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Attention-Deficit/Hyperactivity Disorder Diagnosis, Treatment, and Telehealth Use in Adults — National Center for Health Statistics Rapid Surveys System, United States, October–November 2023

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Abstract

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder that develops during childhood and can last into adulthood. Data from the National Center for Health Statistics Rapid Surveys System collected during October–November 2023 were used to estimate the prevalence of ADHD diagnosis and treatment among U.S. adults. In 2023, an estimated 15.5 million U.S. adults (6.0%) had a current ADHD diagnosis based on self-report; approximately one half received the diagnosis at age ≥18 years. Approximately one third of adults with ADHD took a stimulant medication to treat their ADHD in the previous year, 71.5% of whom had difficulty getting their ADHD prescription filled because it was unavailable. Approximately one half of adults with ADHD have ever used telehealth for ADHD-related services. Telehealth might have benefits for persons with ADHD, including helping them access behavioral treatment or medication prescriptions for ADHD. This report provides national estimates of the prevalence and treatment of ADHD among U.S. adults to help guide clinical care and regulatory decision-making for ADHD among U.S. adults.

Introduction

Worldwide, approximately 2%–5% of adults experience attention-deficit/hyperactivity disorder (ADHD) symptoms such as inattention, hyperactivity, and impulsivity (*1*,*2*). However, recent data on ADHD diagnosis and treatment among adults in the United States are limited; no national data exist on ADHD treatment in U.S. adults, and national prevalence estimates of current ADHD in adults rely on data from 2003.[†] Telehealth policies implemented during the COVID-19 pandemic expanded access to ADHD diagnosis and treatment, including medication (*3*). Pharmacotherapy is a first-line treatment for adults with ADHD (*2*), and prescribing of stimulant medication has increased since the COVID-19 pandemic began (*4*). Shortages of stimulant medications[§] in the United States have affected many persons with ADHD who rely on pharmacotherapy to appropriately treat their ADHD (*2*,*5*). Timely data are needed to develop clinical guidelines,

* Deceased.

[†] https://www.nimh.nih.gov/health/statistics/attention-deficit-hyperactivity-disorder-adhd

[§] https://www.fda.gov/drugs/drug-safety-and-availability/fda-announces-shortage-adderall

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and guide decision-making for policies, including regulation concerning stimulant prescription and telehealth access for ADHD in U.S. adults.

Methods

Rapid Survey System: Survey Panels and Sample

The National Center for Health Statistics (NCHS) Rapid Surveys System (RSS) approximates national representation of the U.S. adult population based on self-reported health data from two commercial online survey panels: NORC at the University of Chicago's AmeriSpeak Panel (*1*) and Ipsos's KnowledgePanel (*2*). These cross-sectional samples are surveyed simultaneously using the same RSS questionnaire, conducted online and by telephone, and are then combined (*6*). To reduce coverage and nonresponse biases, responses are weighted and calibrated to the estimates from the second quarter of the 2023 National Health Interview Survey to reflect the total population of U.S. adults aged ≥18 years. The RSS Round 2 (RSS-2), fielded during October–November 2023, includes data from 7,046 completed interviews (*6*). More details on RSS and incorporated panels are available at https://www.cdc.gov/nchs/rss/rss-topics.html; the RSS-2 brief technical note is available at https://www.cdc.gov/nchs/data/rss/round2/technical-notes.pdf. The cumulative response rates of the two commercial panels were 3.8% and 4.0%, and the RSS-2 overall completion rate was 37.2% (*6*).

RSS-2 ADHD

Adults with current ADHD were identified using two survey questions: "Have you ever been diagnosed with attention-deficit/hyperactivity disorder, or ADHD, by a doctor or other health professional?" and, if so, "Do you currently have ADHD?" (https://www.cdc.gov/nchs/data/rss/round2/questionnaire.pdf). Adults reporting current ADHD received follow-up questions regarding receipt and type of treatment, type of medication use (categorized as stimulant or nonstimulant medications), difficulty obtaining prescription medication, and use of telehealth services for their ADHD care. Demographic variables included age, age at diagnosis (<18 years versus ≥18 years), gender, education, race and ethnicity, household income as a percentage of the federal poverty level, insurance status, and metropolitan status; these data were collected before the survey through panel-specific profile assessments that are harmonized for inclusion in RSS-2 data (*6*). SAS-callable SUDAAN (version 11.0.3; RTI International) was used to conduct all analyses. Variances were computed using the Taylor linearization method. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.¶

¶ 45 C.F.R. part 46, 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.

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Results

Prevalence of ADHD Among U.S. Adults

An estimated 6.0% of adults had a current ADHD diagnosis, equivalent to one in 16, or approximately 15.5 million U.S. adults (Table 1). When compared with adults who have never received a diagnosis of ADHD, those with current ADHD were more likely to be aged <50 years (84.5% versus 51.2%), less likely to have a bachelor's degree or higher (28.1% versus 35.3%), less likely to be non-Hispanic Black or African American (7.4% versus 12.9%), more likely to be non-Hispanic White (70.4% versus 61.4%), and more likely to have a household income below the federal poverty level (22.1% versus 12.3%).

ADHD Diagnosis and Treatment

More than one half of adults with ADHD (55.9%) received their diagnosis during adulthood (age ≥18 years) (Table 2). At the time of the survey, approximately one third of adults with ADHD were not receiving any treatment (36.5%), while another one third were receiving both medication and counseling or behavioral treatment (35.2%). Approximately one half of adults (50.4%) with ADHD were prescribed medication to treat their ADHD during the previous 12 months. Approximately one third of adults with current ADHD reported taking prescription stimulant ADHD medication during the previous 12 months (33.4%); nonstimulant ADHD medication use was less common (5.9%). Among adults who reported taking a stimulant medication, 71.5% reported

TABLE 1. Demographic distribution among adults with current attention-deficit/hyperactivity disorder and adults who have never received an attention-deficit/hyperactivity disorder diagnosis — National Center for Health Statistics Rapid Surveys System, United States, October–November 2023

Characteristic	With current ADHD diagnosis*		Never received an ADHD diagnosis*	
	Unweighted no.	Weighted† % (95% CI)	Unweighted no.	Weighted† % (95% CI)
Total§	**444**	**6.0 (5.3–6.8)**	**6,441**	**92.2 (91.4–93.0)**
Age group at time of survey,¶ yrs				
18–24	70	21.7 (16.4–27.8)	363	10.1 (8.9–11.3)
25–49	278	62.8 (56.6–68.6)	2,338	41.1 (39.6–42.6)
50–64	69	10.6 (7.9–14.0)	1,790	25.0 (23.7–26.3)
≥65	27	4.9 (2.7–8.1)	1,950	23.9 (22.8–25.0)
Gender¶				
Female	214	44.2 (38.0–50.5)	3,502	51.7 (50.1–53.2)
Male	230	55.8 (49.5–62.0)	2,939	48.3 (46.8–49.9)
Education¶				
High school graduate or less	146	41.8 (35.6–48.3)	1,816	37.5 (36.0–39.0)
Some college	154	30.1 (24.6–36.0)	2,046	27.2 (25.9–28.4)
Bachelor's degree or above	144	28.1 (23.1–33.5)	2,579	35.3 (34.0–36.7)
Race and ethnicity¶,**				
Black or African American	30	7.4 (4.5–11.4)	673	12.9 (11.8–14.1)
White	301	70.4 (64.2–76.0)	4,308	61.4 (59.8–63.0)
Hispanic or Latino	75	16.6 (12.0–22.1)	865	17.5 (16.2–18.8)
Other	34	5.6 (3.3–8.8)	544	8.1 (7.3–9.0)
Household income as a percentage of FPL¶				
<100	99	22.1 (17.3–27.6)	710	12.3 (11.2–13.4)
100 to <200	74	14.5 (10.5–19.2)	1,117	17.6 (16.4–18.8)
200 to <400	114	23.3 (18.3–29.0)	1,795	26.6 (25.3–27.9)
≥400	157	40.0 (34.0–46.4)	2,819	43.6 (42.1–45.1)
Metropolitan status¶				
Metro area	372	83.0 (77.9–87.3)	5,529	86.3 (85.2–87.3)
Nonmetro area	72	17.0 (12.7–22.1)	912	13.7 (12.7–14.8)

Abbreviations: ADHD = attention-deficit/hyperactivity disorder; FPL = federal poverty level.

* Respondents were asked, "Have you ever been diagnosed with attention-deficit/hyperactivity disorder, or ADHD, by a doctor or other health professional?" Those who responded "yes" were then asked, "Do you currently have ADHD?"

† Weighted to reflect the total population of U.S. adults aged ≥18 years, based on estimates from the second quarter of the 2023 National Health Interview Survey.

§ Adults who reported previous but not current ADHD diagnosis (129; 1.8%) are not included in the table. Adults who did not answer the initial diagnosis question (32) were excluded from the analysis. Row percentage is reported in the table for this variable.

¶ This information was not collected as part of the Rapid Surveys System survey but came from the panel's profile data. Column percentages are reported in the table for these variables.

** Persons of Hispanic or Latino (Hispanic) origin might be of any race but are categorized as Hispanic; all racial groups are non-Hispanic. Only the Other group included multiple races; the other groups consisted of a single racial group. Data on race and ethnicity were missing for four respondents with a current ADHD diagnosis, and 51 respondents who have never received an ADHD diagnosis.

TABLE 2. Age at diagnosis and treatment among 444 adults with current attention-deficit/hyperactivity disorder — National Center for Health Statistics Rapid Surveys System, United States, October–November 2023

Characteristic	Unweighted no.	Weighted* % (95% CI)
Age group at diagnosis,† yrs		
<18	164	44.1 (37.7–50.6)
≥18	275	55.9 (49.4–62.3)
ADHD treatment during the previous 12 mos§		
None	152	36.5 (30.5–42.8)
Medication and counseling or behavioral treatment	157	35.2 (29.2–41.5)
Counseling or behavioral treatment only	59	13.3 (9.4–18)
Medication only	75	15.1 (11.3–19.6)
Was prescribed medication to treat ADHD during the previous 12 mos¶		
Yes	232	50.4 (43.9–56.9)
No	210	49.6 (43.1–56.1)
Reported taking a prescribed stimulant ADHD medication during the previous 12 mos**		
Yes	152	33.4 (27.5–39.7)
No	292	66.6 (60.3–72.5)
Reported taking a prescribed nonstimulant ADHD medication during the previous 12 mos**		
Yes	27	5.9 (3.4–9.4)
No	417	94.1 (90.6–96.6)
Reported having difficulty getting ADHD prescription filled during the previous 12 mos because their ADHD medication was not available		
Among all adults who reported taking any ADHD medication††	141	61.8 (52.9–70.1)
Among adults who reported taking stimulant ADHD medication§§	108	71.5 (60.9–80.6)

Abbreviation: ADHD = attention-deficit/hyperactivity disorder.

* Weighted to reflect the total population of U.S. adults aged ≥18 years, based on estimates from the second quarter of the 2023 National Health Interview Survey.

† Respondents who self-reported ever being diagnosed with ADHD by a doctor or health professional were asked, "How old were you when a doctor or other health professional first diagnosed you with ADHD?" Data for age at diagnosis were missing for five adults with current ADHD.

§ Respondents who self-reported having ADHD currently were asked, "During the past 12 months, did you receive counseling or therapy from a mental health professional to help you with your ADHD?" and "During the past 12 months, were you prescribed medication to help you with your ADHD?" Data for ADHD treatment were missing for one adult with current ADHD.

¶ Respondents who reported having ADHD currently were asked, "During the past 12 months, were you prescribed medication to help you with your ADHD?" Data on whether a medication to treat ADHD was prescribed during the previous 12 months were missing for two respondents.

** Respondents who reported having ADHD currently were asked, "During the past 12 months, what prescription medications did you take to help you with ADHD? Please do not list any medications you were prescribed but did not take."

†† Sample restricted to the 232 adults who reported that they were prescribed medication to treat their ADHD during the previous 12 months.

§§ Sample restricted to the 152 adults who reported taking a stimulant medication to treat their ADHD during the previous 12 months.

difficulty getting their ADHD prescription filled during the previous 12 months because their medication was not available.

Telehealth Use for ADHD

Almost one half of adults with ADHD (46.0%) reported ever receiving telehealth services for their condition (Table 3). Approximately one in 11 adults (8.9%) received their diagnosis via telehealth only, and an additional one in 10 (9.5%) received their diagnosis through a combination of in-person and telehealth visits. Since the start of the COVID-19 pandemic (i.e., March 2020), approximately one third of adults with current ADHD used telehealth to obtain a prescription for ADHD medication (30.5%) or to receive counseling or therapy for ADHD (30.8%).

Discussion

This analysis of a nationally representative sample of U.S. adults found that in 2023, an estimated 15.5 million (6.0%) had a current ADHD diagnosis, approximately one half of whom received their diagnosis during adulthood. Results highlight the magnitude of ADHD as a public health issue across the life course. Approximately one third of adults with current ADHD are not receiving any ADHD treatment. Among those receiving stimulant pharmacotherapy, seven in 10 reported difficulty obtaining their ADHD medication because it was not available. Approximately one half of adults with current ADHD have ever used telehealth for ADHD services.

Diagnostic criteria for ADHD require evidence of symptoms before age 12 years (*7*), but actual diagnosis might occur years beyond symptom onset. These data suggest diagnosis in adulthood is common. Although the majority of adults with current ADHD received counseling or medication treatment for their ADHD in the previous year, approximately one third did not receive any type of treatment. ADHD pharmacotherapy is associated with reduced social and emotional impairment, unintentional injuries, substance use disorders, and risk of death due to unnatural causes (*2*,*5*).

The finding that 71.5% of adults who reported taking a stimulant medication had difficulty getting their ADHD prescription filled during the previous 12 months highlights the importance of ensuring an adequate supply of these medications. A 2024 CDC Health Advisory** conveyed that medication shortages and major disruptions to ADHD provider access increase concerns about risk for injury and overdose. Patients experiencing these difficulties might seek medication outside the regulated health care system, increasing their risk for overdose because of the prevalence of counterfeit pills in the illegal drug market, which might contain unexpected substances such as fentanyl.

The availability of clinical care guidelines for adults with ADHD could improve standards of care and associated health outcomes for this population (*8*). Reducing delays in diagnosis and treatment access could improve ADHD symptoms and long-term health risks for adults with the condition (*2*,*3*).

** https://emergency.cdc.gov/han/2024/pdf/CDC_HAN_510.pdf

TABLE 3. Telehealth use among 444 adults with current attention-deficit/hyperactivity disorder — National Center for Health Statistics Rapid Surveys System, United States, October–November 2023

Characteristic	Unweighted no.	Weighted* % (95% CI)
Ever received telehealth services for ADHD†		
Yes	201	46.0 (39.9–52.3)
No	240	54.0 (47.7–60.1)
ADHD diagnosis receipt§		
Only telehealth visits	46	8.9 (6.0–12.5)
A mix of in-person and telehealth visits	36	9.5 (6.2–13.7)
Only in-person visits	357	81.7 (76.6–86.0)
At any time since the start of the COVID-19 pandemic (i.e., March 2020) used any telehealth visit¶		
With a doctor, nurse, or other health professional to get a prescription for medication to help their ADHD	136	30.5 (24.9–36.6)
To receive counseling or therapy to help with their ADHD	141	30.8 (25.1–37.0)

Abbreviation: ADHD = attention-deficit/hyperactivity disorder.

* Weighted to reflect the total population of U.S. adults aged ≥18 years, based on estimates from the second quarter of the 2023 National Health Interview Survey.

† Respondents who self-reported having ADHD currently were asked, "Have you ever received any telehealth services for ADHD? That is, have you ever talked about your ADHD with a doctor, nurse, or other health professional by video or by phone?" Data for ever using telehealth services for ADHD were missing for three adults who had a current ADHD diagnosis.

§ Respondents who self-reported having used telehealth to receive ADHD care were asked, "Were you diagnosed with ADHD during telehealth visits, in-person visits, or a combination of both?" Missing data for two respondents and denominator was restricted to adults who reported ever using telehealth services for ADHD.

¶ Respondents could select both items; therefore, percentages are not exclusive.

Research using health care claims data suggests that approximately one half of adults with ADHD received their ADHD care via telehealth, and that adults with ADHD use telehealth approximately twice as frequently as do those without ADHD (*9*). Similarly, the current data indicate that approximately one half of adults with ADHD have ever used telehealth for ADHD care. In March 2023, the Drug Enforcement Administration and the U.S. Department of Health and Human Services extended COVID-19 flexibilities regarding stimulant prescribing via telehealth†† without an initial in-person medical evaluation through December 31, 2024. Findings in this report provide information on the size of the affected population for potential rule changes, and if the exception is not extended, provide information that can help providers prepare for increased in-person health care demands.

Telepsychiatry guidelines for ADHD care acknowledge the potential benefits and risks associated with use of telehealth for ADHD care. Benefits include reduced time and effort, especially given the organizational challenges faced by persons with ADHD; increased access, especially in some geographic areas; and reduced wait times. Risks include concerns about the quality of care, such as accuracy of diagnosis and potential for misuse or diversion of prescription medication, and lack of access to technology by some populations. Experts on ADHD treatment suggest that the benefits of increased access to diagnosis and treatment via telehealth outweigh the risks of undiagnosed and untreated ADHD (*3*). Evaluating, monitoring, and identifying standards for quality telehealth implementation have been demonstrated to help maximize these benefits and limit risks (*10*).

Summary

What is already known about this topic?

Attention-deficit/hyperactivity disorder (ADHD) is a common childhood disorder that can continue into adulthood, but there is limited information about diagnosis and treatment in adults.

What is added by this report?

In 2023, an estimated 15.5 million U.S. adults had an ADHD diagnosis, approximately one half of whom received their diagnosis in adulthood. Approximately one third of adults with ADHD take stimulant medication; 71.5% had difficulty filling their prescription because the medication was unavailable. Approximately one half of adults with ADHD have ever used telehealth for ADHD services.

What are the implications for public health practice?

ADHD affects many adults. Information on diagnosis and treatment helps the development of clinical care guidelines and regulatory decision-making around medication shortages and telehealth for ADHD.

Limitations

The findings in this report are subject to at least three limitations. First, self-reports of ADHD diagnosis might be subject to recall and reporting biases and were not validated against medical records. Second, surveys with commercial online panels have low response rates and might underrepresent certain subpopulations, increasing the potential for nonresponse bias. Nonresponse bias in RSS is reduced through innovative weighting approaches and calibration of the data to benchmark NCHS surveys, with comparisons to the National Health Interview Survey suggesting low bias for prevalence estimates of chronic health conditions (*6*). The data are cross-sectional and cannot be used to examine trends over time. Finally, the sociodemographic and geographic data were collected before the RSS survey administration, which could have affected the demographic distribution for some variables such as age, education, household income, and metropolitan status (*6*).

†† https://www.federalregister.gov/documents/2023/10/10/2023-22406/second-temporary-extension-of-covid-19-telemedicine-flexibilities-for-prescription-of-controlled

Implications for Public Health Practice

Public health professionals can use the findings from this report to better understand the prevalence of ADHD in adulthood, how adults obtain ADHD care, the potential gaps or delays in diagnosis, and the magnitude of treatment needs. As policies are currently developed and evaluated related to ADHD clinical care for adults, access to prescription stimulant medications, and flexibilities related to telehealth, these results can guide clinical care and regulatory decision-making.

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Risk of Clade II Mpox Associated with Intimate and Nonintimate Close Contact Among Men Who Have Sex with Men and Transgender Adults — United States, August 2022–July 2023

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Abstract

A global outbreak of clade II mpox associated with sexual contact, disproportionately affecting gay, bisexual, and other men who have sex with men (MSM), has been ongoing since May 2022. Information on types of contact most associated with transmission is limited. This report used data from a multijurisdictional vaccine effectiveness case-control study of sexually active persons aged 18–49 years who identified as MSM or transgender, collected during August 2022–July 2023. Odds of mpox associated with selected types of intimate and nonintimate close contact with a person with mpox were estimated. Among 457 case-patients and 1,030 control patients who met minimum data requirements, 150 (32.8%) case-patients and 57 (5.5%) control patients reported close contact with a person with mpox and were included in this analysis. Adjusted odds of mpox were 5.4 times as high among those who reported having condomless receptive anal sex with a person with mpox, compared with participants who reported close contact with a person with mpox and no condomless receptive anal sex with that person (OR = 5.4; p = 0.031). Although the mpox vaccine is highly effective, vaccination coverage remains low; a multifaceted approach to prevention remains important and should include vaccination promotion, safer sex practices, and increasing awareness that mpox continues to circulate.

Introduction

In May 2022, an unprecedented worldwide outbreak of clade II mpox, caused by monkeypox virus (MPXV), was detected among persons in countries with no history of sustained community transmission. In the United States and worldwide, the ongoing outbreak has been associated with sexual contact, and has disproportionately affected gay, bisexual, and other men who have sex with men (MSM) (*1*,*2*). Transmission via other forms of nonintimate close contact, such as contaminated household objects and surfaces, is rare, but has also been reported (*3*). The risk of mpox associated with selected intimate and nonintimate close contact behaviors during the outbreak was estimated among MSM and transgender persons aged 18–49 years using data from 12 U.S. jurisdictions.*

Methods

Study Design and Data Collection

A secondary analysis was conducted using data previously collected for a vaccine effectiveness (VE) case-control study using patient self-reported survey data and jurisdiction-reported data from 12 U.S. jurisdictions (*4*). In the VE study, case-patients (those with a confirmed or probable MPXV or orthopoxvirus diagnosis on or after August 19, 2022) were identified through jurisdiction health departments' case registries. Control patients (persons with a health care encounter at the clinic on or after August 19, 2022, and who did not report an mpox diagnosis) were identified through active and passive recruitment approaches in sexual health, HIV care, or HIV preexposure prophylaxis (PrEP) clinics in each jurisdiction. During recruitment, control patients were frequency matched to case-patients based on timing of index event (test result or medical encounter date) and geographic region.

Case- and control patients were eligible to participate if they were sexually active,† aged 18–49 years, and identified as MSM§ or transgender. Eligible participants completed a survey online or by telephone in English or Spanish. The survey included questions about demographic characteristics, mpox vaccination history (verified using jurisdiction vaccination registries, where available), mpox diagnosis, and

* Case- and control patients were recruited from the following 12 U.S. jurisdictions: California (excluding Los Angeles County), Colorado, Connecticut, District of Columbia, Georgia, Los Angeles County, Maryland, Minnesota, New York (excluding New York City), New York City, Oregon, and Tennessee.

† Sexually active was defined as having one or more sexual partner since August 1, 2022.

§ The definition of MSM used in the parent study and this analysis included 1) participants who reported being male and described their sexual identity as gay, bisexual, a different term, or preferred not to answer, or 2) participants who reported being male, described themselves as straight, and responded that they had sex with men.

mpox exposure history[¶] anchored to an index date, defined as the date of receipt of a positive test result (case-patients) or clinic visit (control patients). Participants who reported having close contact with a person with diagnosed mpox or a person with symptoms consistent with mpox but who did not receive a diagnosis (hereafter referred to as close contact with a person with mpox) were asked follow-up questions about specific types of intimate[**] and nonintimate[††] contact. Survey responses were recorded in REDCap (version 13.1.26; Vanderbilt University).

Statistical Methods

The analytic sample was restricted to case- and control patients from the VE study who reported close contact with a person with mpox. Multilevel logistic regression models were used to examine the unadjusted and adjusted odds of select types of intimate and nonintimate contact and case- or control patient status. The unadjusted models examined demographic characteristics (age, race, and gender identity), a composite variable of HIV status and HIV PrEP or treatment (i.e., antiretroviral [ARV]) use and adherence, presence of immunocompromising conditions or medications,[§§] number of recent sexual partners,[¶¶] recent sexually transmitted infection diagnosis, mpox vaccination status,[***] and month of index event, and included a random intercept for jurisdiction to account for clustering. Adjusted models included demographic and health history covariates with $p<0.05$ in the unadjusted models, index month, and all reported close contact behaviors. Analyses were conducted using Stata (version 16; StataCorp). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[†††]

Results

Among the 1,487 eligible survey respondents from the VE study (457 case-patients and 1,030 control patients), 207 (13.9%; 150 case-patients and 57 control patients) reported close contact with a person with mpox and were included in this analysis. Compared with control patients, case-patients were slightly older (aged 35.5 years versus 33 years) and had fewer recent sexual partners (two versus three) (Table 1). A lower proportion of case-patients (45.8%) than control patients (76.9%) reported using HIV PrEP, and a higher proportion of case-patients (72.9%) than control patients (23.5%) were not vaccinated against mpox.

In the unadjusted models, behaviors associated with increased odds of mpox among persons reporting close contact with a person with mpox included condomless receptive anal sex (OR = 3.2; p = 0.006), condomless insertive anal sex (OR = 2.8; p = 0.009), receiving oral sex without a condom (OR = 2.7; p = 0.006), giving oral sex without a condom (OR = 2.0; p = 0.046), and sharing towels, bedding, or clothing (OR = 2.3; p = 0.034) (Table 2). After adjusting for age, race, HIV status and HIV PrEP or ARV use, number of sexual partners, mpox vaccination status, and index month, the only measured type of contact associated with mpox was condomless receptive anal sex. Adjusted odds of mpox were 5.4 times as high among those who reported having condomless receptive anal sex with a person with mpox than among participants who reported close contact with a person with mpox and no condomless receptive anal sex with that person (OR = 5.4; p = 0.031).

Discussion

Numerous studies have identified sexual contact as the primary risk factor for mpox; however, few have examined risk associated with specific intimate and nonintimate close contact behaviors. In this study, data from a previously conducted case-control study were analyzed to estimate the odds of mpox associated with selected intimate and nonintimate behaviors among MSM and transgender persons reporting close contact with a person with mpox. Condomless sex, including anal sex

[¶] Mpox exposure history was assessed by asking participants if, during the 3 weeks before their index date, they had exposure to 1) a person with diagnosed mpox, or 2) a person with symptoms consistent with mpox (e.g., rash or skin lesions, fever, chills, headache, or muscle aches) but who did not receive a diagnosis of mpox. The exposure might have occurred after the contact received a diagnosis or developed mpox symptoms or during the 3 weeks before diagnosis or symptom onset.

[**] Types of intimate contact included condomless receptive anal sex; condomless insertive anal sex; anal sex with a condom; vaginal sex, with or without a condom; receiving oral sex without a condom; giving oral sex without a condom; giving or receiving oral sex with a condom; other intimate contact (e.g., cuddling, kissing, touching partner's genitals or anus, or sharing sex toys); and close contact at a mass gathering where persons were partially undressed and touching (e.g., raves, pool parties, or dance events).

[††] Types of nonintimate contact included providing in-home care to a person with diagnosed mpox; sharing food, utensils, or dishes; sharing towels, bedding, or clothing; sharing drug equipment (e.g., needles, cookers, or bongs); and face-to-face contact (being within 6 ft of an unmasked person with mpox for >3 hours while not wearing a mask).

[§§] Immunocompromising conditions were based on self-report and defined as having a medical condition that weakens the immune response (other than HIV) or taking a medication that weakens the immune response.

[¶¶] Participants were asked to report the number of sexual partners they had had during the 3 weeks before completing the survey. The reported number was truncated at five to account for outliers and implausible values.

[***] Participants were categorized as not vaccinated if no reported doses were received on or before the index date. Participants were categorized as partially vaccinated if they received 1 dose ≥14 days before the index date and fully vaccinated if they received 2 doses ≥24 days apart (to allow for a 4-day window), with the second dose received ≥14 days before the index date. Participants who received their first vaccine dose ≤13 days before their index date were excluded.

[†††] 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. Selected characteristics of mpox case-patients and control patients reporting close contact with a person with mpox — 12 jurisdictions, United States,* August 2022–July 2023

Characteristic	Case-patient,† no. (%)§ n = 150	Control patient,¶ no. (%)§ n = 57	p-value**
Median age, yrs (IQR)	35.5 (31–42)	33 (29–38)	0.036
Race and ethnicity††			
Black or African American, non-Hispanic	46 (30.7)	15 (26.3)	0.168
White, non-Hispanic	45 (30.0)	25 (43.9)	
Hispanic or Latino	47 (31.3)	11 (19.3)	
Other, non-Hispanic	12 (8.0)	6 (10.5)	
Gender identity			
Male	140 (93.3)	52 (91.2)	0.135
Transgender female	7 (4.7)	1 (1.8)	
Transgender male	—	—	
Another gender identity	3 (2.0)	4 (7.0)	
Median (IQR) number of sexual partners§§	2 (1–4)	3 (2–5)	0.013
HIV status			
Living with HIV	69 (48.9)	20 (35.7)	0.063
Not living with HIV	64 (45.4)	34 (60.7)	
Unknown HIV status	0 (0.0)	1 (1.8)	
Prefer not to answer	8 (5.7)	1 (1.8)	
HIV PrEP¶¶			
Yes	38 (45.8)	30 (76.9)	0.005
No	43 (51.8)	9 (23.1)	
Unknown	2 (2.4)	0 (0.0)	
HIV ARV* **			
Not on ARV	6 (8.7)	1 (5.0)	0.724
Yes, nonadherent (missed ≥2 doses in previous 30 days)	28 (40.6)	7 (35.0)	
Yes, adherent	35 (50.7)	12 (60.0)	
HIV status and PrEP/ARV use			
HIV negative, not on PrEP	29 (21.8)	5 (9.3)	0.007
HIV negative, on PrEP	35 (26.3)	29 (53.7)	
HIV positive, not on ARV	6 (4.5)	1 (1.9)	
HIV positive, on ARV but nonadherent	28 (21.1)	7 (13.0)	
HIV positive, on ARV and adherent	35 (26.3)	12 (22.2)	
Immunocompromising condition or medication†††			
Yes	14 (9.3)	3 (5.3)	0.441
No	130 (86.7)	53 (93.0)	
Don't know/Prefer not to answer	6 (4.0)	1 (1.8)	
STI history§§§	46 (30.7)	11 (19.3)	0.102
Mpox vaccination status¶¶¶			
Not vaccinated	97 (72.9)	12 (23.5)	<0.001
Partially vaccinated	25 (18.8)	28 (54.9)	
Fully vaccinated	11 (8.3)	11 (21.6)	

See table footnotes on the next page.

and oral sex, was associated with increased odds of mpox, as was sharing towels, bedding, and clothing. After adjusting for measured confounders, including mpox vaccination and concurrent close contact behaviors, condomless receptive anal sex with a person with mpox remained associated with increased odds of mpox. Although condoms might reduce MPXV exposure at anogenital or oral mucosal sites, condoms alone might not prevent all exposures to MPXV because rash can occur on other parts of the body and transmission can occur through other routes, including saliva and respiratory secretions (*5*).

As clade II mpox continues to circulate in the United States, mpox mitigation activities remain critical (*6*). The mpox vaccine is highly effective (*4*,*7*,*8*) and remains an important tool in interrupting the spread of mpox. However, only one in four of the approximately two million persons eligible to receive the vaccine in the United States has received both doses. A multifaceted approach to reducing mpox transmission risk remains crucial to preventing large outbreaks. In addition to vaccination, clinicians should educate patients about using safer sex strategies to reduce exposure to MPXV, talking with sex partners about any mpox signs or symptoms, being aware of any unexplained rashes or lesions on a partner's body, and avoiding close or intimate contact if they or a sex partner become infected with MPXV or experience an mpox-like rash.§§§

§§§ https://www.cdc.gov/mpox/hcp/clinical-signs/index.html

TABLE 1. (*Continued*) Selected characteristics of mpox case-patients and control patients reporting close contact with a person with mpox — 12 jurisdictions, United States,* August 2022–July 2023

Characteristic	Case-patient,† no. (%)§ n = 150	Control patient,¶ no. (%)§ n = 57	p-value**
Close contact with someone who received an mpox diagnosis			
Yes	109 (72.7)	41 (71.9)	0.827
No	22 (14.7)	10 (17.5)	
Unknown	19 (12.7)	6 (10.5)	
Close contact with someone who had symptoms consistent with mpox** but no mpox diagnosis**			
Yes	67 (44.7)	26 (45.6)	0.992
No	67 (44.7)	25 (43.9)	
Unknown	16 (10.7)	6 (10.5)	
Intimate contact			
Condomless receptive anal sex	58 (38.7)	11 (19.3)	0.008
Condomless insertive anal sex	55 (36.7)	10 (17.5)	0.008
Anal sex with a condom	12 (8.0)	3 (5.3)	0.497
Received oral sex without a condom	66 (44.0)	13 (22.8)	0.005
Gave oral sex without a condom	63 (42.0)	16 (28.1)	0.065
Gave or received oral sex with a condom	10 (6.7)	6 (10.5)	0.353
Close contact at a mass gathering where persons were partially undressed and touching	14 (9.3)	13 (22.8)	0.010
Nonintimate contact			
Provided in-home care	10 (6.7)	4 (7.0)	0.928
Shared food, utensils, or dishes	31 (20.7)	13 (22.8)	0.737
Shared towels, bedding, or clothing	49 (32.7)	10 (17.5)	0.031
Shared drug equipment	10 (6.7)	8 (14.0)	0.093

Abbreviations: ARV = antiretroviral; PrEP = preexposure prophylaxis; STI = sexually transmitted infection.

* Case- and control patients were recruited from the following 12 U.S. jurisdictions: California (excluding Los Angeles County), Colorado, Connecticut, Georgia, District of Columbia, Los Angeles County, Maryland, Minnesota, New York (excluding New York City), New York City, Oregon, and Tennessee.

† Case-patients were identified or verified by jurisdiction health departments and had a confirmed or probable mpox or orthopoxvirus diagnosis on or after August 19, 2022.

§ Numbers might not sum to case- or control patient totals because of missing data. Percentages were calculated using nonmissing data.

¶ Control patients visited an STI, HIV care, or HIV PrEP clinic on or after August 19, 2022.

** P-values comparing the percentage of case-patients to control patients by sociodemographic and health categories were calculated using Pearson's chi-square test. P-values for continuous variables were calculated using the Kruskal-Wallis test.

†† Participants reporting Hispanic ethnicity were categorized as Hispanic or Latino and might be of any race. The Other race category includes Asian, Native Hawaiian or other Pacific Islander, and American Indian or Alaska Native persons.

§§ Participants were asked to report the number of sexual partners they had had during the 3 weeks before completing the survey. The reported number was truncated at five to account for outliers and implausible values.

¶¶ HIV PrEP use was defined as use at time of survey and was calculated among persons who did not report living with HIV.

*** HIV ARV use was defined as use at time of survey and was calculated among persons who reported living with HIV; nonadherence was defined as missing ≥2 doses during the previous 30 days.

††† Immunocompromising conditions were based on self-report and defined as having a medical condition that weakens the immune response, not including HIV, or taking a medicine that weakens the immune response.

§§§ Participants were asked to report STI diagnoses during the 3 weeks before completing the survey.

¶¶¶ Participants were categorized as not vaccinated if no reported doses were received on or before the index date. Participants were categorized as partially vaccinated if they received 1 dose ≥14 days before the index date and fully vaccinated if they received 2 doses ≥24 days apart (to allow for a 4-day window), with the second dose received ≥14 days before the index date. Participants who received their first vaccine dose ≤13 days before their index date were excluded.

**** Symptoms consistent with mpox included rash or skin lesions, fever, chills, headache, and muscle aches.

Studies from areas with endemic mpox and during the ongoing 2022 global outbreak have identified contaminated household items such as linens and utensils as potential, albeit less common, MPXV transmission routes (*3*,*9*,*10*). In this study, sharing bedding, towels, or clothing with a person with mpox was associated with acquiring mpox in the unadjusted but not the adjusted analysis. In addition to contaminated household items, shared bedding during sex might contribute to transmission; more studies are needed to better understand transmission pathways.

Limitations

The findings in this report are subject to at least five limitations. First, selection bias is likely because survey participation was voluntary and recruitment for control patients occurred in sexual health, HIV care, or HIV PrEP clinics. Differences in sexual risk-taking behaviors might exist between those who participated in the survey and those who did not and between persons who did and did not seek health care. Second, survey data were self-reported and might be subject to social desirability or recall bias, particularly because of the sensitive nature of some of the questions regarding sexual behaviors, and

TABLE 2. Odds ratios of mpox associated with reported intimate and nonintimate close contact with a person with mpox — 12 jurisdictions, United States,* August 2022–July 2023

Characteristic	Unadjusted OR (95% CI) n = 207	p-value†	Adjusted OR (95% CI) n = 159	p-value†
Age, yrs	1.1 (1.0–1.1)	0.033	1.1 (1.0–1.2)	0.157
Race and ethnicity§				
White, non-Hispanic	Ref	—	Ref	—
Black or African American, non-Hispanic	1.7 (0.7–3.8)	0.210	0.7 (0.1–3.5)	0.640
Hispanic or Latino	2.4 (1.0–5.4)	0.043	3.4 (0.7–16.5)	0.135
Other, non-Hispanic	1.1 (0.3–3.3)	0.904	0.2 (0–1.6)	0.123
Gender identity				
Male	Ref	—	—	—
Transgender female	2.6 (0.3–22.0)	0.375	—	—
Transgender male	—	—	—	—
Another gender identity	0.3 (0.1–1.4)	0.114	—	—
No. of sexual partners¶	0.8 (0.7–1.0)	0.014	0.9 (0.6–1.3)	0.507
HIV status and PrEP/ARV use**				
HIV negative, not on PrEP	Ref	—	Ref	—
HIV negative, on PrEP	0.2 (0.1–0.6)	0.004	0.3 (0.1–2.2)	0.247
HIV positive, not on ARV	1.0 (0.1–11.2)	0.968	0.3 (0–19.0)	0.586
HIV positive, on ARV but nonadherent	0.7 (0.2–2.6)	0.588	0.4 (0–4.5)	0.469
HIV positive, on ARV and adherent	0.5 (0.2–1.7)	0.279	1.0 (0.1–8.3)	0.985
Immunocompromising condition or medication††	1.8 (0.5–6.6)	0.393	—	—
STI history§§	1.9 (0.9–4.0)	0.105	—	—
Mpox vaccination status¶¶				
Not vaccinated	Ref	—	Ref	—
Partially vaccinated	0.1 (0–0.2)	<0.001	0 (0–0.1)	<0.001
Fully vaccinated	0.1 (0–0.3)	<0.001	0.1 (0–0.4)	0.005
Intimate contact				
Condomless receptive anal sex	3.2 (1.4–7.3)	0.006	5.4 (1.2–24.6)	0.031
Condomless insertive anal sex	2.8 (1.3–6.1)	0.009	1.0 (0.2–5.6)	0.980
Anal sex with a condom	1.6 (0.4–5.8)	0.510	0.5 (0–10.7)	0.661
Received oral sex without a condom	2.7 (1.3–5.4)	0.006	0.8 (0.2–3.4)	0.803
Gave oral sex without a condom	2.0 (1.0–4.1)	0.046	2.6 (0.6–11.2)	0.215
Gave or received oral sex with a condom	0.5 (0.2–1.6)	0.277	0.3 (0–3.7)	0.376
Close contact at a mass gathering where persons were partially undressed and touching	0.3 (0.1–0.7)	0.008	0.3 (0.1–1.3)	0.113
Nonintimate contact				
Provided in-home care	0.9 (0.3–3.2)	0.926	4.3 (0.2–79.9)	0.329
Shared food, utensils, or dishes	0.9 (0.4–2.0)	0.851	1.3 (0.3–5.5)	0.682
Shared towels, bedding, or clothing	2.3 (1.1–5.0)	0.034	1.7 (0.4–6.9)	0.480
Shared drug equipment	0.4 (0.2–1.2)	0.108	0.1 (0–1.1)	0.058

Abbreviations: ARV = antiretroviral; OR = odds ratio; PrEP = preexposure prophylaxis; Ref = referent group; STI = sexually transmitted infection.

* Case- and control patients were recruited from the following 12 U.S. jurisdictions: California (excluding Los Angeles County), Colorado, Connecticut, Georgia, District of Columbia, Los Angeles County, Maryland, Minnesota, New York (excluding New York City), New York City, Oregon, and Tennessee.

† P-value calculated using logistic regression with a random intercept for jurisdiction.

§ Participants reporting Hispanic ethnicity were categorized as Hispanic or Latino and might be of any race. The Other race category includes Asian, Native Hawaiian or other Pacific Islander, and American Indian or Alaska Native persons.

¶ Participants were asked to report the number of sexual partners they had had during the 3 weeks before completing the survey.

** HIV PrEP use was defined as use at time of survey and was calculated among persons who did not report living with HIV. HIV ARV use was defined as use at time of survey and was calculated among persons who reported living with HIV; nonadherence was defined as missing ≥2 doses during the previous 30 days.

†† Immunocompromising conditions were based on self-report and defined as having a medical condition that weakens the immune response, not including HIV, or taking a medicine that weakens the immune response.

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because the time between index event and survey completion varied. Third, intimate contact and sexual behavior variables were limited to a few broad measures in this study and do not account for potentially important factors such as frequency and duration of contact, partner type, group sex, substance use, or impact of sexual networks, all of which might affect risk for mpox transmission. Fourth, <15% of survey participants reported close contact with a person with mpox; because of this small sample size, the analysis might be underpowered to detect associations with behaviors that were less commonly

Summary

What is already known about this topic?

Monkeypox virus can spread through intimate or close contact with a person with mpox.

What is added by this report?

Among men who have sex with men and transgender persons who reported close contact with a person with mpox, condomless receptive anal sex was associated with approximately five times the odds of mpox after controlling for mpox vaccination, sociodemographic characteristics, and concurrent close contact behaviors.

What are the implications for public health practice?

The findings in this report underscore the importance of ongoing multifaceted mpox prevention activities, including mpox vaccination and education on safer sex practices, to reduce the spread of mpox.

reported. Finally, although the 12 U.S. jurisdictions included in this study covered a broad geographic area, data might not be generalizable to the entire U.S. population.

Implications for Public Health Practice

The mpox vaccine is highly effective, and clinicians should continue to promote vaccination among eligible persons.¶¶¶ In addition, results from this study indicate that implementation of multiple prevention approaches, including education on safer sex practices, might further reduce risk.

¶¶¶ https://www.cdc.gov/poxvirus/mpox/vaccines/index.html

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Notes from the Field

Mpox Cluster Caused by Tecovirimat-Resistant Monkeypox Virus — Five States, October 2023–February 2024

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The antiviral drug tecovirimat* has been used extensively to treat U.S. mpox cases since the start of a global outbreak in 2022. Mutations in the mpox viral protein target (F13 or VP37) that occur during treatment can result in resistance to tecovirimat† (*1*,*2*). CDC and public health partners have conducted genetic surveillance of monkeypox virus (MPXV) for F13 mutations through sequencing and monitoring of public databases. MPXV F13 mutations associated with resistance have been reported since 2022, typically among severely immunocompromised mpox patients who required prolonged courses of tecovirimat (*3*–*5*). A majority of patients with infections caused by MPXV with resistant mutations had a history of tecovirimat treatment; however, spread of tecovirimat-resistant MPXV was reported in California during late 2022 to early 2023 among persons with no previous tecovirimat treatment (*3*). This report describes a second, unrelated cluster of tecovirimat-resistant MPXV among 18 persons with no previous history of tecovirimat treatment in multiple states.

Investigation and Outcomes

A unique combination of F13 mutations (asparagine 267 deletion [N267del] and alanine-184-to-threonine substitution [A184T]) was identified in 20 specimens collected from 18 mpox patients in five states (California [five], Illinois§ [eight], Louisiana [two], New York [one], and Texas [two]) during October 6, 2023–February 15, 2024. During their incubation periods, two patients reported travel among states where the mutation had been identified, and two others reported travel to other states. Among 16 patients with available treatment history, none had documentation of receipt of tecovirimat before collection of the resistant sample. One patient with fewer than 10 large lesions (>0.79 in [>2 cm] in diameter) was prescribed a standard (i.e., 14-day) course of tecovirimat after sample collection; the patient recovered. Among 17 patients for whom clinical data were available, signs and symptoms¶ at initial examination were consistent with other clade IIb infections: all 17 patients reported mild (or not severe) mpox disease, although two were hospitalized for pain management. In vitro testing of seven samples identified resistance to tecovirimat, with 177-fold to 583-fold increases in the half-maximal effective concentration (EC_{50})** when compared with a 2003 U.S. MPXV clade IIa reference strain. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.††

Whole genome sequences from all 20 specimens were genetically distinct from those in the 2022–2023 tecovirimat-resistant California cluster (*3*), which belonged to sublineage B.1.17 and contained the N267del mutation but not A184T. Genomes from the 2023–2024 cluster formed a monophyletic cluster within sublineage B.1.20 (the dominant U.S. clade IIb lineage during late 2023–early 2024), indicating that the resistance mutations were acquired by a common ancestor predating the sequenced samples (Figure). Both N267del and A184T mutations were present at allele frequencies >88% across specimens from the same patient and among all patients, which is atypical for acquired resistance (*4*,*5*). Together, the presence of the resistant phenotype and the observation that 88%–100% of the MPXV population within affected patient samples carried the resistant allele indicate tecovirimat would likely have been ineffective among those patients.

Preliminary Conclusions and Recommendations

This is the second report of a tecovirimat-resistant MPXV variant spreading among persons in the United States who had no documentation of previous tecovirimat treatment and the

* https://www.siga.com

† Orthopoxvirus VP37 amino acid substitutions associated with tecovirimat resistance compiled by the Food and Drug Administration from independent animal and cell culture studies and in a case of progressive vaccinia. https://www.fda.gov/emergency-preparedness-and-response/mcm-issues/fda-mpox-response

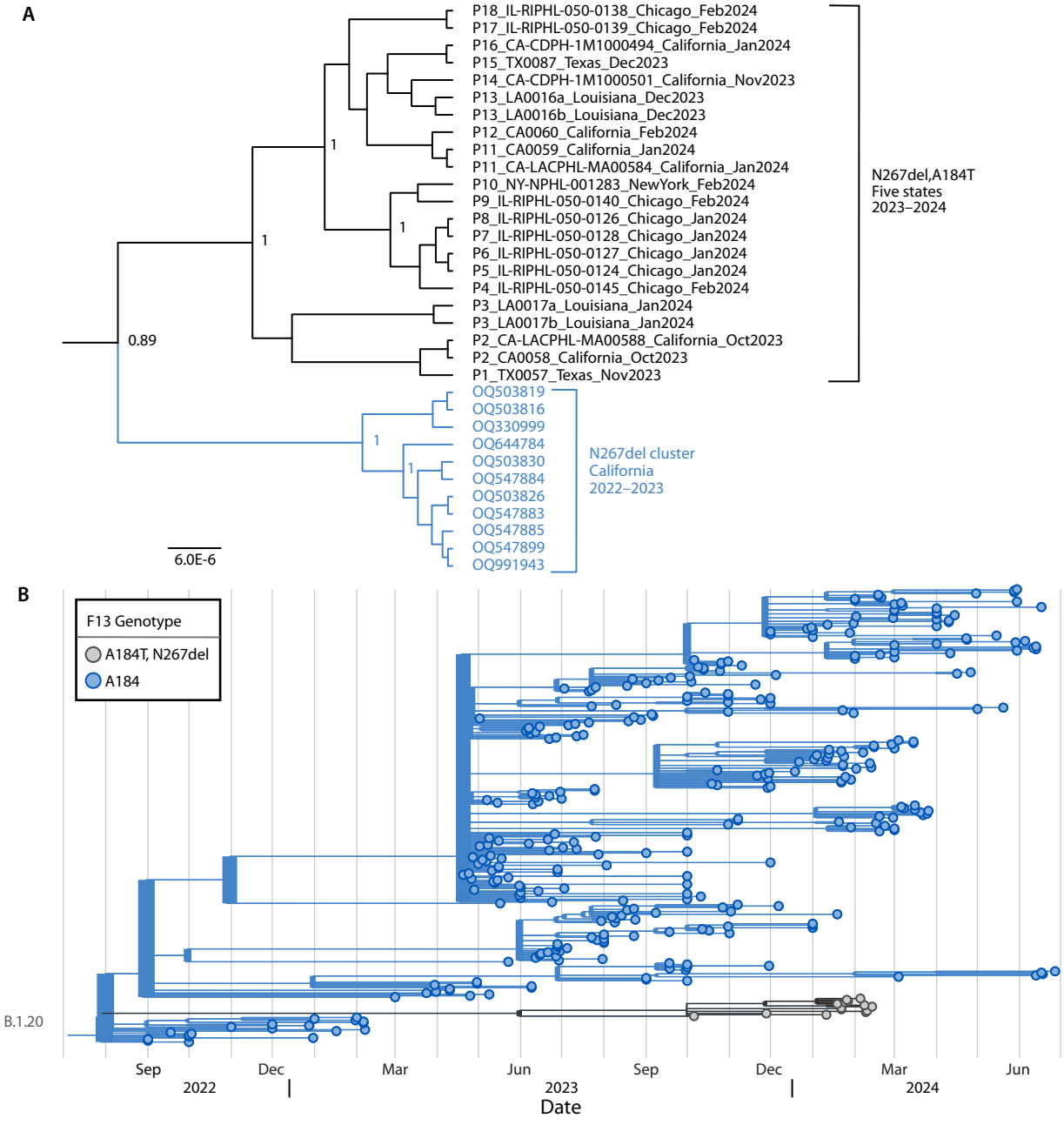
§ All Illinois cases were reported from Chicago.

¶ https://www.cdc.gov/mpox/signs-symptoms/index.html

** MPXV cultured from patient specimens were used to infect confluent Vero E6 cell monolayers pretreated with different concentrations of tecovirimat. After incubation for 72 hours, cells were fixed and stained with formalinized crystal violet and absorbance was measured at 570 nm; intact cell monolayers have a high absorbance indicating that the drug was protective; resistant MPXV requires higher concentrations of tecovirimat to inhibit virus and allow cell growth. EC_{50} was determined using a nonlinear curve fit in GraphPad Prism.

†† 45 CFR 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.

FIGURE. Phylogeny showing the relatedness of tecovirimat-resistant monkeypox viruses among 18 U.S. cases during 2023–2024*,† with a previous tecovirimat-resistant cluster from California (A)§,¶ and with representative monkeypox virus sequences (B) — United States, 2023–2024**



Abbreviations: MPXV = monkeypox virus; A184T = alanine-184-to-threonine substitution; N267del = asparagine 267 deletion; SNP = single nucleotide polymorphism.

* From five states (California, Illinois, Louisiana, New York, and Texas).

† Unique patients are identified by P number; multiple samples were sequenced for four patients.

§ MPXV with N267del, A184T clustered separately from MPXV sequences from a tecovirimat-resistant cluster from California with N267del from late 2022–early 2023 (sublineage B.1.17). During late 2022–early 2023, persons in two of the four California cases (P16 and P2) reported travel to Texas; each had one or two SNP differences from an MPXV sequence from Texas (P15 and P1, respectively). Within the cluster, N267del, A184T sequences differed by an average of five SNPs (range = 0–11), compared with an average of 10.5 SNPs between the two clusters (range = 7–15). A large genomic deletion in sequence TX0087 was counted as one SNP.

¶ Phylogenetic analysis was performed using BEAST 1.10.4 on whole genome sequence alignments of sequences after clipping genomic ends to match the shortest sequence, removing repeat regions, and removing any sites containing ambiguous bases to a final length of 150,505 positions using GTR+G+I nucleotide substitution model, exponential coalescent tree prior, and strict molecular clock set to one; ON676708 was used to root the tree. Scale bar indicates substitutions per site; numbers at the branches indicate posterior probability support values.

** MPXV with N267del, A184T clustered separately from other sublineage B.1.20 MPXV sequences. Visualization of 334 lineage B.1.20 clade IIb MPXV genomes sampled from 3,552 genomes available from the National Center for Biotechnology Information GenBank between September 2022 and June 2024 (updated July 22, 2024) using a local build of Nextstrain (https://nextstrain.org) and visualized using TimeTree (https://timetree.org).

Summary

What is already known about this topic?

Tecovirimat is the first-line drug for treatment of orthopoxvirus infection (e.g., smallpox and mpox). Viral mutations that render the drug ineffective can develop during treatment.

What is added by this report?

A new cluster of mpox cases caused by tecovirimat-resistant monkeypox virus (MPXV) was detected among persons with no documentation of previous tecovirimat treatment over multiple months in five U.S. states.

What are the implications for public health practice?

Routine sequence surveillance is needed to detect and monitor resistance. To prevent development and spread of resistant MPXV, tecovirimat use outside of clinical trials needs to be consistent with CDC's Investigational New Drug protocol for tecovirimat use.

first report of interstate spread. Because not all viruses from mpox cases are sequenced, these findings likely underestimate the prevalence of this newly recognized drug-resistant variant. This study calls attention to a need for increased sequence surveillance to determine whether the resistant virus is still circulating. The findings also underscore the importance of adhering to the CDC Investigational New Drug protocol for tecovirimat use outside of a clinical trial (i.e., indications for tecovirimat use, taking the recommended number of pills according to the prescribed schedule, and following instructions to take the medication with a fatty meal[§§]) and the importance of preventing spread[¶¶] of a potentially resistant virus to others. The findings of this study and the PALM007 study[***] highlight the urgent need for additional therapeutics for treatment of mpox as well as for smallpox biothreat preparedness.

§§ https://www.cdc.gov/mpox/hcp/clinical-care/tecovirimat.html

¶¶ https://www.cdc.gov/mpox/prevention/index.html

*** The antiviral tecovirimat is safe but did not improve clade I mpox resolution in Democratic Republic of the Congo (https://www.nih.gov/news-events/news-releases/antiviral-tecovirimat-safe-did-not-improve-clade-i-mpox-resolution-democratic-republic-congo), although U.S. data from the NIH-sponsored Study of Tecovirimat for Human Mpox Virus trial will be essential in informing the role of tecovirmat for mpox treatment. https://www.clinicaltrials.gov/study/NCT05534984

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Notes from the Field

Suspected Outbreak of Trichinellosis Associated with Undercooked Bear Meat — North Carolina, November 2023

Camden D. Gowler, PhD[1,2]; Nicole Lee, MPH[2]; Tammra Morrison[2]; Vivian Mears[2]; Carl Williams, DVM[2]; Aaron Fleischauer, PhD[2,3]; Erica Wilson, MD[2]

Summary

What is already known about this topic?

Trichinellosis is a rare parasitic disease; an increasing percentage of recent cases are associated with consumption of wild game meat.

What is added by this report?

In November 2023, a presumed outbreak of trichinellosis occurred in western North Carolina, resulting in 10 probable cases. All cases were linked to a gathering where attendees consumed undercooked bear meat.

What are the implications for public health practice?

Communication of safe wild game meat preparation is the most effective way to prevent trichinellosis. Diagnostic antibody tests might have poor accuracy, and treatment costs can be substantial. Cooking wild game meat to an internal temperature ≥165°F (≥74°C) is necessary to kill *Trichinella* spp. parasites.

Trichinella spp. nematodes are complex life cycle parasites that can cause trichinellosis (also called trichinosis) when humans consume undercooked or raw meat harboring dormant larvae (*1*). Trichinellosis is rare in the United States, largely as a result of changes in pig-raising practices, with most recently reported cases being associated with consumption of wild game meat (*2*). Signs and symptoms include myalgia and fever in 54% of cases and facial swelling in 42% (*2*). Timely identification is important because trichinellosis can be severe; 0.2% of cases are fatal (*1*).

On November 29, 2023, the North Carolina Division of Public Health was alerted to a suspected case of trichinellosis in western North Carolina. The index patient experienced influenza-like signs and symptoms and facial swelling. Further investigation linked this patient to a gathering in early November where undercooked bear meat was served.

Investigations and Outcomes

Among 34 surveyed attendees at the November 2023 gathering, 22 (65%) reported consuming undercooked bear meat at the gathering; 10 (45%) of these persons experienced clinical signs and symptoms consistent with the 2014 Council of State and Territorial Epidemiologists' trichinellosis probable case classification* (*3*). Five patients received testing for *Trichinella* immunoglobulin G antibodies; all results were negative. However, confirmatory diagnosis requires additional testing of convalescent samples, and none of those receiving testing returned for convalescent serum testing. No bear meat was available for laboratory testing. Data from attendees and medical records from patients were collected and analyzed to guide public health actions. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.†

Among the 10 probable cases, nine patients had facial swelling, six had myalgia, and four had documented fever. Median patient age was 17 years (range = 10–40 years). Six probable trichinellosis cases occurred among persons aged ≤18 years. The median incubation period (interval from the implicated meal to documented symptom onset) was 21 days (range = 7–26 days) (Figure).

Preliminary Conclusions and Actions

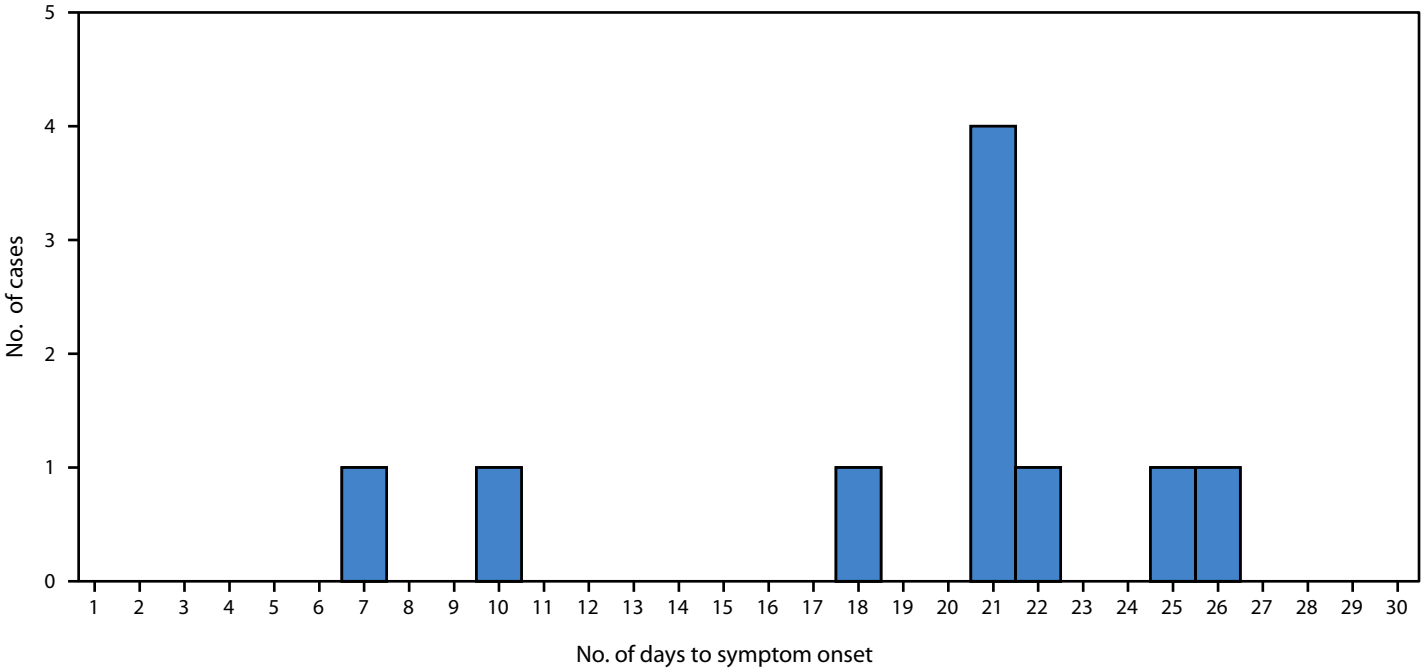
North Carolina public health officials identified probable trichinellosis cases based on clinical and epidemiologic criteria. Although *Trichinella* infections remain rare, thousands of bears are harvested each year in North Carolina (*4*). New *Trichinella* seroprevalence surveys for wild game species might be warranted. A 2022 trichinellosis outbreak associated with undercooked bear meat harvested from Canada resulted in six trichinellosis cases, including cases in two patients who only ate vegetables and were infected by cross-contamination (*5*). Because black bears are common hosts for *Trichinella* spp., communicating methods for properly cooking and preparing wild game meat is important. Cooking game meat to a safe internal temperature (≥165°F [≥74°C]) will kill *Trichinella* spp. and prevent infection, whereas freezing might not be sufficient (*1*).

In severe cases, trichinellosis can result in persistent myalgia or death (*1*). The majority of symptomatic persons in this outbreak were prescribed an antihelminth (albendazole), but use was delayed in some instances. Several patients reported a prohibitively high cost for treatment (approximately $100 per course). Moreover, whether the patient was treated or not, confirming infection through testing of convalescent serum is challenging because acute symptoms

*Clinical signs and symptoms include fever, myalgia, periorbital edema, and eosinophilia.

†45 C.F.R. part 46, 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.

FIGURE. Interval (days) from consumption of undercooked bear meat to symptom onset among persons with probable trichinellosis (N = 10) — North Carolina, November 2023



have often resolved by the time samples can be collected. Recovered patients might have little incentive to return for testing. Challenges associated with diagnosis and treatment of trichinellosis serve as a reminder for local health departments and wildlife management to communicate safe wild game meat preparation.

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