine delivery, epidemiology,

and public health policy) that provides critical feedback on the polio program, recommended in August 2019 that SIAs subsequently be spaced ≥2 months apart to assist in community engagement (*7*). In addition, mobile populations are difficult to identify, track, and target for vaccination; however, the Pakistan program has enhanced internal efforts and is coordinating polio eradication activities with the Afghanistan program (i.e., vaccinations at border crossing, data sharing, and coordination of SIAs).

The Pakistan polio eradication program has grown complex in its management and operational organization. Management review in three districts of Karachi revealed overlapping terms of reference, delayed availability of information, systematic gaps in managerial oversight of decisions and activities, and an overall failure in staff members' accountability when implementing SIAs (McKinsey and Company, unpublished report, 2019). The review concluded that meeting programmatic challenges might require managerial restructuring so that decision-making, oversight, and implementation occur as "One Team." At the union council level, identifying the causes of operational failures in planning and supervision could enable the program to vaccinate those children who chronically have been missed. Local restructuring could improve oversight in such underperforming union councils, which has been considered an impediment to stopping WPV1 circulation in Karachi, Peshawar, and Quetta. Restructuring at national and provincial emergency operation centers and streamlining data flow could improve timely and effective decision-making.

The Pakistan polio eradication program has undertaken a series of management, communication, community engagement, and epidemiologic reviews that have identified essential gaps needing to be addressed. The national leadership has committed to implementing transformative changes, and maintaining this sense of urgency is essential. Managerial and operational weaknesses and gaps have been acknowledged, and the means to rectify them have been identified. Although responding to community concerns to minimize OPV refusal will take time, enhanced efforts (e.g., continual engagements with communities, countering false information, greater accountability, and more effective oversight) have already begun. The goal of interrupting WPV1 transmission in Pakistan is achievable but will require full and rapid implementation of Technical Advisory Group recommendations to improve program management and operational effectiveness.

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Summary

What is already known about this topic?

Since 2016, Afghanistan and Pakistan have been the only countries reporting ongoing transmission of indigenous wild poliovirus type 1 (WPV1).

What is added by this report?

During January 2018–September 2019, the number of WPV1 cases in Pakistan increased, compared with the number during the previous 4 years. Sewage samples indicated wide WPV1 transmission, not only in the three major reservoir areas in three provinces, but also among other districts and provinces. Vaccine refusals, chronically missed children, community campaign fatigue, and poor vaccination management and implementation have exacerbated the situation.

What are the implications for public health practice?

Stopping WPV1 transmission will require continuing cross-border coordination with Afghanistan, gaining community trust, conducting high-quality campaigns, improving oversight of field activities, and improving managerial processes to unify eradication efforts.

[1]Global Immunization Division, Center for Global Health, CDC; [2]World Health Organization, Islamabad, Pakistan; [3]Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, CDC; [4]United Nations Children's Fund, Islamabad, Pakistan; [5]National Emergency Operation Center, Islamabad, Pakistan; [6]World Health Organization, Amman, Jordan.

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Risk Factors for E-Cigarette, or Vaping, Product Use–Associated Lung Injury (EVALI) Among Adults Who Use E-Cigarette, or Vaping, Products — Illinois, July–October 2019

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The United States is experiencing an unprecedented outbreak of e-cigarette, or vaping, product use–associated lung injury (EVALI) (*1*). All EVALI patients have used e-cigarette, or vaping, products, and most (≥85%) have reported using products containing tetrahydrocannabinol (THC) (*2*,*3*), the principal psychoactive component of cannabis. To examine whether e-cigarette, or vaping, product use behaviors differed between adult EVALI patients and adults who use these products but have not developed lung injury, the Illinois Department of Public Health (IDPH) conducted an online public survey during September–October 2019 targeting e-cigarette, or vaping, product users in Illinois. Among 4,631 survey respondents, 94% reported using any nicotine-containing e-cigarette, or vaping, products in the past 3 months; 21% used any THC-containing products; and 11% used both THC-containing products and nicotine-containing products. Prevalence of THC-containing product use was highest among survey respondents aged 18–24 years (36%) and decreased with increasing age. E-cigarette, or vaping, product use behaviors of 66 EVALI patients aged 18–44 years who were interviewed as part of the ongoing outbreak investigation were compared with a subset of 519 survey respondents aged 18–44 years who reported use of THC-containing e-cigarette, or vaping, products. Compared with these survey respondents, EVALI patients had higher odds of reporting exclusive use of THC-containing products (adjusted odds ratio [aOR] = 2.0, 95% confidence interval [CI] = 1.1–3.6); frequent use (more than five times per day) of these products (aOR = 3.1, 95% CI = 1.6–6.0), and obtaining these products from informal sources, such as a dealer, off the street, or from a friend (aOR = 9.2, 95% CI = 2.2–39.4). The odds of using Dank Vapes, a class of largely counterfeit THC-containing products, was also higher among EVALI patients (aOR = 8.5, 95% CI = 3.8–19.0). These findings reinforce current recommendations not to use e-cigarette, or vaping, products that contain THC and not to use any e-cigarette, or vaping, products obtained from informal sources. In addition, because the specific compound or ingredient causing lung injury is not yet known, CDC continues to recommend that persons consider refraining from use of all e-cigarette, or vaping, products while the outbreak investigation continues (*1*).

IDPH developed an online public survey targeting Illinois adults who use e-cigarette, or vaping, products based on the structured questionnaire developed by IDPH and administered to EVALI patients as part of the ongoing outbreak investigation. The public survey included questions about the types of e-cigarette, or vaping, products survey respondents used in the past 3 months, where these products were obtained, combustible cigarette and marijuana use, and any reported illness associated with e-cigarette, or vaping, product use. The public survey link was posted on the IDPH website during September 17–October 8, 2019 and was publicized through the media, posted on IDPH social media accounts, and promoted by local health departments (*4*). Because of an IDPH Institutional Review Board determination, the survey was restricted to persons aged ≥18 years.

To compare survey respondents with EVALI patients, a subset of respondents with similar characteristics to those of EVALI patients was selected. Data were available for 137 EVALI patients reported to IDPH; 15% (20 of 137) were aged <18 years; of adult EVALI patients, 97% (113 of 117) were aged 18–44 years (Supplementary Figure, https://stacks.cdc.gov/view/cdc/82320).* Among EVALI patients aged 18–44 years, 66 of 113 (58%) had the structured patient questionnaire administered either via telephone, by a public health staff member (53 of 66, 80%); during an in-person interview, usually by a health care provider (nine of 66, 14%); or online (four of 66; 6%) (*3*). Among these 66 EVALI patients, 85% reported use of THC-containing e-cigarette, or vaping, products. Based on these characteristics of EVALI patients (i.e. primarily adults aged <44 years with high THC-containing product use prevalence), survey respondents for the comparative analysis were limited to those aged 18–44 years who reported use of THC-containing e-cigarette, or vaping, products. Survey respondents were further restricted to those who resided in one of the 28 Illinois counties with any reported EVALI cases and who did not report seeking health care for illness compatible with EVALI. All interviewed

* EVALI cases were reported to the Illinois Department of Public Health during July 31–October 15, 2019, from 28 counties. These counties accounted for an estimated 83% of the Illinois population in 2018.

EVALI adult patients aged 18–44 years were included in the comparative analysis.

Survey results were summarized with descriptive statistics. P-values were assessed using Pearson's chi-square test; for cells with small numbers, Fisher's exact test was used. To compare EVALI patients with the subset of survey respondents that reported using THC-containing products, aORs were calculated using multivariable logistic regression models that controlled for race/ethnicity and age group. P-values <0.05 were considered statistically significant. Analyses were conducted using SAS (version 9.4; SAS Institute).

Among 7,704 survey respondents, 4,631 (60%) met the study inclusion criteria (i.e., Illinois residents aged ≥18 years who completed demographic questions, reported use of e-cigarette, or vaping, products in the past 3 months, and did not have EVALI) (Supplementary Figure, https://stacks.cdc.gov/view/cdc/82320).[†] The median age of included respondents was 38 years (range = 18–83 years), 3,035 (66%) were men, and 3,932 (89%) identified as non-Hispanic white (white) (Table 1). Overall, 3,641 (94%) respondents reported using any nicotine-containing e-cigarette, or vaping, products in the preceding 3 months, including 3,222 (84%) who reported exclusive use of nicotine-containing products. Use of any THC-containing e-cigarette, or vaping, products was reported by 930 (21%) of survey respondents, including 212 (5%) who used such products exclusively. Use of both nicotine-containing and THC-containing products was reported by 418 (11%) survey respondents. Prevalence of THC-containing product use decreased with increasing age: 36% and 13% of respondents aged 18–24 years and ≥45 years, respectively, reported using THC-containing products. Use of nicotine-containing products was consistent across age groups (93%–96%). Among survey respondents, use of combustible marijuana (24%) was higher than that of combustible tobacco (7%).

Approximately 82% of male survey respondents aged 18–34 years reported frequent (more than five times per day) use of nicotine-containing e-cigarette, or vaping, products, compared with 76% of women of the same age (Table 2). Among adults aged 18–34 years, the prevalence of frequent use of THC-containing e-cigarette, or vaping, products was twice as high among men (25%) as among women (13%). Among survey respondents who reported any use of THC-containing products, exclusive use was reported by a higher proportion of women than of men both among those aged 18–34 years (26% versus 17%) and among those aged ≥35 years (31% versus 22%). A similar proportion of male and female survey respondents aged 18–34 years obtained THC-containing products from informal sources (a dealer, friends, or on the street) (72% and 68%, respectively); however, among adults aged ≥35 years, men were more likely to report informal sources of THC-containing products (56%) than were women (39%).

Among the 4,631 survey respondents, 519 (11%) met the additional age, THC-use, and county of residence criteria for the comparative analysis with the 66 interviewed EVALI patients aged 18–44 years. Significant demographic differences between EVALI patients and this subset of survey respondents were identified (Table 3). Compared with the subset of survey respondents, EVALI patients had higher odds of being aged <30 years (odds ratio [OR] = 6.0, 95% CI = 3.1–11.5) and of identifying as a racial/ethnic group other than white (OR = 2.9, 95% CI = 1.7–5.2). Among EVALI patients who used THC-containing e-cigarette, or vaping, products, the odds for frequent use of these products were significantly higher compared with the subset of THC-using survey respondents (aOR = 3.1, 95% CI = 1.6–6.0). In addition, the odds were significantly higher among EVALI patients for exclusive use of THC-containing e-cigarette, or vaping, products (aOR = 2.0, 95% CI = 1.1–3.6) and obtaining THC-containing products through informal sources versus from a licensed dispensary or store[§] (aOR = 9.2, 95% CI = 2.2–39.4). Compared with the subset of survey respondents, EVALI patients also had higher odds of reporting use of Dank Vapes (aOR = 8.5, 95% CI = 3.8–19.0), a class of largely counterfeit THC-containing products of unknown provenance that are marketed under a common name and distributed through informal sources (*5*).

Discussion

Since the introduction of e-cigarettes into the United States in 2007, use of these devices has increased rapidly, particularly among youths (*6*). Although initially created for use with nicotine-containing products, e-cigarettes are also used to aerosolize THC (*7*). In this survey of Illinois residents who used e-cigarette, or vaping, products and did not have EVALI, use of THC-containing products was less prevalent (21%) than was use of nicotine-containing products (94%); however, a higher

[†] Thirty-two survey respondents were aged <18 years; 1,800 resided in states other than Illinois or did not confirm Illinois residency, and age or gender information was missing for 1,120 respondents. Respondents who reported no e-cigarette, or vaping, product use in the past 3 months (n = 106) or who visited an emergency department and/or were hospitalized for vaping-related symptoms (n = 15) were excluded.

[§] No EVALI patients in Illinois have reported purchasing THC-containing e-cigarette, or vaping, products online. Among public survey respondents who reported using THC-containing e-cigarette, or vaping, products, five of 519 (1%) reported online purchase of dry marijuana herb, butane hash oil, or THC-containing prefilled cartridges. Online sites likely represent a mix of illicit and licit sources; therefore, respondents who purchased THC-containing products online were not included in the comparison of informal to formal place of e-cigarette, or vaping, product purchase.

TABLE 1. E-cigarette, or vaping, and combustible product use among survey respondents aged ≥18 years who used e-cigarettes during the 3 months preceding the survey (N = 4,631), by age group, sex, and race/ethnicity — Illinois, July–October 2019*

Characteristic	No./Total no. (%)							
	E-cigarette, or vaping, product use					Combustible product use		
	THC-containing only†	Nicotine-containing only†	Both THC- and nicotine-containing†	Any nicotine-containing	Any THC-containing	Marijuana	Cigarettes	All respondents
Age group (yrs)								
18–24	29/443 (7)	306/443 (69)	108/443 (24)	414/443 (93)	206/571 (36)	264/592 (45)	56/592 (9)	**601 (13)**
25–34	72/1,036 (7)	845/1,036 (82)	119/1,036 (11)	964/1,036 (93)	289/1,236 (23)	353/1,256 (28)	83/1,256 (7)	**1,273 (27)**
35–44	54/1,238 (4)	1,053/1,238 (85)	131/1,238 (11)	1,185/1,239 (96)	264/1,422 (19)	309/1,437 (21)	77/1,437 (5)	**1,457 (31)**
≥45	57/1,135 (5)	1,018/1,135 (90)	60/1,135 (5)	1,078/1,135 (95)	171/1,283 (13)	193/1,291 (15)	93/1,290 (7)	**1,300 (28)**
Sex								
Men	119/2,530 (5)	2,118/2,530 (84)	293/2,530 (12)	2,412/2,531 (95)	603/2,959 (20)	740/3,002 (25)	163/3,002 (5)	**3,035 (66)**
Women	93/1,322 (7)	1,104/1,322 (84)	125/1,322 (9)	1,229/1,322 (93)	327/1,553 (21)	379/1,574 (24)	146/1,573 (9)	**1,596 (34)**
Race/Ethnicity§,¶								
White	165/3,304 (5)	2,789/3,304 (84)	350/3,304 (11)	3,140/3,305 (95)	757/3,836 (20)	919/3,885 (24)	252/3,884 (6)	**3,932 (89)**
Black	6/60 (10)	42/60 (70)	12/60 (20)	54/60 (90)	24/74 (32)	26/78 (33)	10/78 (13)	**79 (2)**
Other	12/149 (8)	119/149 (80)	18/149 (12)	137/149 (92)	47/183 (26)	57/187 (30)	13/187 (7)	**188 (4)**
Hispanic	22/181 (12)	135/181 (75)	24/181 (13)	159/181 (88)	63/215 (29)	67/219 (31)	18/219 (8)	**221 (5)**
All respondents	**212/3,852 (5)**	**3,222/3,852 (84)**	**418/3,852 (11)**	**3,641/3,853 (94)**	**930/4,512 (21)**	**1,119/4,576 (24)**	**309/4,575 (7)**	**4,631**

Abbreviation: THC = tetrahydrocannabinol.
* Online survey responses were collected during September 17–October 8, 2019.
† Only survey respondents who answered both the question about use of THC-containing e-cigarette products (n = 4,512) and the question about nicotine-containing e-cigarette products (n = 3,853) were used to calculate these mutually exclusive categories.
§ Whites, blacks, and persons of other races were non-Hispanic; Hispanic persons could be of any race.
¶ Race/ethnicity data was missing for 211 survey respondents.

proportion of survey respondents aged <35 years reported using THC-containing products, consistent with the observed age distribution of EVALI patients in this outbreak both in Illinois and nationally (*1*,*2*). Two thirds of survey respondents were men, reflecting the sex distribution of outbreak-associated EVALI patients, in Illinois and nationally (*1*,*2*). Among persons aged 18–34 years, the prevalence of frequent daily use of both nicotine-containing and THC-containing e-cigarette, or vaping, products was higher among men than among women. These findings suggest that e-cigarette, or vaping, product use behaviors among younger adults, especially men, might place them at higher risk for developing EVALI associated with this outbreak.

A much higher proportion of adult EVALI patients reported use of THC-containing e-cigarette, or vaping, products (85%) than did adults who use e-cigarette, or vaping, products and have not developed lung injury (21%). When e-cigarette, or vaping, product use among EVALI patients aged 18–44 years was compared with that of a subset of survey respondents aged 18–44 years who reported use of THC-containing products, a number of significant differences were found. Specifically, patients with EVALI had higher odds of reporting exclusive use of THC-containing products, as well as reporting frequent use of these products, obtaining them through informal sources, and using a counterfeit THC-containing product marketed as Dank Vapes. Because the comparative analysis was restricted to survey respondents who reported using THC-containing e-cigarette, or vaping products, the calculated ORs comparing THC-containing product use behaviors between EVALI patients and survey respondents are likely conservative.

The findings in this report are subject to at least six limitations. First, the survey was restricted to persons aged ≥18 years and findings might not be representative of younger persons; 15% of EVALI patients in Illinois during July–October

Summary

What is already known about this topic?

Most U.S. patients with e-cigarette, or vaping, product use–associated lung injury (EVALI) report using tetrahydrocannabinol (THC)-containing e-cigarette, or vaping, products. Product use behaviors that increase risk for EVALI are unknown.

What is added by this report?

Compared with survey respondents aged 18–44 years reporting using of THC-containing e-cigarette, or vaping, products, EVALI patients aged 18–44 years had higher odds of reporting exclusive and frequent use of THC-containing products and obtaining these products from informal sources, such as a dealer, off the street, or from a friend, and of using Dank Vapes, a class of largely counterfeit THC-containing products.

What are the implications for public health practice?

CDC recommends not using THC-containing e-cigarette, or vaping, products, or any e-cigarette, or vaping, products obtained from informal sources.

TABLE 2. E-cigarette, or vaping, product use behaviors among survey respondents aged ≥18 years who used e-cigarettes during the 3 months preceding the survey (N = 4,631), by age group and sex — Illinois, July–October 2019*

	18–34 years (n = 1,874)			≥35 years (n = 2,757)			All ages		
	No./Total no. (%)			No./Total no. (%)			No./Total no. (%)		
E-cigarette, or vaping, use behavior	Men (n = 1,283)	Women (n = 591)	P-value†	Men (n = 1,752)	Women (n = 1,005)	P-value†	Men (n = 3,035)	Women (n = 1,596)	P-value†
Any nicotine-containing products	964/1,020 (95)	414/459 (90)	0.002	1,448/1,511 (96)	815/863 (94)	0.12	2,412/2,531 (95)	1,229/1,322 (93)	0.003
Only nicotine-containing products	809/964 (84)	342/414 (83)	0.55	1,309/1,448 (90)	762/815 (94)	0.01	2,118/2,412 (88)	1,104/1,229 (90)	0.07
Any nicotine-containing product <1x/day§	21/956 (2)	19/407(5)	0.01	17/1,428 (1)	10/800 (1)	0.90	36/2,382 (2)	24/1,202 (2)	0.28
Any nicotine-containing product >5x/day§	780/956 (82)	309/407 (76)	0.02	1,271/1,428 (89)	663/800 (83)	<0.0001	2,051/2,384 (86)	972/1,207 (82)	<0.0001
Any THC-containing products	321/1,243 (26)	174/564 (31)	0.03	282/1,716 (16)	153/989 (15)	0.51	603/2,959 (20)	327/1,553 (21)	0.59
Only THC-containing products	56/321 (17)	45/174 (26)	0.03	63/282 (22)	48/153 (31)	0.04	119/603 (20)	93/327 (28)	0.003
Any THC-containing product <1x/day§	64/255 (25)	44/123 (36)	0.03	74/220 (34)	36/110 (33)	0.87	138/475 (29)	80/233 (34)	0.15
Any THC-containing product >5x/day§	64/255 (25)	16/123 (13)	0.007	40/220 (18)	24/110 (22)	0.43	104/475 (22)	40/233 (17)	0.14
Dank Vapes¶	102/240 (42)	51/126 (40)	0.71	53/223 (24)	19/105 (18)	0.25	155/463 (33)	70/231 (30)	0.40
Obtained any THC-containing product informally**	172/240 (72)	82/120 (68)	0.51	118/210 (56)	42/107 (39)	0.004	290/450 (64)	124/227 (55)	0.01
Both THC- and nicotine-containing products	155/1,020 (15)	72/459 (16)	0.81	138/1,510 (9)	53/863 (6)	0.01	293/2,530 (12)	125/1,322 (9)	0.04

Abbreviations: CI = confidence interval; THC = tetrahydrocannabinol.

* Online survey responses were collected during September 17–October 8, 2019.

† Calculated using Pearson's chi-square test.

§ Frequency of use was reported by individual product. If any e-cigarette, or vaping, product was reported as being used more than five times a day, the survey respondent was classified as using that class of product (nicotine- or THC-containing) more than five times/day. The same criteria were used to classify product use as less than one time/day.

¶ Dank Vapes are a class of largely counterfeit THC-containing products of unknown provenance that are marketed under a common name and distributed through informal sources.

** Obtaining any THC-containing e-cigarette, or vaping, products from informal sources (a dealer, off the street, or from a friend) was compared with obtaining any THC-containing products from a formal source (store or licensed dispensary). Because online sources might be formal (e.g., a licensed dispensary) or informal, persons who reported online purchases were excluded from this analysis. Fewer than 1% of public survey respondents reported online purchases.

2019 were aged <18 years. Second, survey respondents were self-selected and might not be representative of the overall population of persons who use e-cigarette, or vaping, products in Illinois. To address this potential for bias, the comparative analysis was restricted to survey respondents in the same age group, geographic areas of residence, and with similar types of product use as those of EVALI patients and was adjusted for higher survey response rates among whites and older adults. Third, only 58% of Illinois EVALI patients aged 18–44 years have been interviewed; this nonresponse rate might introduce selection bias, although the characteristics of interviewed patients were similar to those of all reported EVALI patients. Fourth, EVALI patients who reported exclusive use of nicotine-containing products were also included in the comparative analysis with the subset of survey respondents who reported use of THC-containing products. Including these EVALI patients might have introduced bias, however, the prevalence of using nicotine-containing products was similar among the two groups. In addition, because analysis of product use behaviors was limited to only those persons who reported using a specific product (e.g., THC product use behaviors were only compared among EVALI patients and survey respondents who reported using THC-containing products) the inclusion of these EVALI patients did not affect the analysis of THC-containing product use behaviors. Fifth, although a similar survey instrument was used with EVALI patients and online survey respondents, most EVALI patients were interviewed by public health staff members via telephone. Differences in data collection methodology might have affected reporting of product use behaviors by EVALI patients compared with that of anonymous online survey respondents. Finally, these data were only collected from Illinois residents. Illinois has a

TABLE 3. Characteristics of e-cigarette, or vaping, product use behaviors among adult* EVALI patients and survey respondents†,§ who reported using tetrahydrocannabinol (THC)-containing products — Illinois, July–October 2019

Characteristic	No./Total no. (%)		Odds ratio (95% CI)¶	P-value¶	Adjusted odds ratio (95% CI)**	P-value
	EVALI patients (n = 66)	Survey respondents (n = 519)				
Sex						
Men	49/66 (74)	341/519 (66)	1.6 (0.8–2.7)	0.17	1.6 (0.9–3.0)	0.11
Women	17/66 (26)	178/519 (34)	reference	—††	—††	—††
Age group (yrs)						
18–29	54/66 (82)	222/519 (43)	6.0 (3.1–11.5)	<0.0001	—**	—**
30–44	12/66 (18)	297/519 (57)	reference	—††	—††	—††
Race/Ethnicity						
All other racial/ethnic groups§§	23/66 (35)	87/519 (17)	2.9 (1.7–5.2)	0.0001	—**	—**
Unknown	6/66 (9)	22/519 (4)	3.0 (1.2–7.9)	0.03	—**	—**
White, non-Hispanic	37/66 (56)	410/519 (79)	reference	—††	—††	—††
E-cigarette, or vaping, use behavior						
Any nicotine-containing products	45/66 (68)	237/361 (66)	1.1 (0.6–2.0)	0.69	1.1 (0.6–1.9)	0.87
Only nicotine-containing products	10/45 (22)	0/237 (0)	—¶¶	—¶¶	—¶¶	—¶¶
Any nicotine-containing product <1x/day***,†††	5/42 (12)	16/232 (7)	1.8 (0.5–5.6)	0.34	1.4 (0.5–4.2)	0.57
Any nicotine-containing product >5x/day***	27/42 (64)	178/232 (77)	0.5 (0.3–1.1)	0.09	0.8 (0.4–1.7)	0.57
Any THC-containing products¶¶	56/66 (85)	519/519 (100)	—¶¶	—¶¶	—¶¶	—¶¶
Only THC-containing products	21/56 (38)	124/519 (24)	1.9 (1.1–3.4)	0.03	2.0 (1.1–3.6)	0.03
Any THC-containing product <1x/day***	7/49 (14)	122/403 (30)	0.4 (0.2–0.9)	0.02	0.4 (0.2–1.0)	0.04
Any THC-containing product >5x/day***	19/49 (39)	76/403 (19)	2.7 (1.5–5.1)	0.001	3.1 (1.6–6.0)	0.0009
Dank Vapes§§§	45/53 (85)	140/391 (36)	10.1 (4.6–22.0)	<0.0001	8.5 (3.8–19.0)	<0.0001
Obtained any THC-containing product informally¶¶¶	48/50 (96)	251/378 (66)	12.1 (2.9–50.8)	<0.0001	9.2 (2.2–39.4)	0.003
Both THC- and nicotine-containing products	35/66 (53)	237/361 (66)	0.59 (0.3–1.0)	0.05	0.56 (0.3–1.0)	0.05

Abbreviations: CI = confidence interval; EVALI = E-cigarette, or vaping, product use–associated lung injury; THC = tetrahydrocannabinol.

* Online survey responses were collected during September 17–October 8, 2019. Survey respondents were asked about e-cigarette, or vaping, product use in the 3 months preceding survey completion; EVALI patients were asked about e-cigarette, or vaping, product use in the 3 months preceding symptom onset.

† Aged 18–44 years.

§ Only survey respondents who resided in one of the 28 Illinois counties with any reported outbreak-associated EVALI cases during July 31-October 15, 2019 were included in this analysis.

¶ Calculated using Pearson's chi-square test.

** Adjusted for race/ethnicity and age group. Each adjusted odds ratio used the age group ≥30 years and non-Hispanic white as the reference group. Therefore, adjusted odd ratios for age groups and race/ethnicity are not presented.

†† Values were not calculated for reference cells.

§§ Includes survey respondents who identified as Hispanic, non-Hispanic black, and non-Hispanic other.

¶¶ Only survey respondents who reported using THC-containing e-cigarette, or vaping, products in the past 3 months were included in this analysis, therefore, odds ratios were not calculated for this e-cigarette, or vaping, use behavior.

*** Frequency of use was reported by individual product. If any e-cigarette, or vaping, product was reported as being used more than five times a day, the survey respondent or case were classified as using that class of product (e.g., nicotine- or THC-containing) more than five times/day. The same criteria were used to classify product use frequency as less than one time/day).

††† Because of small cell size, Fisher's exact test was used to calculate the 95% CI and p-value for the unadjusted odds ratio.

§§§ Dank Vapes are a class of largely counterfeit THC-containing products of unknown provenance that are marketed under a common name and distributed through informal sources.

¶¶¶ Obtaining any THC-containing e-cigarette, or vaping, products from informal sources (a dealer, off the street, or from a friend) was compared with obtaining any THC-containing products from a formal source (store or licensed dispensary). Because online sources might be formal (e.g., a licensed dispensary) or informal, persons who reported online purchases were excluded from this analysis. No EVALI patients and <1% of public survey respondents reported online purchases.

comprehensive medical marijuana program in place but has not yet implemented sales of marijuana for recreational use; the legal purchase of tobacco products is restricted to persons aged ≥21 years. E-cigarette, or vaping, product use behaviors likely vary by jurisdictional policies that control access to these products; this might limit the generalizability of the results in this report.

This is the first report to analyze e-cigarette, or vaping, product use behaviors associated with increased risk of EVALI during this outbreak. The use of an anonymous public survey facilitated the rapid collection of data to inform the ongoing investigation. Differences were observed in e-cigarette, or vaping, product use behaviors between adults who use THC-containing e-cigarette, or vaping, products and patients with EVALI. The findings in this report reinforce current recommendations that persons should not use e-cigarette, or vaping, products that contain THC, or any e-cigarette, or vaping, products obtained from informal sources such as off the street, from a dealer, or from a friend. In addition, because the specific compound or ingredient causing lung injury is not yet known,

CDC continues to recommend that persons consider refraining from use of all e-cigarette, or vaping, products while the outbreak investigation continues (*1*).

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Evaluation of Bronchoalveolar Lavage Fluid from Patients in an Outbreak of E-cigarette, or Vaping, Product Use–Associated Lung Injury — 10 States, August–October 2019

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CDC, the Food and Drug Administration (FDA), state and local health departments, and multiple public health and clinical partners are investigating a national outbreak of e-cigarette, or vaping, product use–associated lung injury (EVALI). Based on data collected as of October 15, 2019, 86% of 867 EVALI patients reported using tetrahydrocannabinol (THC)-containing products in the 3 months preceding symptom onset (*1*). Analyses of THC-containing product samples by FDA and state public health laboratories have identified potentially harmful constituents in these products, such as vitamin E acetate, medium chain triglyceride oil (MCT oil), and other lipids (*2*,*3*) (personal communication, D.T. Heitkemper, FDA Forensic Chemistry Center, November 2019). Vitamin E acetate, in particular, might be used as an additive in the production of e-cigarette, or vaping, products; it also can be used as a thickening agent in THC products (*4*). Inhalation of vitamin E acetate might impair lung function (*5*–*7*).

Bronchoscopy and bronchoalveolar lavage[†] (BAL) can be part of the clinical and diagnostic workup of EVALI patients. The decision to perform this procedure is made by the clinical team on a case-by-case basis (*8*). During August–October 2019, BAL fluid specimens were collected by clinical teams caring for hospitalized EVALI patients. Public health laboratories and health departments from 10 states (California, Connecticut, Hawaii, Illinois, Maryland, Michigan, Minnesota, Texas, Utah, and Wisconsin) coordinated the submission of residual BAL fluid specimens from 29 patients to CDC.

To better characterize exposure among EVALI patients, CDC developed and validated isotope dilution mass spectrometry methods to analyze specific toxicants of concern and active compounds in case-associated BAL fluid.[§] These CDC analytic methods can identify vitamin E acetate, MCT oil (medium chain triglycerides), plant oils (long chain triglycerides), petroleum distillates (including mineral oil), diluent terpenes, cannabinoids, and nicotine in BAL fluid. The quality of case-associated BAL specimens was assessed by measuring dipalmitoylphosphatidylcholine (DPPC), the principal phospholipid in naturally-occurring lung surfactant: the presence of acceptable levels of DPPC confirms that the lavage procedure recovered adequate pulmonary epithelial fluid. When specimen volume was insufficient to perform all planned analyses, analysis of vitamin E acetate and cannabinoids was prioritized. Among the 27 BAL fluid specimens with sufficient volume for testing, all had measurable levels of DPPC. Overall, 21 (72%) patients with available specimens were male, and their median age was 23 years (range = 16–67 years), which is consistent with the sex and age patterns of EVALI patients reported to CDC to date (*1*). Two of the patients died.

Vitamin E acetate was detected in all 29 patient BAL samples. Among 23 patients for whom self-reported THC use information was available, 20 reported using THC-containing products. THC or its metabolites were detected in 23 of 28 patient BAL samples, including in those of three patients who said they did not use THC products. Nicotine metabolites were detected in 16 of 26 patient BAL specimens. Results for plant oils, MCT oil, petroleum distillates, and diluent terpenes were all below analyte-specific levels of detection (typically in the low ng/mL range).

This is the first reported identification of a potential toxicant of concern (vitamin E acetate) in biologic specimens obtained from EVALI patients. These findings provide direct evidence of vitamin E acetate at the primary site of injury among EVALI

[*] These two authors contributed equally.

[†] Bronchoalveolar lavage, performed in the evaluation of lung disease, involves instillation of sterile saline into a subsegment of the lung, followed by suction and collection of the fluid for analysis.

[§] CDC has not yet published these validated isotope dilution mass spectrometry methods.

patients and are consistent with FDA product testing and media reports of state public health laboratory testing documenting vitamin E acetate in product samples used by EVALI patients (*2*,*3*) (Personal communication, D.T. Heitkemper, FDA Forensic Chemistry Center, November 2019). Other diluents and additives of concern (e.g., plant oils, MCT oil, petroleum distillates, and diluent terpenes) were notably not detected in BAL fluid specimens from EVALI patients.

Although vitamin E acetate was detected in all specimens in this analysis of a convenience sample of 29 EVALI case-associated BAL specimens, additional studies are needed, including comparison with BAL fluid specimens from healthy volunteers and animal studies using controlled exposures to establish whether a causal link exists between this exposure and EVALI. Based on these data from 29 patients, it appears that vitamin E acetate is associated with EVALI; however, it is possible that more than one compound or ingredient could be a cause of lung injury, and evidence is not yet sufficient to rule out contribution of other toxicants to EVALI.

These findings reinforce CDC's recommendation that persons should not use e-cigarette, or vaping, products containing THC, especially those obtained from informal sources such as friends or family, or those from the illicit market, where product ingredients are unknown or can be highly variable (*9*). Until the relationship of vitamin E acetate and lung health is better characterized, it is important that vitamin E acetate not be added to e-cigarette, or vaping, products. CDC will continue to update guidance, as appropriate, as new data become available from this outbreak investigation.

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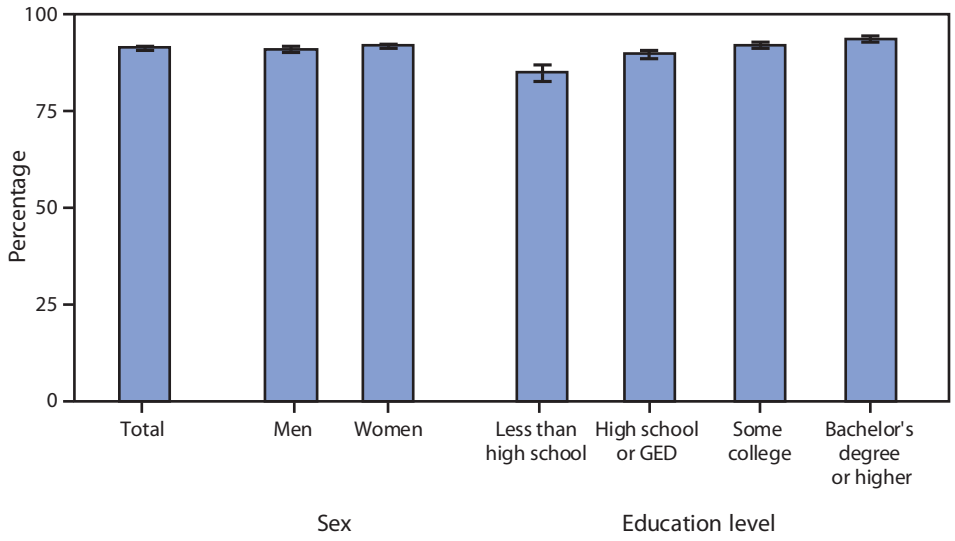
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Adults Aged ≥25 Years Who Had Seen a Health Care Professional in the Past 12 Months and Who Easily Understood Information from Their Health Care Providers Most or All of the Time,† by Sex and Education Level — National Health Interview Survey,§ United States, 2017



Abbreviation: GED = general educational development certificate.
* With 95% confidence intervals indicated by error bars.
† Based on the response to survey questions that asked "How often did your health care providers tell or give you information about your health and health care that was easy to understand? Would you say always, most of the time, some of the time, or none of the time?" Response categories "always" and "most of the time" were combined and displayed. Adults who had not seen a doctor in the past 12 months were excluded from these estimates.
§ Estimates were based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and were derived from the National Health Interview Survey Sample Adult component.

In 2017, 91.6% of adults aged ≥25 years easily understood information from their health care providers most or all of the time. The percentage of adults who easily understood health care information most or all of the time increased as education level increased. Adults who had completed a bachelor's degree or higher were the most likely to understand their health care providers at least most of the time (93.9%), whereas those without a high school diploma were the least likely (85.2%). Men (91.0%) were somewhat less likely than women (92.1%) to have easily understood information from providers most or all of the time.

Source: National Health Interview Survey, 2017. https://www.cdc.gov/nchs/nhis.htm.

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