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Emergence of Extensively Drug-Resistant Shigellosis — United States, 2011–2023

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Abstract

Shigellosis is a nationally notifiable diarrheal illness caused by gram-negative bacteria. *Shigella* infection is spread through fecal-oral transmission and sexual contact. Although most infections are self-limited, antibiotics are indicated for severe illness or to reduce transmission in settings with high risk for spread. Since 2015, a growing proportion of cases has been caused by extensively drug-resistant (XDR) *Shigella* species, defined as being resistant to ampicillin, azithromycin, ceftriaxone, ciprofloxacin, and trimethoprim-sulfamethoxazole. No Food and Drug Administration–approved oral antimicrobial agents are available to treat these XDR infections. To describe U.S. trends and epidemiologic characteristics of XDR shigellosis, CDC analyzed *Shigella* isolates submitted to PulseNet, CDC's molecular surveillance network for enteric pathogens, during January 1, 2011–October 20, 2023; antimicrobial resistance was characterized using whole-genome sequencing data and antimicrobial susceptibility testing. Among 16,788 isolates with resistance data during this period, 510 (3.0%) were XDR. The percentage of XDR isolates increased from 0% during 2011–2015 to 8.5% in 2023. Species information was available for 505 (99%) of 510 XDR isolates; among those, 333 (65.9%) were *Shigella sonnei* and 172 (34.1%) were *Shigella flexneri*. Among patients with XDR shigellosis, the median patient age was 41 years (IQR = 31–54 years) and 86.2% were men. Among patients with available travel history, 76.2% (173 of 227) reported no recent domestic travel and 82.4% (169 of 205) reported no recent international travel. Among 116 persons with available HIV status, 54 (46.6%) reported HIV co-infection. Strengthened surveillance, timely reporting, and targeted prevention strategies are needed to limit transmission of XDR *Shigella* strains.

Introduction

Shigella species are highly infectious gram-negative bacteria that cause acute diarrheal illness and spread easily from person to person through fecal-oral transmission or sexual contact, or through contaminated food, water, or fomites. Infection can occur with as few as 10 organisms. Most infections resolve without requiring treatment with antimicrobial agents; however, antibiotics are indicated for severe illness or to reduce transmission in high-risk settings (*1*). In the United States, shigellosis is a nationally notifiable disease. Extensively drug-resistant (XDR) *Shigella* (defined as *Shigella* species isolates that are resistant to ampicillin, azithromycin, ceftriaxone, ciprofloxacin, and trimethoprim-sulfamethoxazole) is a public health concern because no Food and Drug Administration–approved oral antimicrobial agents are available, alternative oral treatment options are limited, and resistance genes can spread to other enteric bacteria. The proportion of XDR *Shigella* among all isolates has increased, and

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national trends and epidemiologic characteristics have not been fully described. To address this gap, CDC examined antimicrobial resistance patterns of *Shigella* isolates that were submitted to PulseNet, CDC's molecular surveillance network for foodborne diseases, during January 1, 2011 (when azithromycin was added to CDC's National Antimicrobial Resistance Monitoring System [NARMS] panel) through October 20, 2023. This report describes temporal trends in the proportion of XDR *Shigella* isolates and characterizes demographic, clinical, and epidemiologic features of patients with XDR shigellosis to help guide the development and implementation of prevention strategies to limit transmission.

Methods

Data Source

State and local public health laboratories submit *Shigella* isolates to PulseNet for routine surveillance and outbreak detection; submissions are determined by jurisdictional protocols and laboratory capacity, rather than by patient-level clinical or demographic factors. During January 1, 2011–October 20, 2023, a total of 16,788 *Shigella* isolates submitted to PulseNet had resistance data from whole-genome sequencing (WGS), antimicrobial susceptibility testing (AST), or both. WGS and AST represent different but highly concordant methods used to track antimicrobial resistance in enteric bacteria for surveillance purposes (*2*). Of the 16,788 isolates, 1,510 had AST data, including 1,454 with both AST and WGS; 56 had AST only, and 15,278 had WGS only. Use of WGS increased over the study period as sequencing capacity expanded nationally. Trends were interpreted using counts and proportions. Some epidemiologic variables, including sexual exposure, housing status, and sexually transmitted infection (STI) co-infection, were not routinely collected for *Shigella* cases and were therefore not analyzed.

Antimicrobial Resistance Testing

Antimicrobial resistance was characterized by NARMS using AST or WGS. AST used broth microdilution with Sensititer panels (Thermo Fisher Scientific; panel types varied) per manufacturer's instructions and Clinical and Laboratory Standards Institute (CLSI) guidelines. Results were interpreted using CLSI M100 (35th edition; 2025) clinical breakpoints where available. Resistance determinants (genetic markers that predict phenotypic antimicrobial resistance) were identified in WGS data using ResFinder and PointFinder databases (*3*). Isolates were classified as XDR if 1) they were resistant by AST to ampicillin, azithromycin, ceftriaxone, ciprofloxacin, and trimethoprim-sulfamethoxazole or 2) WGS identified resistance determinants for each of these agents (at least two for ciprofloxacin). In addition to the five antibiotics used to define XDR, isolates were tested for resistance to other agents on NARMS panels, including chloramphenicol and meropenem. Resistance determinants for fosfomycin were identified by WGS. Epidemiologic variables requested for XDR cases included age, sex, race, ethnicity, HIV status, and reported domestic and international travel history. Data were reviewed

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in the System for Enteric Disease Response, Investigation, and Coordination, CDC's secure platform for outbreak investigations and coordination. Frequencies and percentages were calculated in Stata (version 15.1; StataCorp) and stratified by U.S. Census Bureau region. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.*

Results

Characteristics of XDR *Shigella* Isolates

During January 2011–October 2023, a total of 510 XDR *Shigella* isolates were identified; species information was available for 505 (99%) of these, and the first XDR isolates were identified in 2016. These XDR isolates account for 3.0% of 16,788 *Shigella* isolates with resistance information. The percentage classified as XDR increased from 0% during 2011–2015 to 8.5% in 2023 (Figure), and 167 (32.7%) XDR isolates were also found to be resistant to chloramphenicol; no resistance to meropenem or fosfomycin was identified.

Characteristics of Patients with XDR Shigellosis

The median age of persons with XDR shigellosis was 41 years (IQR = 31–54 years) (Table 1). Among 492 persons with available data on sex and age, 473 (96.1%) were aged ≥18 years, including 424 (86.2%) men and 49 (10.0%) women; 19 (3.9%) cases occurred in persons aged <18 years (Supplementary Table). During the analysis period, most XDR cases (415; 84.3%) occurred during 2022–2023. Among 388 persons with available race data, 292 (75.3%) identified as White, 46 (11.9%) as Black or African American, 20 (5.2%) as Asian, three (0.8%) as American Indian or Alaska Native, two (0.5%) as Native Hawaiian or Pacific Islander, six (1.5%) as multiracial, and 19 (4.9%) as other (Table 1). Among 270 persons with ethnicity data, 52 (19.3%) identified as Hispanic or Latino. Among 116 patients with HIV status available, 54 (46.6%) reported HIV co-infection. Among 258 patients for whom hospitalization data were available, 97 (37.6%) were hospitalized; information on duration of hospitalization was not available. No deaths were reported.

Travel-Associated Cases

Information on domestic travel history was available for 227 persons, 54 (23.8%) of whom reported domestic travel and 173 (76.2%) who reported no domestic travel. Among 205 persons for whom information on international travel history was available, 36 (17.6%) reported international travel and 169 (82.4%) reported no international travel. Interpretation was limited by missing dates of travel relative to illness onset.

Specimen Source, *Shigella* Species, and Geographic Distribution

Among 498 isolates with known specimen source, 483 (97.0%) were from stool and nine (1.8%) were from blood; the remaining six (1.2%) were from colon (one), rectal swab (one), tissue (one), and other sources (three). Among the 505 XDR isolates with species data, 65.9% were *Shigella sonnei* and 34.1% were *Shigella flexneri* (Table 2). By comparison, *S. flexneri* made up 18.5% of all sequenced *Shigella* isolates during the same period. XDR *Shigella* trends and species distribution were examined by U.S. Census Bureau region. The percentage of XDR cases caused by *S. flexneri* varied by location and time, peaking at 84.6% in the Northeast Region during 2021. In the West Region, the percentage reached 54.8% in 2023; in the Midwest Region, *S. flexneri* was first reported in 2023. The highest percentages of *S. flexneri* isolates among XDR cases were in Oregon (15 of 21; 71.4%), California (48 of 111; 43.2%), and Colorado (24 of 60; 40.0%). Some data fields, including sexual exposure, housing status, and STI co-infection, were incomplete and therefore not analyzed.

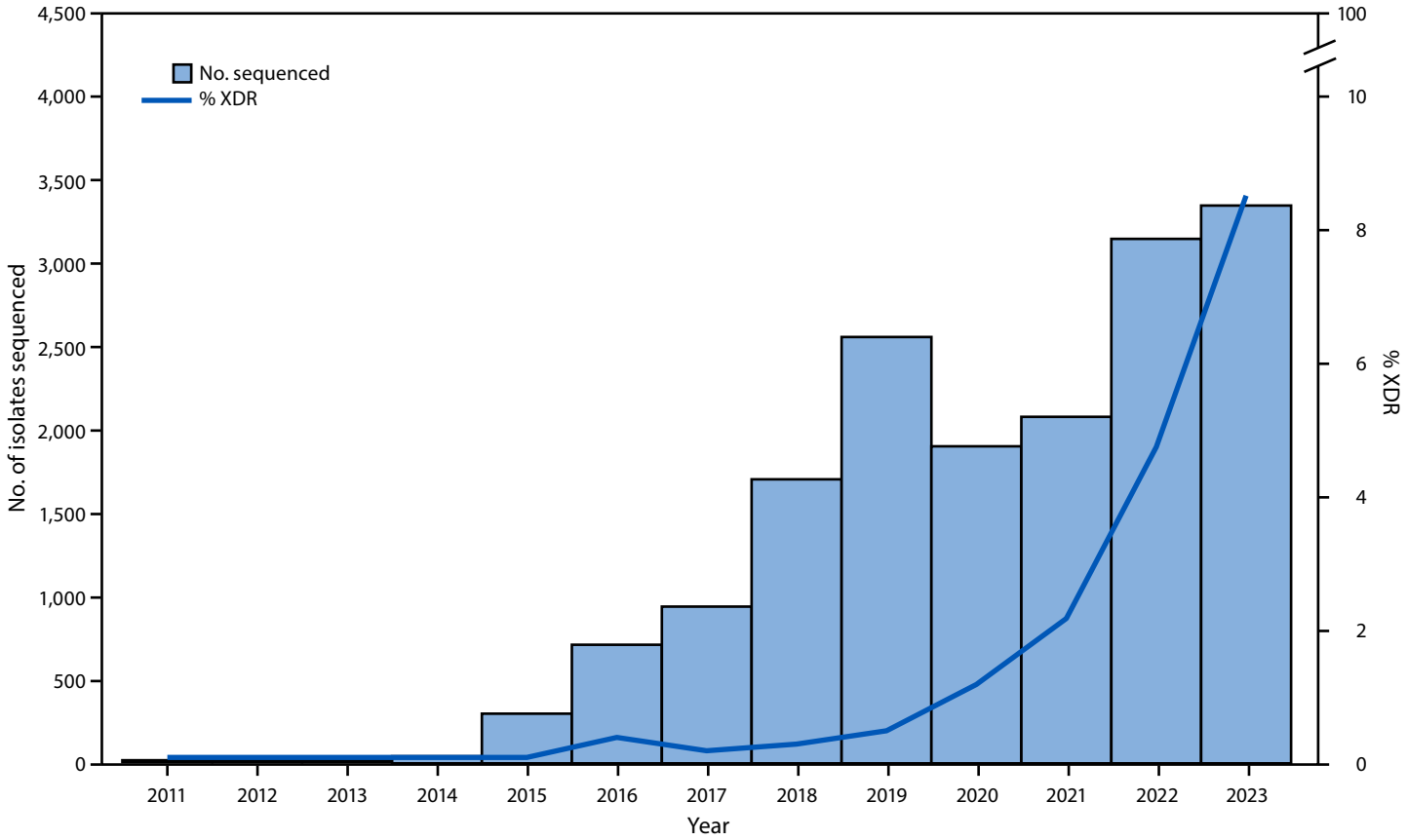
Discussion

The percentage of *Shigella* isolates with resistance data that were XDR increased from 0% during 2011–2015 to 8.5% in 2023. Historically in the United States, shigellosis, a nationally notifiable disease, primarily affected children and was most often caused by drug-susceptible strains (*1*,*4*). In contrast, during 2016–2023, persons with XDR shigellosis for whom demographic data were available were predominantly non-Hispanic White men. Sexual exposure data were incomplete and not analyzed; however, previous studies identified sexual contact among men who have sex with men as an important *Shigella* transmission route (*5*). The emergence of XDR strains raises concerns for persons with immunocompromise, including those with HIV, for whom treatment options are limited and risk for severe illness is higher (*5*,*6*). XDR *Shigella* co-infection with other bacterial STIs has also been reported (*7*).

Species-specific factors were notable. *S. sonnei* has historically predominated in U.S. surveillance (*4*). Although *S. sonnei* still accounted for most XDR cases, the percentage of *S. flexneri* XDR isolates (34.1%) was almost twice that in overall U.S. *Shigella* surveillance (18.5%). This higher proportion of *S. flexneri* among XDR isolates might reflect network-related factors or regional antimicrobial pressures rather than intrinsic biologic differences between species (*8*). Published studies associate *S. flexneri* with more severe outcomes, including dysentery, hospitalization, and a higher case-fatality rate (*1*).

* 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.

FIGURE. Number of sequenced *Shigella* isolates submitted to PulseNet and percentage that were extensively drug resistant*,† — United States, January 2011–October 2023



Abbreviations: AST = antimicrobial susceptibility testing; WGS = whole-genome sequencing; XDR = extensively drug resistant.
* XDR *Shigella* infections are resistant to ampicillin, azithromycin, ceftriaxone, ciprofloxacin, and trimethoprim-sulfamethoxazole, based on AST, WGS, or both.
† Of 16,788 isolates with resistance data, 15,278 had WGS only, 56 had AST only, and 1,454 had both WGS and AST data. Percent XDR was calculated among all isolates with resistance data (16,788).

The combination of XDR strains, possible higher virulence of *S. flexneri*, and risk among persons with immunocompromise warrants further study. Interpretation of reported travel histories was limited by missing data and lack of timing information.

Clinicians should rely on AST results from a clinical laboratory to guide therapy when possible. Treatment of XDR shigellosis remains challenging because no optimal therapy has been established. Chloramphenicol is not routinely recommended for shigellosis in the United States. Pivmecillinam, fosfomycin, and oral carbapenems (e.g., sulopenem) might be effective (*1*,*9*), but as of 2025, none was approved by the Food and Drug Administration (FDA) for shigellosis.

Limitations

The findings in this report are subject to at least four limitations. First, surveillance likely underestimated XDR *Shigella* isolate incidence: not all isolates were sequenced or had AST, many specimens that were positive by culture-independent diagnostic tests were not cultured, underdiagnosis and incomplete reporting occurred, and submissions varied by jurisdiction over time. Second, AST results were not available for all isolates; however, given the high (>95%) concordance between AST and WGS, WGS is considered an acceptable method for surveillance (*2*). Third, WGS was limited before 2019, and state sequencing capacity varies, which might contribute to regional differences and observed increases in XDR detection. Finally, demographic, behavioral, and clinical data were often incomplete, surveillance capacity varied across jurisdictions, and travel history was missing for approximately one half of patients with XDR shigellosis.

Implications for Public Health Practice

XDR *Shigella* infection is an emerging concern in the United States. Because no oral antimicrobial agents are FDA approved, prevention, early detection, AST-guided therapy, and timely reporting are important to protect populations at higher risk for XDR *Shigella* infection (*10*).

Acknowledgments

State and local health departments, laboratory partners, and all epidemiologists involved in this investigation.

TABLE 1. Characteristics of persons with extensively drug-resistant shigellosis — United States, 2011–2023

Characteristic (no. with available data)	No. (%)
Age group and sex (492)	
≥18 yrs	473 (96.1)
Female	49 (10.0)
Male	424 (86.2)
<18 yrs	19 (3.9)
Female	9 (1.8)
Male	10 (2.0)
Median age, yrs (IQR)	41 (31–54)
Race and ethnicity (388)	
American Indian or Alaska Native	3 (0.8)
Asian	20 (5.2)
Black or African American	46 (11.9)
Native Hawaiian or Pacific Islander	2 (0.5)
White	292 (75.3)
Multiracial	6 (1.5)
Other	19 (4.9)
Hispanic or Latino (270)	52 (19.3)
HIV co-infection (116)	54 (46.6)
Hospitalization and death (258)	
Hospitalization	97 (37.6)
Death	0 (—)
Travel history	
Domestic (227)	54 (23.8)
International (205)	36 (17.6)
Specimen source (498)	
Stool	483 (97.0)
Blood	9 (1.8)
Other*	6 (1.2)

* Colon (one), rectal swab (one), tissue (one), and other sources (three).

XDR *Shigella* Working Group

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TABLE 2. Percentage of extensively drug-resistant *Shigella *flexneri* isolates among all XDR *Shigella* species isolates,† by U.S. Census Bureau region§ and year — United States, 2011–2023¶**

	Northeast		Midwest		South		West		Total	
Year	Total no. XDR*	No. (%) *S. flexneri***	Total no. XDR*	No. (%) *S. flexneri***	Total no. XDR*	No. (%) *S. flexneri***	Total no. XDR*	No. (%) *S. flexneri***	Total no. XDR*	No. (%) *S. flexneri***
2016	1	0 (—)	0	0 (—)	0	0 (—)	1	0 (—)	**2**	**0 (—)**
2017	0	0 (—)	0	0 (—)	0	0 (—)	1	1 (100.0)	**1**	**1 (100.0)**
2018	0	0 (—)	0	0 (—)	3	0 (—)	0	0 (—)	**3**	**0 (—)**
2019	1	0 (—)	1	0 (—)	2	0 (—)	6	2 (33.3)	**10**	**2 (20.0)**
2020	10	0 (—)	2	0 (—)	0	0 (—)	9	2 (22.2)	**21**	**2 (9.5)**
2021	13	11 (84.6)	1	0 (—)	5	2 (40.0)	24	6 (25.0)	**43**	**19 (44.2)**
2022	26	15 (57.7)	11	0 (—)	22	9 (40.9)	86	33 (38.4)	**145**	**57 (39.3)**
2023	74	28 (37.8)	47	5 (10.6)	66	7 (10.6)	93	51 (54.8)	**280**	**91 (32.5)**
Total	**125**	**54 (43.2)**	**62**	**5 (8.1)**	**98**	**18 (18.4)**	**220**	**95 (43.2)**	**505**	**172 (34.1)**

Abbreviation: XDR = extensively drug resistant.

* XDR *Shigella* species isolates are defined as isolates that are resistant to ampicillin, azithromycin, ceftriaxone, ciprofloxacin, and trimethoprim-sulfamethoxazole.

† Five of 510 XDR isolates were excluded because species data were missing.

§ New York City and Los Angeles County were classified within the Northeast and West U.S. Census Bureau regions, respectively.

¶ No XDR *Shigella* cases were reported during 2011–2015; the first XDR cases were identified in 2016. The study period begins in 2011 because azithromycin was added to the National Antimicrobial Resistance Monitoring System testing panel that year, and resistance to azithromycin is part of the XDR case definition.

** Among all XDR *Shigella* species isolates per region per year.

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Summary

What is already known about this topic?

U.S. cases of extensively drug-resistant (XDR) *Shigella* infections are increasing; no Food and Drug Administration–approved oral treatment is available. *Shigella* bacteria are easily transmissible and resistance genes can spread to other enteric bacteria, making XDR *Shigella* a public health threat. U.S. trends have not been fully described.

What is added by this report?

Among nearly 17,000 *Shigella* species isolates with resistance data, XDR isolates increased from 0% in 2011 to 8.5% in 2023. Whereas earlier U.S. outbreaks involved drug-susceptible strains and primarily affected children, national surveillance data indicate that most XDR cases occurred among adult men. Approximately one third of patients were hospitalized.

What are the implications for public health practice?

The high transmission potential of XDR *Shigella* strains highlights the importance of susceptibility testing and timely reporting of this nationally notifiable disease for prevention.

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Severe Illness Associated with Eating Mushroom-Containing Chocolate Products — United States, January–October 2024

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Abstract

In late spring 2024, CDC was alerted to an outbreak of poisoning potentially associated with eating Diamond Shruumz microdosing chocolate bars. Diamond Shruumz microdosing chocolate bars are edible products designed so that small doses of mushroom-derived psychoactive compounds and other psychoactive ingredients can be eaten in a presectioned serving. In response to this alert, CDC and the Food and Drug Administration coordinated a nationwide outbreak investigation to characterize the potential poisonings associated with eating Diamond Shruumz microdosing chocolate bars. A case of poisoning was defined as an illness with moderate or major clinical effects (i.e., symptoms) as defined by America's Poison Centers in a person who ate any Diamond Shruumz product or another mushroom-containing chocolate product during January–October 2024. In total, 180 cases were reported in 34 states. Among these, 73 persons were hospitalized, including 38 persons who required intensive care unit (ICU) admission, 29 who required endotracheal intubation, and two deaths. Eating Diamond Shruumz chocolate bars was associated with higher odds of hospitalization (odds ratio [OR] = 3.29; 95% CI = 1.51–7.40), ICU admission (OR = 6.30; 95% CI = 2.17–22.6), seizures (OR = 8.45; 95% CI = 3.00–27.9), and endotracheal intubation (OR = 8.04; 95% CI = 2.24–44.2), compared with eating other mushroom-containing chocolate products. Eating larger amounts of Diamond Shruumz chocolate bars was associated with an increased likelihood of hospitalization, ICU admission, and endotracheal intubation (p-value for trend tests [p-trend] = 0.023, 0.004, and <0.001, respectively). Diamond Shruumz products were recalled, and the public was advised not to eat, sell, or serve any Diamond Shruumz products and to discard any Diamond Shruumz products previously purchased. Testing of some Diamond Shruumz products identified substances present in psychoactive mushrooms, including muscimol, psilocin (a Schedule I controlled substance), kavalactones, and other substances in some, but not all, tested products. Consumers should be aware of the poisoning risk associated with eating Diamond Shruumz products and other mushroom-containing microdosing chocolate products due to variability in ingredient composition, the absence of standardized regulatory oversight for sampling and testing finished products, and the potential toxicity of compounds intended to produce psychoactive effects.

Investigation and Results

In spring 2024, CDC was notified by America's Poison Centers and the Arizona Department of Health Services (ADHS) of reports of four persons who had severe illness with symptoms including seizures or central nervous system (CNS) depression and had eaten Diamond Shruumz mushroom-containing microdosing chocolate bars (*1*). In response, CDC collaborated with the Food and Drug Administration (FDA) to initiate a national outbreak investigation, which led to identification of 180 cases in 34 states, including the four cases originally identified by ADHS and America's Poison Centers. These data were previously reported (*1*). The ADHS investigation examined the four June 2024 Arizona cases of illness among persons who ate Diamond Shruumz chocolate bars (*1*). The resulting national investigation examined cases of illness among all U.S. persons who ate 1) any Diamond Shruumz products (including chocolate bars, gummies, and cones [products that resemble ice cream cones]) or 2) any other brands of mushroom-containing chocolate products during January–October 2024 across the United States (*2*,*3*). The national investigation evaluated the clinical characteristics and indicators of illness severity related to type and quantity of product eaten, using data from the National Poison Data System (NPDS), the data warehouse for the nation's 53 poison centers, as well as compiling and storing reports to poison centers, FDA, health departments, and health care providers. This report describes the findings from that investigation.

Data Source

During June–July 2024, after notification of the four Arizona poisoning cases identified by ADHS and America's Poison Centers among persons who ate Diamond Shruumz chocolate bars, CDC reviewed data from NPDS for all reported cases nationwide. This review of NPDS data confirmed cases of severe illness in persons who ate Diamond Shruumz chocolate bars and identified new cases among persons who ate gummies or cones also branded as Diamond Shruumz. This review also identified additional cases of severe illness among persons who

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ate mushroom-containing chocolate products manufactured by other and unknown brands. CDC then collaborated with the Council of State and Territorial Epidemiologists to develop a questionnaire to collect information on the demographic characteristics, microdosing products eaten, signs and symptoms of illness, and types of health care received among persons with poisoning cases. Health departments completed the questionnaire using information obtained from participants (or their proxies), clinicians, and medical records.

Case Definition and Ascertainment

A case of poisoning was defined as an illness characterized by moderate[†] or major[§] symptoms, including death, in a person who ate any Diamond Shruumz product (i.e., chocolate bars, gummies, or cones) or another brand of mushroom-containing chocolate product during January 1–October 11, 2024 (*2*). States used a standardized questionnaire to collect information about cases identified from any reporting source (e.g., poison centers, NPDS, FDA, or cases directly reported by affected persons or health care providers, including hospitals).

Analyses

A descriptive analysis of cases was conducted, including demographic characteristics, clinical signs and symptoms, and products eaten. To ascertain the associations between eating specific types of products and indicators of severe illness (i.e., occurrence of seizures, emergency department or urgent care [ED/UC] visits, hospitalization, intensive care unit [ICU] admission, and endotracheal intubation), persons who ate only mushroom-containing chocolate products other than those branded as Diamond Shruumz were considered the referent group. Comparator groups included persons who ate Diamond Shruumz chocolate bars only, Diamond Shruumz gummies only, Diamond Shruumz cones only, and all other combinations (e.g., combined eating of any Diamond Shruumz product and any other mushroom-containing chocolate product). The Cochran-Armitage test was used to examine trends in the proportion of persons with indicators of severe illness across increasing amounts of Diamond Shruumz chocolate bars eaten; $p<0.05$ was considered statistically significant. All analyses were performed using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[¶]

Characteristics of Persons with Poisoning Cases

As previously reported, in addition to the initial four Arizona cases, an additional 176 U.S. cases were identified, for a total of 180 cases among 179 persons in 34 states (one person developed moderate or major clinical symptoms on two separate occasions, and each event was considered a separate case) (*1*). Illness onset occurred during January 1–October 11, 2024 (Supplementary Figure 1) (Supplementary Figure 2).

Among the 178 cases with available demographic information, 81 (46%) occurred among adults aged 18–29 years, and 99 (59%) of 168 cases with available information on sex occurred among males (Table 1). Among the cases for which health outcome information was available, 150 (87%) involved care in an ED/UC; 73 (44%) of poisoning events required hospitalization, 38 (23%) required ICU admission, and 29 (18%) required endotracheal intubation. The three most frequently reported signs and symptoms were confusion (66%), drowsiness (47%), and agitation (45%); 29% of cases involved seizures. Two (1.1%) deaths were noted as being associated with the outbreak.

Types of Products Eaten and Indicators of Severe Illness

Among all 180 cases, 118 (66%) involved persons who had eaten any Diamond Shruumz product, including 85 (72%) who had eaten a Diamond Shruumz chocolate bar and 25 (21%) who had eaten Diamond Shruumz gummies (14) or cones (11) (Supplementary Table). Approximately one third of cases (62; 34%) involved eating a chocolate product not branded as Diamond Shruumz, and eating both Diamond Shruumz and other brands of mushroom-containing chocolate products was reported in an additional two cases (1.1%). Among 62 persons who reportedly consumed only other mushroom-containing chocolate products, a specific brand was named for 26 (42%). The median interval between eating a product and onset of first symptoms was 90 minutes (IQR = 30–180 minutes) (Table 1).

Cases among persons who had eaten only Diamond Shruumz chocolate bars were significantly more likely to involve seizures (odds ratio [OR] = 8.45), hospitalization (OR = 3.29), ICU admission (OR = 6.30), and endotracheal intubation (OR = 8.04) than were cases among persons who had eaten only other chocolate products (Table 2). The prevalences of

[†] Moderate clinical effects are symptoms resulting from an exposure that are more pronounced, more prolonged, or of a more systemic nature than are minor symptoms (i.e., symptoms that are minimally bothersome to the patient and resolve rapidly with no residual disability or disfigurement). Usually, some form of treatment is indicated for moderate symptoms, but moderate symptoms are not life-threatening and do not result in a residual disability or disfigurement. Examples include hypotension that resolves with treatment, isolated brief seizures that resolve spontaneously or rapidly with treatment, and hypoglycemia with confusion.

[§] Major symptoms are life-threatening or result in a substantial residual disability or disfigurement. Examples include status epilepticus, cardiovascular instability, and coma with hypotension.

[¶] 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.

TABLE 1. Characteristics of persons with moderate or major symptoms after eating a Diamond Shruumz or another mushroom-containing chocolate product (N = 180) — United States, January 1–October 11, 2024*

Characteristic (no. with available information)†	No. (%)
Age group, yrs (n = 178)	
<18	24 (13.5)
18–29	81 (45.5)
30–39	39 (21.9)
40–49	20 (11.2)
≥50	14 (7.9)
Sex (n = 168)	
Female	69 (41.1)
Male	99 (58.9)
Race and ethnicity (n = 125)	
Black or African American, NH	18 (14.4)
Hispanic or Latino	13 (10.4)
White, NH	89 (71.2)
Other (including multiracial)	5 (4.0)
Signs and symptoms	
Date of first onset of signs and symptoms, median (range) (n = 155)	Jun 8 (Jan 6–Sep 12)
Confusion (n = 157)	104 (66.2)
Drowsiness or difficulty staying awake (n = 150)	71 (47.3)
Agitation (n = 155)	69 (44.5)
Loss of consciousness (n = 155)	67 (43.2)
Hallucinations or delusions (n = 137)	59 (43.1)
Nausea (n = 144)	58 (40.3)
Feeling of a fast or irregular heartbeat (n = 137)	56 (40.9)
Tachycardia (n = 130)	53 (40.8)
Vomiting (n = 153)	52 (40.0)
Hypertension (n = 129)	46 (35.7)
Seizure (n = 144)	41 (28.5)
Shortness of breath (n = 137)	32 (23.4)
Health outcomes	
ED/UC visit (n = 172)	150 (87.2)
Hospitalized (n = 167)	73 (43.7)
Admitted to ICU (n = 164)	38 (23.2)
Received endotracheal intubation (n = 166)	29 (17.5)
Died (n = 174)	2 (1.1)
Length of hospitalization, days, mean (SD) (67)	2.2 (4.4)
Median (range)	1.0 (<1–33.0)
Duration of endotracheal intubation, mean (SD) (27)	1.6 (1.1)
Median (range)	1.0 (<1–4.0)

TABLE 1. (*Continued*) Characteristics of persons with moderate or major symptoms after eating a Diamond Shruumz or another mushroom-containing chocolate product (N = 180) — United States, January 1–October 11, 2024*

Characteristic (no. with available information)†	No. (%)
Types of products eaten§	
Any Diamond Shruumz product (n = 148)	118 (79.7)
Any Diamond Shruumz chocolate bar¶ (n = 130)	85 (65.4)
Any Diamond Shruumz gummies** (n = 115)	14 (12.2)
Any Diamond Shruumz cone†† (n = 118)	11 (9.3)
Any other chocolate product§§ (n = 151)	64 (42.4)¶¶
Interval from eating product to symptom onset (minutes) (n = 96)	
Median (IQR)	90 (30–180)
Range	0 (10–109)

Abbreviations: ED/UC = emergency department/urgent care; ICU = intensive care unit; NH = non-Hispanic.

* One person developed moderate or major symptoms twice; therefore, a total of 180 cases occurred among 179 persons.

† The denominator represents the number of cases for which information for that particular variable was available. Percentages are based on denominators excluding missing data.

§ Reports of products eaten are not mutually exclusive; some persons with cases reported eating more than one type of product (i.e., 166 persons ate one type of product, 10 persons ate two types of products, and one person each ate three types of products, four types of products, five types of products, or six types of products).

¶ Ate at least one of the available flavors of Diamond Shruumz chocolate bars (i.e., dark chocolate, fruity cereal, cinnamon, birthday cake, cookie butter, and cookies and cream).

** Ate at least one of the available flavors of Diamond Shruumz gummies (i.e., strawberry kiwi, grape lemonade, sour apple peach, rainbow, Hawaiian punch, blue razz watermelon, blue razz euphoria, watermelon wonderland, radical rainbow, lucid lemon-lime, and peach paradise).

†† Ate at least one of the available flavors of Diamond Shruumz cones (i.e., double chocolate chip, mint chocolate chip, sprinkles, cookies and cream, and strawberry cheesecake).

§§ Chocolate products other than Diamond Shruumz included Awaken Superfood White Chocolate, Fusion, Hixotic, Lucid Journeys, Magic Kingdom, Megadose Rize Milk Crunch, Moom, Mushroom Lyfe, Polka Dot (Magic Belgium Milk Chocolate Mushroom Candy, Belgian Chocolate Bar, Magic Chocolate, Magic Mushroom, and Belgian Chocolate Reese), Punch edible, Stoned, Sunday Bar, Super Smashed (Mushrooms and Shrooms Magic), Tre House Magic Mushroom, Willy Wonky Mushroom Chocolate Bar, Wonderbar, mmelt Magic Mushroom Chocolate Bars, and Wonderland Happy Dots Proprietary Magical Blend. The brand was not specified for 36 cases.

¶¶ This category includes two persons who consumed both Diamond Shruumz and non–Diamond Shruumz products.

hospitalization, ICU admission, and endotracheal intubation significantly increased with increasing amounts of Diamond Shruumz chocolate bars eaten (p-trend = 0.024, 0.004, and <0.001, respectively) (Table 3).

Public Health Response

Notification and Voluntary Product Recall

On June 7, 2024, FDA published a notification about the investigation of the cases (*3*). On June 12, CDC released a Health Alert Network advisory alerting clinicians of the outbreak (*2*), and on June 18, FDA contacted the brand owner, requesting a voluntary recall of all Diamond Shruumz products. The brand owner issued a nationwide recall for all Diamond Shruumz products (*3*). By July 16, state partners reported that some recalled products were still available at several smoke and vape shops, and FDA worked with the National Association of Convenience Stores and the National Smoke Shop Association to increase awareness of the recall. On July 20, FDA published, and subsequently updated, a list of Diamond Shruumz suppliers (*3*).

Product Testing Results

Early in the investigation, FDA and state partners collected samples of Diamond Shruumz products from several sources, and FDA tested 54 samples at the National Forensic Chemistry Center. As of November 15, 2024, testing had identified

TABLE 2. Associations between type of products eaten and indicators of severe illness among persons with moderate or major symptoms — United States, January 1–October 11, 2024

Outcome and types of products eaten (no. with available information)*	No. with outcome (column %)		OR (95% CI)
	Yes	No	
Seizures (n = 41/137)			
Diamond Shruumz chocolate bars only	30 (73.2)	29 (30.2)	8.45 (3.00–27.9)
Diamond Shruumz gummies only	3 (7.3)	5 (5.2)	4.82 (0.60–33.5)
Diamond Shruumz cones only	1 (2.4)	7 (7.3)	1.19 (0.02–12.5)
All other combinations	1 (2.4)	5 (5.2)	1.65 (0.03–19.1)
Any other chocolate product only	6 (14.6)	50 (52.1)	Ref†
Total	**41 (100.0)**	**96 (100.0)**	—
Emergency department or urgent care center visit (n = 143/164)			
Diamond Shruumz chocolate bars only	69 (48.3)	10 (47.6)	NC
Diamond Shruumz gummies only	4 (2.8)	4 (19.1)	NC
Diamond Shruumz cones only	5 (3.5)	3 (14.3)	NC
All other combinations	4 (2.8)	4 (19.1)	NC
Any other chocolate product only	61§ (42.7)§	0 (—)	Ref†
Total	**143 (100.0)**	**21 (100.0)**	—
Hospitalization (n = 71/159)			
Diamond Shruumz chocolate bars only	44 (62.0)	34 (38.6)	3.29 (1.51–7.40)
Diamond Shruumz gummies only	5 (7.0)	3 (3.4)	4.16 (0.71–30.0)
Diamond Shruumz cones only	3 (4.2)	5 (5.7)	1.53 (0.21–8.96)
All other combinations	3 (4.2)	5 (5.7)	1.53 (0.21–8.96)
Any other chocolate product only	16 (22.5)	41 (46.6)	Ref†
Total	**71 (100.0)**	**88 (100.0)**	—
ICU admission (n = 37/156)			
Diamond Shruumz chocolate bars only	30 (81.1)	47 (39.5)	6.30 (2.17–22.6)
Diamond Shruumz gummies only	2 (5.4)	6 (5.0)	3.25 (0.26–26.4)
Diamond Shruumz cones only	0 (—)	8 (6.7)	NC
All other combinations	0 (—)	8 (6.7)	NC
Any other chocolate product only	5 (13.5)	50 (42.0)	Ref†
Total	**37 (100.0)**	**119 (100.0)**	—
Endotracheal intubation (n = 29/158)			
Diamond Shruumz chocolate bars only	24 (82.8)	53 (41.1)	8.04 (2.24–44.2)
Diamond Shruumz gummies only	2 (6.9)	6 (4.7)	5.73 (0.40–61.8)
Diamond Shruumz cones only	0 (—)	8 (6.2)	NC
All other combinations	0 (—)	8 (6.2)	NC
Any other chocolate product only	3 (10.3)	54 (41.9)	Ref†
Total	**29 (100.0)**	**129 (100.0)**	—

Abbreviations: ICU = intensive care unit; NC = not calculable; OR = odds ratio; Ref = referent group.

* Cases occurred among persons who ate Diamond Shruumz products (chocolate bars, gummies, or cones) or other brands of mushroom-containing chocolate products. Cases were excluded if eating Diamond Shruumz products was reported without specification of product type. If eating one specific product type was reported, but information was missing for other product types, no exposure to the unknown products was assumed. If Diamond Shruumz products and another brand of chocolate products were eaten, cases were coded as all other combinations. Some ORs were not calculable due to zero counts in some cells.

† The Ref for this analysis comprised participants who reported eating only another brand of chocolate bar (i.e., no Diamond Shruumz products were reportedly eaten). However, some participants who might not have known the brand of mushroom-containing chocolate bar they ate might have selected this option; therefore, the Ref might contain persons who ate Diamond Shruumz products.

§ A total of 62 persons consumed another brand of mushroom-containing chocolate products only, but only 61 of these persons also had emergency department or urgent care outcome data.

chemicals found in psychoactive mushrooms (i.e., muscimol and psilocin; psilocin is a Schedule I controlled substance), the kava plant (i.e., kavalactones), a synthetic hallucinogen (i.e., acetylpsilocin), and a pharmaceutical (i.e., pregabalin) in various samples (*2*,*3*). FDA testing also detected muscimol and ibotenic acid in a raw ingredient that was reportedly used in manufacturing some Diamond Shruumz products (*3*). Different samples of the same product type and flavor contained different substances.

Discussion

A nationwide investigation identified 180 cases of moderate or major illness in persons who ate Diamond Shruumz microdosing products and other mushroom-containing chocolate products (*1*). The findings in this report indicate that Diamond Shruumz chocolate bars were more likely to be associated with indicators of severe illness, especially at higher levels of consumption, than were non–Diamond Shruumz chocolate products.

TABLE 3. Number of persons* with indicators of severe illness among those with moderate or major symptoms† after eating Diamond Shruumz chocolate bars, by number of pieces eaten — United States, January 1–October 11, 2024

Outcome level	No. of pieces eaten, no. (column %)				p-value for trend§
	0.5–3	4–6	7–10	>10	
Seizure					
Yes	2 (25)	3 (60)	6 (85.7)	10 (47.6)	
No	6 (75)	2 (40)	1 (14.3)	11 (52.4)	0.43
Emergency department or urgent care center visit					
Yes	3 (33.3)	5 (83.3)	16 (100)	24 (88.9)	
No	6 (66.7)	1 (16.7)	0 (0)	3 (11.1)	<0.001
Hospitalization					
Yes	3 (33.3)	2 (33.3)	8 (57.1)	19 (70.4)	
No	6 (66.7)	4 (66.7)	6 (42.9)	8 (29.6)	0.024
ICU admission					
Yes	1 (11.1)	1 (16.7)	4 (28.6)	16 (59.3)	
No	8 (88.9)	5 (83.3)	10 (71.4)	11 (40.7)	0.004
Endotracheal intubation					
Yes	0 (0)	0 (0)	4 (28.6)	14 (51.9)	
No	9 (100)	6 (100)	10 (71.4)	13 (48.1)	<0.001

Abbreviation: ICU = intensive care unit.

* Analysis was restricted to persons who ate Diamond Shruumz chocolate bars. An entire Diamond Shruumz chocolate bar consists of 12–15 presectioned pieces with a total weight of 1.6 oz (43.4 g). Diamond Shruumz's website suggested that eating two squares was a "starting dose for microdosing"; no maximum dose was listed.

† Moderate symptoms are more pronounced, more prolonged, or characterized as having a more systemic nature than are minor symptoms (i.e., symptoms that are minimally bothersome to the patient and resolve rapidly with no residual disability or disfigurement). Usually, some form of treatment is indicated for moderate symptoms, but they are not life-threatening and do not result in any residual disability or disfigurement. Major symptoms are life-threatening or result in a substantial residual disability or disfigurement.

§ Cochran-Armitage trend test.

Multiple substances identified in Diamond Shruumz products might have contributed to severe illness through CNS modulatory neurotransmitters (*4*–*7*). Muscimol and certain kavalactones act on the GABA-A receptor and are associated with CNS depression (*7*,*8*). Seizures have been reported in cases of poisoning from *Amanita muscaria* (a mushroom containing muscimol and ibotenic acid), pregabalin, and tryptamines (e.g., psilocin, psilocybin, and dimethyltryptamine) (*5*,*6*,*8*). Because the products and patient symptoms varied widely, the exact pathway leading to severe illness in these cases remains unclear.

Approximately one third of all cases occurred among persons who reportedly ate only other mushroom-containing chocolate products, suggesting that the risk for moderate or major illness might not be limited to Diamond Shruumz products, although some consumers might have misreported eating a different chocolate product when they had actually eaten a Diamond Shruumz product. In addition, each person who ate only other mushroom-containing chocolate products sought emergency department care, possibly reflecting differential case finding rather than increased illness severity.

Summary

What is already known about this topic?

Edible products that contain small doses of psychoactive substances have been known to cause serious or life-threatening illnesses. In late spring 2024, CDC was alerted to an outbreak of illness potentially associated with eating mushroom-containing microdosing products.

What is added by this report?

A national investigation identified 180 cases of severe illness in 34 states associated with eating Diamond Shruumz or other mushroom-containing chocolate products. Among cases with available outcome data, 43.7% of persons required hospitalization, 23.2% required intensive care unit admission, 17.5% required endotracheal intubation, and 1.1% died. Severe outcomes were most common among persons who ate Diamond Shruumz chocolate bars, and outcomes worsened with larger amounts eaten. Diamond Shruumz products have since been recalled.

What are the implications for public health practice?

Consumers should be aware that microdosing psychedelic products can cause severe illness or death and that recalled products should not be sold, purchased, or eaten.

Limitations

The findings in this report are subject to at least two limitations. First, this investigation likely underestimates the incidence of mushroom-containing microdosing product poisonings in the United States because persons might be reluctant to report eating these products, particularly persons who had less severe outcomes. In addition, the case definition only included reports of illness after eating Diamond Shruumz products of any type (i.e., chocolate, gummies, or cones) as well as other brands of mushroom-containing chocolate products, excluding other forms of mushroom-containing edible products, such as gummies, manufactured by other brands. A previous report by the Blue Ridge Poison Center in Charlottesville, Virginia, described five persons who sought medical attention after eating different mushroom gummy brands (*9*). Although the exact brands eaten in the Virginia investigation were unavailable for testing, analysis of several brands purchased by investigators revealed the presence of potentially harmful undisclosed ingredients and Schedule I drugs (i.e., psilocin and psilocybin) (*9*). Second, this investigation was limited to the collection of information from persons experiencing moderate or major illness after eating specific microdosing products; therefore, no comparison group of persons who did not eat these products was available for analysis, and comparisons were among persons who ate at least one microdosing product. However, the detailed information available on product types and amounts enabled dose-response analyses and the identification of product types that were potentially associated with more severe outcomes.

Implications for Public Health Practice

The findings in this report highlight the potential risks associated with eating microdosing mushroom products. On December 18, 2024, FDA issued an alert declaring *Amanita muscaria*, its extracts, and certain constituents (e.g., muscimol and ibotenic acid) are not authorized for use as ingredients in conventional food (i.e., food additives) (*10*). Consumers should be aware of the potential for severe health risks associated with eating microdosing products harboring ingredients not suitable for human consumption. Consumers and clinicians can contact America's Poison Centers for poison triage services by calling the Poison Help Line at 1-800-222-1222 or through the PoisonHelp.org website.

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