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Brain Injury Awareness Month — March 2020

Brain Injury Awareness Month, recognized each March, provides an important opportunity to bring attention to the prevention of traumatic brain injury (TBI) and to promote strategies to improve the quality of life for persons living with TBI and their families.

TBIs, caused by an impact or force to the head or body or a penetrating injury to the head, affect millions of U.S. persons each year (*1*). Falls are a leading mechanism of TBI, and older adults are at increased risk for sustaining a TBI and experiencing TBI-associated adverse outcomes (*1*,*2*). A report in this issue of *MMWR* found a nationwide 17% increase in the rate of fall-related TBI deaths during 2008–2017, with increases in most states (*3*). The largest increases in fall-related TBI deaths occurred among persons aged ≥75 years.

Evidence-based prevention efforts to decrease falls are important to reducing the incidence and prevalence of TBI among older adults. CDC's STEADI (Stopping Elderly Accidents, Deaths & Injuries; https://www.cdc.gov/steadi/index.html) initiative includes resources and tools for health care providers to improve identification of patients at risk for a fall, as well as effective strategies to reduce the risk for fall-related injuries, including TBI.

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Deaths from Fall-Related Traumatic Brain Injury — United States, 2008–2017

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One in 10 U.S. residents aged ≥18 years reports falling each year (*1*). Among all age groups, falls can cause serious injury and are the second leading cause of traumatic brain injury (TBI)–related deaths (*2*). TBI is a head injury caused by a bump, blow, or jolt to the head or body or a penetrating head injury that results in disruption of normal brain function.* CDC estimated national and state-specific rates and trends for TBI-related deaths (TBI deaths) caused by unintentional falls (fall-related TBI deaths) among U.S. residents during 2008–2017, by selected decedent characteristics. The national age-adjusted rate of fall-related TBI deaths increased by 17%

* https://www.cdc.gov/traumaticbraininjury/index.html.

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from 2008 to 2017. Rate trends at the national level increased significantly for nearly all decedent characteristics, with the most notable increases observed among persons living in noncore (i.e., most rural), nonmetropolitan counties and those aged ≥75 years. Analysis of state-specific rate trends determined that rates of fall-related TBI deaths increased significantly in 29 states over the 10-year study period. A fall can happen to anyone of any age, but falls are preventable. Health care providers and the public need to be aware of evidence-based strategies to prevent falls, given that rates of fall-related TBI deaths are increasing. Health care providers can educate patients on fall and TBI prevention, assess their risk for falls, and when needed, encourage participation in appropriate evidence-based fall prevention programs.[†]

National Vital Statistics System multiple-cause-of-death database on death certificates filed in 50 states and the District of Columbia (DC) were analyzed to determine the incidence of fall-related TBI deaths among U.S residents by year, decedent characteristics (sex, age group, race/ethnicity, and urban/rural residence classification status[§]), and state of residence. To identify cases, an initial screen for *International Classification of Diseases, Tenth Revision* (ICD-10) underlying-cause-of-death codes in the range W00–W19 was performed, indicating an unintentional fall as the underlying cause of death. A fall-related death was further identified as a TBI death when any of the ICD-10 multiple-cause-of-death codes indicated a TBI-related diagnosis (*2*).[¶] Study years 2008–2017 were selected to support estimation of 10-year national and state-specific trends.

Annual death rates and accompanying 95% confidence intervals (CIs) were calculated per 100,000 population by integrating the National Vital Statistics System data with U.S. bridged-race population estimates.[**] With the exception of age-group rates, death rates were age-adjusted to the U.S. year 2000 standard age distribution. National and state-specific rate trends of fall-related TBI deaths were modeled using Joinpoint regression software (version 4.6.0.0; National Cancer Institute) to estimate average annual percent changes (AAPCs) for the 10-year study period. AAPCs were considered statistically significant at $\alpha = 0.05$.

During 2008–2017, the national age-adjusted rate of fall-related TBI deaths increased by 17%, from 3.86 per 100,000 persons to 4.52 (Table 1), representing 17,408 fall-related TBI deaths in 2017. State-specific age-adjusted rates ranged from 2.25 (Alabama) to 9.09 (South Dakota) during 2017 (Figure). Considering only the study endpoint years (2008 and 2017), the number of fall-related TBI deaths increased

[†] https://www.cdc.gov/homeandrecreationalsafety/pdf/falls/cdc_falls_compendium-2015-a.pdf.
[§] https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf.

[¶] TBI injury-related diagnosis codes identified by ICD-10 include S01.0–S01.5, S01.7–S01.9, S02.0–S02.1, S02.3, S02.7–S02.9, S04.0, S06.0–S06.9, S07.0–S07.1, S07.8–S07.9, S09.7–S09.9, T90.1–T90.2, T90.4–T90.5, T90.8–T90.9.
[**] https://www.cdc.gov/nchs/nvss/bridged_race.htm.

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TABLE 1. Number* and rate† of traumatic brain injury–related deaths caused by unintentional falls — United States, 2008–2017§

Year	No. of deaths	Rate (95% CI)
2008	12,311	3.86 (3.80–3.93)
2009	12,804	3.94 (3.87–4.01)
2010	13,386	4.05 (3.98–4.12)
2011	13,632	4.02 (3.95–4.09)
2012	14,272	4.12 (4.05–4.19)
2013	15,064	4.26 (4.19–4.33)
2014	15,918	4.40 (4.33–4.47)
2015	16,258	4.42 (4.35–4.49)
2016	16,694	4.44 (4.37–4.51)
2017	17,408	4.52 (4.45–4.59)

Abbreviation: CI = confidence interval.
* Numbers exclude decedents with unknown age.
† Deaths per 100,000 population, age-adjusted to the 2000 U.S. standard population; decedents with unknown age were excluded.
§ Based on multiple-cause-of-death data from the National Center for Health Statistics (NCHS) Vital Statistics System (https://www.cdc.gov/nchs/nvss/deaths.htm) and NCHS Bridged-Race Population data (https://www.cdc.gov/nchs/nvss/bridged_race.htm).

Summary

What is already known about this topic?

Falls can cause serious injuries, including a traumatic brain injury (TBI). Unintentional falls represent the second leading cause of TBI-related death.

What is added by this report?

The national age-adjusted rate of fall-related TBI deaths increased by 17% from 2008 to 2017; rates increased significantly in 29 states and among nearly all groups, most notably persons living in noncore nonmetropolitan counties and those aged ≥75 years.

What are the implications for public health practice?

Health care providers can educate patients about falls and TBIs, assess fall risk, and encourage participation in evidence-based fall prevention programs. Annual wellness visits might serve as a time to review previously assessed fall risk factors and update personalized prevention plans.

in 49 of 51 jurisdictions (50 states and DC), and corresponding age-adjusted rates increased in 45 of these 49 jurisdictions (Supplementary Table, https://stacks.cdc.gov/view/cdc/85245). The largest AAPCs in rates of fall-related TBI deaths occurred in Maine (6.5%), South Dakota (6.1%), and Oklahoma (5.2%). A significant increase in rates occurred in 29 states (Arkansas, California, Colorado, Connecticut, Florida, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, Nevada, New Hampshire, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Virginia, and Wisconsin). The remaining 21 states and DC experienced no significant change in rates.

During 2017, national rates of fall-related TBI death were highest among persons aged ≥75 years (54.08 per 100,000) and males (6.31) (Table 2). Notably, the rate among persons aged ≥75 years was approximately eight times higher than that among those aged 55–74 years (6.24), and the rate among males was nearly double that of females (3.17). For the period 2008 to 2017, significantly increasing rate trends in fall-related TBI deaths were identified for both males and females, persons aged ≥55 years, non-Hispanic whites, non-Hispanic blacks, and Hispanics, and across all levels of urbanization. The largest modeled rate increases occurred among persons living in noncore nonmetropolitan counties (AAPC = 2.9%) and those aged ≥75 years (AAPC = 2.6%). The only significantly decreasing national rate trend identified was for persons aged 0–17 years (AAPC = –4.3%).

Discussion

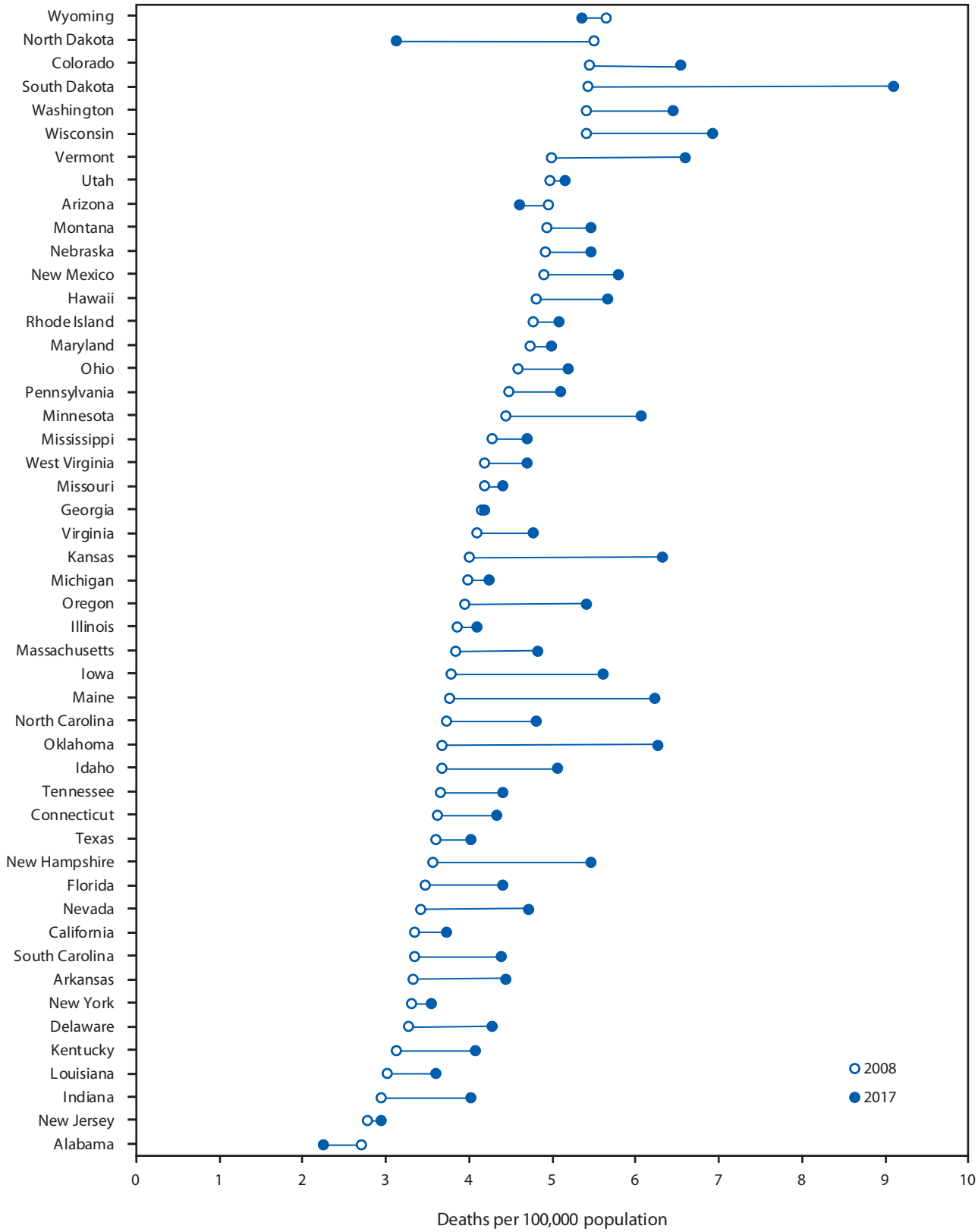
Nationally, nearly 17,500 fall-related TBI deaths occurred during 2017, and state-specific age-adjusted rates ranged from 2.25 (Alabama) to 9.09 (South Dakota). The rate of this health event significantly increased during 2008–2017 in 29 states, and the national rate increased by 17%. This increase in the national rate of fall-related TBI deaths is consistent with findings from a recent CDC surveillance report that estimated a 22% increase in this health event during 2006–2014.††

Variations in the rate of fall-related TBI deaths among states might have partially resulted from urban and rural differences in the risk of traumatic injury mortality (*3*). U.S. rural regions experience a higher rate of TBI-related mortality (*4*), and heterogeneity in the availability and accessibility of resources (e.g., access to high-level trauma centers and rehabilitative services) can result in disparities in post-injury outcomes (*5*). Over the 10-year study period, noncore, nonmetropolitan counties experienced the most rapidly increasing rates. These results are consistent with previous findings of higher TBI-related mortality rates among nonmetropolitan counties compared with those in metropolitan counties across the United States (*4*).

During 2017, the rate of fall-related TBI deaths was higher among males; this finding might result from circumstances of the falls, such as a higher proportion of men falling from heights (e.g., ladders) (*6*) leading to moderate or severe injuries, including a TBI. The highest rate of fall-related TBI deaths in 2017 was among adults aged ≥75 years, and over the study period, this group experienced the largest increase in rates among all age groups, consistent with older age being a major risk factor for falls (*7*). CDC's Stopping Elderly Accidents, Deaths, & Injuries (STEADI)§§ initiative can aid health care providers in screening older patients for risk for falls, assessing

†† https://www.cdc.gov/traumaticbraininjury/data/tbi-deaths.html.
§§ https://www.cdc.gov/steadi/.

FIGURE. Age-adjusted* rate of traumatic brain injury–related deaths caused by unintentional falls, by state† — United States, 2008 and 2017



* Age-adjusted to the 2000 U.S. standard population.
† Forty-nine states; Alaska and the District of Columbia not shown because total case count was <20.

TABLE 2. Numbers* and rates† of traumatic brain injury–related deaths caused by unintentional falls, by decedent characteristics — United States, 2008 and 2017§

Characteristic	2008		2017		2008–2017 rate trend AAPC (95% CI)
	No. of deaths	Rate (95% CI)	No. of deaths	Rate (95% CI)	
Total	**12,311**	**3.86 (3.80 to 3.93)**	**17,408**	**4.52 (4.45 to 4.59)**	**1.8¶ (1.5 to 2.1)**
Sex					
Male	7,129	5.49 (5.36 to 5.62)	10,180	6.31 (6.19 to 6.44)	1.6¶ (1.3 to 2.0)
Female	5,182	2.69 (2.61 to 2.76)	7,228	3.17 (3.09 to 3.24)	1.9¶ (1.5 to 2.4)
Age group (yrs)**					
0–17	75	0.10 (0.08 to 0.12)	54	0.07 (0.05 to 0.09)	−4.3¶ (−7.6 to −0.9)
18–34	304	0.43 (0.38 to 0.48)	295	0.39 (0.34 to 0.43)	−1.1 (−3.0 to 0.8)
35–54	1,241	1.43 (1.35 to 1.51)	1,137	1.37 (1.29 to 1.45)	−0.3 (−1.2 to 0.5)
55–74	2,855	5.22 (5.03 to 5.41)	4,470	6.24 (6.05 to 6.42)	1.8¶ (1.4 to 2.3)
≥75	7,836	42.89 (41.94 to 43.83)	11,452	54.08 (53.09 to 55.07)	2.6¶ (2.0 to 3.2)
Race/Ethnicity††					
White	10,501	4.09 (4.01 to 4.17)	14,472	4.90 (4.82 to 4.98)	2.1¶ (1.7 to 2.4)
Black	581	1.99 (1.82 to 2.16)	844	2.29 (2.13 to 2.45)	1.6¶ (0.2 to 3.1)
AI/AN	68	4.13 (3.08 to 5.18)	121	5.16 (4.20 to 6.11)	1.0 (−1.9 to 4.1)
A/PI	361	3.61 (3.22 to 3.99)	645	3.68 (3.39 to 3.97)	0.3 (−0.7 to 1.3)
Hispanic	777	3.23 (2.98 to 3.48)	1,282	3.51 (3.31 to 3.71)	1.2¶ (0.3 to 2.0)
Not stated	23	NA§§	44	NA§§	NA§§
Level of urbanization					
Large central metro	3,320	3.77 (3.64 to 3.90)	4,604	4.31 (4.18 to 4.44)	1.4¶ (1.2 to 1.6)
Large fringe metro	2,946	3.90 (3.76 to 4.05)	4,051	4.31 (4.17 to 4.44)	1.4¶ (0.5 to 2.3)
Medium metro	2,673	3.96 (3.81 to 4.11)	3,889	4.72 (4.57 to 4.87)	2.1¶ (1.5 to 2.7)
Small metro	1,181	3.76 (3.54 to 3.97)	1,791	4.76 (4.54 to 4.98)	2.2¶ (1.4 to 3.1)
Micropolitan (nonmetro)	1,292	4.10 (3.87 to 4.33)	1,793	4.98 (4.75 to 5.22)	2.1¶ (1.5 to 2.8)
Noncore (nonmetro)	899	3.65 (3.41 to 3.89)	1,280	4.60 (4.34 to 4.86)	2.9¶ (2.5 to 3.4)

Abbreviations: AAPC = average annual percent change; AI/AN = American Indian/Alaska Native; A/PI = Asian or other Pacific Islander; CI = confidence interval; NA = not available.

* Numbers exclude decedents with unknown age.

† Per 100,000 population, age-adjusted to the 2000 U.S. standard population; rates exclude decedents with unknown age.

§ Based on multiple-cause-of-death data from the National Center for Health Statistics (NCHS) Vital Statistics System (https://www.cdc.gov/nchs/nvss/deaths.htm) and NCHS Bridged-Race Population data (https://www.cdc.gov/nchs/nvss/bridged_race.htm).

¶ Statistically significant at α = 0.05.

** Age group rates are not age-adjusted.

†† Whites, blacks, AI/ANs, and A/PIs were non-Hispanic; Hispanics could be of any race.

§§ Accompanying rates are not available because of lack of corresponding population denominator data.

modifiable risk factors, and intervening to reduce risk using effective interventions. Health care providers might consider prescribing exercises that incorporate balance, strength and gait activities, such as tai chi, and reviewing and managing medications linked to falls (*8*). Actions the public can take to prevent falls include talking to their health care provider about their or their parents' risk for falls, performing strength and balance exercises, having an annual eye exam, and making the home safer (e.g., removing tripping hazards).

The findings in this report are subject to at least three limitations. First, estimated annual rates and trends in rates of fall-related TBI deaths might be affected by misclassification or incomplete reporting of the cause of death on death certificates, which could lead to overestimation or underestimation of this health event (*9*). Second, misclassification of race and ethnicity on death certificates is a common occurrence, particularly for American Indian/Alaska Native, Asian/Pacific Islander, and Hispanic populations and could lead to an underestimation of deaths among these populations (*10*). Finally, in cases of multiple trauma, non-TBI diagnoses might have also contributed to deaths included in the analysis.

A fall can happen to anyone of any age and can cause serious injuries, including a TBI. Although falls are preventable, the public should be aware that fall-related TBI deaths are increasing in many states as well as nationally. Nationally, this increase might be explained by longer survival following the onset of common diseases such as stroke, cancer, and heart disease¶¶ or be attributable to the increasing population of older adults*** in the United States. In older adults, evidence-based fall prevention strategies can prevent falls and avert costly medical expenditures (*8*). Additional research is needed to determine the magnitude of medically treated falls that could be prevented

¶¶ https://www.sciencedirect.com/science/article/pii/S002243750600051X?via%3Dihub.

*** https://www.census.gov/prod/2014pubs/p25-1140.pdf.

and direct medical costs that could be averted by employing evidence-based fall prevention strategies in other age groups. Nonetheless, annual wellness visits might serve as a time to focus on previously assessed risk factors for falls and to update personalized prevention plans.

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Student-Reported School Safety Perceptions, Connectedness, and Absenteeism Following a Multiple-Fatality School Shooting — Broward County, Florida, February 14–21, 2018

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From July 2009 to June 2018, the rates of multiple-victim, school-associated homicides in the United States fluctuated substantially, with evidence of a significant increase in recent years (*1*). Data on the effects of such incidents on students' school attendance and perceptions of safety and connectedness are limited (*2*,*3*) but important. This study used data from a neighboring within-district school before and after a multiple-fatality shooting at Marjory Stoneman Douglas High School in Parkland, Florida, on February 14, 2018. Self-administered questionnaires were completed by one group of students on February 14 just before the shooting (575) and another group during February 15–21 (502); demographics for these groups appeared similar. Linear and logistic regression analyses controlling for demographic characteristics explored differences between groups for safety-related perceptions or experiences, school connectedness, and absenteeism. Compared with students surveyed before the shooting, students surveyed in the days immediately following the shooting had lower odds of feeling safe at school, higher odds of absenteeism, and higher school connectedness scores. Findings suggest the shooting had an immediate, sizeable effect on safety perceptions and absenteeism among students in a neighboring school. Findings also suggest higher school connectedness following the shooting. Further study of school connectedness, including how to enhance and sustain it, might help schools and communities better respond to traumatic events in the community.

Data were collected from a census of students in one high school participating in an ongoing evaluation project in Broward County Public Schools. Data collection was to be split over 2 days, February 14–15, 2018; however, Marjory Stoneman Douglas High School, a within-district neighboring school, experienced a school shooting resulting in 17 homicides and 17 additional persons injured on February 14.* Data collection that day was completed before the shooting occurred. Remaining data collection, originally scheduled for February 15, occurred February 15–21 at the discretion of school administration.

Teachers proctored a 47-item, voluntary, anonymous, paper-and-pencil questionnaire during personalization periods.† Approximately half the periods received questionnaires as scheduled on February 14, and remaining periods completed questionnaires within 1 week. Passive parental consent forms were sent home in advance; students who did not assent or whose parents opted them out did not participate. Response rates, calculated from enrollment, were 49.0% overall (53.1% and 44.9% for February 14 and 15–21, respectively). Questionnaires missing >25% of responses (29) were not analyzed. The Institutional Review Board at ICF, the research and evaluation firm contracted to conduct the original evaluation, approved the project, following CDC ethics guidelines.§

This analysis focuses only on responses to questions about safety-related perceptions/experiences, school connectedness, and absenteeism from a larger questionnaire. Safety-related indicators included feeling safe at school and avoiding school spaces because of feeling uncomfortable or unsafe. School connectedness was measured by the average score of a 5-item scale (range = 1–5; 5 reflects greatest connectedness), based on a valid and reliable school connectedness scale used elsewhere (*4*). Scale indicators included feeling close to people at school, feeling accepted and belonging at school, feeling happy at school, believing staff members at school treat students fairly, and believing staff members at school care about them. Responses were dichotomized, reflecting responses of "strongly agree" or "agree" for individual indicator analysis. Absenteeism was assessed with two indicators: that the student did not go to school for ≥1 day in the past 30 days, and that the student did not go to school for ≥1 day in the past 30 days because of feeling unsafe.

Variable frequencies were calculated for students surveyed before the shooting and those surveyed after. Chi-squared tests and a t-test assessed differences between administration groups. Logistic and linear regression models adjusting for sex, age, and race/ethnicity tested differences between groups for

*https://www.npr.org/2019/02/14/694688365/we-live-with-it-every-day-parkland-community-marks-one-year-since-massacre.

† Personalization periods are similar to traditional study halls and are designated class periods in which all students are expected to enroll.

§ https://www.cdc.gov/os/integrity/hrpo/regAndGuidance.htm.

all safety, connectedness, and absenteeism variables.[¶] Analyses were conducted using SPSS (Statistics Subscription; IBM).

Participants comprised 1,077 students, including 575 (53.4%) surveyed before the shooting and 502 (46.6%) surveyed after. Chi-squared tests revealed no significant demographic differences between students surveyed before and after the shooting, with a slight overrepresentation of Hispanic students (Table 1); however, there were significant differences for one of two safety-related variables, three of five school connectedness variables, and both absenteeism variables. In addition, a t-test revealed a significant difference in average school connectedness. Differences were further explored through adjusted regression models (Table 2). Logistic regressions revealed that students surveyed after the shooting, compared with those surveyed before, had significantly lower odds of feeling safe at school (adjusted odds ratio [AOR] = 0.48; 95% confidence interval [CI] = 0.36–0.63), but significantly higher odds of reporting feeling happy at school (AOR = 1.58; 95% CI = 1.23–2.02), believing staff members at school treat students fairly (AOR = 1.46; 95% CI = 1.14–1.87), and believing staff members at school care about them (AOR = 1.38; 95% CI = 1.08–1.76). In addition, students surveyed after the shooting had significantly higher odds of not going to school for ≥1 day in the past 30 days (AOR = 2.06; 95% CI = 1.55–2.74) and missing school ≥1 day in the past 30 days because they felt unsafe (AOR = 7.18; 95% CI = 4.87–10.60). Linear regression results found that students surveyed after the shooting had significantly higher average school connectedness scores (mean = 3.35) than those before the shooting (mean = 3.22) (Table 1) (regression coefficient [B] = 0.125; standard error = 0.05; 95% CI = 0.03–0.22) (Table 2).

Discussion

From July 2009 to June 2018, rates of multiple-victim, school-associated homicides increased in the United States (*1*), yet data surrounding these events are limited. Findings of this study provide unique insight into students' perceptions and experiences following a school shooting. Findings revealed an immediate, detrimental difference to perceived school safety and attendance among students following a shooting in a nearby school. Compared with students surveyed before the shooting, students surveyed after the shooting had approximately one half the odds of reporting feeling safe at school, twice the odds of reporting general absenteeism, and seven times the odds of reporting absenteeism because they felt unsafe.

Other research has shown that students' fear and absenteeism were higher after the 1999 Columbine school shooting (*2*,*3*). These studies, using national samples, reported generally consistent findings, but of a smaller magnitude than the current study's findings. The larger magnitudes in this study might be partially explained by closer temporal and physical proximity of students to the event, because physical proximity to or social distance from traumatic events influences their impact (*2*,*5*).

These findings show that a school shooting's effects extend beyond the school where it occurred. Students could have been influenced by factors such as degree of exposure, media coverage, number of victims known, and perceived similarity to victims, which have been associated with general distress and acute stress immediately following traumatic events (*5*).

Results also suggest possible strengthening of overall school connectedness and three of five connectedness indicators. Students surveyed after the shooting had 37%–57% higher odds of reporting feeling happy at school, that school staff members cared about them, and that school staff members treated students fairly. This aligns with literature documenting increased social solidarity following traumatic events that impact communities collectively (*6*,*7*). Following the shooting, the studied school gave students opportunities to discuss the incident with classmates and staff members. The school implemented an open-door policy for students and staff members to visit administrators or counselors at any time, fostered efforts of student-led clubs and organizations to support Marjory Stoneman Douglas High School students and staff members, and explored strategies to make their own school safer. These opportunities might have fostered increased connectedness, which might provide, at least in the short term, a protective buffer against negative posttrauma impacts. Activating existing support networks can help support individuals following trauma (*8*), and promoting connectedness can have numerous benefits,[**] including a beneficial effect on youths' risk for interpersonal violence and suicide (*9*).

The findings in this study are subject to at least four limitations. First, cross-sectional data do not allow before and after comparisons of the same students or long-term follow-up. Second, students could not be randomly assigned to "before" or "after" conditions; however, demographic characteristics of the two administration groups were similar. Third, data collection might have been affected by students' absences attributable to the shooting. Questionnaire administration records estimate absenteeism of 28% and 33% during the first and second administration groups, respectively. Connectedness estimates could be inflated if less connected students were absent, and

[¶] Average school connectedness was examined using a t-test and linear regression. All other variables, including specific school connectedness indicators, were examined using chi-squared tests and logistic regression models.

[**] https://www.cdc.gov/healthyyouth/protective/school_connectedness.htm.

TABLE 1. Demographic characteristics and safety-related perceptions/experiences, school connectedness, and absenteeism characteristics of students surveyed before and after a school shooting — 2018 Youth Health and School Climate Survey, Broward County, Florida, February 14–21, 2018

Characteristic	No. (%)		Chi-squared or t-test results[§]	p-value
	Students surveyed before the shooting (n = 575)*	Students surveyed after the shooting (n = 502)[†]		
Sex				
Female	288 (50.3)	253 (50.6)	0.01	0.91
Male	285 (49.7)	247 (49.4)		
Age (yrs)				
≤12	6 (1.0)	2 (0.4)	6.63	0.36
13	0 (0.0)	2 (0.4)		
14	70 (12.2)	74 (14.7)		
15	151 (26.4)	133 (26.5)		
16	137 (24.0)	123 (24.5)		
17	141 (24.7)	106 (21.1)		
≥18	67 (11.7)	62 (12.4)		
Race/Ethnicity				
Black, non-Hispanic	153 (26.9)	125 (25.1)	5.13	0.16
Hispanic	337 (59.3)	287 (57.5)		
White, non-Hispanic	45 (7.9)	40 (8.0)		
Other or multiracial, non-Hispanic	33 (5.8)	47 (9.4)		
Safety-related perceptions/experiences				
Feel safe at school[¶]	437 (78.7)	313 (64.4)	26.44	<0.001
Avoid spaces at school attributable to feeling uncomfortable or unsafe**	85 (16.2)	73 (15.8)	0.02	0.88
School connectedness				
Feel close to people at school[††]	264 (46.2)	225 (45.3)	0.08	0.77
Feel accepted and like I belong at school[§§]	300 (52.7)	283 (56.6)	1.61	0.20
Feel happy at school[¶¶]	218 (38.4)	249 (49.7)	13.69	<0.001
Staff members at school treat students fairly***	222 (39.4)	240 (48.4)	8.74	<0.01
Staff members at school care about me[†††]	246 (43.7)	254 (51.4)	6.30	0.01
Average school connectedness score, mean (SD)[§§§]	3.22 (0.78)	3.35 (0.75)	2.65	<0.01
Absenteeism				
Did not go to school for ≥1 day in the past 30 days, mean (SD)[¶¶¶]	373 (65.7)	391 (79.1)	23.79	<0.001
Did not go to school for ≥1 day in the past 30 days because of feeling unsafe, mean (SD)****	41 (11.0)	178 (46.2)	114.09	<0.001

Abbreviation: SD = standard deviation.

* Students were surveyed on February 14, the day of, but before, the shooting at another school in the district.

† Students were surveyed after February 14 and within 1 week of the shooting at another school in the district.

§ School connectedness differences tested with a t-test; all other differences tested using chi-squared tests. Statistical tests were considered significant if p<0.05.

¶ Question asked: "Do you feel safe at your school?" (response options: yes and no).

** Question asked: "Do you avoid spaces at school because you feel uncomfortable or unsafe in the space?" (response options: yes and no).

†† Reflects responses of "strongly agree" or "agree" to the statement "I feel close to people at this school" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

§§ Reflects responses of "strongly agree" or "agree" to the statement "I am accepted and feel like I belong at this school" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

¶¶ Reflects responses of "strongly agree" or "agree" to the statement "I feel happy at this school" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

*** Reflects responses of "strongly agree" or "agree" to the statement "Staff (such as a teacher, counselor, nurse, coach, or other school staff) at this school treats students fairly" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

††† Reflects responses of "strongly agree" or "agree" to the statement "Staff (such as a teacher counselor, nurse, coach, or other school staff) at this school care about me" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

§§§ Overall school connectedness score is an average of the 5 school connectedness items (range = 1–5). Scores >3 reflect a positive perception of school connectedness.

¶¶¶ Question asked: "During the past 30 days, on how many days did you not go to school" (response options: 0 days, 1 day, 2 or 3 days, and 4 or more days).

**** Question asked: "During the past 30 days, on how many days did you not go to school because you felt unsafe at school or on your way to or from school?" (response options: 0 days, 1 day, 2 or 3 days, and 4 or more days).

absenteeism and safety-related findings might be underestimates. Finally, the overall response rate of <50% could affect generalizability of the findings. Compared with enrollment records, the sample's demographic patterns were similar to that of the school.

Despite these limitations, this study has important strengths. It reports on school connectedness, a construct yet to be examined following school shootings. Furthermore, the studied sample comprises primarily black and Hispanic students, rather

TABLE 2. Association between survey administration time point* and safety-related perceptions/experiences, school connectedness, and absenteeism, adjusted for sex, age, and race/ethnicity (logistic and linear regression analyses†) — 2018 Youth Health and School Climate Survey, Broward County, Florida, February 14–21, 2018

Characteristic	AOR or B (SE)	(95% CI)	p-value
Logistic regression results† (AOR)			
Safety-related perceptions/experiences			
Feel safe at school§	0.48	(0.36–0.63)	<0.001
Avoid spaces at school attributable to feeling uncomfortable or unsafe¶	0.95	(0.67–1.34)	0.76
School connectedness			
Feel close to people at school**	0.97	(0.76–1.24)	0.80
Feel accepted and like I belong at school††	1.18	(0.92–1.51)	0.19
Feel happy at school§§	1.58	(1.23–2.02)	<0.001
Staff members at school treat students fairly¶¶	1.46	(1.14–1.87)	<0.01
Staff members at school care about me***	1.38	(1.08–1.76)	0.01
Absenteeism			
Did not go to school 1 or more days in the past 30 days†††	2.06	(1.55–2.74)	<0.001
Did not go to school 1 or more days in the past 30 days because of feeling unsafe§§§	7.18	(4.87–10.60)	<0.001
Linear regression results† (B [SE])			
School connectedness			
Average school connectedness score	0.13 (0.05)	(0.03–0.22)	<.01

Abbreviations: AOR = adjusted odds ratio; B = regression coefficient; CI = confidence interval; SE = standard error.

* For the first administration, students were surveyed on February 14 (the day of, but before, the shooting at another school in the district). For the second administration, students were surveyed after February 14 and within 1 week of the shooting at another school in the district.

† Regressions controlled for sex, age (used as a continuous variable), and race/ethnicity (four categories, with white, non-Hispanic as the referent). Statistical tests were considered significant if p<0.05. The administration time point indicator was coded as zero for students surveyed before the shooting (on February 14; referent group), and 1 for students surveyed after the shooting (after February 14).

§ Question asked: "Do you feel safe at your school?" (response options: yes and no).

¶ Question asked: "Do you avoid spaces at school because you feel uncomfortable or unsafe in the space?" (response options: yes and no).

** Reflects responses of "strongly agree" or "agree" to the statement "I feel close to people at this school" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

†† Reflects responses of "strongly agree" or "agree" to the statement "I am accepted and feel like I belong at this school" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

§§ Reflects responses of "strongly agree" or "agree" to the statement "I feel happy at this school" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

¶¶ Reflects responses of "strongly agree" or "agree" to the statement "Staff (such as a teacher, counselor, nurse, coach, or other school staff) at this school treats students fairly" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

*** Reflects responses of "strongly agree" or "agree" to the statement "Staff (such as a teacher counselor, nurse, coach, or other school staff) at this school care about me" (response options: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree).

††† Question asked; "During the past 30 days, on how many days did you not go to school" (response options: 0 days, 1 day, 2 or 3 days, and 4 or more days).

§§§ Question asked: "During the past 30 days, on how many days did you not go to school because you felt unsafe at school or on your way to or from school?" (response options: 0 days, 1 day, 2 or 3 days, and 4 or more days).

than predominately white students as often has been found in studies following similar events (*8*).

Collectively, findings underscore the immediate, detrimental effect on students' safety perceptions and absenteeism following a multiple-fatality shooting at a neighboring school, suggesting trauma-informed supports might be beneficial for students attending schools near sites of school shootings. Findings also suggest a measurable shift in school connectedness following the shooting, possibly from formal and informal efforts to provide, and spontaneous instances of, social support and solidarity, which might buffer trauma-related impacts. Further study of school connectedness, including how to enhance and sustain it, might help schools and communities better respond to traumatic events in the community.

Summary

What is already known about this topic?

Limited research has shown increases in students' fear and absenteeism in the aftermath of school shootings. However, no study has examined students in an affected district immediately before and after a school shooting.

What is added by this report?

Detrimental changes to perceived school safety and absenteeism and an increase in school connectedness were identified among Florida high school students in one school immediately following a shooting at a nearby school.

What are the implications for public health practice?

Findings suggest a need for trauma-informed supports for students attending schools near sites of school shootings. Increasing school connectedness, through formal and informal efforts, in addition to spontaneous instances of social support and solidarity, might help buffer trauma-related impacts.

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E-cigarette, or Vaping, Product Use–Associated Lung Injury Among Clusters of Patients Reporting Shared Product Use — Wisconsin, 2019

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On July 10, 2019, Wisconsin Department of Health Services (WDHS) was notified of five previously healthy adolescents with severe lung injuries who reported use of e-cigarette, or vaping, products before symptom onset. As of December 31, 2019, 105 confirmed or probable cases of e-cigarette, or vaping, product use–associated lung injury (EVALI)* had been reported to WDHS . Three social clusters (A, B, and C), comprising eight EVALI patients (cluster A = two patients, cluster B = three, and cluster C = three) were identified. WDHS investigated these clusters with standard and follow-up interviews; laboratory analysis of e-cigarette, or vaping, products; and analysis of bronchoalveolar lavage (BAL) fluid. All eight patients reported daily use of tetrahydrocannabinol (THC)-containing e-cigarette, or vaping, product cartridges (THC cartridges) in the month preceding symptom onset. All THC cartridges were purchased from local illicit dealers, and all patients reported using THC cartridges labeled as "Dank Vapes," among other illicit brand names. At least two members of each cluster reported frequent sharing of THC cartridges before symptom onset. All eight patients also reported daily use of nicotine-containing e-cigarette, or vaping, products. Vitamin E acetate (VEA) was detected in all five THC cartridges tested from two patients, and in BAL fluid from two other patients. These findings suggest that THC cartridges containing VEA and sold on the illicit market were likely responsible for these small clusters of EVALI. Based on information presented in this and previous reports (*1*,*2*) CDC recommends not using THC-containing e-cigarette, or vaping, products, especially those obtained from informal sources such as friends, family, or in-person or online dealers (*1*). VEA is strongly linked to the EVALI outbreak and should not be added to e-cigarette, or vaping, products (*1*).

A cluster was defined as two or more patients with confirmed or probable EVALI who directly shared e-cigarette, or vaping, products; obtained products from the same source; or reported a social connection and use of the same e-cigarette, or vaping, product brand names in the 3 months preceding symptom onset. All patients were interviewed by telephone using a standard EVALI questionnaire developed by WDHS, and five of the eight cluster-associated patients (A = one, B = three, C = one) completed in-depth follow-up telephone interviews to provide additional product use details. This included, for each product used, the dates of initiation and cessation, frequency and amount used, and the extent of sharing with other EVALI patients. In addition to interviews, one patient in cluster A and two patients in cluster C submitted a total of 11 e-cigarette, or vaping, products that were tested for the presence of VEA and other additives† by the Food and Drug Administration (FDA), and BAL fluid from two patients (one each from cluster B and cluster C) were analyzed by CDC (*3*).§

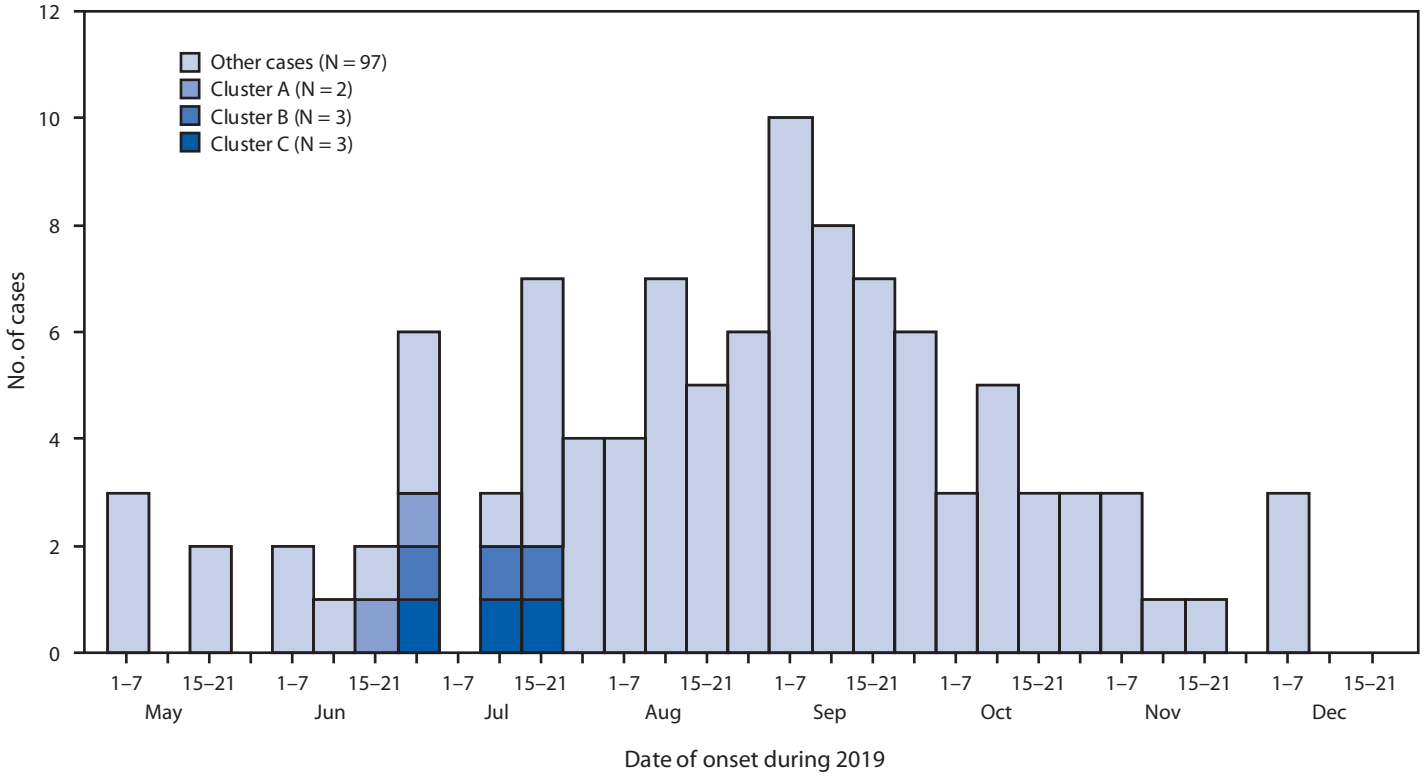
Symptom onset for these eight patients ranged from June 18 through July 21, 2019 (Figure 1). Patients were aged 16–20 years (median = 17 years), and six were male. All eight patients reported daily use of THC cartridges purchased from local illicit dealers in the month before symptom onset. This included use of the Dank Vapes brand by all patients and an average of 2.6 unique brands of illicit THC cartridges per patient (range = one to five brands) (Table). At least two patients in each cluster reported frequent sharing of THC cartridges in the month preceding symptom onset, including concurrent use of the same cartridge in the same device (Table). On average, patients reported inhaling approximately one half of a 1-g THC cartridge daily (range = 0.2–1 cartridge per day) in the month before symptom onset; two patients (one in cluster B and one in cluster C) reported that this was more than usual for them. All patients also reported daily use of nicotine-containing e-cigarette, or vaping, products. These included commercial pods and refillable e-liquids purchased from retail

* https://www.cdc.gov/tobacco/basic_information/e-cigarettes/assets/2019-Lung-Injury-Surveillance-Case-Definition-508.pdf.

† FDA testing of 11 e-cigarette, or vaping, products included nontargeted testing with Fourier Transform Infrared Spectroscopy (10 products); gas chromatography mass spectrometry (GC-MS) (seven); and headspace GC-MS (three) to detect the presence of VEA, THC, and other compounds available in four chemical libraries (Aldrich Condensed Phase Library, High Resolution Nicolet Sampler Library, Wiley/ National Institute of Standards and Technology Library, and Designer Drug Library). Targeted testing included high-performance liquid chromatography with ultraviolet detection for nicotine (one) and cannabinoids (three); high-pressure liquid chromatography-ultraviolet, inductively coupled plasma mass spectrometry for heavy metals, liquid chromatography with mass spectrometry detection for synthetic cannabinoids, opioids, poisons, pesticides, and other toxins (three); fatty acid methyl ester GC-MS (two); and gas chromatography with flame ionization detection to quantify the amount of vitamin E acetate present in the sample (two).

§ Analysis of BAL fluids by CDC used isotope dilution mass spectrometry methods to evaluate the presence of specific toxicants of concern: vitamin E acetate, medium chain triglyceride oil, plant oils (long chain triglycerides), petroleum distillates (including mineral oil), diluent terpenes, cannabinoids, and nicotine.

FIGURE 1. Dates of illness onset among 105 confirmed or probable e-cigarette, or vaping, product use–associated lung injury patients, including social clusters — Wisconsin, 2019



locations or online. The amount of nicotine product use per day was not quantifiable because of variability among brands. Patients reported initiating use of THC cartridges a median of 9 months before onset of symptoms (range = <1 to 12 months) (Figure 2). Patients in cluster A initiated daily use of Dank Vapes 2–4 weeks before symptom onset, whereas patients in clusters B and C reported a longer duration of THC cartridge use before symptom onset, without changing brands or sources. All patients reported long-term use of nicotine-containing products, which were initiated a median of 33 months before symptom onset (range = 5–60 months) (Figure 2).

Eleven e-cigarette, or vaping, products from three patients were tested. All five THC cartridges collected from two patients contained VEA; one product contained nicotine, VEA, and cannabinol; none of the five commercial nicotine products collected from two patients contained VEA. None of the products tested contained significant levels of other toxicants included in the FDA testing protocol. BAL fluids were tested for two patients, and both contained VEA; no other potential toxicants were identified in these BAL fluids.

Injury severity and clinical course varied among these eight patients (Table). Six patients were hospitalized for a median of 6.5 days (range = 6–20), five were admitted to the intensive care unit, and two required mechanical ventilation. Two patients from cluster A received a diagnosis of EVALI in outpatient settings. One patient from cluster B reported persistent respiratory symptoms 3 months after discharge.

Summary

What is already known about this topic?

E-cigarette, or vaping, product use–associated lung injury (EVALI) has been linked to the use of tetrahydrocannabinol (THC)-containing products and vitamin E acetate.

What is added by this report?

Three small patient clusters in Wisconsin reported frequent, shared use of THC cartridges obtained from informal sources before symptom onset. Vitamin E acetate was detected in all five THC cartridges used by two of the patients and in bronchoalveolar lavage fluid from two other patients.

What are the implications for public health practice?

These findings support the link between vitamin E acetate and THC-containing products obtained from informal sources in EVALI cases. CDC recommends that persons not use THC-containing e-cigarette, or vaping, products, particularly from informal sources.

TABLE. Product use and clinical details for eight cluster-associated patients with e-cigarette, or vaping, product use–associated lung injury (EVALI) — Wisconsin, 2019

	Cluster A		Cluster B			Cluster C		
Patient no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Interview type	Standard	In-depth	In-depth	In-depth	In-depth	In-depth	Standard	Standard
THC product								
Brand names	Dank Vapes	Dank Vapes	Dank Vapes Cookies Dr. Zodiak Mario Carts	Dank Vapes Cookies	Dank Vapes Cookies	Dank Vapes Chronic Carts TKO	Dank Vapes Chronic Carts Supreme Off-White Monopoly	Dank Vapes Cookies Dr. Zodiak
Dose*	0.5	0.5	1	0.5	1	0.5	0.5	0.2
Months of use†	<1	<1	9	3	12	9	12	9
Product testing for VEA§	Not available for testing	2 of 2	Not available for testing	Not available for testing	Not available for testing	Not available for testing	Not available for testing	3 of 3
Social link and shared product use	Shared use¶ Same illicit dealer		Shared use¶ Same illicit dealer		Friend Same illicit dealer	Shared use¶ Same illicit dealer		Friend, Unknown source
Nicotine product								
Brand names	N/A	Solace Nord	Juul Salt-E	Juul	Juul	Juul Jewel Suorin	Juul Jewel Air Factory	Juul Vuse Alto
Frequency	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily
Months of use†	60	60	21	5	36	30	36	18
Product testing for VEA§	Not available for testing	Not available for testing	Not available for testing	Not available for testing	Not available for testing	Not available for testing	0 of 1	1 of 5**
Clinical course								
Hospital stay (days)	0	0	6	7	20	6	8	9
ICU	No	No	No	Yes	Yes	Yes	Yes	Yes
Intubated	No	No	No	No	Yes	Yes	No	No
BAL fluid testing for VEA	Not available for testing	Not available for testing	Positive	Not available for testing	Not available for testing	Not available for testing	Positive	Not available for testing

Abbreviations: BAL = bronchoalveolar lavage; ICU = intensive care unit; N/A = not available; THC = tetrahydrocannabinol; VEA = vitamin E acetate.
* Number of 1-g THC cartridges used per day in the month before symptom onset.
† Number of months between reported initiation of product use and onset of EVALI.
§ VEA detected (number of products containing VEA of the total number tested). https://www.fda.gov/news-events/public-health-focus/lung-injuries-associated-use-vaping-products.
¶ Shared use is defined as directly sharing the same THC cartridges at the same time and place.
** One product was packaged as a THC cartridge but contained nicotine, VEA, and cannabinol.

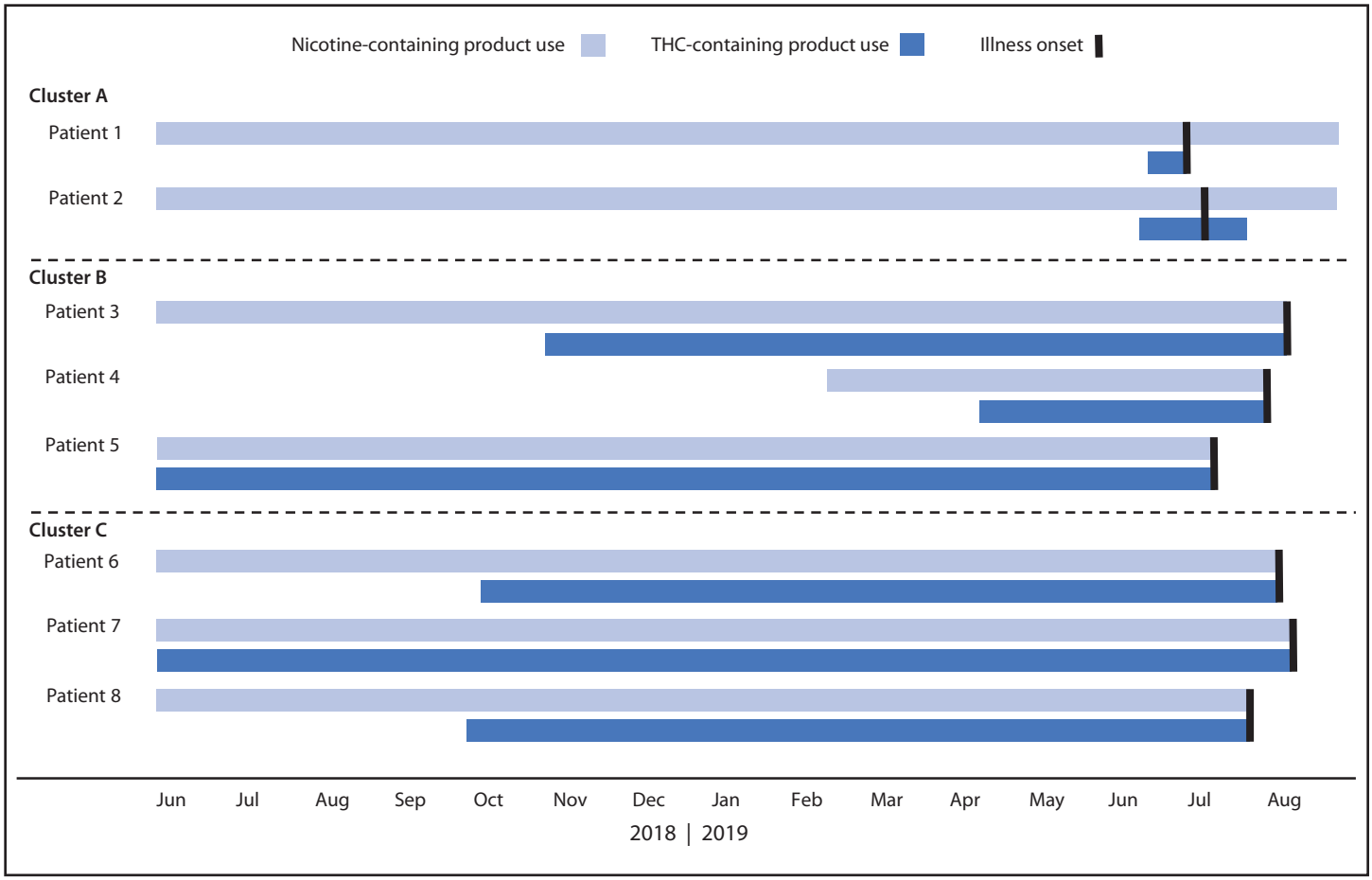
Discussion

Consistent with previous reports (*1*,*2*), THC cartridges containing VEA were closely linked to these small EVALI clusters. Nationwide, 80% of hospitalized EVALI patients reported use of THC-containing e-cigarette, or vaping, products, and 56% of EVALI patients with data on product use specifically reported using Dank Vapes in the 3 months preceding symptom onset (*4*). Similar results have been reported in Illinois, Wisconsin (*5*), and Utah (*6*), which, together, suggest that Dank Vapes and other illicit THC-containing products obtained from informal sources played a major role in the nationwide EVALI outbreak. The current findings reinforce this relationship by linking multiple EVALI patients to the same illicit THC cartridges. Although the specific sources of shared THC cartridges were not provided by patients, law enforcement activity in Wisconsin during that time indicates that counterfeit THC cartridges were being packaged and sold under the same brand names as those shared by EVALI patients, and could represent a potential source.¶ VEA was detected in THC cartridges or BAL fluids from at least one patient in each cluster, suggesting that the presence of VEA in illicit THC cartridges likely played a role in these clusters as well. This is consistent with the detection of VEA in BAL fluids from 48 EVALI patients in 16 states (*2*), and THC cartridges obtained from patients nationwide (*6*,*7*) and law enforcement in Minnesota (*8*).

The duration of THC cartridge use before symptom onset among these patients is an important new insight of this report. Patients began using THC cartridges a median of 9 months before illness onset, but this ranged from <1 month among patients in cluster A to 12 months among some patients in

¶ https://www.jsonline.com/story/news/crime/2019/09/16/wisconsin-brothers-charged-huge-counterfeit-vaping-cartridge-bust/2346311001.

FIGURE 2. Dates of initiation* and cessation of nicotine- and tetrahydrocannabinol (THC)-containing product use and illness onset among eight cluster-associated e-cigarette, or vaping, product use–associated lung injury patients† — Wisconsin, 2019



* All patients reported long-term use of nicotine-containing products, which were initiated a median of 33 months before symptom onset (range = 5–60 months).

† The following is a summary of pertinent events for patients in cluster C; similar patterns of product use initiation, sharing, and symptom onset were observed for patients in clusters A and B. Within cluster C, patient 6 and patient 7 were close friends who reported frequent sharing of Dank Vapes, Chronic Carts, and various other illicit THC cartridges before symptom onset, which occurred for both patients in early July 2019. All of the THC cartridges used by patients 6 and 7 were obtained from the same local illicit dealer, from whom they had purchased similar THC cartridges for the past 9–12 months. In the week preceding symptom onset, they reported using more than the usual quantity together, approximately one half of a 1-g cartridge per person per day; they also reported daily use of nicotine-containing e-cigarette, or vaping, products. Patients 6 and 7 developed nausea, vomiting, fever, and respiratory symptoms within 5 days of each other and stopped using e-cigarette, or vaping, products shortly after symptom onset. Patient 8 was a friend of patients 6 and 7 but did not report sharing products with them and was unsure if they shared the same local illicit dealer. This patient also reported daily use of Dank Vapes, among other brands, beginning 9 months before symptom onset, which occurred 2 weeks before that of patient 6. All three patients were hospitalized in the intensive care unit, and one required mechanical ventilation. Bronchoalveolar lavage fluid from patient 6 tested positive for vitamin E acetate, and all three THC cartridges from patient 8 contained vitamin E acetate.

clusters B and C. None of the patients reported any change in brand name or source over that period, yet all reported symptom onset within a similar window of time. This suggests that a change might have occurred in the constituents of illicit THC-containing e-cigarette, or vaping, products, including the addition of VEA, shortly before June 2019, when these patients began to have symptoms. This timeline is consistent with the spike in EVALI-related emergency department visits observed nationwide in June 2019 (*9*), and with law enforcement seizures in Minnesota that found VEA in all THC cartridges seized in a September 2019 raid, but not in any products seized in 2018 (*8*).

Frequent use of THC cartridges was notable among these patients. Seven of eight patients reported using at least one half of a 1-g THC cartridge per day before symptom onset. Patients estimated that a full 1-g THC cartridge corresponded to approximately 300 to 500 hits (i.e., inhalations) and would require nearly continuous use throughout a day to expend. Using THC-containing e-cigarette, or vaping, products more than five times per day was found to be significantly associated with EVALI in a case-control study of Illinois patients (*10*) and might be a contributing factor in the EVALI outbreak.

All cluster-associated patients reported daily use of nicotine-containing products. However, no patients reported exclusive

use of nicotine-containing products, and all reported long-term use with no change in brands or patterns of use preceding symptom onset. Also, VEA was not detected in any of the five commercial nicotine products tested, suggesting that nicotine-containing products were not associated with EVALI among these eight patients.

The findings in this report are subject to at least four limitations. First, this analysis was restricted to a small cluster of EVALI cases in Wisconsin and might not be representative of the nationwide EVALI outbreak. Second, the majority of data for this report were collected in October 2019, approximately 4 months after initial symptom onset for most patients, and recollections of brand names, frequency, and initiation of product use are subject to recall bias. Third, testing of THC cartridges or BAL fluids for VEA was only possible for four of the eight patients, which limited the ability to draw a definitive linkage to VEA for all cases. Finally, only five of eight cluster-associated patients were reached for in-depth interviews, which limited the ability to assess shared product use among three patients not reached for follow-up.

These findings reinforce current recommendations to not use THC-containing e-cigarette, or vaping products, especially those obtained from informal sources (*1*). Moreover, vitamin E acetate should not be added to e-cigarette, or vaping, products. Adults using e-cigarette, or vaping, products as an alternative to cigarettes should not go back to smoking. Irrespective of the ongoing investigation, e-cigarette, or vaping, products should never be used by youths, young adults, or pregnant women (*1*).

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Intervention To Stop Transmission of Imported Pneumonic Plague — Uganda, 2019

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Plague, an acute zoonosis caused by *Yersinia pestis,* is endemic in the West Nile region of northwestern Uganda and neighboring northeastern Democratic Republic of the Congo (DRC) (*1–4*). The illness manifests in multiple clinical forms, including bubonic and pneumonic plague. Pneumonic plague is rare, rapidly fatal, and transmissible from person to person via respiratory droplets. On March 4, 2019, a patient with suspected pneumonic plague was hospitalized in West Nile, Uganda, 4 days after caring for her sister, who had come to Uganda from DRC and died shortly thereafter, and 2 days after area officials received a message from a clinic in DRC warning of possible plague. The West Nile-based Uganda Virus Research Institute (UVRI) plague program, together with local health officials, commenced a multipronged response to suspected person-to-person transmission of pneumonic plague, including contact tracing, prophylaxis, and education. Plague was laboratory-confirmed, and no additional transmission occurred in Uganda. This event transpired in the context of heightened awareness of cross-border disease spread caused by ongoing Ebola virus disease transmission in DRC, approximately 400 km to the south. Building expertise in areas of plague endemicity can provide the rapid detection and effective response needed to mitigate epidemic spread and minimize mortality. Cross-border agreements can improve ability to respond effectively.

Investigation and Findings

The index patient (patient A) was a Ugandan woman, aged 35 years, living in DRC, approximately 5 km from the Ugandan border. On February 27, 2019, Ugandan family members traveled to DRC for the funeral of patient A's child, aged 4 years, and found patient A severely ill. They transported her to her ancestral Ugandan village in Zombo District of West Nile. While there, she complained of chest pain, experienced at least one episode of hemoptysis, and was admitted to a nearby clinic around midday the following day, February 28. She died a few hours later; no clinical samples were collected. She was buried in her ancestral village, preparation for which began the day of her death and culminated 2 days later, on March 2 (Table).

Meanwhile, on March 1, a local government office in Uganda received an alert from a private health clinic in DRC warning of possible plague circulation in a village near the border, the village from which patient A had come. Consequently, a team from UVRI's plague program, along with local health officials, initiated plague education and risk communication at area health clinics and with village residents, in concert with the burial of patient A. Reportedly, her husband in DRC died of an acute illness at approximately the same time, and others in patient A's family in DRC were ill, some with "fever and swellings."

On March 3 in Uganda, patient B, aged 23 years (the sister of patient A), developed fever. In a health care facility the following day, she tested positive for malaria and lacked signs of pneumonia. She received intravenous artesunate for malaria, but in light of the suspicion for plague in the area, she was admitted and empirically started on gentamicin. Approximately 8 hours later, she coughed up blood-tinged sputum. Other patients were removed from the room, and droplet precautions were instituted.

Blood from patient B tested negative for Ebola virus disease and other hemorrhagic fever viruses at UVRI using established methods (*5*). Sputum yielded the maximal positive reaction (4+) on a commercial rapid diagnostic test (RDT) (New Horizons Diagnostics) for detection of *Yersinia pestis* fraction 1 (F1) antigen. Cultures of blood and sputum (obtained approximately 8 hours after initiation of antibiotic treatment) were negative. Subsequent testing of plasma and sputum by real-time polymerase chain reaction (PCR) yielded evidence of *Y. pestis* DNA. The patient was treated with gentamicin for 7 days and doxycycline for 4 days and was discharged on March 14. *Y. pestis* infection was confirmed by seroconversion on a total immunoglobulin F1 antigen passive hemagglutination assay (acute titer = 0 [collected March 4]; convalescent titer = 1:2,048 [collected March 18]).

Patient B did not travel to DRC for the burial of patient A's child and did not arrive in the ancestral village to care for her sister until the morning of February 28. Patient B cared for patient A that morning, including using her hand to clean around patient A's mouth, feeding her, transporting her to the

TABLE. Timeline of imported pneumonic plague transmission and public health response — Uganda, Feb 27–Mar 5, 2019

Date	Event
Feb 27	Ugandan family travels to the DRC for funeral and discovers patient A ill. Family transports patient A back to Uganda.
Feb 28	Patient A is cared for by patient B and others and transported to clinic in late morning. Patient A dies shortly after arrival.
Mar 1	Letter from DRC clinic arrives describing possible plague in the area where patient A resided.
Mar 2	Patient A is buried in her ancestral village in Uganda. UVRI plague team provides plague education to funeral attendees and begins area clinic plague refresher training.
Mar 3	Patient B experiences disease onset at approximately 11 a.m.
Mar 4	Patient B goes to clinic at approximately 9 a.m.; 8 hours later has difficulty breathing and coughs blood. Clinic staff members begin isolation measures, droplet precautions, and self-prophylaxis.
Mar 5	UVRI plague team and local officials perform additional contact tracing and administer prophylaxis to identified contacts.

Abbreviations: DRC = Democratic Republic of the Congo; UVRI = Uganda Virus Research Institute.

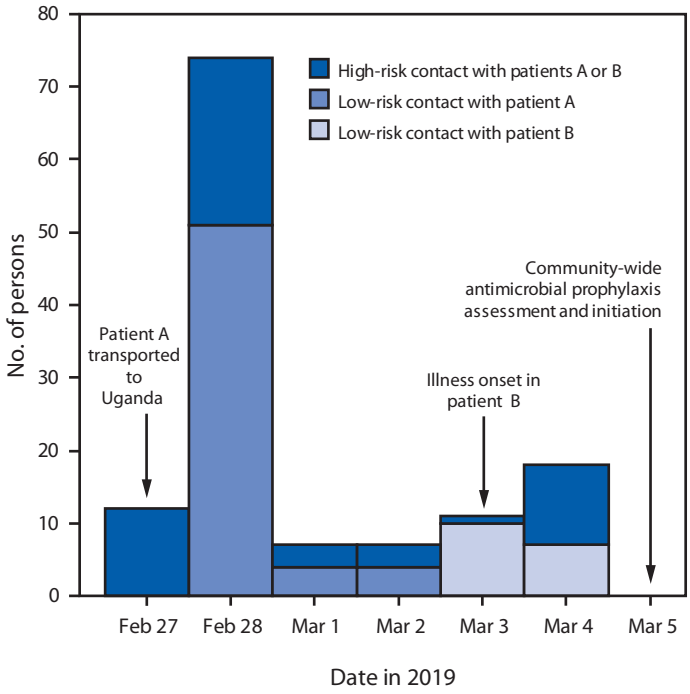
clinic via motorbike, and attending to her at the clinic. She was not involved in transport of patient A's body back to the village or in burial preparations.

Public Health Response

On March 5, UVRI and district representatives rapidly mobilized and executed contact tracing and prophylaxis administration. In total, 129 persons were identified as contacts of patient A or B, including eight (6%) clinic staff members; 127 were placed on a 5-day prophylactic course of doxycycline, co-trimoxazole, or ciprofloxacin. Most persons identified as contacts (80; 62%) reported physical contact with or exposure within ≤1 m of either patient. Ninety-eight (76%) persons reported contact with patient A, including those involved in handling her body after her death. Fifty-three traced contacts (41%) had high-risk exposure as determined by subjective assessment of their distance from either patient and presumed patient infectiousness (Figure).

During a 10-day follow-up period, no identified contacts developed plague-like symptoms, and no indication of plague activity in Uganda was detected despite active clinic-, community-, and rodent-based surveillance for plague in the region. Comprehensive public health response was limited by jurisdiction; the UVRI team was unable to provide expertise and resources to support plague control just over the border in DRC. The fate of patient A's DRC-based family and community members, given the likely ongoing circulation of *Y. pestis* among rodents and fleas in that village, is not known.

FIGURE. Number of persons exposed to patients A or B, by date, according to first reported exposure and assessment of pneumonic plague transmission risk — Uganda, 2019*,†,§



* High-risk contact with patients A or B includes transporting patient A via carrying or motorbike; caring for, washing, or feeding patient A on Feb 27 or Feb 28; physical manipulation of the body of patient A by washing, massaging, removing clothes, or dressing; providing health care or cleaning services related to patients A or B (until 48 hours after administration of antibiotics); coming in close and prolonged contact with patient B (e.g., sleeping in the same bed after illness onset or transporting to health facility). Figure reflects exposures among traced contacts; patient B is excluded from counts of persons with high-risk exposure to patient A.

† Low-risk contact with patient A includes touching the body of patient A or briefly being in the same room as patient A.

§ Low-risk contact with patient B includes staying in the same room but at a distance during the day of illness onset, visiting her in the health care facility, or briefly touching her.

Discussion

Plague persists in transmission cycles involving rodents and fleas on several continents, including Africa (*1*). Although plague generates fear because of its historical reputation, pneumonic plague transmission in modern times can be controlled by implementing droplet precautions, antimicrobial therapy, and prophylaxis of contacts (*6*,*7*). This report summarizes importation of plague from DRC into Uganda. Rapid and effective response curtailed epidemic spread of pneumonic plague beyond a single transmission event from patient A to patient B in Uganda.

Worldwide, most plague occurs following the bite of an infected flea and results in bubonic plague, characterized by acute fever and a painful swollen lymph node (*1*,*4*). Untreated,

infection can spread to the lungs (*2*). Pneumonic plague transmission occurs via respiratory droplets and requires close contact with severely ill persons (*7*). The highest-risk exposures are those within 2 meters of persons coughing blood-tinged sputum; transmission might also occur during body preparation in traditional burials (*8*). The typical incubation period for primary pneumonic plague is <1 to 4 days, and the condition is often fatal if effective antibiotics are not initiated within 24–36 hours of illness onset (*2*).

Patient B's exposure to patient A was limited to the morning hours of February 28 and was followed by patient B's illness onset approximately 72 hours later. Persons with high-risk exposures to patient A as identified upon contact tracing were 3–5 days postexposure when antibiotic prophylaxis was initiated on March 5. Because only patient B became ill, the secondary attack rate among all persons with high-risk exposures was 2%. Postexposure prophylaxis might have prevented illness among some of those who received it, particularly those exposed to patient B, who were all still within the incubation period. This outcome highlights that pneumonic plague is not as transmissible as is often believed; and spread typically occurs among persons with close and substantial, rather than incidental, contact with a patient with late-stage disease (*7*). Secondary transmission rates in outbreaks in Madagascar and Uganda have been estimated at approximately 8%; however, transmission also depends on cultural and behavioral factors that might place persons at increased risk above the inherent transmissibility of the organism (*8*,*9*). Engagement with community leaders, members, health workers, and traditional healers in areas where plague is endemic can improve early recognition and implementation of simple interventions to curtail epidemic spread (*7*,*10*).

Even in areas with endemic plague, clinical diagnosis is challenging because of the nonspecific nature of the febrile illness in the absence of painful lymphadenopathy or blood-tinged sputum (*3*). RDT, real-time PCR, and paired serology testing were all positive for plague in patient B, despite collection of clinical specimens after initiation of effective antibiotic treatment, which did, however, hinder recovery of the organism in culture. RDT use occurred as part of ongoing research jointly conducted by CDC and UVRI to evaluate the sensitivity and specificity of RDTs for plague on human clinical specimens. Validated RDTs used by trained personnel might have value in providing rapid information to guide public health response but should be supported by additional diagnostic tests. Even in the remote setting of northwestern Uganda, collection of multiple clinical samples and use of multiple tests allowed for confirmation of the etiology.

Summary

What is already known about this topic?

Plague is an acute zoonosis that occurs on several continents and can manifest in different clinical forms. Pneumonic plague is highly fatal and directly transmissible from person to person via infectious respiratory droplets.

What is added by this report?

Importation of pneumonic plague from the Democratic Republic of the Congo into an area of Uganda with effective public health response capabilities resulted in prompt action to halt transmission. Despite multiple high-risk exposures, only a single transmission event occurred.

What are the implications for public health practice?

Building expertise in areas of plague endemicity can provide the rapid detection and response needed to mitigate epidemic spread and minimize mortality. Cross-border agreements can improve ability to respond effectively.

CDC has worked with Uganda's Ministry of Health and UVRI since 2003 to provide technical support for clinic- and animal-based plague surveillance, laboratory capacity, and community education and to conduct multifaceted research into improved diagnostics and effectiveness of environmental plague prevention approaches. Despite initial cross-border notification of suspected plague in DRC, lack of an established local cross-border collaboration prevented the resources and plague expertise in Uganda from supporting mitigation of ongoing risk just over the porous geopolitical boundary. Cross-border collaboration can improve capability to effectively respond to public health threats that affect border regions.

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Active Monitoring of Persons Exposed to Patients with Confirmed COVID-19 — United States, January–February 2020

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In December 2019, an outbreak of coronavirus disease 2019 (COVID-19), caused by the virus SARS-CoV-2, began in Wuhan, China (*1*). The disease spread widely in China, and, as of February 26, 2020, COVID-19 cases had been identified in 36 other countries and territories, including the United States. Person-to-person transmission has been widely documented, and a limited number of countries have reported sustained person-to-person spread.* On January 20, state and local health departments in the United States, in collaboration with teams deployed from CDC, began identifying and monitoring all persons considered to have had close contact† with patients with confirmed COVID-19 (*2*). The aims of these efforts were to ensure rapid evaluation and care of patients, limit further transmission, and better understand risk factors for transmission.

As of February 26, 12 travel-related COVID-19 cases had been diagnosed in the United States, in addition to three COVID-19 cases in patients with no travel history (including two cases in close household contacts) and 46 cases reported among repatriated U.S. citizens.§ Following confirmed diagnosis, the 12 patients with travel-related COVID-19 were isolated in the hospital if medically necessary, or at home once home care was deemed clinically sufficient.¶ Among the first 10 patients with travel-related confirmed COVID-19 reported in the United States, a total of 445 persons (range = 1–201 persons per case) who had close contact with one of the 10 patients on or after the date of the patient's symptom onset were identified. Nineteen (4%) of the 445 contacts were members of a patient's household, and five of these 19 contacts continued to have household exposure to the patient with confirmed COVID-19 during the patient's isolation period; 104 (23%) were community members who spent at least 10 minutes within 6 feet of a patient with confirmed disease; 100 (22%) were community members who were exposed** to a patient in a health care setting; and 222 (50%) were health care personnel.††

Active symptom monitoring of the 445 close contacts, consisting of daily telephone, text, or in-person inquiries about fever or other symptoms for 14 days following the last known exposure to a person with confirmed COVID-19, was conducted by local health jurisdictions. During the 14 days of active symptom monitoring, 54 (12%) close contacts developed new or worsening symptoms deemed by local public health authorities to be concerning for COVID-19 and were thus considered persons under investigation (PUIs)§§ and subsequently were tested for SARS-CoV-2. Two persons who were household members of patients with confirmed COVID-19 tested positive for SARS-CoV-2. This yielded a symptomatic secondary attack rate of 0.45% (95% confidence interval [CI] = 0.12%–1.6%) among all close contacts,¶¶ and a symptomatic secondary attack rate of 10.5% (95% CI = 2.9%–31.4%) among household members. Both persons with confirmed secondary transmission had close contact with the respective source patient before COVID-19

* https://www.cdc.gov/coronavirus/2019-ncov/travelers/index.html.

† Close contact was defined by the state and local health jurisdictions with reference to the following online guidance: https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-risk-assesment-hcp.html.

§ https://emergency.cdc.gov/han/2020/han00428.asp.

¶ https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-prevent-spread.html.

** For these investigations, exposure of community members within a health care setting was defined as either at least 10 minutes spent within 6 feet of the patient with confirmed COVID-19 (e.g., in a waiting room) or having spent time in the same airspace (e.g., the same examination room) for 0–2 hours after the confirmed COVID-19 patient. The duration of time in the same airspace after the patient with confirmed COVID-19 was applied differently by health jurisdictions. However, no contacts were enumerated among those who were in the same airspace >2 hours after the patient with confirmed COVID-19.

†† Health care personnel were defined as volunteers or paid persons who serve in a health care setting who might come into direct or indirect contact with patients or infectious materials. Examples of close contact with a patient or with infectious material could include spending prolonged time within 6 feet of the patient, conducting or being present during an aerosol-generating procedure, or direct contact with the patient's secretions or excretions. Interim guidance for assessing the exposure risk and for symptoms that should prompt further evaluation among health care personnel is available at https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-risk-assesment-hcp.html.

§§ At the time of the investigations, persons with close contact to a confirmed COVID-19 patient could be considered PUIs if they developed fever or signs or symptoms of lower respiratory tract illness. This threshold might be lower for contacts who are health care workers. At this time, symptomatic close contacts of a patient with confirmed COVID-19 should be further evaluated in consultation with public health authorities to review signs or symptoms and possible exposure on a case-by-case basis. Further information is available at https://www.cdc.gov/coronavirus/2019-nCoV/hcp/clinical-criteria.html.

¶¶ The 95% confidence interval around the binomial proportion was calculated using the Wilson score interval.

was confirmed and were isolated from the source patient after the patient's COVID-19 diagnosis.

No other close contacts who were tested for SARS-CoV-2 had a positive test, including the five household members who were continuously exposed during the period of isolation of their household member with confirmed COVID-19. An additional 146 persons exposed to the two patients with secondary COVID-19 transmission underwent 14 days of active monitoring. Among these, 18 (12%) developed symptoms compatible with COVID-19 and were considered PUIs. All tested negative, and no further symptomatic COVID-19 cases (representing tertiary transmission) have been identified.

In the United States, two instances of person-to-person transmission of SARS-CoV-2 have been documented from persons with travel-related COVID-19 to their household contacts. Since February 28, an increasing number of newly diagnosed confirmed and presumptive COVID-19 cases have been in patients with neither a relevant travel history nor clear epidemiologic links to other confirmed COVID-19 patients. However, despite intensive follow-up, no sustained person-to-person transmission of symptomatic SARS-CoV-2 was observed in the United States among the close contacts of the first 10 persons with diagnosed travel-related COVID-19. Analyses of timing of exposure during each patient's illness as well as the type and duration of exposures will provide information on potential risk factors for transmission. Infection control and prevention efforts by patients with COVID-19, their household members, and their health care providers,*** in combination with contact tracing activities, are important to mitigate community spread of the disease.

*** https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-prevent-spread.html; https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html.

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Notes from the Field

Monkey Bite in a Public Park and Possible Exposure to Herpes B Virus — Thailand, 2018

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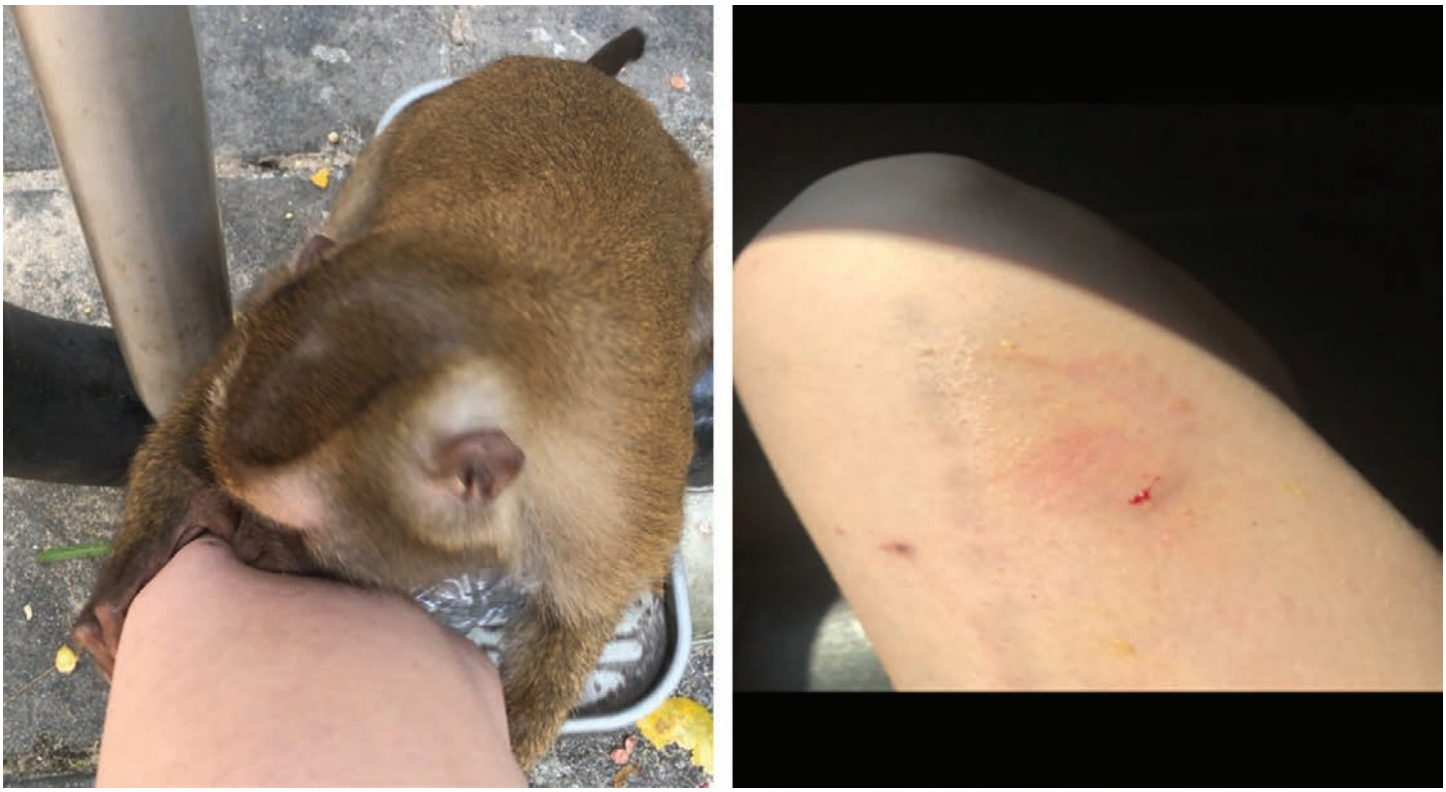
On January 7, 2019, the Oregon Public Health Division (OPHD) was contacted by a local health department regarding an Oregon teen who, on December 24, 2018, was bitten by a macaque monkey (Figure) in a public park in Phuket, Thailand. The bleeding wound was immediately rinsed with bottled water without soap. Subsequently, hotel staff members applied a topical pain reliever. The following day, the teen went to a local clinic in Thailand and received the first dose of rabies postexposure prophylaxis vaccine; rabies immune globulin was not administered. She received 2 additional doses of rabies vaccine while in Thailand.

On January 5, 2019, the patient left Thailand and was evaluated by a physician in Oregon on January 7. The physician contacted the local health department, seeking guidance about when to administer the final dose of rabies vaccine. Upon learning about the macaque bite, the local health department contacted OPHD, where staff members expressed concern about possible exposure to *Macacine herpesvirus* 1 (B virus). This virus, commonly found in macaques,* can, in rare cases, cause severe encephalitic infection in humans if not treated promptly (*1*). The case fatality rate of untreated B virus infection approaches 80% (*2*). OPHD contacted CDC, and the National B Virus Resource Center (NBVRC) in Atlanta, Georgia, to discuss testing.†

OPHD recommended that if illness compatible with B virus infection developed (e.g., fever, chills, myalgia, headache, blisters or discomfort near the wound, or problems with coordination) the patient should seek medical evaluation, and the provider should notify NBVRC immediately. On January 8, 2019, the patient received the final dose of rabies vaccine. Per recommendations for persons possibly exposed to B virus, serum specimens were collected at that visit and 3 weeks later§ (January 29) for B virus immunoglobulin (Ig) M and

* https://www.cdc.gov/herpesbvirus/cause.html.
† https://www.cdc.gov/herpesbvirus/laboratory.html.
§ https://www.cdc.gov/herpesbvirus/laboratory.html.

FIGURE. Macaque monkey biting an Oregon resident in a public park in Thailand and the resultant wound — 2018



Photo/patient

IgG testing at NBVRC.[¶] Neither specimen was positive for antibodies against B virus.

Following an initial exposure to B virus, the peripheral viral load can be insufficient to stimulate an immune response and can result in negative tests for antibodies against B virus. B virus can migrate to the dorsal ganglion and cause infection years later (Julia Hilliard, NBVRC, personal communication, 2019). Because B virus can establish a lifelong latent infection with possible subsequent illness (*3*), the patient was advised always to carry a Medical Alert card[**] in case symptoms occur despite her initial negative tests (*4*).

Symptomatic B virus infection in humans is rare. Seroconversion in some persons suggests that asymptomatic infection can occur (Julia K. Hilliard, NBVRC, personal communication, 2019). Nearly all documented B virus infections in humans involved exposures in laboratories or animal facilities (*4*). Transmission from macaques to humans in public settings, such as parks, has not been documented. Nonetheless, macaques in these settings often carry B virus and can shed the virus asymptomatically (*4*); the macaque in this case ran away and could not be tested. Although the risk for human B virus disease from macaque exposure in these settings is considered low, precautions are indicated given the severe consequences of infection. Macaque bites and scratches are of particular concern (*1*,*4*). Wounds from macaque bites should be scrubbed with soap, detergent, or iodine for 15 minutes and irrigated with running water for an additional 15–20 minutes before seeking medical attention.[††] Treatment varies based on the details of the incident.[§§] There is no vaccine against B virus.

Rabies from nonhuman primate bites is uncommon because primates are not primary rabies reservoirs. Nonetheless, rabies postexposure prophylaxis for victims of nonhuman primate bites in countries where rabies is enzootic should be considered (*5*). Persons visiting areas with free-ranging macaques should avoid close contact with these animals (*1*). Macaque bites or scratches should be thoroughly washed, and medical treatment should be sought immediately.

¶ http://biotech.gsu.edu/virology/PDFs/2012%20Sample%20Collect%20&%20Shipmt.pdf.
** http://biotech.gsu.edu/virology/PDFs/2011%20Medical%20Alert.pdf.
†† https://www.cdc.gov/herpesbvirus/firstaid-treatment.html.
§§ https://www.cdc.gov/herpesbvirus/healthcare-providers.html.

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[1]Epidemic Intelligence Service, CDC; [2]Northwest Portland Area Indian Health Board, Portland, Oregon; [3]Acute and Communicable Disease Prevention, Oregon Public Health Division, Portland, Oregon; [4]Clackamas County Public Health Division, Oregon City, Oregon; [5]Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, CDC; [6]National B Virus Resource Center Laboratory, Georgia State University, Atlanta, Georgia.

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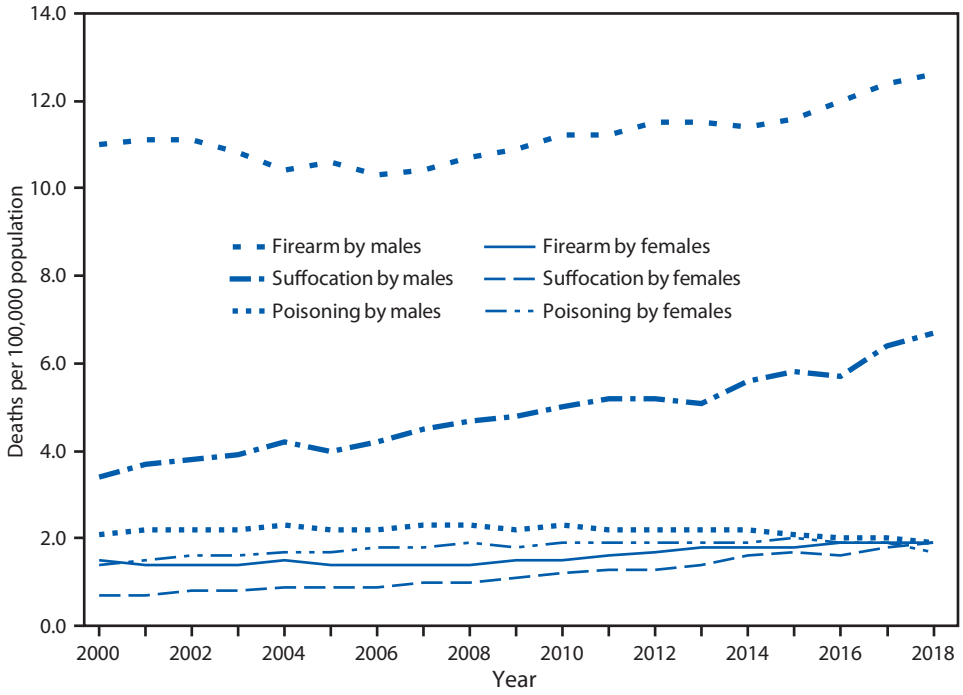
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Suicide Rates,* by Sex and Three Most Common Methods† — United States, 2000–2018



* Age-adjusted rates per 100,000 based on the 2000 U.S. standard population.

† The three most common methods of suicide are determined by numbers of deaths and are identified with *International Classification of Diseases, Tenth Edition* codes X72–X74 (firearm), X70 (suffocation), and X60–X69 (poisoning). In 2018, among males there were 34,915 suicides by these three methods (92.5% of all male suicides), and among females there were 9,594 (90.7% of all female suicides).

The three most common methods of suicide among males and females during 2000–2018 were by firearm, suffocation, and poisoning. After remaining steady from 2000 to 2006, age-adjusted firearm suicide rates increased during 2006–2018 among males (from 10.3 to 12.6 per 100,000) and females (from 1.4 to 1.9). Suffocation suicide rates among males and females increased steadily during 2000–2018 (from 3.4 to 6.7 for males and from 0.7 to 1.9 for females). In contrast to the other suicide methods, poisoning suicide rates during 2000–2018 initially increased and then declined, from 2.3 in 2010 to 1.9 in 2018 among males and from 2.0 in 2015 to 1.7 in 2018 among females. Throughout the period 2000–2018, suicide rates by all methods were higher among males than among females, with the greatest difference in the rates for suicide by firearm.

Source: National Center for Health Statistics, National Vital Statistics System, mortality data. https://www.cdc.gov/nchs/nvss/deaths.htm.

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For more information on this topic, CDC recommends the following link: https://www.cdc.gov/violenceprevention/suicide/index.html.

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