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Contact Tracing for Mpox Clade II Cases Associated with Air Travel — United States, July 2021–August 2022

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Abstract

Monkeypox virus (MPXV) can spread among humans through direct contact with lesions, scabs, or saliva; via respiratory secretions; and indirectly from fomites; via percutaneous injuries; and by crossing the placenta to the fetus during pregnancy. Since 2022, most patients with mpox in the United States have experienced painful skin lesions, and some have had severe illness. During 2021–2022, CDC initiated aircraft contact investigations after receiving reports of travelers on commercial flights with probable or confirmed mpox during their infectious period. Data were collected 1) during 2021, when two isolated clade II mpox cases not linked to an outbreak were imported into the United States by international travelers and 2) for flights arriving in or traveling within the United States during April 30–August 2, 2022, after a global clade II mpox outbreak was detected in May 2022. A total of 113 persons (100 passengers and 13 crew members) traveled on 221 flights while they were infectious with mpox. CDC developed definitions for aircraft contacts based on proximity to mpox cases and flight duration, sent information about these contacts to U.S. health departments, and received outcome information for 1,046 (68%) of 1,538 contacts. No traveler was found to have acquired mpox via a U.S. flight exposure. For persons with mpox and their contacts who had departed from the United States, CDC forwarded contact information as well as details about the exposure event to destination countries to facilitate their own public health investigations. Findings from these aircraft contact investigations suggest that traveling on a flight with a person with mpox does not appear to constitute an exposure risk or warrant routine contact tracing activities. Nonetheless, CDC recommends that persons with mpox isolate and delay travel until they are no longer infectious.

Introduction

Monkeypox virus (MPXV) can spread among humans through direct contact with lesions, scabs, or saliva; via respiratory secretions; indirectly from fomites; via percutaneous injuries; and by crossing the placenta to the fetus during pregnancy (*1*). Mpox is a disease caused by infection with MPXV. Since May 2022, approximately 33,000 mpox cases have occurred in the United States*; most patients have experienced painful skin lesions, typically in the anogenital region, and some have suffered life-threatening complications or protracted illness. Before 2021, mpox cases outside of Africa occurred in a U.S. zoonotic outbreak involving imported wild African rodents in 2003 and in a limited number of travelers infected before travel from West Africa. No cases of transmission attributed to aircraft cabin exposure from these travelers have been reported (*2*). In 2021, two travelers flew on commercial flights into the United States while infectious with mpox (*3*,*4*). Then, in May 2022, a large

* https://www.cdc.gov/poxvirus/mpox/response/2022/mpx-trends.html

Continuing Education examination available at https://www.cdc.gov/mmwr/mmwr_continuingEducation.html

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global outbreak of MPXV clade IIb was recognized, primarily associated with male-to-male sexual contact. This outbreak has affected more than 110 countries, and hundreds of persons have traveled via commercial aircraft while infectious with mpox (*5*). Because of concerns for the potential for in-flight transmission, CDC initiated aircraft contact investigations after receiving reports of persons with probable or confirmed mpox traveling on commercial flights during the infectious period. This report describes findings from these investigations.

Methods

Data Source

This report includes data on aircraft contact investigations initiated by CDC for persons with mpox[†] who were identified by U.S. public health departments as having traveled on domestic or arriving international flights while infectious. These mpox cases occurred in 2021 or during April 30–August 2, 2022. The infectious period was defined as the period commencing with the onset of illness through such time that all lesions had crusted over, the crusts had separated, and a fresh layer of healthy skin had formed under the crust.

Notification of Potential Exposure

CDC is notified when a U.S. or a foreign public health agency learns that persons with certain communicable diseases of public health concern were infectious while traveling on a commercial aircraft. Based on disease-specific protocols (CDC, unpublished data, 2019), CDC determines whether the criteria to initiate an aircraft contact investigation have been met. If the criteria are met, CDC sends a traveler manifest request to the airline, enabling identification of potentially exposed passengers and crew members.

CDC adapted the mpox community exposure risk assessment[§] to define an exposure risk zone for aircraft contact investigations. In general, air passengers seated within a 3-foot radius (one seat in any direction) of the potentially infectious person on flights of ≤3 hours' duration or within a 6-foot radius (two seats in any direction) on flights of >3 hours' duration were considered to be in the exposure risk zone. For two flights in July 2021 involving an infectious passenger who had an extensive purulent rash, the exposure risk zone was expanded to include all passengers who had potentially used the same lavatory (*3*).

Crew members serving the cabin where infectious passengers had been seated were considered contacts of those patients. If crew members were determined to be infectious while on duty, fellow crew members who worked the same flights for >3 cumulative hours were also classified as having had an exposure. Passengers were not considered contacts of infected cabin crew members because crew members typically wore

[†] Persons with mpox defined per U.S. case definitions: https://www.cdc.gov/poxvirus/mpox/clinicians/case-definition.html.

[§] https://www.cdc.gov/poxvirus/mpox/clinicians/monitoring.html

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gloves (standard procedure while distributing or retrieving items) and masks (customary practice during the COVID-19 pandemic); also, direct interactions with any individual passenger were likely brief.

Notification per International Health Regulations

CDC used information from the flight manifests provided by airlines to identify travelers seated in the exposure risk zone and obtain their contact information, the latter supplemented by federal and third-party databases. CDC shared this information securely with U.S. or foreign public health agencies in jurisdictions of the travelers' residence to enable contact tracing and symptom monitoring for 21 days after flight (the maximum known incubation period for mpox).

In accordance with the 2005 International Health Regulations (IHR), CDC sent notifications to other countries, via their National Focal Points, about any potentially infectious persons aboard flights departing the United States and any aircraft contacts who traveled to their countries (*6*). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.¶

Results

Contacts of Airline Passengers with Mpox Not Linked to an Outbreak (2021)

During 2021, two isolated confirmed clade II mpox cases not linked to an outbreak were imported into the United States by international travelers who had traveled on three commercial flights (3,4). CDC received individual outcome information for all 149 aircraft contacts (138 passengers and 11 crew members) from the 30 domestic health departments that had conducted public health follow-up (Table). No secondary mpox cases were reported.

Contacts of Airline Passengers with Outbreak-Related Mpox (2022)

In 2022, a total of 111 persons with probable or confirmed clade II mpox linked to the global outbreak who traveled on commercial aircraft while infectious were identified. Among 1,389 identified aircraft contacts, CDC received aggregate outcome information from 30 U.S. health departments about 897 (65%) (884 passengers and 13 crew members), who traveled on 218 commercial flights during April 30–August 2. None of the aircraft contacts was reported to have developed mpox during symptom monitoring.

CDC Notification of National Focal Points

CDC notified National IHR Focal Points in 41 countries about 299 international travelers. This group included 84 persons with mpox and 215 exposed contacts of persons with infectious mpox on flights, all of whom traveled to these countries before or after their U.S. arrival. Among the 21 National IHR Focal Points that provided outcome information on contact tracing to CDC, one reported that an aircraft contact had developed symptoms within the 21-day monitoring and received a diagnosis of mpox. CDC does not have further details, including seating proximity to the infected traveler or case investigation data (including any potential community exposures) to assess risk factors beyond aircraft exposure. The original report came from a subnational agency, and the reporting country's privacy laws did not permit further inquiry.

Discussion

U.S. health departments reported no cases of mpox attributed to flight exposures during the U.S. public health follow-up

¶ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE. Aircraft contacts of persons with probable or confirmed mpox on commercial flights into or within the United States and outcomes as reported by U.S. jurisdictions, July 2021–August 2022

Data elements and risk assignments considered in contact tracing	Reporting period, no. (%)			
	Jul 2021*	Nov 2021	Apr–Aug 2022	Total
Mpox cases	1	1	111	**113**
Flights	2	1	218	**221**
Aircraft passenger contacts†	129	9	796	**934**
Aircraft crew contacts§	11	0	593	**604**
Travelers for whom FPHNs were sent¶	56	22	221	**299**
U.S. jurisdictions assigned contacts	26	4	51	**51**
Contacts with outcomes reported to CDC	140 (100)	9 (100)	897 (65)	**1,046 (68)**

Abbreviation: FPHN = foreign public health notification.

* For two flights in July 2021 involving an infectious passenger who had an extensive purulent rash, the exposure risk zone was expanded to include all passengers who had potentially used the same lavatory.

† Passengers were considered aircraft contacts if seated within two seats of an infected traveler for flights >3 hours, or within one seat for flights ≤3 hours, in any direction.

§ Crew either serving infected travelers or working with an infected crew member for >3 hours were classified as having an exposure.

¶ An FPHN is a notice sent by CDC to another country through its National International Health Regulations Focal Point pursuant to Article 44 of the 2005 International Health Regulations, which calls for collaboration among countries in the detection, assessment, and response to events of potential public health significance. https://pubmed.ncbi.nlm.nih.gov/27166578

Summary

What is already known about this topic?

Monkeypox virus (MPXV) can spread among persons and cause severe mpox. Before 2021, limited information to assess the risk for MPXV transmission aboard commercial aircraft was available. Two earlier investigations identified no secondary cases among passengers seated near infected travelers.

What is added by this report?

During 2021–2022, 113 persons traveled on commercial flights while they were infectious with clade II mpox. Among 1,046 traveler contacts followed by U.S. public health agencies, CDC identified no secondary cases.

What are the implications for public health practice?

Traveling on a flight with a person with mpox does not appear to constitute an exposure risk or warrant routine contact tracing activities.

of 1,046 passengers and crew members identified as aircraft contacts during July 2021–August 2022. One case of mpox in a traced aircraft contact was reported in a non-U.S. resident by a public health authority in another country; however, the epidemiologic information provided was insufficient to ascertain the likelihood that transmission occurred during the flight.

These findings are consistent with those from an investigation of mpox exposures among aircraft contacts conducted by Australia's Victorian Department of Health involving 15 international flights occurring during May–October 2022 (*7*). Australian investigators used a broader definition to identify exposed passengers, whereby travelers seated beyond two seats in any direction were included as contacts. Australian public health officers did not identify any secondary cases of mpox among the flight contacts, either monitored or unmonitored (i.e., using other means to link cases to the flights). Available evidence suggests that the risk for acquiring mpox during air travel, even among travelers exposed to persons with infectious cases, is very low. This very low risk could be attributed, at least in part, to the unlikely occurrence on flights of the direct contact with mpox lesions that is associated with most secondary cases (*1*). Based on available information, including preliminary analyses of these data, CDC discontinued routine aircraft contact investigations for mpox in August 2022.

Relative to clade II mpox, clade I infections have historically been associated with increased transmissibility (*8,9*). However, both clade I and clade II mpox spread in the same ways, primarily via close physical or intimate contact with infected lesions and less often via infectious respiratory secretions and fomites. The type of contact most often associated with secondary cases (e.g., sex or sharing bedding) is unlikely to occur on aircraft. Limited aircraft contact investigations could be considered for the first probable or confirmed clade I MPXV infections identified in recent air travelers to corroborate equivalent risk with clade II.

Limitations

The findings in this report are subject to at least three limitations. First, outcome data were missing for approximately one third of identified aircraft contacts. This shortcoming might be accounted for by factors such as competing priorities for resources at state, local, and territorial health departments; inaccurate or incomplete traveler contact information; and nonresponsive travelers. Second, passengers were not considered contacts if the patient was a crew member, which might have led to identification of fewer contacts. Finally, although the findings presented in this report might apply to MPXV irrespective of clade, the cases all involved clade II MPXV.

Implications for Public Health Practice

Aircraft contact investigations are complex and resource-intensive endeavors that can divert resources from other public health activities with higher prevention yield, particularly during a large outbreak response. This report provides the largest published series of mpox aircraft contacts and suggests a very low risk for clade II MPXV transmission in the commercial aircraft cabin setting. Traveling on a flight with a person with mpox caused by clade II MPXV does not appear to constitute an exposure risk or warrant routine contact tracing activities. The criteria for conducting aircraft contact investigations should be subject to continuous evaluation based on the most current scientific evidence to guide public health risk assessments and interventions. CDC continues to recommend that persons with mpox isolate and delay travel until they are no longer infectious.**

** https://www.cdc.gov/poxvirus/mpox/if-sick/what-to-do.html

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Members of the Mpox Emergency Response, particularly the Global Migration Task Force, CDC; U.S. partner state, tribal, local, and territorial health departments; partner National International Health Regulations Focal Points in other countries.

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Leptospirosis Outbreak in Aftermath of Hurricane Fiona — Puerto Rico, 2022

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Abstract

Leptospirosis, an acute bacterial zoonotic disease, is endemic in Puerto Rico. Infection in approximately 10%–15% of patients with clinical disease progresses to severe, potentially fatal illness. Increased incidence has been associated with flooding in endemic areas around the world. In 2022, Hurricane Fiona, a Category 1 hurricane, made landfall and inundated Puerto Rico with heavy rainfall and severe flooding, increasing the risk for a leptospirosis outbreak. In response, the Puerto Rico Department of Health (PRDH) changed guidelines to make leptospirosis cases reportable within 24 hours, centralized the case investigation management system, and provided training and messaging to health care providers. To evaluate changes in risk for leptospirosis after Hurricane Fiona to that before the storm, the increase in cases was quantified, and patient characteristics and geographic distribution were compared. During the 15 weeks after Hurricane Fiona, 156 patients experienced signs and symptoms of leptospirosis and had a specimen with a positive laboratory result reported to PRDH. The mean weekly number of cases during this period was 10.4, which is 3.6 as high as the weekly number of cases during the previous 37 weeks (2.9). After Hurricane Fiona, the proportion of cases indicating exposure to potentially contaminated water increased from 11% to 35%, and the number of persons receiving testing increased; these factors likely led to the resulting overall surge in reported cases. Robust surveillance combined with outreach to health care providers after flooding events can improve leptospirosis case identification, inform clinicians considering early initiation of treatment, and guide public messaging to avoid wading, swimming, or any contact with potentially contaminated floodwaters.

Introduction

Leptospirosis, an acute bacterial zoonotic disease, is endemic in Puerto Rico, which reports higher numbers of annual leptospirosis cases than any other U.S. jurisdiction (*1*–*4*). Previous hurricanes in Puerto Rico have been followed by increased leptospirosis incidence (*5*,*6*). Pathogenic *Leptospira* bacteria (the causative agent) can survive in soil and water, are maintained in animal hosts, and are transmitted through the urine of infected animals. Leptospirosis infection in humans causes a spectrum of disease severity. Most illness is mild and characterized by fever, chills, myalgia, nausea, vomiting, diarrhea, headache, conjunctivitis, and other signs and symptoms. Infection in approximately 10%–15% of patients with clinical disease progresses to severe, potentially fatal illness with multiorgan involvement that can include renal failure, liver failure, pulmonary hemorrhage, and meningitis (*7*,*8*).

Leptospirosis can be challenging to diagnose because infection can cause a wide range of nonspecific symptoms, clinical presentation can be confused with other diseases, and the sensitivity and specificity of the laboratory diagnostics depend on when a sample is collected: real-time polymerase chain reaction (PCR) testing is recommended when the bacteria are most likely to be present in blood (approximately 4–6 days post-illness onset); in contrast, serologic tests have low sensitivity in the first week after illness onset given the time for the immune response to generate antibodies (3–10 days after symptom onset) (*9*). A negative real-time PCR or serologic test result from a specimen collected in the acute phase of illness does not rule out infection. Patients who have received only negative test results from specimens collected during the first week of illness are recommended to have serologic testing of a convalescent sample collected 7–14 days after the first sample. However, collection of specimens during convalescence is challenging because it requires patients to return for repeat testing. Among patients clinically suspected to have leptospirosis, initiation of empiric antibiotic treatment (e.g., doxycycline) is recommended while awaiting laboratory results (*9*). Early recognition and treatment with antibiotics for patients in whom leptospirosis is suspected reduces morbidity and mortality.

Epidemiologic Investigation and Results

Because of an expected increase in leptospirosis cases after heavy flooding when Category 1 Hurricane Fiona made landfall on September 18, 2022, PRDH took action to strengthen surveillance, guide response efforts, and improve patient outcomes. Leptospirosis cases were identified through the existing passive surveillance system. This includes reporting by health care providers of patients with observed clinically compatible illness as suspected cases and laboratories (including hospitals, private laboratories, and the PRDH laboratory) reporting results for specimens submitted for leptospirosis testing. A confirmed case was defined as a suspected case with a positive real-time PCR result for

leptospirosis, and a probable case was defined as a suspected case with detection of leptospirosis-specific immunoglobulin M (IgM) antibodies by enzyme linked immunosorbent assay (ELISA).* Microagglutination testing, the reference standard serologic test for leptospirosis, was considered for probable cases but was not possible because of shipping difficulties. For each case, all available test results were used for case classification (Supplementary Figure, https://stacks.cdc.gov/view/cdc/160382), including those from both acute- and convalescent-phase specimens (those collected ≤7 days and >7 days after symptom onset, respectively).

To evaluate differences in confirmed and probable cases before and after Hurricane Fiona, leptospirosis cases with onset dates during the 37 weeks before Hurricane Fiona (January 2–September 17, 2022) were compared with cases with onset dates during the 15 weeks after Hurricane Fiona (September 18–December 31, 2022). The pre-hurricane period of 37 weeks was chosen to characterize the cases before Hurricane Fiona and to obtain the number of cases sufficient for statistical power; the post-hurricane period of 15 weeks was chosen for evaluation because the number of cases had generally stopped decreasing and began to plateau at this time. To estimate the relative increase in cases, the mean weekly number of confirmed and probable cases before and after Hurricane Fiona were compared. Annual municipality-level incidences of confirmed and probable cases during both periods were calculated by dividing the number of cases by the population size (from the 2020 U.S. Census) and duration of the period (i.e., 37 weeks before Hurricane Fiona and 15 weeks after Hurricane Fiona), and then multiplying by 52 weeks.

To investigate whether persons who received a positive leptospirosis test result might have been infected with dengue virus, which causes similar signs and symptoms and is endemic in Puerto Rico, the PRDH Passive Arboviral Disease Surveillance System was searched for dengue cases among persons who had the exact same date of birth, similar patient name, and date of symptom onset within 2 weeks of the identified leptospirosis cases. Leptospirosis case trends during January 3, 2021–September 30, 2023 were also compared.† This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.§

During the 15 weeks after Hurricane Fiona made landfall, 823 suspected leptospirosis cases were reported to PRDH: 91 with only real-time PCR test results, 157 with only IgM ELISA results, 573 with results from both tests, and two without results from either tests; 156 of the 823 suspected cases were categorized as either confirmed from a positive real-time PCR test result (40, 26%) or as probable by IgM ELISA (116, 74%) (Table). The median age of persons with confirmed and probable cases was 42 years (IQR = 29–60 years); 116 (74%) were male. Among confirmed and probable cases, the most

TABLE. Description of confirmed and probable leptospirosis cases before and after Hurricane Fiona* — Puerto Rico, 2022

Characteristic	No. (%) 37 weeks before Hurricane Fiona landfall n = 108	No. (%) 15 weeks after Hurricane Fiona landfall n = 156	p-value†
Case classification			
Confirmed	16 (15)	40 (26)	0.034
Probable	92 (85)	116 (74)	
Median age, yrs (IQR)	48 (38–59)	42 (29–60)	0.037
Sex			
Female	27 (25)	40 (26)	>0.9
Male	81 (75)	116 (74)	
Leptospirosis testing			
Both IgM and real-time PCR testing	48 (44)	113 (72)	<0.001
IgM testing only	58 (54)	34 (22)	
Real-time PCR testing only	2 (2)	9 (6)	
Outcome			
Hospitalized	100 (93)	112 (72)	<0.001
Died	15 (14)	10 (6)	0.041
Received antibiotic treatment§	107 (99)	148 (95)	0.087
Contact source			
Potentially contaminated water¶	12 (11)	55 (35)	<0.001
Potentially contaminated food¶	17 (16)	29 (19)	0.5
Animals (including pets)¶	66 (61)	100 (64)	0.6
Had occupational risk factor**	16 (15)	29 (19)	0.4
Dengue test results			
No testing performed	85 (79)	104 (67)	0.054
RT-PCR– or IgM-negative	19 (18)	36 (23)	
RT-PCR–positive	4 (4)	16 (10)	
Sign or symptom			
Fever††	69 (64)	129 (83)	<0.001
Myalgia††	57 (53)	88 (56)	0.6
Headache††	53 (49)	102 (65)	0.008
Conjunctivitis††	11 (10)	13 (8)	0.6
Thrombocytopenia††	36 (33)	53 (34)	>0.9
Rash††	11 (10)	45 (29)	<0.001
Persistent vomiting††	31 (29)	48 (31)	0.7
Abdominal pain††	57 (53)	73 (47)	0.3
Severe bleeding††	15 (14)	22 (14)	>0.9
Nausea††	43 (40)	69 (44)	0.5
Diarrhea††	46 (43)	66 (42)	>0.9
Kidney failure	23 (21)	29 (19)	0.6
Liver failure	11 (10)	14 (10)	0.7
Meningitis	1 (1)	1 (1)	>0.9

Abbreviations: IgM = immunoglobulin M; PCR = polymerase chain reaction; RT-PCR = reverse transcription PCR.

* Hurricane Fiona made landfall in Puerto Rico on September 18, 2022.

† Pearson's chi-square test; Wilcoxon rank sum test; Fisher's exact test

§ Antibiotic treatment status was missing for one person.

¶ Information on contact with potentially contaminated water, potentially contaminated food, or animals was missing for four persons.

** Included farmer, rancher, fishery sector worker, veterinarian, slaughterhouse worker, and animal caretaker, among others.

†† Information for the following signs and symptoms was missing for six persons: fever, myalgia, headache, conjunctivitis, thrombocytopenia, rash, persistent vomiting, abdominal pain, severe bleeding, nausea, and diarrhea.

* IgM tests conducted at the PRDH laboratory used the GenBio IgM ImmunoDOT *Leptospira* assay. IgM assay types used at private and hospital laboratories were not available in the data sets analyzed.

† Code used for analyses is available at https://github.com/fjones2222/lepto-hurricane-fiona.

§ 45 C.F.R. part 46.102(l) (2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

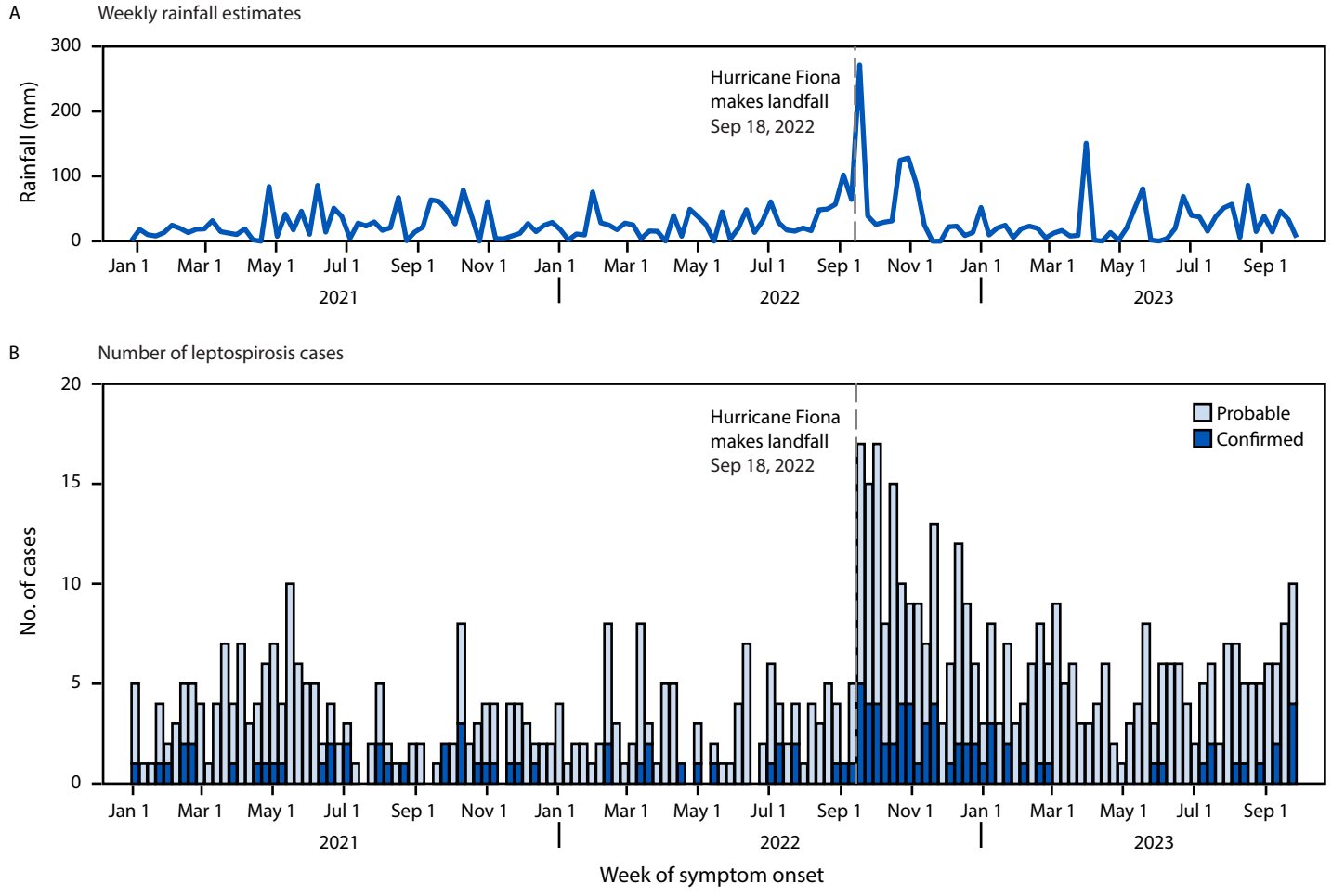
frequently reported symptoms were fever (83%), headache (65%), myalgia (56%), abdominal pain (47%), nausea (44%), and diarrhea (42%). A total of 112 (72%) patients were hospitalized and 10 (6%) died. Overall, 148 (95%) patients received antibiotic treatment. Sixteen persons (10%) with probable cases also received a positive test result for dengue virus infection by reverse transcription–polymerase chain reaction (RT-PCR).

Incidence of confirmed and probable cases was highest during the first 5 weeks after Hurricane Fiona (14.4 per week) (Figure 1). The average weekly number of confirmed and probable cases during the 15 weeks after Hurricane Fiona (10.4) was 3.6 (95% CI = 2.6–4.9) times as high as that during the 37 weeks before landfall (2.9). The number of weekly confirmed and probable leptospirosis cases remained elevated throughout 2023: the average weekly number of cases was 3.3 in 2021, 5.1 in 2022, and 5.2 in 2023.

The proportion of patients with severe illness was lower during the 15 weeks after Hurricane Fiona than during the 37 weeks before: hospitalized (72% versus 93%, p<0.01) and died (6% versus 14%, p = 0.04) (Table). Patients with symptom onset after Hurricane Fiona more frequently reported exposure to potentially contaminated water than before the hurricane (35% versus 11%). The frequency of other exposures was similar before and after Hurricane Fiona: contact with animals (64% versus 61%), contact with potentially contaminated foods (19% versus 16%), and occupational exposures (e.g., farmer, rancher, fishery sector worker, veterinarian, slaughterhouse worker, or animal caretaker) (19% versus 15%).

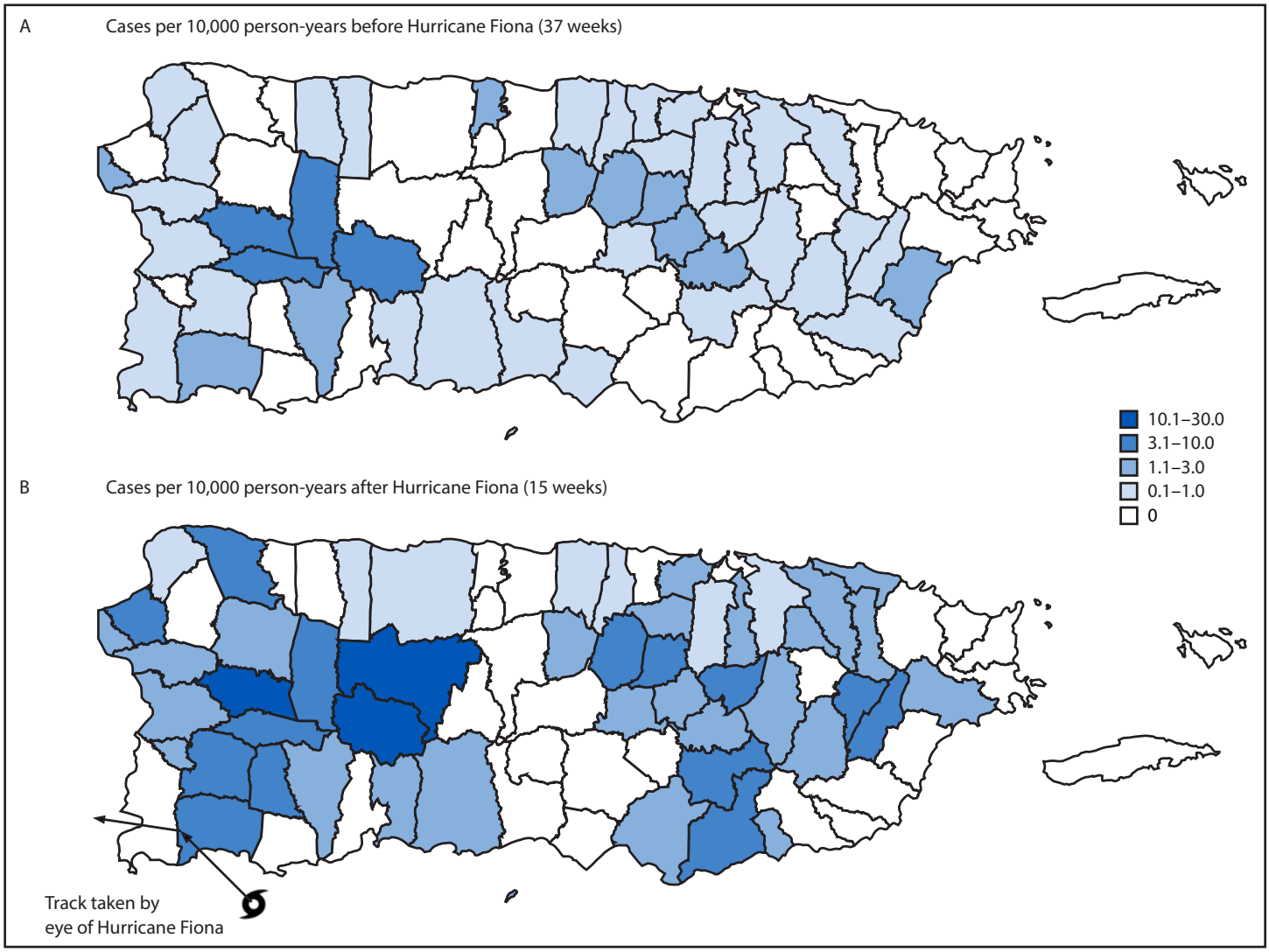
Patients with symptom onset after Hurricane Fiona resided in 48 (62%) of 78 municipalities, compared with patients with symptom onset before the hurricane, who resided in 43 (55%) of 78 municipalities (Figure 2). Thirty-three municipalities had one or more cases both before and after Hurricane Fiona;

FIGURE 1. Weekly rainfall estimates* (A) and number of probable and confirmed leptospirosis cases (B) before and after Hurricane Fiona landfall — Puerto Rico, January 3, 2021–September 30, 2023



* https://climateserv.servirglobal.net/map

FIGURE 2. Municipality-level incidence of probable and confirmed leptospirosis cases* before (A) (N = 108) and after (B) (N = 156) Hurricane Fiona landfall — Puerto Rico, January 2–December 31, 2022



* Overall incidence of confirmed and probable cases (per 10,000 person-years) was 0.5 before Hurricane Fiona and 1.7 after Hurricane Fiona.

during both periods, the incidence was highest in the inland western municipalities.

Public Health Response

Anticipating increased risk for leptospirosis from flooding, PRDH requested technical assistance to form a response team from CDC on September 20, 2 days after Hurricane Fiona made landfall. Objectives were to increase health care provider awareness, support laboratory testing, and facilitate reporting and analysis of leptospirosis cases. On September 23, 2022, the required provider reporting time was reduced from within 5 days to within 24 hours. Additional efforts to improve surveillance capacity included streamlining surveillance data collection and centralizing data entry into a single reporting system. On September 28, PRDH issued a leptospirosis clinical management and surveillance guide. A virtual clinical training (a video with on-demand access is available online[¶]) was created for health care providers to emphasize the importance of recognizing and reporting leptospirosis cases and early treatment with antibiotics like doxycycline to reduce severe disease and mortality. The training also discussed dengue case recognition, given the similarities between dengue and leptospirosis clinical presentations. Diagnostic capacity at the PRDH public health laboratory was strengthened by increasing the availability of reagents for PCR and IgM ELISA tests and designating additional PRDH staff members for sample processing and testing. PRDH continued proactive communication with the public through continuous messaging on social media about

[¶] https://www.salud.pr.gov/CMS/493

Summary

What is already known about this topic?

Leptospirosis, an acute bacterial zoonotic disease, can progress to severe, potentially fatal illness. Increased incidence has been associated with flooding in areas around the world where the disease is endemic.

What is added by this report?

In 2022, a large leptospirosis outbreak occurred in Puerto Rico after Hurricane Fiona made landfall. Proactive public health response activities leveraged existing surveillance and laboratory capacity. The increase in reported cases was likely the result of a combination of widespread exposure to contaminated water and increased testing.

What are the implications for public health practice?

Robust laboratory and epidemiologic surveillance combined with outreach to health care providers after flooding events can improve leptospirosis case identification, inform clinicians considering early initiation of antibiotic therapy, and guide public messaging to avoid contact with floodwaters.

avoiding wading, swimming, or any contact with potentially contaminated floodwaters and providing weekly epidemiologic reports on the PRDH website.

Discussion

A large increase in leptospirosis cases occurred immediately after Hurricane Fiona made landfall, with elevated case counts lasting >3 months. Rapid public health response efforts led to increased availability of surveillance data to monitor the outbreak as it evolved and provided timely, accurate information to the community about leptospirosis risk and prevention.

Increased exposure to pathogenic *Leptospira* bacteria from contaminated floodwater likely resulted in increased incidence of leptospirosis after Hurricane Fiona. This hypothesis is consistent with the increase in the proportion of patients who reported exposure to potentially contaminated water from 11% during the period before landfall to 35% after landfall. Increased physician awareness and testing likely also contributed to the increased reported incidence. Severe outcomes (hospitalization and death) were less frequent among persons with cases reported after Hurricane Fiona. Possible explanations for this decrease include increased detection of less severe cases, earlier initiation of treatment, or both. Weekly case numbers remained elevated through September 2023, which might reflect a sustained increase in case detection.

One primary challenge was the variability of leptospirosis diagnostic test sensitivity and specificity at different time points after a patient's symptom onset. Although real-time PCR assays have low sensitivity >1 week after symptom onset, leptospirosis serologic tests have limited sensitivity during the first week after symptom onset because of the time until appearance of IgM antibodies (i.e., 3–10 days) (*9*). In addition, some probable cases might have had false positive IgM ELISA results, as reported in other areas with endemic disease, because of persistence of IgM antibodies from a previous infection for ≥12 months (*10*). In such cases, the symptoms relating to the person seeking care and testing might be caused by a different pathogen. Although coinfection could not be ruled out, the 16 probable cases of leptospirosis that had confirmed dengue infections by RT-PCR would be consistent with this scenario.

Implications for Public Health Practice

Early case identification and treatment are critical to reducing morbidity and mortality associated with leptospirosis. In areas with endemic leptospirosis, health departments can reinforce leptospirosis surveillance and increase both public and clinician awareness, particularly during hurricane season or months with high risk for flooding. Maintaining and strengthening leptospirosis surveillance in Puerto Rico will help identify populations at risk, guide prevention and response recommendations, protect health, and better prepare for the impact of future hurricane or flooding events.

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Oropouche Virus Disease Among U.S. Travelers — United States, 2024

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Abstract

On August 27, 2024, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Beginning in late 2023, Oropouche virus was identified as the cause of large outbreaks in Amazon regions with known endemic transmission and in new areas in South America and the Caribbean. The virus is spread to humans by infected biting midges and some mosquito species. Although infection typically causes a self-limited febrile illness, reports of two deaths in patients with Oropouche virus infection and vertical transmission associated with adverse pregnancy outcomes have raised concerns about the threat of this virus to human health. In addition to approximately 8,000 locally acquired cases in the Americas, travel-associated Oropouche virus disease cases have recently been identified in European travelers returning from Cuba and Brazil. As of August 16, 2024, a total of 21 Oropouche virus disease cases were identified among U.S. travelers returning from Cuba. Most patients initially experienced fever, myalgia, and headache, often with other symptoms including arthralgia, diarrhea, nausea or vomiting, and rash. At least three patients had recurrent symptoms after the initial illness, a common characteristic of Oropouche virus disease. Clinicians and public health jurisdictions should be aware of the occurrence of Oropouche virus disease in U.S. travelers and request testing for suspected cases. Travelers should prevent insect bites when traveling, and pregnant persons should consider deferring travel to areas experiencing outbreaks of Oropouche virus disease.

Investigation and Results

Natural History and Clinical Symptoms

Oropouche virus (Simbu serogroup, genus *Orthobunyavirus*) is endemic to the Amazon region and was previously identified as a cause of human disease in several countries in South and Central America and the Caribbean (*1*). The virus circulates in a sylvatic cycle, possibly involving certain vertebrate hosts (e.g., sloths, nonhuman primates, and birds) and mosquitoes, and an urban cycle in which humans serve as amplifying hosts with known vectors being biting midges (*Culicoides paraensis*) and possibly mosquitoes (e.g., *Culex quinquefasciatus*) (*1*).

The clinical signs and symptoms of Oropouche virus disease are similar to those of other arboviral diseases such as dengue, Zika, and chikungunya. After an incubation period of 3–10 days, patients typically experience abrupt onset of fever, chills, headache, myalgia, and arthralgia. Other symptoms might include retroorbital pain, photophobia, vomiting, diarrhea, fatigue, maculopapular rash, conjunctival injection, and abdominal pain. Initial symptoms usually last only a few days, but up to 70% of patients are reported to have recurrent symptoms within days to weeks after resolution of their initial illness (*2*). Although illness is typically mild, hemorrhagic manifestations (e.g., epistaxis, gingival bleeding, melena, menorrhagia, and petechiae) or neuroinvasive disease (e.g., meningitis and meningoencephalitis) can rarely occur (*1,3,4*). No vaccines to prevent or medicines to treat Oropouche virus disease exist; treatment is supportive.

Recent Outbreaks in South America and Cuba

During December 2023–June 2024, large Oropouche virus disease outbreaks were recognized in areas with known endemic disease, and the virus emerged in new areas in South America and Cuba where it had not been historically reported (*3*). As of August 2024, over 8,000 laboratory-confirmed cases have been reported in Bolivia, Brazil, Colombia, Cuba, and Peru (*3*). These large outbreaks have resulted in travel-associated cases, with 19 Oropouche virus disease cases in European travelers returning from Cuba (n = 18) and Brazil (one) during June–July 2024 (*5*). Recently, cases of severe disease leading to two deaths and vertical transmission associated with fetal death and possible congenital malformations in Brazil have raised concerns about the threat of Oropouche virus to human health (*3*).

Identification of U.S. Cases

CDC and New York State Department of Health (NYSDOH) Wadsworth Center conducted Oropouche virus testing for travelers who had returned from areas with known Oropouche virus circulation and had an illness that was clinically compatible with Oropouche virus disease. Clinical diagnostic testing at CDC's Arboviral Diseases Branch and NYSDOH Wadsworth Center Arbovirus Laboratory is performed using a 90% plaque reduction neutralization test ($PRNT_{90}$) to detect virus-specific neutralizing antibodies in serum or cerebrospinal fluid, with titers ≥10 considered positive. CDC also conducted surveillance testing on specimens

collected ≤7 days after symptom onset using an Oropouche virus real-time reverse transcription–polymerase chain reaction (RT-PCR) assay (*6*). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.*

The Florida Department of Health (FLDOH) identified suspected cases primarily by reviewing patients who received negative test results for dengue from state and commercial laboratories and who had a clinically compatible illness and exposure to areas with potential Oropouche virus circulation. Details of epidemiologic investigations, including risk factors, clinical features, and outcomes, are captured from patient interview, clinician interview, or review of medical records using a standardized case investigation form.

Characteristics of U.S. Cases

Evidence of Oropouche virus infection was identified in 21 U.S. residents returning from travel to Cuba, including 20 in Florida and one in New York. Most patients were initially evaluated during their acute illness, but at least three patients were evaluated when their symptoms reoccurred after initial symptom resolution. The median patient age was 48 years (range = 15–94 years) and 48% were female (Table 1). Pregnancy status was not included in this report for reasons of confidentiality. Reported symptoms commenced during May–July and most commonly included fever (95%), myalgia (86%), headache (76%), fatigue or malaise (62%), and arthralgia (57%). Other reported signs and symptoms included diarrhea (48%), abdominal pain (29%), nausea or vomiting (29%), rash (29%), retroorbital pain (24%), back pain (19%), and mucosal bleeding (5%) (Table 2). The combination of fever and myalgia with or without other symptoms was reported

* 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE 1. Characteristics of U.S. travelers with Oropouche virus disease (N = 21) — United States, 2024

Characteristic	No. (%)
Age group, yrs	
0–19	2 (10)
20–39	5 (24)
40–59	10 (48)
≥60	4 (19)
Sex	
Female	10 (48)
State of residence	
Florida	20 (95)
New York	1 (5)
Location of travel	
Cuba	21 (100)
Symptom onset, month	
May	1 (5)
June	6 (29)
July	14 (67)

TABLE 2. Signs and symptoms* reported by U.S. travelers with Oropouche virus disease (N = 21) — United States, 2024

	Sign or symptom											
Patient	Fever	Myalgia	Headache	Fatigue/ Malaise	Arthralgia	Diarrhea	Retroorbital pain	Abdominal pain	Nausea/ Vomiting	Back pain	Rash	Mucosal bleeding
A	X	X	X	X	X	—	X	—	X	X	—	—
B	X	X	X	X	X	—	X	—	—	—	X	—
C	X	X	X	X	X	—	—	—	—	X	X	—
D	X	X	X	X	X	X	—	X	—	—	—	—
E	X	X	X	X	—	X	—	X	X	—	—	—
F	X	X	X	X	—	X	—	X	—	X	—	—
G	X	X	X	X	—	—	—	—	—	—	—	—
H	X	X	X	—	X	—	—	—	X	—	—	—
I	X	X	X	—	X	—	—	X	—	—	—	X
J	X	X	X	—	—	—	—	—	X	—	—	—
K	X	X	X	—	—	X	—	—	—	—	X	—
L	X	X	X	—	—	—	—	—	—	—	—	—
M	X	X	X	—	—	—	—	—	—	—	—	—
N	X	X	—	X	X	—	—	—	—	X	X	—
O	X	X	—	X	X	X	—	—	—	—	—	—
P	X	X	—	—	X	X	X	X	—	—	—	—
Q	X	X	—	—	X	X	—	—	—	—	X	—
R	X	—	X	X	—	X	X	X	X	—	—	—
S	X	—	X	X	X	X	—	—	—	—	—	—
T	X	—	—	X	—	X	—	—	—	—	X	—
U	—	X	X	X	X	—	X	—	X	—	—	—
Total no. (%) reporting sign or symptom	**20 (95)**	**18 (86)**	**16 (76)**	**13 (62)**	**12 (57)**	**10 (48)**	**5 (24)**	**6 (29)**	**6 (29)**	**4 (19)**	**6 (29)**	**1 (5)**

* Within cells, X = sign or symptom reported; dash = no sign or symptom reported.

in 17 (81%) patients; the combination of fever and headache was reported in 15 (71%). All three symptoms occurred in 13 (62%) patients. Overall, three were hospitalized, and no deaths were reported.

Laboratory evidence of Oropouche virus infection was identified by real-time RT-PCR in 13 patients, by $PRNT_{90}$ in seven, and by both assays in one patient. Most real time RT-PCR–positive specimens were collected on days 1–4 (median = 2.5 days; range = 1–7 days) after symptom onset. $PRNT_{90}$–positive specimens were collected a median of 17 days (range = 9–32 days) after symptom onset.

Public Health Response

As a result of the emergence and spread of Oropouche virus in the Americas, CDC is working with state public health jurisdictions and international partners to enable rapid detection and surveillance of Oropouche virus transmission and disease to guide public health prevention measures. CDC is currently developing a plan for rapid detection and response to Oropouche virus disease cases in the United States, assisting health departments with clinical diagnostic and surveillance testing for suspected cases, working to validate a molecular assay to detect acute infections, and updating CDC's Travelers' Health notices[†] and website[§] on Oropouche as new information becomes available. In addition, CDC is providing clinical consultation and guidance to pregnant persons and their care providers and are tracking the impact of emerging health threats, like Oropouche virus, on pregnant persons and their infants.[¶] Although Oropouche virus disease is not nationally notifiable, CDC encourages jurisdictions to report cases voluntarily to ArboNET, the national arboviral disease surveillance system, using interim case definitions.[**] For questions about testing or reporting, health departments can contact eocevent495@cdc.gov.

Discussion

The 21 U.S. travel-associated Oropouche virus disease cases were all identified among U.S. residents who had traveled to Cuba. The clinical features of the travelers' illnesses are similar to those reported in the literature (*1,4,7*). Most patients had a self-limited febrile illness, commonly associated with myalgia and headache with or without additional signs or symptoms, including gastrointestinal symptoms (reported by approximately two thirds of patients). At least three patients initially sought care after experiencing relapse of symptoms following resolution of the initial illness. This reported reoccurrence of symptoms is unique to Oropouche virus disease and is not typically reported in cases of similar arboviral diseases, such as dengue or Zika virus disease (*2*). The reoccurrence of symptoms is likely underestimated because of limitations in obtaining a complete clinical history or follow-up after the initial illness.

Among most patients, Oropouche virus disease is mild; however, two deaths in previously healthy young persons with Oropouche virus infection were recently reported in Brazil (*3*). In July, the Pan American Health Organization (PAHO) issued an epidemiologic alert concerning possible vertical transmission of Oropouche virus disease associated with adverse pregnancy outcomes, including fetal deaths and congenital malformations (*3*).

Clinicians should report suspected Oropouche virus disease cases to state, tribal, local, or territorial health departments to facilitate testing and implementation of community prevention measures and messaging.[††] Information for health care providers regarding clinical features, diagnosis, and clinical management are available on CDC's website.[§§] Supportive care is recommended for clinical management of patients. Patients should be advised to avoid nonsteroidal anti-inflammatory drugs to reduce the risk for bleeding. Oropouche and dengue viruses can cocirculate and cause similar symptoms; patients with clinically suspected dengue should be managed according to dengue clinical management recommendations[¶¶] until dengue is ruled out. Interim considerations for clinical management of pregnant persons with Oropouche virus disease and infants born to these pregnant persons are available.[***]

Oropouche virus disease should be considered in a patient who has been in an area with documented or suspected Oropouche virus circulation (*3*) within 2 weeks of initial symptom onset and who experiences an abrupt onset of fever, headache, and one or more of the following: myalgia, arthralgia, photophobia, retroorbital or eye pain, or signs and symptoms of neuroinvasive disease (e.g., stiff neck, altered mental status, seizures, limb weakness, or cerebrospinal fluid pleocytosis). Because patients with Oropouche virus disease can experience reoccurrence of symptoms after resolution of the initial illness, patients might seek care >2 weeks after travel. In suspected Oropouche virus disease cases, testing should be conducted for other diseases with similar symptoms, including dengue, particularly given the recent large dengue outbreak in the Americas with approximately 11 million cases reported since late 2023 (*8*). Because of the concern for vertical transmission of Oropouche virus from a pregnant patient to the fetus,

[†] https://wwwnc.cdc.gov/travel/notices
[§] https://www.cdc.gov/oropouche/about/index.html
[¶] https://www.cdc.gov/set-net/about/index.html
[**] https://www.cdc.gov/oropouche/php/reporting/index.html
[††] https://emergency.cdc.gov/han/2024/han00515.asp
[§§] https://www.cdc.gov/oropouche/hcp/clinical-overview/index.html
[¶¶] https://www.cdc.gov/dengue/hcp/clinical-care/index.html
[***] https://www.cdc.gov/oropouche/hcp/clinical-care-pregnancy/index.html; https://www.cdc.gov/oropouche/hcp/clinical-care/infants.html

Summary

What is already known about this topic?

Oropouche virus is an emerging arthropod-borne virus in the Americas. Recent reports of outbreaks in areas without previous endemic transmission, fatal cases, and vertical transmission associated with adverse pregnancy outcomes have raised concerns about human health risks.

What is added by this report?

As of August 16, 2024, a total of 21 Oropouche virus disease cases among U.S. travelers returning from Cuba have been reported. Most patients had self-limited illness. At least three patients experienced recurrent symptoms after resolution of the initial illness.

What are the implications for public health practice?

Clinicians and public health jurisdictions should be aware of the occurrence of Oropouche virus disease in U.S. travelers and request testing for suspected cases. Travelers should prevent insect bites when traveling, and pregnant persons should consider deferring travel to areas experiencing outbreaks of Oropouche virus disease.

paired specimens should be collected from pregnant patients to confirm a recent infection.

Implications for Public Health Practice

Guidance on clinical case identification and management might be modified as the epidemiologic situation evolves, particularly if local transmission in the United States is identified and as more is learned about disease and transmission risk. Based on presently available data, the risk for sustained local transmission in the continental United States is likely low, whereas the risk for sustained transmission in Puerto Rico and U.S. Virgin Islands is unknown. CDC is working with partners to understand more about what is driving the current outbreaks and how that might affect risk of transmission. Vector competence studies are underway to understand the potential role of several U.S. *Culicoides* spp. of biting midges and mosquito species (*Cx. quinquefasciatus* and *Aedes aegypti)* in Oropouche virus transmission.

Providers should advise persons of the risk for Oropouche virus disease and counsel them to use personal protective measures[†††] against mosquito and biting midge bites if traveling to areas with virus circulation. Travelers should use personal protective measures for 3 weeks after return from an area with Oropouche virus circulation, or during the first week of illness in symptomatic patients to prevent further spread, especially in areas where mosquitoes or biting midges are active. Because of the risk for possible vertical transmission providers should inform persons who are pregnant and considering travel to areas with reported Oropouche virus transmission of the possible risks to the fetus. Pregnant travelers should prevent insect bites during travel[§§§] and consider deferring travel to areas experiencing outbreaks of Oropouche virus disease.[¶¶¶] CDC is working with PAHO and other partners to learn more about the potential risks associated with infection with Oropouche virus during pregnancy and to increase testing capacity in the region.

[†††] https://www.cdc.gov/oropouche/prevention/index.html

[§§§] https://www.cdc.gov/mosquitoes/prevention/preventing-mosquito-bites-while-traveling.html

[¶¶¶] https://wwwnc.cdc.gov/travel/notices/level2/oropouche-cuba

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Notes from the Field:

E-Cigarette and Nicotine Pouch Use Among Middle and High School Students — United States, 2024

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Current e-cigarette use among U.S. youth has declined considerably since 2019*; however, approximately 2.13 million youths used e-cigarettes in 2023 (*1*). As sales of nicotine pouches (small, dissolvable, flavored pouches containing nicotine derived from tobacco that users place in the mouth between the lip and gum)† have continued to rise nationally since 2016, their use among U.S. youths has become concerning (*2*,*3*). All pouches and most e-cigarettes contain nicotine,§ which is highly addictive and can harm the developing adolescent brain (*4*,*5*).

Investigation and Outcomes

The Food and Drug Administration and CDC analyzed nationally representative data from the 2024 National Youth Tobacco Survey (NYTS), a cross-sectional, school-based, self-administered web-based survey of U.S. students in middle school (grades 6–8) and high school (grades 9–12), which was conducted among 29,861 students from 283 schools during January 22–May 22, 2024.¶ Current (i.e., past–30-day) use of e-cigarettes and nicotine pouches was assessed overall, and by frequency of use, device type used for e-cigarettes, any brand and usual brand used,** and flavor types. Weighted prevalence estimates, 95% CIs, and population totals were calculated using SAS-callable SUDAAN software (version 11.0.4; RTI International).†† Changes in current use since 2023 were evaluated using *t*-tests; p-values <0.05 were considered statistically significant. The 2023 NYTS data collection methods and estimates have been published (*1*). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.§§

In 2024, 5.9% of middle and high school students reported current e-cigarette use, including 7.8% of high school students and 3.5% of middle school students (Table). Among students who currently used e-cigarettes, 38.4% reported frequent use,¶¶ and 26.3% reported daily use. The device types used most often by students reporting current e-cigarette use were disposables (55.6%), followed by prefilled or refillable pods or cartridges (15.6%) and tanks or mod systems*** (7.0%); 21.8% of students currently using e-cigarettes were unsure of the device type used. Among students who currently used e-cigarettes, 36.1% used Elf Bar, followed by Breeze (19.9%), Mr. Fog (15.8%), Vuse (13.7%), and JUUL (12.6%); 87.6% used a flavored product; fruit (62.8%), candy (33.3%), and mint (25.1%) were the flavor types most frequently reported.

In 2024, 1.8% of middle and high school students reported current nicotine pouch use, including 2.4% of high school students and 1.0% of middle school students. Among students who currently used nicotine pouches, 29.3% reported frequent use, and 22.4% reported daily use. Among students reporting current nicotine pouch use, 68.7% used ZYN, followed by on! (14.2%), Rogue (13.6%), Velo (10.7%), and Juice Head ZTN (9.8%); 85.6% used a flavored product: mint (53.3%), fruit (22.4%), and menthol (19.3%) were the flavor types most frequently reported.

From 2023 to 2024, current e-cigarette use declined among middle and high school students overall (from 7.7% to 5.9%; p<0.05) and high school students (from 10.0% to 7.8%; p<0.05). No significant changes were observed for current e-cigarette use among middle school students or for current nicotine pouch use among high school students or middle and high school students overall.

Conclusions and Actions

In 2024, an estimated 1.63 million U.S. middle and high school students currently used e-cigarettes, a significant decline from 2.13 million in 2023. In contrast, from 2023 to 2024, no significant changes occurred in current nicotine pouch use among middle and high school students overall (an estimated 480,000 students in

* http://dx.doi.org/10.15585/mmwr.ss6812a1

† Unlike other smokeless tobacco products, such as snuff and snus, nicotine pouches do not contain any tobacco leaf.

§ E-cigarettes: https://www.fda.gov/tobacco-products/products-ingredients-components/e-cigarettes-vapes-and-other-electronic-nicotine-delivery-systems-ends; nicotine pouches: https://www.fda.gov/tobacco-products/products-ingredients-components/other-tobacco-products.

¶ In 2024, the student-level participation rate was 78.3%, and the school-level participation rate was 42.7%, for an overall response rate of 33.4%.

** Brand response options were: blu, Breeze, Elf Bar, Esco Bars, Fume, JUUL, HQD, Kangvape (including Onee Stick), Logic, Mr. Fog, NJOY, SMOK (including NOVO), Suorin (including Air Bar), Vuse, "some other brand(s) not listed here," and "I don't know the brand." Those who selected "some other brand(s) not listed here" could provide a write-in response. Write-in responses were recoded into valid responses. Estimates for Geek Bar and Lost Mary were based on the write-in responses and might be underestimated.

†† Data were weighted to account for complex survey design and to adjust for nonresponse. The weighted proportions of students in each grade matched national population proportions for U.S. public and private schools derived from data from the National Center for Education Statistics (2021–2022 Common Core of Data and 2019–2020 Private School Universe Study) and Market Data Retrieval, Inc. Population number estimates were rounded down to the nearest 10,000 students.

§§ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

¶¶ Frequent use was defined as use on ≥20 days during the previous 30 days. Daily use was defined as use on all of the previous 30 days. These estimates are not mutually exclusive.

*** An e-cigarette with a tank that the user refills with liquids or a mod system that can be customized by the user with their own combination of batteries or other parts.

TABLE. Number and percentage of middle and high school students reporting current (past–30-day) e-cigarette use and nicotine pouch use,* overall and by selected characteristics and school level — National Youth Tobacco Survey, United States, 2024

Characteristic	Overall		High school		Middle school	
	Estimated no. of users	Weighted % (95% CI)	Estimated no. of users	Weighted % (95% CI)	Estimated no. of users	Weighted % (95% CI)
E-cigarette use†						
Current e-cigarette use among all students	1,630,000	5.9 (5.3–6.6)	1,210,000	7.8 (6.9–8.8)	410,000	3.5 (2.9–4.2)
Among students currently using e-cigarettes						
Frequency of use during the previous 30 days§						
1–5 days	720,000	44.1 (40.1–48.1)	510,000	42.3 (37.7–47.1)	200,000	49.7 (43.9–55.6)
6–19 days	280,000	17.5 (15.5–19.6)	180,000	15.5 (13.3–18.0)	90,000	23.5 (20.0–27.3)
20–30 days	620,000	38.4 (34.5–42.5)	510,000	42.1 (37.7–46.7)	110,000	26.8 (21.5–32.8)
Daily e-cigarette use§	430,000	26.3 (23.0–30.0)	360,000	29.7 (25.9–33.8)	60,000	15.6 (11.5–20.7)
Device type most often used¶						
Disposables	870,000	55.6 (52.4–58.8)	690,000	58.7 (54.9–62.4)	180,000	47.0 (41.7–52.4)
Prefilled or refillable pods or cartridges	240,000	15.6 (13.5–18.0)	170,000	15.1 (12.9–17.6)	60,000	17.1 (12.7–22.8)
Tanks or mod systems	110,000	7.0 (5.7–8.6)	80,000	7.0 (5.5–8.9)	20,000	6.6 (4.4–9.8)
Don't know the type	340,000	21.8 (19.4–24.4)	220,000	19.2 (16.5–22.3)	110,000	29.3 (25.0–34.0)
Any brand**						
Elf Bar	560,000	36.1 (32.8–39.6)	380,000	33.2 (29.3–37.3)	170,000	44.4 (39.3–49.6)
Breeze	310,000	19.9 (15.3–25.5)	220,000	19.0 (13.6–26.0)	80,000	21.7 (16.5–28.1)
Mr. Fog	240,000	15.8 (9.6–24.7)	190,000	16.5 (8.9–28.5)	40,000	12.5 (8.9–17.3)
Vuse	210,000	13.7 (10.8–17.2)	160,000	14.2 (10.8–18.4)	40,000	11.3 (7.5–16.5)
JUUL	190,000	12.6 (10.6–14.9)	110,000	10.1 (8.3–12.3)	70,000	19.0 (14.5–24.4)
Esco Bars	160,000	10.2 (8.3–12.4)	100,000	8.9 (6.9–11.4)	50,000	13.0 (9.5–17.4)
Fume	140,000	9.1 (7.2–11.4)	90,000	7.7 (5.8–10.2)	40,000	11.9 (8.1–17.1)
SMOK (including NOVO)	120,000	7.7 (6.2–9.6)	80,000	7.2 (5.6–9.3)	30,000	7.9 (5.4–11.6)
Kangvape (including Onee Stick)	120,000	7.6 (5.9–9.9)	70,000	6.6 (4.7–9.3)	30,000	9.3 (6.7–12.8)
blu	100,000	6.9 (5.6–8.4)	50,000	5.0 (3.8–6.5)	40,000	11.5 (8.6–15.1)
NJOY	90,000	6.1 (4.8–7.7)	60,000	5.5 (4.2–7.3)	20,000	6.7 (4.4–10.0)
Geek Bar††	90,000	5.8 (4.3–7.8)	70,000	6.5 (4.7–8.9)	—§§	—
Suorin (including Air Bar)	80,000	5.2 (4.1–6.6)	40,000	4.3 (3.2–5.7)	20,000	6.9 (4.9–9.8)
HQD	70,000	5.0 (3.9–6.3)	40,000	3.8 (2.9–5.2)	20,000	7.2 (4.7–10.7)
Logic	70,000	4.9 (3.8–6.3)	40,000	3.9 (2.9–5.2)	20,000	6.9 (4.5–10.4)
Lost Mary††	50,000	3.4 (2.4–4.9)	40,000	3.5 (2.3–5.3)	—	—
Some other brand not listed	320,000	20.6 (17.9–23.4)	240,000	20.9 (17.7–24.5)	70,000	18.6 (15.4–22.2)
Not sure or don't know the brand	490,000	31.1 (28.2–34.2)	350,000	30.6 (27.0–34.4)	120,000	32.6 (28.7–36.8)
Usual brand¶¶						
Elf Bar	240,000	15.9 (13.1–19.2)	160,000	14.0 (10.7–18.1)	80,000	22.0 (17.6–27.0)
Breeze	130,000	8.7 (5.2–14.2)	100,000	9.0 (5.0–15.7)	—	—
JUUL	50,000	3.2 (2.4–4.4)	20,000	2.5 (1.6–3.8)	20,000	5.4 (3.7–7.8)
Vuse	40,000	3.1 (1.8–5.3)	—	—	—	—
Fume	20,000	1.8 (1.1–3.0)	20,000	2.1 (1.2–3.7)	—	—
Geek Bar††	20,000	1.5 (0.9–2.3)	10,000	1.7 (1.0–2.7)	—	—
Esco Bars	20,000	1.4 (0.9–2.2)	10,000	1.1 (0.6–1.9)	—	—
SMOK (including NOVO)	20,000	1.3 (0.8–2.3)	10,000	1.6 (0.9–2.9)	—	—
blu	10,000	1.1 (0.7–1.9)	—	—	—	—
Lost Mary††	10,000	0.9 (0.5–1.5)	—	—	—	—
HQD	—	—	—	—	—	—
Kangvape (including Onee Stick)	—	—	—	—	—	—
Logic	—	—	—	—	—	—
Mr. Fog	—	—	—	—	—	—
NJOY	—	—	—	—	—	—
Suorin (including Air Bar)	—	—	—	—	—	—
No usual brand	90,000	6.1 (4.9–7.5)	70,000	6.1 (4.7–7.9)	20,000	6.1 (4.3–8.5)
Some other brand not listed	310,000	20.2 (17.6–23.1)	250,000	21.6 (18.4–25.1)	60,000	16.0 (12.7–19.9)
Not sure or don't know the brand	420,000	27.1 (24.0–30.5)	310,000	27.3 (23.5–31.5)	100,000	26.7 (22.6–31.2)
Flavored e-cigarette use***						
Any flavor other than tobacco-flavored or unflavored	1,430,000	87.6 (85.2–89.7)	1,070,000	88.2 (85.2–90.7)	350,000	85.7 (81.1–89.3)
Exclusive use of tobacco-flavored or unflavored	100,000	6.4 (5.1–7.8)	70,000	6.1 (4.7–7.8)	30,000	7.3 (4.9–10.8)
Unspecified	90,000	6.0 (4.6–7.9)	60,000	5.7 (4.0–8.1)	20,000	7.0 (4.9–9.9)

See table footnotes on page 777.

TABLE. (*Continued*) Number and percentage of middle and high school students reporting current (past–30-day) e-cigarette use and nicotine pouch use,* overall and by selected characteristics and school level — National Youth Tobacco Survey, United States, 2024

Characteristic	Overall		High school		Middle school	
	Estimated no. of users	Weighted % (95% CI)	Estimated no. of users	Weighted % (95% CI)	Estimated no. of users	Weighted % (95% CI)
Flavor type used among students currently using e-cigarettes†††						
Fruit	960,000	62.8 (60.0–65.4)	710,000	62.3 (59.0–65.5)	240,000	64.2 (58.6–69.4)
Candy, desserts, or other sweets	510,000	33.3 (30.5–36.3)	360,000	32.2 (28.6–36.0)	140,000	36.4 (32.0–41.0)
Mint	380,000	25.1 (22.3–28.1)	310,000	27.7 (24.2–31.4)	60,000	17.3 (13.5–22.0)
Menthol	230,000	15.1 (12.1–18.7)	190,000	17.0 (13.2–21.6)	30,000	9.5 (6.4–13.9)
Nonalcoholic drinks§§§	170,000	11.6 (9.9–13.6)	130,000	11.8 (9.9–14.1)	40,000	10.6 (7.8–14.3)
Unflavored	170,000	11.4 (9.6–13.5)	120,000	11.0 (8.8–13.6)	40,000	12.4 (9.2–16.6)
Alcoholic drinks§§§	130,000	8.9 (7.2–10.9)	90,000	8.6 (6.5–11.2)	30,000	9.2 (6.5–12.9)
Tobacco-flavored	130,000	8.5 (7.0–10.3)	70,000	6.8 (5.4–8.7)	50,000	13.1 (9.5–17.8)
Spice§§§	90,000	6.4 (5.3–7.8)	60,000	5.9 (4.7–7.4)	20,000	7.2 (4.8–10.7)
Chocolate	80,000	5.8 (4.5–7.4)	50,000	4.7 (3.3–6.4)	30,000	8.1 (5.8–11.3)
Some other flavor	100,000	7.1 (5.7–8.7)	70,000	6.9 (5.3–9.0)	20,000	7.0 (4.7–10.3)
Use of any flavors that included the word "ice" or "iced" (such as "blueberry ice" or "strawberry ice")¶¶¶						
Yes	850,000	54.6 (51.5–57.7)	620,000	53.8 (49.8–57.7)	220,000	56.8 (52.1–61.3)
No	490,000	31.8 (29.2–34.6)	380,000	33.5 (30.2–37.0)	100,000	27.4 (23.8–31.4)
Don't know	210,000	13.6 (11.8–15.5)	140,000	12.7 (10.8–14.9)	60,000	15.8 (12.4–19.9)
Use of any concept flavors with a name that did not describe a specific flavor (such as "solar," "purple," "jazz," "island bash," or "fusion")****						
Yes	310,000	20.4 (18.4–22.7)	230,000	20.2 (17.8–22.8)	70,000	20.6 (17.3–24.3)
No	750,000	49.0 (46.0–52.0)	580,000	50.8 (47.1–54.4)	170,000	44.3 (40.2–48.4)
Don't know	470,000	30.6 (27.7–33.6)	330,000	29.0 (25.5–32.8)	130,000	35.1 (31.4–39.1)
Nicotine pouch use††††						
Current nicotine pouch use among all students	480,000	1.8 (1.5–2.1)	360,000	2.4 (2.0–2.9)	110,000	1.0 (0.8–1.2)
Among students currently using nicotine pouches						
Frequency of use during the previous 30 days§						
1–5 days	250,000	53.7 (47.9–59.3)	190,000	55.2 (48.6–61.6)	50,000	49.9 (37.9–61.9)
6–19 days	80,000	17.1 (13.4–21.5)	50,000	15.0 (10.8–20.5)	20,000	22.6 (15.5–31.7)
20–30 days	140,000	29.3 (24.7–34.3)	100,000	29.8 (24.3–36.0)	30,000	27.5 (18.5–38.8)
Daily nicotine pouch use§	100,000	22.4 (18.4–27.0)	80,000	22.9 (17.9–28.7)	20,000	20.5 (13.6–29.6)
Any brand use**						
ZYN	320,000	68.7 (62.7–74.1)	270,000	77.6 (71.4–82.7)	40,000	39.8 (30.5–50.0)
on!	60,000	14.2 (11.1–17.9)	40,000	13.8 (10.2–18.4)	10,000	14.8 (9.2–23.0)
Rogue	60,000	13.6 (10.5–17.4)	40,000	14.0 (10.4–18.7)	10,000	11.7 (7.0–19.0)
Velo	50,000	10.7 (8.3–13.8)	30,000	8.5 (6.1–11.8)	10,000	17.1 (11.4–24.9)
Juice Head ZTN	40,000	9.8 (7.6–12.5)	30,000	8.9 (6.5–12.0)	10,000	11.9 (7.4–18.7)
Fre	40,000	9.7 (7.1–13.0)	20,000	8.1 (5.4–11.9)	10,000	13.4 (7.6–22.4)
2one	30,000	7.4 (5.3–10.2)	10,000	5.2 (3.2–8.4)	10,000	12.8 (7.6–20.7)
Some other brand not listed	20,000	4.6 (2.9–7.2)	—	—	<10,000	7.3 (4.3–11.9)
Not sure or don't know the brand	70,000	15.3 (11.7–19.8)	30,000	10.4 (7.0–15.2)	30,000	29.0 (21.8–37.6)
Usual brand¶¶						
ZYN	290,000	62.4 (56.8–67.7)	250,000	72.0 (66.5–77.0)	30,000	33.5 (24.3–44.2)
on!	20,000	4.3 (2.5–7.2)	—	—	—	—
Rogue	10,000	3.5 (1.9–6.2)	—	—	—	—
Fre	10,000	3.4 (2.1–5.4)	—	—	—	—
Juice Head ZTN	10,000	3.1 (1.9–5.2)	—	—	—	—
Velo	10,000	3.0 (1.9–4.7)	—	—	—	—
2one	<10,000	1.9 (1.1–3.3)	—	—	—	—
No usual brand	10,000	2.3 (1.3–4.1)	—	—	—	—
Some other brand not listed	—	—	—	—	—	—
Not sure or don't know the brand	60,000	13.5 (10.3–17.6)	30,000	9.5 (6.2–14.2)	20,000	26.0 (19.7–33.5)
Flavored nicotine pouch use***						
Any flavor other than tobacco-flavored or unflavored	410,000	85.6 (81.5–88.9)	310,000	86.1 (81.1–89.9)	90,000	85.4 (78.6–90.3)
Exclusive use of tobacco-flavored or unflavored	40,000	9.9 (7.2–13.5)	30,000	10.0 (6.8–14.6)	10,000	9.4 (5.5–15.7)
Unspecified	20,000	4.5 (2.9–6.9)	10,000	3.9 (2.1–6.9)	—	—

See table footnotes on the next page.

TABLE. (*Continued*) Number and percentage of middle and high school students reporting current (past–30-day) e-cigarette use and nicotine pouch use,* overall and by selected characteristics and school level — National Youth Tobacco Survey, United States, 2024

Characteristic	Overall		High school		Middle school	
	Estimated no. of users	Weighted % (95% CI)	Estimated no. of users	Weighted % (95% CI)	Estimated no. of users	Weighted % (95% CI)
Flavor type used among students currently using nicotine pouches†††						
Mint	240,000	53.3 (47.4–59.1)	200,000	58.8 (52.5–64.8)	30,000	36.8 (25.5–49.6)
Fruit	100,000	22.4 (17.9–27.6)	70,000	20.2 (15.1–26.6)	20,000	27.7 (19.9–37.1)
Menthol	80,000	19.3 (15.1–24.3)	70,000	21.1 (16.1–27.2)	10,000	14.7 (9.0–23.1)
Unflavored	60,000	13.3 (10.0–17.5)	40,000	13.8 (9.9–18.9)	10,000	11.8 (7.3–18.5)
Spice§§§	40,000	10.2 (7.5–13.7)	20,000	8.5 (5.6–12.5)	10,000	16.2 (10.1–25.1)
Candy, desserts, or other sweets	40,000	9.5 (7.3–12.2)	20,000	7.8 (5.6–10.6)	10,000	15.7 (10.0–23.8)
Chocolate	30,000	8.1 (5.9–10.9)	20,000	5.8 (4.0–8.4)	10,000	14.4 (8.6–23.3)
Tobacco-flavored	30,000	8.0 (5.9–10.7)	20,000	7.2 (5.0–10.2)	10,000	11.3 (6.7–18.2)
Nonalcoholic drinks§§§	30,000	7.5 (5.3–10.5)	20,000	6.6 (4.2–10.4)	10,000	10.5 (6.0–17.7)
Alcoholic drinks§§§	30,000	6.6 (4.5–9.6)	10,000	5.5 (3.4–8.8)	<10,000	9.1 (5.2–15.4)
Some other flavor	40,000	9.6 (7.1–13.0)	20,000	6.6 (4.2–10.1)	10,000	17.1 (11.8–24.1)
Use of any flavors that included the word "ice" or "iced" (such as "blueberry ice" or "strawberry ice")¶¶¶						
Yes	100,000	23.3 (19.8–27.2)	60,000	19.8 (16.0–24.2)	30,000	34.2 (26.0–43.6)
No	250,000	55.9 (50.8–60.9)	210,000	62.0 (56.0–67.7)	40,000	37.7 (29.3–46.9)
Don't know	90,000	20.8 (16.9–25.2)	60,000	18.2 (13.8–23.7)	30,000	28.0 (20.5–37.0)
Use of any concept flavors with a name that did not describe a specific flavor (such as "solar," "purple," "jazz," "island bash," or "fusion")****						
Yes	50,000	11.4 (8.5–15.3)	20,000	8.6 (5.5–13.3)	20,000	20.9 (14.3–29.5)
No	290,000	64.4 (59.3–69.2)	230,000	70.2 (64.0–75.8)	40,000	46.2 (37.0–55.8)
Don't know	100,000	24.1 (20.0–28.8)	70,000	21.2 (16.4–26.8)	30,000	32.9 (25.7–40.9)

* Current use of e-cigarettes or nicotine pouches was determined by asking, "During the past 30 days, on how many days did you use [e-cigarettes/a nicotine pouch]?" Current use was defined as use on ≥1 day during the previous 30 days.

† Estimated number of students was rounded down to the nearest 10,000 persons. Subgroup estimates might not sum to overall population estimates because of rounding or exclusion of students who currently used e-cigarettes and who did not report grade level (154), device type (61), any brand (65), usual brand (77), flavor types used (105), use of flavor including the word "ice" or "iced" (83), or use of flavors without specific flavor descriptor (97).

§ Frequent use was defined as use on ≥20 days during the previous 30 days. Daily use was defined as use during all of the previous 30 days. These estimates are not mutually exclusive.

¶ Device type was ascertained by response to the question, "Which of the following best describes the type of e-cigarette you have used in the past 30 days? If you have used more than one type, please think about the one you use most often."

** Students currently using e-cigarettes or nicotine pouches were asked, "During the past 30 days, what [e-cigarette/nicotine pouch] brands did you use? (Select one or more)." Those who selected "some other brand(s) not listed here" could provide a write-in response. Write-in responses corresponding to an original response option were recoded.

†† Geek Bar and Lost Mary were not included in the list of prespecified response options but were the two most common write-in responses for "some other brand(s) not listed here." Estimates for Geek Bar and Lost Mary might be underestimated.

§§ Data were statistically unreliable because of an unweighted denominator <50 or a relative SE >30%.

¶¶ If a student currently using e-cigarettes or nicotine pouches reported a single brand when asked, "During the past 30 days, what [e-cigarette/nicotine pouch] brands did you use (Select one or more)," it was reported as the usual brand. Those who selected two or more brands were asked, "During the past 30 days, what brand of [e-cigarettes/nicotine pouches] did you usually use? (Choose only one answer)." Write-in responses of "some other brand(s) not listed here" were recoded to a corresponding original response option.

*** Students currently using e-cigarettes or nicotine pouches were asked, "In the past 30 days when you used [e-cigarettes/nicotine pouches], what flavors did you use? (Select one or more)?" Those who provided no valid responses were classified as using "unspecified" flavors.

††† Flavor type was ascertained by response to the question, "In the past 30 days when you used [e-cigarettes/nicotine pouches], what flavors did you use? (Select one or more)." Those who selected "some other flavor not listed here" could provide a write-in response; write-in responses corresponding to an original response option were recoded.

§§§ These flavor options provided examples: "alcoholic drinks (such as wine, margarita, or other cocktails)"; "non-alcoholic drinks (such as coffee, soda, lemonade, or other beverage)"; and "spice (such as cinnamon, vanilla, or clove)."

¶¶¶ Students currently using e-cigarettes or nicotine pouches were asked, "Did any of the flavors you used in the past 30 days have names or descriptions that included the word 'ice' or 'iced' (for example, blueberry ice or strawberry ice)?"

**** Students currently using e-cigarettes or nicotine pouches were asked, "Did any of the flavors that you used in the past 30 days have a name that did not describe a specific flavor, such as 'solar,' 'purple,' 'jazz,' 'island bash,' 'fusion,' or some other word or phrase?"

†††† Estimated population number of students was rounded down to the nearest 10,000 persons. The total of subgroup estimates might not sum to overall population estimates because of rounding or exclusion of students who currently used nicotine pouches and who did not report grade level (129), any brand (nine), usual brand (12), flavor types used (24), use of flavor including the word "ice" or "iced" (20), or use of flavors without specific flavor descriptor (33).

Summary

What is already known about this topic?

E-cigarettes remain the most used tobacco product among U.S. youths. The wide availability and growing sales of nicotine pouches has also raised concerns about potential use of these products among youths.

What is added by this report?

During 2023–2024, current e-cigarette use among middle and high school students declined from 7.7% to 5.9%. Current nicotine pouch use (1.8%) did not change significantly during this period.

What are the implications for public health?

Youth e-cigarette use has declined; however, comprehensive tobacco control strategies, regulations, and enforcement remain critical to preventing and reducing e-cigarette and nicotine pouch use among youths.

2024), despite rising sales of nicotine pouches (*2*).[†††] Continued surveillance of youth tobacco product use patterns and implementation of comprehensive tobacco control strategies, regulations, and enforcement[§§§] are important for preventing and reducing tobacco product use by youths and associated adverse health outcomes, including a potential lifetime of nicotine addiction.

[†††] The scope of the current report examined changes in prevalence from 2023 to 2024. Although outside the scope of this report, a small but statistically significant increase in current nicotine pouch use occurred from 2022 to 2024. The 2022 NYTS methodology report and a copy of the 2022 data file can be found at https://www.cdc.gov/tobacco/about-data/surveys/national-youth-tobacco-survey.html.

[§§§] https://www.cdc.gov/tobacco/php/state-and-community-work/guides-for-states.html?CDC_AAref_Val=https://www.cdc.gov/tobacco/stateandcommunity/guides/index.htm; https://www.fda.gov/tobacco-products/ctp-newsroom/fdas-comprehensive-plan-tobacco-and-nicotine-regulation

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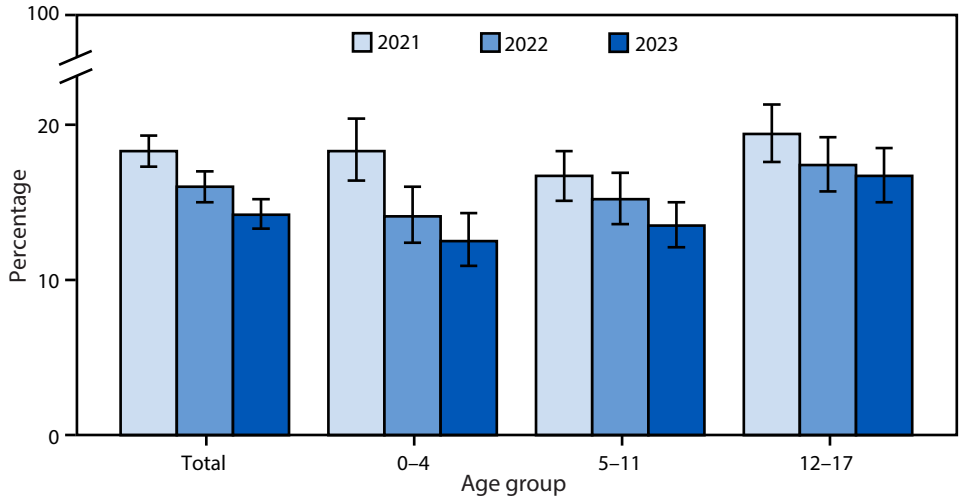
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Children and Adolescents Aged ≤17 Years Who Used Telemedicine During the Past 12 Months,† by Age Group and Year — United States, 2021–2023



* With 95% CIs indicated by error bars. Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population.
† Based on a "yes" response to the question, "During the past 12 months, have you had an appointment with a doctor, nurse, or other health professional by video or by phone?"

The percentage of children and adolescents aged 0–17 years using telemedicine during the past 12 months declined from 18.3% in 2021 to 14.2% in 2023. Telemedicine use declined across all three age groups during this period. In both 2022 and 2023, telemedicine use increased with age.

Supplementary Table: https://stacks.cdc.gov/view/cdc/159160

Source: National Center for Health Statistics, National Health Interview Survey, 2021, 2022, and 2023. https://www.cdc.gov/nchs/nhis.htm

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