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Outbreak of Cyclosporiasis Among Patrons of a Mexican-Style Restaurant — Limestone County, Alabama, May–June 2023

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Abstract

In early June 2023, the Alabama Department of Public Health identified five laboratory-confirmed cyclosporiasis case reports with a common patient exposure of eating at one Mexican-style restaurant. Common signs of cyclosporiasis include diarrhea, abdominal cramps, nausea, and loss of appetite. Although most illnesses are self-limited, antibiotic treatment can prevent relapsing illness. Onset of illness for the initial five patients occurred during May 26–30. An outbreak investigation was initiated on June 7. Routine case investigations and case finding through the restaurant's food delivery service contact list identified 42 additional cases. Multivariable analysis of case-control study data revealed that illness was associated with consumption of cilantro (odds ratio = 40.9; 95% CI = 6.4–808.6). The cilantro was traced back to a Texas firm with no identified food manufacturing license that sourced the product from Mexico. The outbreak and its investigation demonstrate the ongoing need for regulatory controls of produce suppliers, documentation and review of business licenses, and increasing public awareness of food safety and outbreaks. Distribution of potentially contaminated products via improper supply chain channels remains a public health challenge. Avoiding infection in the United States involves preventing contaminated produce from reaching local retailers and consumers.

Investigation and Results

Epidemiologic Investigation

On June 7, 2023, the Alabama Department of Public Health (ADPH) opened an outbreak investigation after reviewing five reports of laboratory-confirmed cases of cyclosporiasis, an intestinal illness caused by the parasite *Cyclospora cayetanensis*. The case reports identified one Mexican-style restaurant as a common exposure. Onset of illness for all patients was May 26–30. Alabama's Cyclosporiasis Investigation Form was used to interview the five persons in whom the initial confirmed cases were identified. An outbreak-specific questionnaire was created based on the menu provided by the restaurant and was distributed to patrons who ate at the restaurant May 20–June 6. Routine case investigations and case finding through the restaurant's food delivery service contact list identified 42 additional cases. ADPH's Institutional Review Board Primary Review Team determined that this study was exempt from the Federal Policy for the Protection of Human Research Subjects.

Case-control study. Case-patients (47) were persons who ate food from the restaurant during May 20–June 6 and developed diarrhea 2–14 days after their meal date. Thirty-eight cases (81%) with evidence of *Cyclospora cayetanensis* infection by polymerase chain reaction were considered confirmed; nine cases (19%) that lacked laboratory evidence were considered suspected. The control group (17) included persons who ate food from the restaurant May 20–June 6 and did not become ill (Figure 1). The median (IQR) incubation period was 7 (2–14) days. Most patients with cases of cyclosporiasis were female (32; 68%), White (47; 100%), and non-Hispanic (47; 100%); characteristics of control group subjects were

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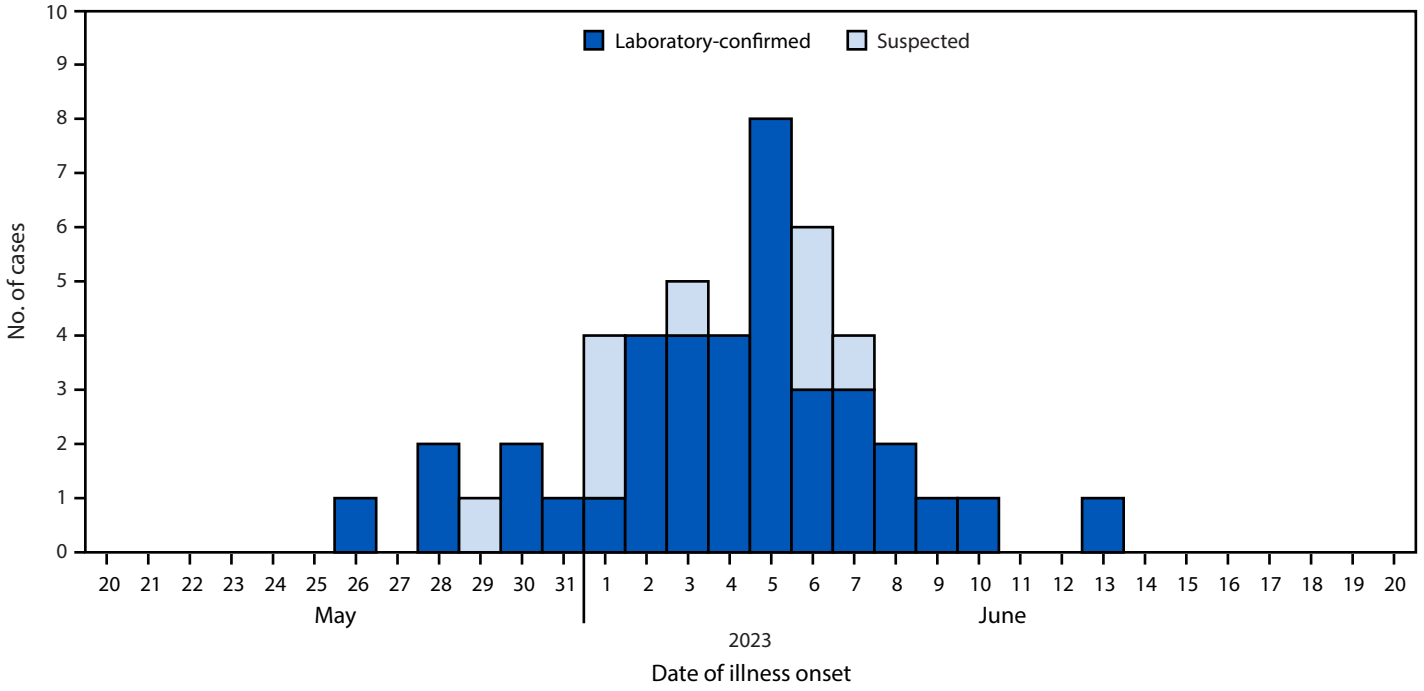
CENTERS FOR DISEASE CONTROL AND PREVENTION

FIGURE 1. Laboratory-confirmed and suspected cases of cyclosporiasis associated with a Mexican-style restaurant, by case classification and date of illness onset (N = 47) — Limestone County, Alabama, May–June 2023



similar: female (10; 59%), White (16; 94%), and non-Hispanic (17; 100%).

Case-control data were analyzed in a three-step analysis using Firth's penalized likelihood logistic regression to minimize estimate bias caused by small sample sizes, rare events, and complete independence of patients infected with cyclosporiasis and control subjects, followed by stepwise variable selection with backward elimination. In step one, univariate odds ratios (ORs) and 95% CIs were calculated for each menu item. The only food item significantly associated with illness

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(p-value <0.05) in univariate analysis was salsa roja (OR = 20.5; 95% CI = 3.9–145.0). In step two, ORs and 95% CIs were calculated for each fresh produce ingredient. Four ingredients were significantly associated with illness on univariate analyses: cilantro (OR = 27.7), jalapeños (OR = 27.7), onions (OR = 22.2), and tomatoes (OR = 8.0) (Table). When these four ingredients were included in a multivariable analysis using Firth's penalized likelihood regression, ORs for cilantro and jalapeños were elevated but not statistically significant (both 65.8; p-value = 0.161). In step three involving backward stepwise logistic regression only cilantro remained significantly associated with illness (OR = 40.9; 95% CI = 6.4–808.6) in a model where the four ingredients were included. The model was run multiple times with jalapeños listed last in the order of elimination and then cilantro listed last in the order of elimination. Data analysis was conducted using SAS software (version 9.4; SAS Institute).

Environmental Health Investigation

On June 9, the ADPH Bureau of Environmental Services conducted an environmental assessment of the restaurant. This assessment included a food flow (*1*) for ingredients or menu items that contain fresh, uncooked produce: salsa roja, taco salad, queso, guacamole, chicken soup, pico de gallo (Mexican salsa made with tomatoes, onions, jalapeños, cilantro, and lime juice), salsa verde, and cilantro; these items are commonly associated sources for cyclosporiasis outbreaks. The environmental assessment revealed no substantial findings. Because all ingredients used during the period when patients ate at the restaurant had been discarded before the environmental assessment, no laboratory testing of restaurant ingredients was performed. Invoices obtained from the restaurant indicated that fresh produce was received during May 25–June 5 from a distributor in Georgia. The invoices were shared with Georgia Department of Public Health and Georgia Department of Agriculture on July 10.

Laboratory investigation. Stool specimens were collected from patients with suspected cyclosporiasis. Some specimens were collected by health care providers and then forwarded to the ADPH Bureau of Clinical Laboratories (BCL), whereas other specimens were collected by ADPH. After specimens were received by BCL, they were forwarded to CDC for genotyping. Among the 38 laboratory-confirmed cyclosporiasis cases, 29 were successfully genotyped by CDC. Genotyped specimens were assigned to one of six temporal-genetic cluster codes. Of those genotyped specimens, 23 (79%) were assigned to 2023_012, two (7%) to 2023_015, and one (3%) each to 2023_002, 2023_024, 2023_041, and 2023_069 temporal-genetic cluster codes. A large percentage of specimens with the same temporal-genetic cluster code suggests specimens were genetically related and likely linked to the same source.

TABLE. Three-step case-control analysis of food items consumed by patrons of a Mexican-style restaurant — Limestone County, Alabama, May 20–June 6, 2023

Menu item	Case-patients (47)	Control subjects (17)	OR* (95% CI)	p-value
Step 1. Univariate analysis of menu items				
Salsa roja	42	4	20.5 (3.9–145.0)	0.001
Pico de gallo†	10	2	2.2 (0.4–12.6)	0.36
Taco	2	5	0.5 (0.1–3.2)	0.48
Burrito	7	1	2.1 (0.2–18.8)	0.52
Pollo con arroz	5	3	0.6 (0.04–8.1)	0.67
Step 2. Ingredient-level analysis				
Ingredient				
Cilantro	46	9	27.7 (5.3–283.9)	0.001
Jalapeño	46	9	27.7 (5.3–283.9)	0.001
Onion	46	10	22.2 (4.2–227.1)	0.002
Tomato	45	12	8.0 (1.7–49.2)	0.018
Bell pepper	6	1	1.7 (0.3–17.5)	0.59
Lime juice	15	4	1.4 (0.4–5.4)	0.58
Mushroom	1	0	1.1 (0.1–168.0)	0.96
Iceberg lettuce	18	7	0.9 (0.3–2.7)	0.82
Romaine lettuce	6	3	0.7 (0.2–3.0)	0.57
Avocado	11	5	0.7 (0.2–2.5)	0.60
Garlic	2	1	0.6 (0.1–7.0)	0.68
Chile	0	1	0.1 (<0.001–2.3)	0.36
Poblano	0	1	0.1 (<0.001–2.3)	0.36
Step 3. Multivariable analysis of cilantro, jalapeños, onions, and tomatoes using backward stepwise logistic regression				
Cilantro			40.9 (6.4–808.6)	0.001

Abbreviation: OR = odds ratio.
* ORs were estimated using Firth's penalized likelihood regression method to minimize the analytical bias caused by small samples, rare events, and complete separation of case-patients with cyclosporiasis and control subjects.
† Mexican salsa made with tomatoes, onions, jalapeños, cilantro, and lime juice.

Public Health Response

ADPH issued a statewide Health Action Network alert to Alabama health providers on June 14 and a news release on June 15 to notify the public that the number of cyclosporiasis cases had increased since the beginning of June. ADPH also provided recommendations to the restaurant that included changing produce suppliers and increasing sanitation measures such as using high heat to clean utensils and other food preparation tools because *C. cayetanensis* is resistant to routine chemical disinfection or sanitizing methods and can be destroyed by high heat (*2*). Because the restaurant purchased produce from a supplier in Georgia, the Georgia Department of Agriculture's Rapid Response Team (GA RRT) began traceback for cilantro, jalapeños, onions, and tomatoes provided to the restaurant by distributor A on July 10 (Figure 2). GA RRT reached out to its counterparts in Florida, Pennsylvania, and

Summary

What is already known about this topic?

Cyclosporiasis is an intestinal illness caused by the parasite *Cyclospora cayetanensis*. In the United States, cyclosporiasis outbreaks are commonly associated with fresh, imported produce.

What is added by this report?

In June 2023, a total of 47 cases of cyclosporiasis were associated with consumption of food from a Mexican-style restaurant in Alabama. Analysis of case-control data identified cilantro as the likely food source. Collaboration among multiple states and their respective agencies enabled successful traceback of cilantro to a source in Mexico.

What are the implications for public health practice?

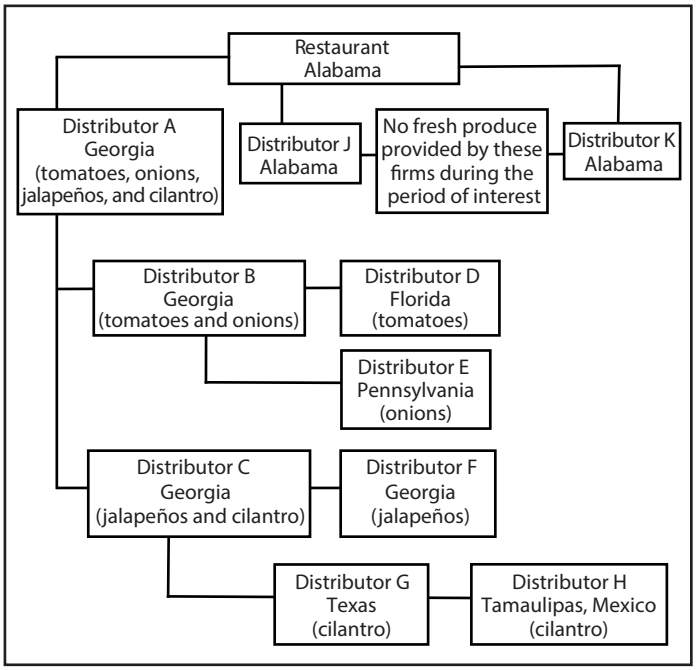
Cilantro imported from Mexico remains a food source of concern for cyclosporiasis. Distribution of potentially contaminated products via improper supply chain channels remains a public health challenge.

Texas upon discovering that distributor A obtained produce from distributors B and C, who reported acquiring produce from distributors in other states.

Because distributor A was a Georgia-based firm, GA RRT led the traceback investigation. Distributor A provided the requested invoices for the following suspected produce sources: cilantro, jalapeños, onions, and tomatoes. Distributor A purchased tomatoes and onions from distributor B. Tomatoes were supplied by a firm in Florida (distributor D) and onions by a firm in Pennsylvania (distributor E). Cilantro and jalapeños were purchased from distributor C (Georgia). Jalapeños were supplied by a firm in Georgia (distributor F), and cilantro was supplied by a Texas firm (distributor G).

GA RRT communicated its findings about distributor C to the Texas Department of Agriculture's Rapid Response Team (TX RRT); a food manufacturing license for this firm could not be identified. Records obtained by TX RRT indicate that the cilantro was purchased from an import-export firm (distributor H) located in Tamaulipas, Mexico, and was held in cold storage in Texas before the sale to other firms across the United States. TX RRT could not determine where in Mexico the cilantro was grown on the basis of records provided by distributor C (Figure 2).

FIGURE 2. Traceback diagram of ingredients suspected in a cyclosporiasis outbreak associated with a Mexican-style restaurant* — Limestone County, Alabama, June 2023



* The restaurant purchased produce from three different distributors, but only one distributor, distributor A in Georgia, provided produce during the time of interest for the outbreak. Distributor A supplied tomatoes, onions, jalapeños, and cilantro during the time of interest. Distributor A purchased the tomatoes and onions from distributor B in Georgia. Distributor B purchased the tomatoes from distributor D in Florida and purchased the onions from distributor E in Pennsylvania. Distributor A purchased the jalapeños and the cilantro from distributor C in Georgia. Distributor C purchased the jalapeños from distributor F in Georgia. Distributor C purchased the cilantro from distributor G in Texas. Distributor G purchased the cilantro from distributor H in Tamaulipas, Mexico.

Discussion

Epidemiologic, laboratory, environmental, and traceback evidence from this outbreak of cyclosporiasis among patrons of a Mexican-style restaurant linked the illness to contaminated cilantro imported from Mexico. Cilantro from Mexico has been identified as a food source for multiple cyclosporiasis infections during the past 3 decades (*3*). Collaboration among agencies, including state departments of health and agriculture and CDC, was essential to the successful traceback of the food source implicated by multivariable analysis. Genotyping data further supported the suspicion that cases from the restaurant were related.

C. cayetanensis, the parasite that causes cyclosporiasis, is resistant to routine chemical disinfection or sanitizing methods, limiting the ability for restaurant operators and food distributors to eliminate risk for contamination through effective sanitation practices (*3*). Because the restaurant's environmental assessment report included no substantial findings, contamination likely occurred before arrival at the restaurant. ADPH recommended that the restaurant change suppliers for fresh produce to avoid the need for restaurant closure. The ADPH press release advised the public to thoroughly wash fresh produce before eating, cutting, or cooking (*4*). Because states do not have authority to conduct investigations across international borders, ADPH was unable to determine whether contamination occurred pre- or postharvest. Collaboration with partner organizations is essential to tracing ingredients back to their source and to identifying contributing factors

and environmental antecedents at each step of the food supply chain. Through this investigation, a domestic distributor without an identified manufacturing license who sourced produce from an international supplier was discovered, presenting an opportunity for regulatory intervention and education to prevent the future sale and distribution of potentially contaminated product through improper supply channels.

Limitations

The findings of this report are subject to at least three limitations. First, the wide CIs around the risk estimates indicate reduced statistical power to estimate precise risk associated with the implicated food ingredients, likely due to a small sample size and an imbalance favoring cases over controls (ratio = 2.8:1). Second, the backward stepwise regression procedures used can lead to biased estimates and be order-dependent, although, to reduce this bias, the stepwise model included all four ingredients from step two and was run with multiple orders of ingredients, with both cilantro and jalapeños in the last elimination step. Finally, testing cilantro from the grower or distributor to confirm the presence of *C. cayetanensis* in the ingredient as indicated by the epidemiologic analysis was not possible.

Implications for Public Health Practice

Because of the global nature of the U.S. food supply and the interconnectedness among growers, distributors, and consumers, rapid collaboration is essential for effective traceback investigations and implementation of control measures in response to foodborne illness outbreaks. These findings highlight the need for active disease surveillance by public health teams, regulatory oversight of food distributors, and focused educational initiatives for both distributors and restaurants to reduce future risk of distribution of contaminated products.

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Concurrent Norovirus Outbreaks Associated with Consumption of Oysters Harvested in Mexico — California, December 2023–January 2024

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Abstract

Norovirus is the most common cause of foodborne illness outbreaks in the United States. In January 2024, local health jurisdictions and the California Department of Public Health (CDPH) identified two concurrent norovirus outbreaks across eight Southern California local health jurisdictions. CDPH was notified in late December 2023 and early January 2024 of gastrointestinal illnesses in persons who consumed raw oysters from food service facilities in San Diego County (outbreak 1). Additional illness reports came from multiple jurisdictions that included Los Angeles County and other areas in Southern California (outbreak 2). In total, approximately 400 persons across eight local health jurisdictions reported gastrointestinal illness after raw oyster consumption. A multiagency investigation confirmed that outbreaks 1 and 2 were unrelated, and implicated oysters were traced to two separate, nonoverlapping harvest regions in Mexico. A total of 179 outbreak-associated cases, including 24 laboratory-confirmed norovirus cases, were identified. Patient samples from both outbreaks identified norovirus genogroups I and II; other enteric viruses (sapovirus, astrovirus, rotavirus, and adenovirus) were also identified from one or both outbreaks. Noroviruses were genetically related by genotype within each outbreak but dissimilar between outbreaks. In outbreak 2, oysters might have been contaminated at a location separate from the original growing area, also known as wet storage. Concurrent outbreaks with similar modes of transmission can be unrelated, and the source for each should be confirmed through traceback. Proper storage and handling of shellfish is essential to maintaining safety of food products to consumers. Cooking oysters to 145°F (62.8°C) is recommended before consumption.

Investigations and Findings

Epidemiologic Investigation

Illness reports. On December 31, 2023, a food service facility notified the California Department of Public Health (CDPH) and County of San Diego (CoSD) Health and Human Services Agency (HHSA) of gastrointestinal (GI) illness reports among 37 persons who had consumed oysters there during December 27–29, 2023; these illnesses were confirmed by CoSD public health laboratory on January 2, 2024, as caused by norovirus infections. By January 9, CoSD HHSA identified 16 additional GI illness complaints from customers who consumed oysters at three locations of a local restaurant chain unrelated to the first facility.

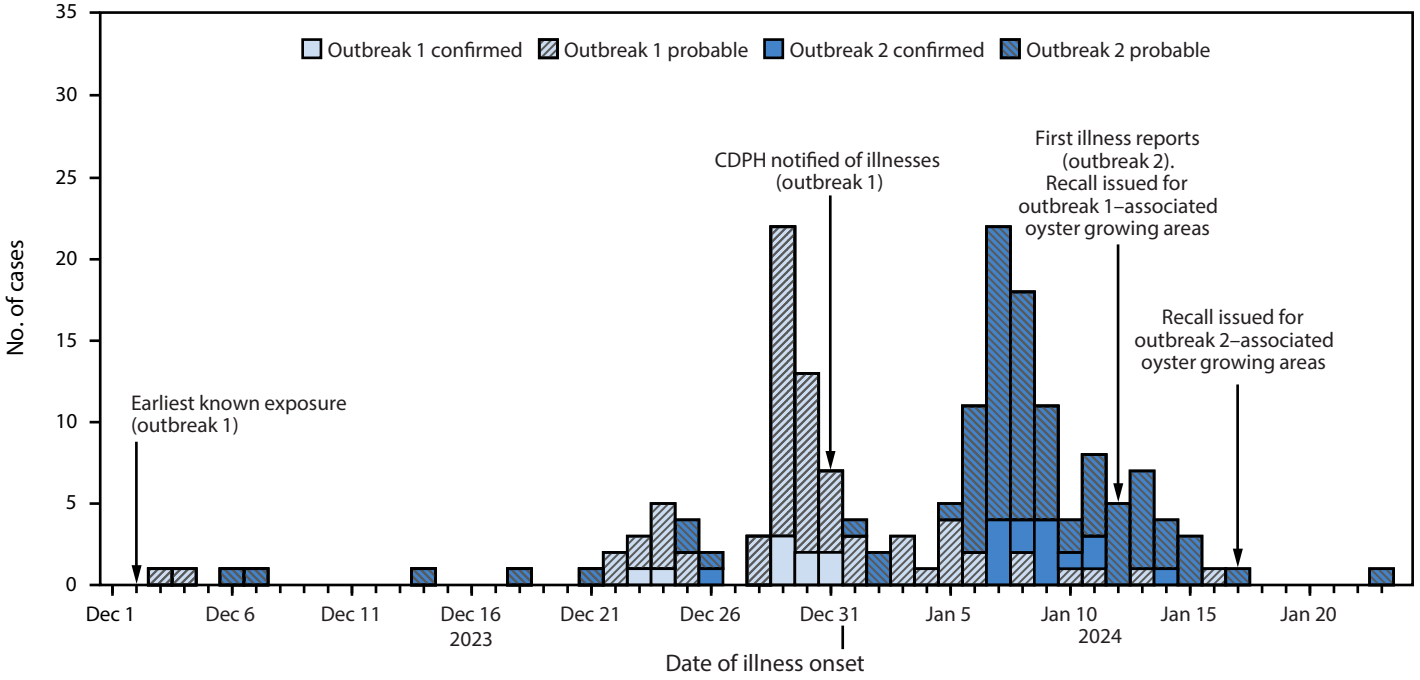
On January 12, 2024, CDPH received reports from Southern California local health jurisdictions within and surrounding Los Angeles County of GI illness and norovirus infections among persons who consumed oysters at additional food service facilities. By January 16, 140 illness reports were associated with 51 facilities throughout greater Los Angeles and San Diego (Figure).

These GI illnesses were initially considered a single oyster-associated norovirus outbreak because of similarities in the temporal and geographic patterns of cases. Norovirus cases are not reportable in California; however, all outbreaks associated with norovirus are reportable by health care providers and local health jurisdictions and are investigated by public health agencies when possible. CDPH, in collaboration with local health jurisdictions, established a case definition; compiled clinical, exposure, and laboratory information; and performed traceback for implicated oysters. The investigation objectives were to determine the outbreak scope and oyster source, halt further transmission, and identify preventative measures. This activity was reviewed by CDPH and CDC, deemed not research, and was conducted consistent with applicable federal law, state law, and CDC policy.*

Case definition. A confirmed outbreak-associated case was defined as a laboratory-confirmed norovirus infection in a person with illness onset during December 1, 2023–January 31, 2024, who consumed oysters in Southern California 12–48 hours before illness onset. A probable case was occurrence of vomiting or diarrhea (three or more loose stools in a 24-hour period) with illness onset during December 1, 2023–January 31, 2024, in a person who

* 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. Illness onset dates of confirmed* and probable† norovirus cases in two outbreaks associated with consumption of raw oysters harvested in Mexico — California, December 2023–January 2024



Abbreviation: CDPH = California Department of Public Health.

* Laboratory-confirmed norovirus infection with illness onset during December 1, 2023–January 31, 2024, in a person who consumed oysters in Southern California 12–48 hours before illness onset.

† Vomiting or diarrhea with illness onset during December 1, 2023–January 31, 2024, in a person who consumed oysters in Southern California 12–48 hours before illness onset.

consumed oysters in Southern California 12–48 hours before illness onset. On January 17, 2024, Southern California local health jurisdictions deployed an electronic survey to persons with potential cases who reported their illness to public health agencies and followed up with telephone interviews to determine if the outbreak case definition had been met and to collect additional clinical and oyster exposure information. Excluding the initial ill persons from San Diego who reported their illnesses to the food service facility, all cases were passively reported by ill persons to public health agencies after release of health advisories and recall notices.

Patient characteristics. Based on information provided by local health departments, approximately 400 persons from eight local health jurisdictions reported illness after consuming oysters; among those interviewed by telephone, 179 persons met the confirmed or probable case definition for illness (Table 1). Patients were median age 40 (IQR = 32.3–55) years, and 100 (56%) were female. Outbreak 1 cases included patients who ate at four facilities exclusively in San Diego County; outbreak 2 cases included patients who ate at 60 facilities in Los Angeles County and surrounding local health jurisdictions. Oysters were consumed during December 2, 2023–January 19, 2024, by 78 outbreak 1 patients and 101 outbreak 2 patients. Illness onset for the two outbreaks occurred during December 3, 2023–January 21, 2024. The median duration of signs and symptoms (e.g., vomiting, diarrhea, nausea, stomach pain or cramps, and fever) was 72 (IQR = 36–120) hours. Twenty-one (12%) patients sought medical care, two (1%) were hospitalized, and no deaths were reported.

Environmental Health Investigation

CDPH and environmental health staff members from local health jurisdictions completed concurrent traceback investigations and collected shellfish tags (federally required records attached to raw molluscan shellfish that must contain harvest, dealer, and certification information as well as consumption warnings) and invoices at all facilities associated with illness reports. The traceback investigation identified that the two outbreaks were unrelated.

Sources of outbreak-associated oysters. A common distributor, distributor A, was identified for the oysters associated with outbreak 1. These oysters were harvested on December 18 and December 27, 2023, from the growing region of Bahia Salina Sonora, Mexico. The harvest area, which might have had fecal contamination from sewage runoff, was the suspected contamination source for outbreak 1 based on investigations by Mexican authorities. Distribution of these oysters was limited to facilities in San Diego County.

TABLE 1. Characteristics of persons with probable and confirmed norovirus illnesses associated with consumption of raw oysters from Mexico — California, December 2023–January 2024

Characteristic	No. (%)		
	Total	Outbreak 1	Outbreak 2
Total no. of cases	**179**	**78**	**101**
Probable	**78 (43.6)**	69 (88.5)	86 (85.1)
Confirmed	**101 (56.4)**	9 (11.5)	15 (14.9)
Median age, yrs (IQR)	**40 (32.3–55.0)**	42 (32.3–63)	38.5 (32.8–49)
Sex			
Female	**100 (55.9)**	40 (51.3)	60 (59.4)
Male	**78 (43.6)**	38 (48.7)	40 (39.6)
Unknown	**1 (0.5)**	0 (—)	1 (1.0)
Consumed raw oysters	**179 (100.0)**	78 (100.0)	101 (100.0)
Symptom duration, hrs, median (IQR)	**72 (36.0–120.0)**	96 (48.0–124.0)	48 (27.0–93.5)
Vomiting	**145 (81.0)**	63 (80.8)	82 (81.2)
Diarrhea	**160 (89.4)**	76 (97.4)	84 (83.2)
Nausea			
Yes	**72 (40.2)**	0 (—)	72 (71.3)
No	**7 (3.9)**	0 (—)	7 (6.9)
Unknown	**100 (55.9)**	78 (100.0)	22 (21.8)
Stomach pain or cramps			
Yes	**146 (81.6)**	60 (76.9)	86 (85.1)
No	**31 (17.3)**	16 (20.5)	15 (14.9)
Unknown	**2 (1.1)**	2 (2.6)	0 (—)
Fever			
Yes	**84 (46.9)**	45 (57.7)	39 (38.6)
No	**86 (48.0)**	30 (38.5)	56 (55.4)
Unknown	**9 (5.1)**	3 (3.8)	6 (6.0)
Sought any medical care (outpatient, emergency department, urgent care, or telehealth)			
Yes	**21 (11.7)**	10 (12.8)	11 (10.9)
No	**15 (8.4)**	0 (—)	15 (14.9)
Unknown	**143 (79.9)**	68 (87.2)	75 (74.2)
Hospitalized	**2 (1.1)**	0 (—)	2 (2.0)

Oysters associated with outbreak 2 were distributed to facilities throughout Los Angeles and Southern California, including facilities in San Diego County. Oysters associated with outbreak 2 were harvested during November 21–December 29, 2023, from the Laguna de Guerrero Negro and Laguna Manuela growing areas of Baja California, Mexico. These harvest areas were in a similar region but located approximately 25 miles apart; however, all outbreak 2–associated oysters had been held in wet storage during November 22, 2023–January 5, 2024, in Rincón de Ballenas, a natural body of water located in the Ensenada Bay in Baja California, Mexico. Wet storage is the practice of storing live, market-ready oysters in natural bodies of water or in tanks containing seawater at a location that can be separate from the original growing area and can contain multiple lots from different harvest areas.

Environmental traceback confirmed the discrete nature of outbreaks 1 and 2, with no identified shared wet storage or harvest areas between the two outbreaks, and different oyster types associated with each. During inspection of implicated facilities in Southern California, multiple gaps in food safety procedures were identified. This included mislabeling of shellfish tags; missing information regarding harvest dates, wet storage dates, and harvest locations; and identification of dealers who were distributing oysters without certifications. CDPH issued notices of violations to inspected facilities that did not adhere to regulatory guidelines.[†]

Laboratory Investigation

Twelve patients from outbreak 1 and 17 from outbreak 2 submitted stool specimens within 10 days of symptom onset to a local public health laboratory to be tested for enteric viral pathogens. CDPH used reverse transcription real-time polymerase chain reaction (RT-qPCR) to confirm local laboratory results and to screen stool samples for viruses following the national norovirus outbreak surveillance network (CaliciNet) protocol (*1*). Conventional RT-PCR, targeting capsid and polymerase genes, was performed, amplicons were genotyped by Sanger sequencing, and results were submitted to the CaliciNet national database. Rotavirus typing was performed at CDC. Among the 29 specimens tested, 27 were positive for at least one enteric virus (Table 2). Patient samples from outbreak 1 yielded norovirus genogroup I (eight specimens), II (seven), sapovirus (six), human astrovirus (three), and rotavirus (two). Patient samples from outbreak 2 yielded norovirus genogroup I (three), II (15), sapovirus (five), rotavirus (two), and adenovirus (one). Among all patients with positive specimens, one to five enteric viruses were detected per specimen. Viruses were genetically similar by norovirus genotype (i.e., the same genotype with some nucleotide differences) and other enteric virus strains within each outbreak but isolates in the two outbreaks were dissimilar. Oysters collected from a distributor and from the same harvest area as those in the implicated outbreak 2 lots were tested by the Food and Drug Administration (FDA) using RT-qPCR for viral pathogens; no viral pathogens were detected.[§]

Public Health Response

In late December 2023, FDA released a health advisory for contaminated oysters from certain harvest areas in Bahia Salina, Sonora, Mexico in response to outbreak 1 (*2*). On January 12, 2024, distributor A issued a recall. On January 17, 2024, in response to outbreak 2, FDA issued a second health advisory for contaminated oysters from some harvest areas in Baja California, Mexico, leading to recall of the product (*3*). Growing areas were closed by Mexican authorities for 21 days after confirmation of positive norovirus samples from patients with outbreak-associated cases. CDPH and California local

[†] https://www.fda.gov/media/143238/download?attachment
[§] https://www.fda.gov/food/laboratory-methods-food/bam-chapter-26-and-appendices-concentration-extraction-and-detection-enteric-viruses-food

TABLE 2. Laboratory sequencing results of specimens from confirmed norovirus cases* associated with raw oyster consumption from Mexico — California, December 2023–January 2024

Case ID	Outbreak	Local health jurisdiction	Facility	Norovirus genogroup	Other viruses
1	1	San Diego	A	I	Sapovirus GIV.1
2	1	San Diego	A	I/II	—
3†	1	San Diego	A	—	Sapovirus GII.2
4	1	San Diego	A	II	Astrovirus 4
5†	1	San Diego	A	—	Sapovirus GII.5
6	1	San Diego	A	I	—
7	1	San Diego	B	I/II	Rotavirus G3P[8], Sapovirus GI.3, Astrovirus 4
8	1	San Diego	B	I/II	Rotavirus, Astrovirus 5
9	1	San Diego	B	I/II	Sapovirus GIV.1
10	1	San Diego	B	I/II	—
11	1	San Diego	B	I/II	Sapovirus GIV.1
12	2	San Diego	C	I/II	—
13	2	San Diego	C	II	Sapovirus GIV.1
14	2	San Diego	D	II	—
15	2	San Diego	D	II	—
16	2	San Diego	E	II	Sapovirus GIV.1
17	2	San Diego	E	II	—
18	2	San Diego	F	I/II	—
19	2	San Diego	G	II	Rotavirus G3P[8], Sapovirus GIV.1, Adenovirus 31
20†	2	San Diego	G	—	Sapovirus GIV.1
21	2	San Diego	H	II	Rotavirus G3P[8]
22	2	San Diego	H	I/II	Sapovirus GI.1
23	2	San Diego	I	II	—
24	2	Los Angeles	J	II	—
25	2	Los Angeles	K	II	—
26	2	Pasadena	L	II	—
27	2	Orange	M	II	—

Abbreviation: ID = identification.
* Two cases had specimens that tested negative for enteric viruses.
† These persons received negative norovirus test results but received positive test results for the other enteric viruses listed in the table.

health jurisdictions issued advisories and press releases to consumers, restaurants, and retailers not to eat, serve, or sell any oysters that were grown in certain regions of Mexico implicated in the investigation (*4*–*8*).

Discussion

Geographic separation of the implicated harvest locations, different distributors, and distinct virus genotypes and oyster types confirmed the occurrence of two concurrent but separate norovirus outbreaks associated with consumption of raw oysters from Mexico. The epidemiologic and laboratory investigation identified raw oysters from two sources in Mexico as the likely source of both norovirus outbreaks and other enteric virus detections. Continuing multiple traceback efforts even after identifying the source of outbreak 1 oysters led to recognition that the two outbreaks were unrelated.

Multiple foodborne illness outbreaks have been associated with consuming raw oysters, including a multistate outbreak of norovirus illness in the Southern United States (*9*). Early communication among CDPH, local health jurisdictions, federal partners, and facilities permitted rapid identification and response to illness reports as well as traceback and source determination.

Oysters can become contaminated with enteric viruses from human fecal matter in their growing environment during transport or wet storage, and during handling at food service processing facilities before human consumption. The recognition of wet storage as the likely source of contamination in outbreak 2 was the result of the growing area investigation by Mexican authorities. Although some oysters could have entered wet storage already contaminated, the geographic separation of harvest areas (approximately 25 miles) in outbreak 2 points to wet storage playing a role. Wet storage, both in natural bodies of water and land-based systems, is a common practice globally that prolongs the time from harvest to distribution and consumption. Wet storage was previously identified as a source of contamination for bacterial outbreaks in raw oysters in Hong Kong. However, no documented enteric viral outbreaks have previously been associated with wet storage (*10*).

Limitations

The findings in this report are subject to at least three limitations. First, the source of contamination of outbreak 1 was suspected but not definitively confirmed as the harvest area. Second, because of the role of wet storage in outbreak 2, the definitive source of contamination could not be confirmed. Finally, passive reporting might have led to underascertainment of cases.

Summary

What is already known about this topic?

Consumption of contaminated raw oysters is a common cause of foodborne illness outbreaks.

What is added by this report?

During December 2023–January 2024, approximately 400 persons across eight California local health jurisdictions reported gastrointestinal illness after consumption of raw oysters. The investigation identified two concurrent but unrelated outbreaks attributable to norovirus and other viral enteric pathogens. In the second outbreak, oysters might have been contaminated during wet storage of live oysters at a location separate from the original growing area.

What are the implications for public health practice?

Raw oysters are a continuing source of enteric illness. Producers and distributors should be aware of and prevent shellfish contamination in wet storage. Consumers should cook oysters to 145°F (62.8°C) before consumption. Concurrent outbreaks of foodborne illness with similar modes of transmission can be unrelated and should be confirmed by product traceback.

Implications for Public Health Practice

Although the exact source of contamination for outbreak 2 was not determined, shellfish growers should consider measures to prevent possible contamination of oysters from multiple harvest lots during wet storage.¶ Producers should be aware of the potential risks associated with wet storage of oysters and should take steps to reduce exposure risks to consumers. Consumers should be aware of the health risks for raw oyster consumption, which can be avoided through cooking; the recommended method of oyster preparation is to thoroughly cook raw oysters to 145°F (62.8°C) before consumption.**

¶ https://www.fda.gov/media/181370/download?attachment

** https://www.foodsafety.gov/blog/safe-selection-and-handling-fish-and-shellfish

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Notes from the Field

Increase in Human and Animal Tularemia Cases — Minnesota, 2024

Maria Bye, MPH[1]; Jordan Mandli, PhD[1]; Aaron Barnes, MD, PhD[2]; Elizabeth Schiffman, MPH, MA[1]; Kirk Smith, DVM, PhD[1]; Stacy Holzbauer, DVM[3]

Tularemia is an uncommon but potentially serious bacterial zoonotic disease caused by the U.S. Department of Health and Human Services Tier 1 select agent *Francisella tularensis* that affects 200–300 persons annually in the United States (*1*). Although cases are reported from almost every state, tularemia is most frequently reported from the central United States. Symptoms vary based on the exposure route and commonly include fever and localized symptoms (e.g., lymphadenopathy and skin ulcers). Humans and animals are usually infected through the bites of arthropods (typically ticks and deer flies), contact with infected animals, or inhalation of contaminated material. No Food and Drug Administration–approved vaccine for prevention of tularemia exists. During 2000–2023, a median of one human and two animal cases were reported annually to the Minnesota Department of Health (MDH) and Board of Animal Health, respectively. Animal tularemia cases increased significantly in 2023, when 20 animal cases, but no human cases, were reported. In 2024, five human cases and 27 animal cases were reported in Minnesota, all in the seven-county Minneapolis-St. Paul metropolitan area. MDH staff members investigated each reported human and animal case to identify exposures and provide public health recommendations. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.*

Investigation and Outcomes

MDH obtained medical records and interviewed tularemia patients to collect information on their illness and exposures and obtained veterinary records and interviewed animal owners to learn about tularemia-positive animal illnesses, identify exposures, and assess zoonotic exposures in the household. Exposures of clinical laboratory staff members were also assessed. Veterinary personnel were assessed for occupational exposures to tularemia-positive animals. A high-risk exposure to an infected animal was defined as a bite, scratch, needlestick injury, or exposure to aerosolized infectious material from an infected animal. Any person with a high-risk household,veterinary, or clinical laboratory exposure was recommended antibiotic postexposure prophylaxis (PEP), generally with doxycycline or ciprofloxacin (*2*). Site investigations (i.e., tick drag sampling and site characterization using a standardized data collection form) were conducted for animal cases with illness onset in the past month or any human case in the Minneapolis-St. Paul metropolitan area (after obtaining consent) (*3*).

Human Cases and Human Exposures

In 2024, the MDH Public Health Laboratory identified five laboratory-confirmed human tularemia cases (all *F. tularensis* subsp. *tularensis*) (Table), among whom four patients had the pneumonic form of tularemia. During 2000–2023, among 32 tularemia cases identified in Minnesota, two (6.3%) were pneumonic tularemia. All five patients were hospitalized for a median 6 (IQR = 3) days. In three cases, tularemia was not identified as the cause of infection until after hospital discharge. Once tularemia was identified, patients were treated with oral ciprofloxacin or doxycycline, and all recovered without complication. Two clinical laboratorians manipulated cultures outside of a biosafety cabinet and were advised to self-monitor for tularemia signs or symptoms for 14 days; neither experienced illness.

Animal Cases

Twenty-seven tularemia-positive animals were reported by direct laboratory report or veterinarians via telephone or email in 2024. Twenty-one (78%) animal cases were in domestic cats, five (19%) in domestic dogs, and one (4%) in a wild rabbit. Typhoidal tularemia (nonlocalized infection) and oropharyngeal tularemia (fever, oral ulcers, and lymphadenopathy) were the most common clinical forms identified. Most pets (78%) survived, four (15%) died from their infection, and two (7%) were euthanized because of cost or prognosis. Three pet owners and one veterinary staff member were determined to have been exposed, and one pet owner was advised to receive PEP after a scratch from an infected cat. The pet owner took the course of PEP as advised. No cases of tularemia occurred among exposed pet owners.

Site investigations for three human and two animal cases were conducted at the likely exposure location and nearby public spaces. No ticks were found by drag sampling. Two patients with pneumonic disease who consented to a site investigation reported mowing over animal carcasses during their exposure period; a rabbit and mouse carcass were found at the likely exposure sites but were too decomposed for testing.

* 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. Characteristics of human and animal tularemia cases — Minnesota, 2024

Characteristic	No. (%)*
Human patients (n = 5)	
Female	2 (40)
White, non-Hispanic	5 (100)
Age, yrs, median (range)	64 (45–72)
Disease attribute	
Pneumonic	4 (80)
Ulceroglandular	1 (20)
Hospitalized	5 (100)
Hospitalization length, days (range)	6 (5–9)
Signs and symptoms	
Fever	5 (100)
Weakness and lethargy	5 (100)
Anorexia	4 (80)
Headache	3 (60)
Muscle aches	3 (60)
Cough	2 (40)
Altered mental status	2 (40)
Vomiting	1 (20)
Lymphadenopathy	1 (20)
Skin ulcer	1 (20)
Pericarditis	1 (20)
Encephalopathy	1 (20)
Imaging results	
Abnormal chest x-ray (i.e., pneumonia or pleural effusion)	4 (80)
Underlying condition	
Diabetes	2 (40)
Exposure	
Lawn mowing	4 (80)
Animal bite	1 (20)
Outcome	
Hospitalized	5 (100)
Length of hospitalization, days, median (range)	6 (5–9)
Survived	5 (100)
Animal cases (n = 27)	
Animal species	
Feline	21 (78)
Canine	5 (19)
Lagomorph	1 (4)
Disease attribute	
Glandular	3 (11)
Oropharyngeal	10 (37)
Pneumonic	1 (4)
Typhoidal	11 (41)
Undetermined	2 (8)
Likely transmission route	
Animal contact	12 (44)
Animal ingestion	4 (15)
Vectorborne	1 (4)
Unknown	10 (38)
Outcome	
Survived	21 (78)
Died from tularemia infection	4 (15)
Euthanized	2 (7)
Human exposures, no.	
Pet owners	3
Veterinary staff members	1

* Percentage of total human or animal cases.

Summary

What is already known about this topic?

Tularemia is an uncommon but potentially serious bacterial zoonotic disease typically transmitted by an arthropod bite or exposure to infected animals. Although cases are reported from almost every state, tularemia is most frequently reported in the central United States. During 2000–2023, a median of one human and two animal tularemia cases were reported annually in Minnesota.

What is added by this report?

During 2024, five human and 27 animal tularemia cases were reported in Minnesota. All human patients were hospitalized; none died. Investigation of all human and animal cases did not definitively identify a source.

What are the implications for public health practice?

Tularemia should be considered in febrile patients with potential tularemia exposure and in animals with compatible signs or symptoms. Animal cases can be used to direct public health messaging to pet owners and others at higher risk for exposure.

Preliminary Conclusions and Actions

Compared with the median number of tularemia cases reported in Minnesota during 2000–2023, human tularemia cases increased from one to five and animal cases increased from two to 27 in 2024. Increased veterinary awareness after tularemia-related communications in 2023 likely contributed to the increase in animal tularemia case reporting, in addition to a true increase in cases. On June 20, MDH issued a press release to notify the public of the increased risk for tularemia in Minnesota (*4*). Veterinarian alert emails sent through the Minnesota Board of Animal Health veterinarian email distribution list and physician alerts provided on regularly scheduled infectious disease clinician calls raised awareness of the increase in cases.

Health care providers should consider tularemia in febrile patients with a history of tick or deer fly bites, contact with ill animals, or mowing over a rabbit or rodent, even in areas of the United States, such as Minnesota, where tularemia is less commonly reported. When ordering testing for a patient in whom tularemia is suspected, providers should alert the laboratory to ensure that laboratorians take appropriate precautions such as working in a biosafety cabinet and wearing gloves, gowns, and eye protection. Veterinarians should consider tularemia in cats and dogs with compatible symptoms, including high fever, oral ulcers, and lymphadenopathy. Although dogs are less likely to experience acute clinical illness than are cats, dogs might be at risk for severe infection (*5*). Persons who have higher-risk exposure to an animal with tularemia through bites,

aerosolization, or direct contact with an animal's body fluids, should promptly receive PEP (*2*). Animal cases can be used to direct protective public health messaging to pet owners and others at higher risk for exposure.

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Erratum

Vol. 74, No. 11

The report, "Notes from the Field: Response to a Case of Travel-Associated Lassa Fever — Iowa, October–November 2024," contained two errors.

On page 194, the sixth sentence of the Introduction should have read, "A blood specimen collected at hospital C was tested within hours at the Nebraska Public Health Laboratory using the **BioFire Global Fever Special Pathogens Panel** (*2*), which returned a presumptive positive result for Lassa virus."

On page 196, reference 2 in the References should have read, "BioFire Defense. **BioFire Global Fever Special Pathogens Panel**. Salt Lake City, UT: BioFire Defense; 2025. **https://www.biofiredefense.com/gfspecialpathogens/**."

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