National Enteric Disease Surveillance: COVIS Annual Summary, 2011

Summary of Human *Vibrio* Cases Reported to CDC, 2011

The Cholera and Other *Vibrio* Illness Surveillance (COVIS) system is a national surveillance system for human infection with pathogenic species of the family *Vibrionaceae*, which cause vibriosis and cholera. The Centers for Disease Control and Prevention (CDC) maintains COVIS. Information from COVIS helps track *Vibrio* infections and determine host, food, and environmental risk factors for these infections.

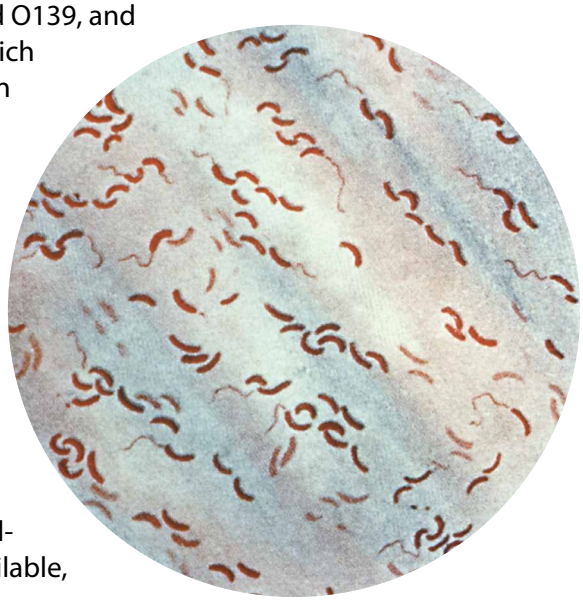
CDC initiated COVIS in collaboration with the Food and Drug Administration and the Gulf Coast states (Alabama, Florida, Louisiana, Mississippi, and Texas) in 1988. Using the COVIS report form (available at http://www.cdc.gov/nationalsurveillance/PDFs/CDC5279_COVISvibriosis.pdf), participating health officials report cases of vibriosis and cholera. The case report includes clinical data, including information about underlying illness; detailed history of seafood consumption; detailed history of exposure to bodies of water, raw or live seafood or their drippings, or contact with marine life in the seven days before illness onset; and traceback information on implicated seafood.

Before 2007, only cholera, which by definition is caused by infection with toxigenic *Vibrio cholerae* serogroup O1 or O139, was nationally notifiable. In January 2007, infection with other serogroups of *V. cholerae* and other species from the family *Vibrionaceae* also became nationally notifiable, as vibriosis.

CDC requests that all State Health Departments send all *Vibrio* isolates to CDC for additional characterization. For example, CDC serotypes all *V. parahaemolyticus* isolates received. For *V. cholerae*, CDC identifies serogroups O1, O75, O139, and O141 and determines whether the isolate produces cholera toxin. Although all *Vibrio* infections are nationally notifiable, many cases are likely not recognized because Vibrios are not easily identified on routine enteric media. A selective medium, such as thiosulfate citrate bile salts sucrose agar (TCBS), should be used.

This report summarizes human *Vibrio* infections occurring during 2011 reported to COVIS. Results are presented in two categories: (1) infection with pathogenic species of the family *Vibrionaceae* (other than toxigenic *Vibrio cholerae* serogroups O1 and O139), which cause vibriosis; this category includes infection with toxigenic *V. cholerae* of serogroups other than O1 and O139, and (2) infection with toxigenic *V. cholerae* serogroups O1 and O139, which cause cholera. While many *Vibrio* species are well-recognized human pathogens, the status of some species (including *Photobacterium damselae* subsp. *damselae* (formerly *V. damsela*), *V. furnissii*, *V. metschnikovii*, and *V. cincinnatiensis*) as human enteric or wound pathogens is less clear.

Understanding the routes by which infection is transmitted is essential for control. For vibriosis, cases are summarized by place of exposure (travel-associated vs. domestically acquired). For domestically acquired vibriosis, transmission routes (e.g., foodborne, non-foodborne, and unknown, see Appendix for classification method) are determined based on reported patient exposures and specimen sites. For toxigenic *V. cholerae* (all serogroups), exposures are summarized by place of exposure (travel-associated vs. domestically acquired) and then, if information is available, by source (such as consumption of contaminated seafood).



This Gram-stain depicts flagellated *Vibrio comma* bacteria, a strain of *V. cholerae*.

National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne Waterborne, and Environmental Diseases

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I. Vibriosis

Pathogenic species of the family *Vibrionaceae* (excluding toxigenic *V. cholerae* O1 and O139)

In 2011, 853 *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139) were reported to COVIS (Table 1). Among patients for whom information was available, 272 (34%) of 811 were hospitalized, and 48 (6%) of 785 died. The most frequently reported species was *V. parahaemolyticus*, which was isolated from 334 (39%) of the 853 patients. Of the patients infected with *V. parahaemolyticus* for whom information was available, 75 (24%) of 315 were hospitalized, and 2 (<1%) of 304 died. *V. alginolyticus* was isolated from 156 (18%) of the 853 patients; of the patients for whom information was available, 16 (11%) of 147 were hospitalized; no deaths were reported. *V. vulnificus* was isolated from 113 (13%) of the 853 patients; of the patients for whom information was available, 89 (87%) of 113 were hospitalized, and 34 (31%) of 108 died.

Table 1. Vibriosis cases by species, selected demographic characteristics, and outcome, United States, 2011

			Demographic Characteristics				Outcomes			
Vibrio Species	**Cases**		**Age (years)**		**Sex**		**Hospitalizations**		**Deaths**	
	N	**%**	**Median**	**Range**	**Male (n/N)**	**%**	**n/N**	**%**	**n/N**	**%**
V. alginolyticus	156	18	33	2-86	118/155	76	16/146	11	0/144	0
V. cholerae (excluding toxigenic O1 and O139)*	86	10	48	1-85	59/86	69	28/82	34	3/80	4
Photobacterium damselae subsp. *damselae* (formerly *V. damsela*)	7	1	55	6-77	4/7	57	3/6	50	0/1	0
V. fluvialis	37	4	65	20-108	18/37	49	18/34	53	0/33	0
Grimontia hollisae (formerly *V. hollisae*)	7	1	50	42-75	7/7	100	4/7	57	0/6	0
V. mimicus	15	2	45	4-87	11/14	79	6/15	47	0/15	0
V. parahaemolyticus	334	39	45	1-94	225/334	67	75/315	24	7/304	2
V. vulnificus	113	13	60	8-91	87/111	78	89/113	87	34/108	31
Species not identified	87	10	44	3-93	51/86	59	19/82	23	4/78	5
Multiple species†	11	1	52	23-80	7/11	64	4/11	36	0/10	0
Total	**853**	**100**	**47**	**1-108**	**587/848**	**69**	**272/811**	**34**	**48/785**	**6**

*Includes 86 non-toxigenic *V. cholerae* (non-O1, non-O139 [68 cases], O1 [2 cases], O139 [1 case], and no serogroup specified [2 cases]) and 13 toxigenic *V. cholerae* (O75 [12 cases] and O141 [1 case]).

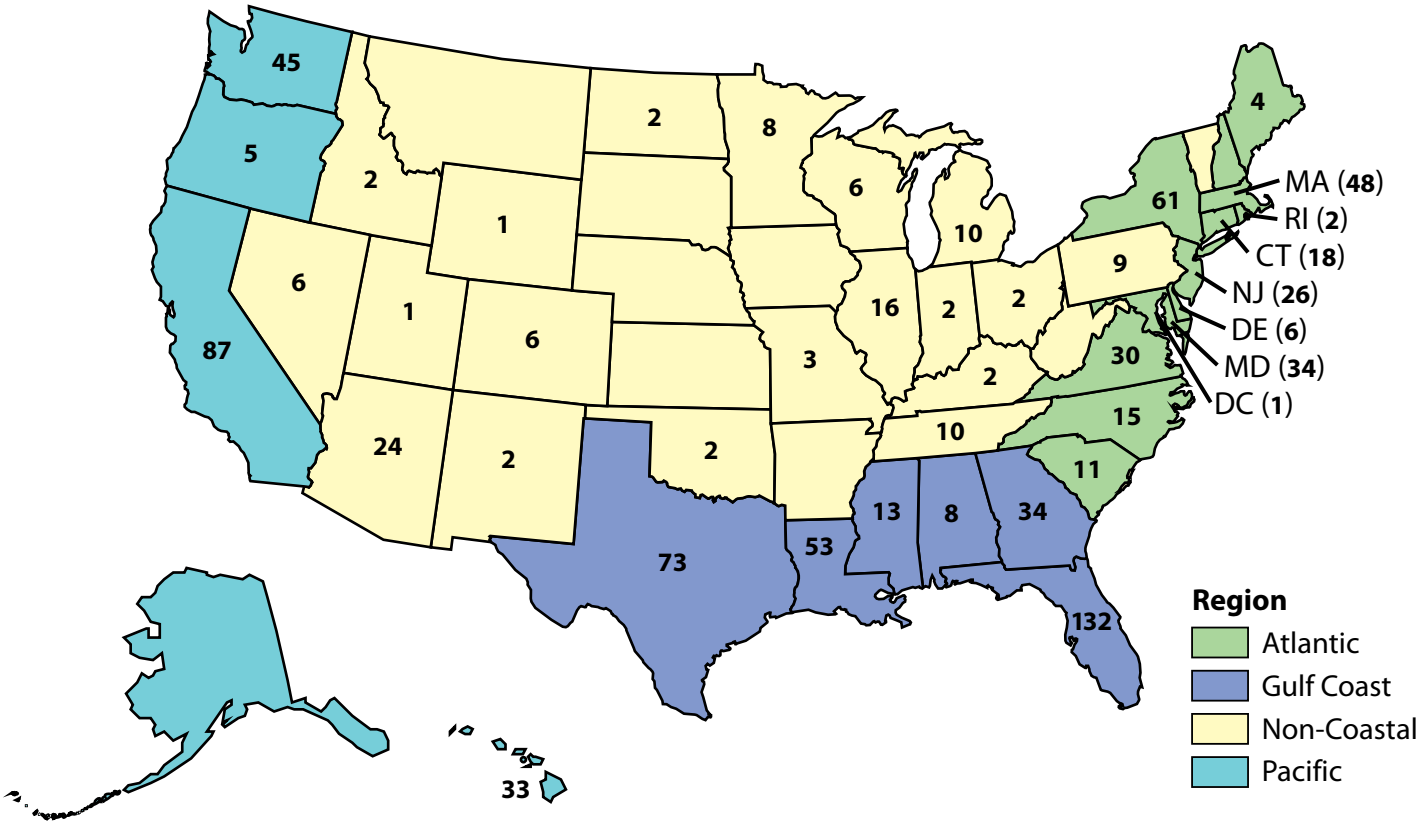
†The following combinations of *Vibrio* species were isolated from patients infected with multiple species: *V. alginolyticus*, V. *parahaemolyticus* (3 patients); *V. cholerae* O1, *V. parahaemolyticus* (1 patient); *V. fluvialis*, *V. parahaemolyticus* (1 patient); *P. damselae* subsp. *damselae*, *Vibrio* species not identified (1 patient); *V. fluvialis*, *V. furnissii* (1 patient); *V. parahaemolyticus*, *V. vulnificus* (1 patient); *V. cholerae* non-O1, non-O139, *Vibrio* species not identified (1 patient); *V. alginolyticus*, *Vibrio* species not identified (1 patient); *V. alginolyticus*, *P. damselae* subsp. *damselae* (1 patient). None of these are included in the rows for individual species.

Geographic Location

Of the 853 cases of vibriosis, 279 (33%) were reported from Gulf Coast states, 170 (20%) from Pacific Coast states, 288 (34%) from Atlantic Coast states, and 116 (14%) from non-coastal states (Figure 1).

The *Vibrio* species reported most frequently from Gulf Coast states were *V. vulnificus* (26%), *V. alginolyticus* (22%), *V. parahaemolyticus* (21%), and *V. cholerae* (excluding toxigenic *V. cholerae* O1 and O139) (13%). The *Vibrio* species reported most frequently from non-Gulf Coast states were *V. parahaemolyticus* (48%), *V. alginolyticus* (17%), *Vibrio* species not identified (12%), *V. vulnificus* (7%) and *V. cholerae* (excluding toxigenic *V. cholerae* O1 and O139) (7%).

Figure 1. Number of cases of *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139), by state, 2011 (N=853 from 43 states).



Transmission categories and reported exposures

Among the 853 vibriosis patients, 43 (5%) reported international travel in the seven days before illness began. Among the 810 domestically-acquired vibriosis cases, 409 (50%) were classified as confirmed or probable foodborne, 320 (40%) as confirmed or probable non-foodborne, and 81 (10%) as having an unknown transmission route (Figure 2). Illnesses peaked in the summer months for all categories, but the peak was most pronounced for foodborne infections (Figure 3).

Among the 184 patients with foodborne vibriosis who reported eating a single seafood item (Table 2), 117 (63%) ate oysters (91% of whom consumed them raw), 12 (7%) ate clams (75% of whom consumed them raw), 25 (14%) ate shrimp, and 13 (7%) ate finfish.

For cases with non-foodborne transmission, 243 (76%) patients reported having skin exposure to a body of water within 7 days before illness began, 28 (9%) reported handling seafood, and 40 (13%) reported contact with marine wildlife.

Figure 2. Domestically acquired vibriosis cases by transmission route and species, United States, 2010 (N=871).

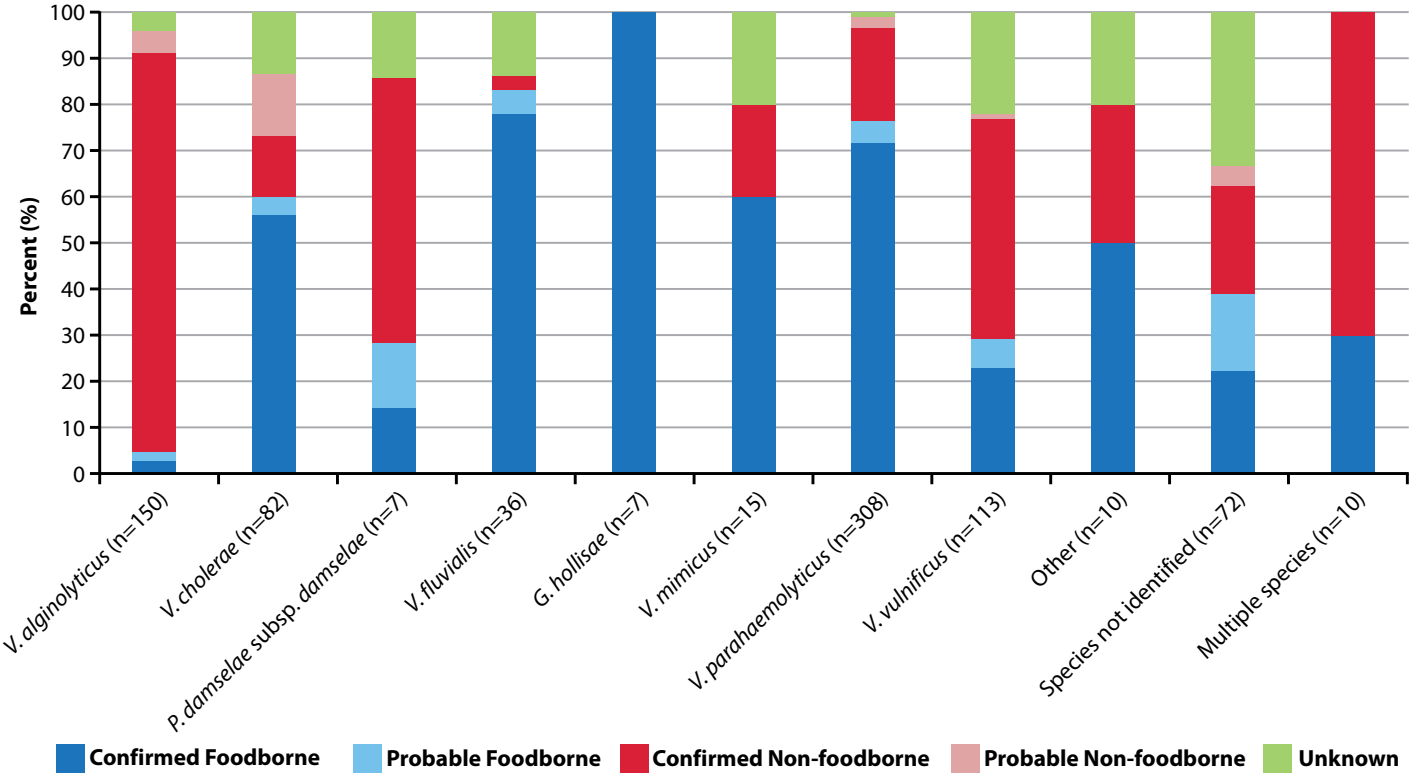


Figure 3. Domestically-acquired vibriosis cases, by month of illness onset or specimen collection (when onset date not available) and transmission route, 2011 (N=810).

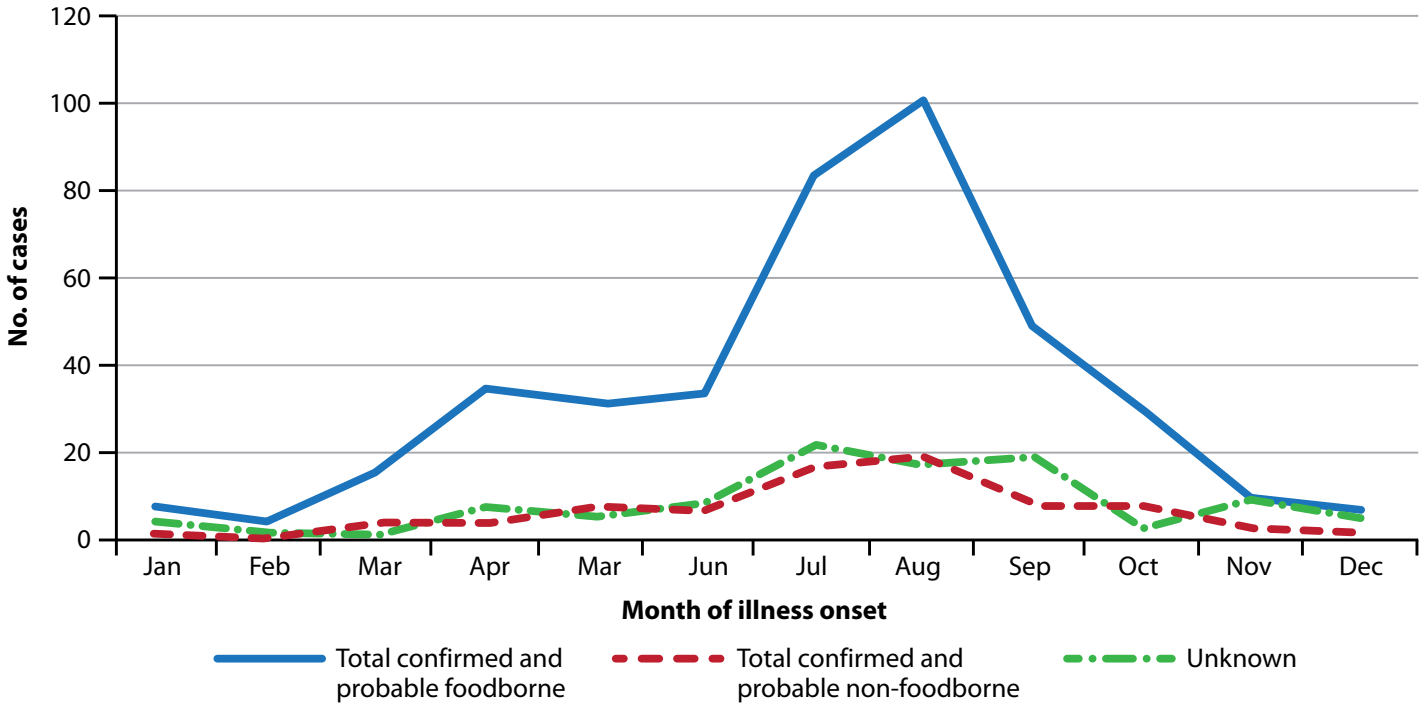


Table 2. Seafood exposures among 184 patients with domestically-acquired foodborne vibriosis who reported eating a single seafood item in the week before illness onset, 2011.

	Mollusks			Crustaceans				Other	
	Oysters	Clams	Mussels	Shrimp	Lobster	Crab	Crayfish	Other Shellfish*	Finfish†
Patients who ate single seafood item n (% of 184)	117 (64)	12 (7)	0 (0)	25 (14)	0 (0)	14 (8)	2 (1)	1 (0.5)	13 (7)
Patients who ate the single seafood item raw, n (% of n in row above)	107 (91)	9 (75)	0 (0)	5 (20)	0 (0)	1 (7)	0 (0)	0 (0)	4 (31)

* Other shellfish reported: conch

† Finfish reported: catfish, cod, haddock, halibut, salmon, unspecified sushi, tilapia, tuna.

Laboratory

In 2011, 173 isolates were confirmed at CDC as *V. parahaemolyticus*; 41 serotypes of *V. parahaemolyticus* were identified: 16% were of the pandemic clone serotype O3:K6, 10% were O4:Kuk, 10% O4:K12, 10% O1:Kuk, 10% O3:Kuk, and 21% were one of 36 other serotypes.

Toxigenic *V. cholerae*, excluding serogroups O1 and O139

Serogroup O141

In 2011, one patient with toxigenic *V. cholerae* serogroup O141 infection was reported. This patient reported consumption of raw oysters. The patient was not hospitalized.

Serogroup O75

In 2011, a total of 12 patients with toxigenic *V. cholerae* O75 infection were reported. Of note, the first reported outbreak in the United States of toxigenic *V. cholerae* O75 occurred in 2011. A total of 11 patients were reported as part of the outbreak; two were hospitalized and none died. All patients reported consumption of raw or lightly cooked oysters. Oyster traceback was available for 8 patients, and Apalachicola Bay harvest area 1642 was implicated as the source. The other 2011 patient with toxigenic *V. cholerae* O75 was lost to follow-up, so the patient's exposures were not reported.

Table 3. Cases of toxigenic *V. cholerae* O141 and O75 infections, 2011.

State	Age	Sex	Month of Illness onset	International Travel	Exposure	Serogroup
Louisiana	39	F	October	No	consumption of raw oysters	O141
Florida	31	F	March	No	consumption of raw oysters	O75
Indiana	42	M	April	No	consumption of raw oysters	O75
Florida	72	F	April	No	consumption of raw oysters	O75
Georgia	59	M	April	No	consumption of raw oysters	O75
Louisiana	68	F	April	No	consumption of raw oysters	O75
Florida	74	M	April	No	consumption of raw oysters	O75
Florida	48	M	April	No	consumption of lightly cooked oysters	O75
Florida	22	M	April	No	consumption of raw oysters	O75
Florida	40	M	April	No	consumption of raw oysters	O75
Tennessee	34	F	April	No	consumption of raw oysters	O75
Alabama	60	M	May	No	consumption of raw oysters	O75
Louisiana	39	F	July	No	lost to follow-up	O75

*This patient also was infected with *V. mimicus*

†Illness occurred in 2009, but isolate was submitted to CDC in October 2010

II. Cholera

Serogroup O1 & O139

In 2011, 42 patients with toxigenic *V. cholerae* serogroup O1 infection were reported; 40 infections were culture-confirmed, and two were confirmed by serologic testing. Of the 42 patients, 52% were hospitalized and none died. Thirty-nine (93%) cases were travel-associated (22 with travel to Haiti, 11 to the Dominican Republic, and 6 to other cholera-affected countries). For the other 3 cases, one patient reported consumption of imported seafood, one of 'souvenir seafood' from Haiti, and exposures for one were not reported.

Table 4. Cases of toxigenic *V. cholerae* O1 infection, 2011

State	Age	Sex	Month of Illness Onset	International Travel	Exposure	Serogroup
Florida	53	M	January	Yes	Haiti	O1 ET Ogawa
Florida	73	M	January	Yes	Haiti	O1 ET Ogawa
Kansas	38	F	January	Yes	Haiti	O1 ET Ogawa
Massachusetts	30	M	January	Yes	Dominican Republic	O1 ET Ogawa
Florida	31	F	January	No	Consumption of 'souvenir seafood' (conch from Haiti)	O1 ET Ogawa
Massachusetts	19	F	January	Yes	Dominican Republic	O1 ET Ogawa
Massachusetts	16	M	January	Yes	Dominican Republic	O1 ET Ogawa
Massachusetts	59	M	Unknown	Yes	Dominican Republic	O1 ET Ogawa
Michigan	46	F	February	Yes	Haiti	O1 ET Ogawa
New York City	29	M	January	Yes	Dominican Republic	O1 ET Ogawa
New York City	29	M	January	Yes	Dominican Republic	O1 ET Ogawa
New York City	29	M	January	Yes	Dominican Republic	O1 ET Ogawa
New York City	28	M	January	Yes	Dominican Republic	SEROPOSITIVE
Texas	43	M	January	Yes	Dominican Republic	O1 ET Ogawa
Florida	38	F	January	Yes	Haiti	SEROPOSITIVE
Florida	51	F	February	Yes	Philippines	O1 ET Ogawa
Alaska	26	M	March	Yes	Ghana	O1 ET Ogawa
New Mexico	65	M	March	Yes	Bangladesh	O1 ET Ogawa
Guam	27	M	Unknown	Unknown	Unknown	O1 ET Ogawa
New Jersey	78	F	May	Yes	India	O1 ET Ogawa
New York	74	M	June	Yes	Haiti	O1 ET Ogawa
Florida	44	M	June	Yes	Haiti	O1 ET Ogawa
Puerto Rico	70	M	June	Yes	Dominican Republic	O1 ET Ogawa
New York City	76	M	June	Yes	Haiti	O1 ET Ogawa

Table 4. Cases of toxigenic *V. cholerae* O1 infection, 2011

State	Age	Sex	Month of Illness Onset	International Travel	Exposure	Serogroup
Pennsylvania	56	F	July	Yes	Haiti	O1 ET Ogawa
New York City	46	F	July	No	Consumption of imported shrimp	O1 ET Ogawa
Florida	34	M	July	Yes	Haiti	O1 ET Ogawa
Kentucky	65	M	July	Yes	Haiti	O1 ET Ogawa
Kentucky	35	F	Unknown	Yes	Haiti	O1 ET Ogawa
Florida	52	F	September	Yes	Haiti	O1 ET Ogawa
Florida	42	M	September	Yes	Resident of Haiti	O1 ET Ogawa
California	55	F	September	Yes	Pakistan	O1 ET Ogawa
New York City	51	F	September	Yes	Dominican Republic	O1 ET Ogawa
New York City	34	F	September	Yes	Haiti	O1 ET Ogawa
Florida	50	F	September	Yes	Haiti	O1 ET Ogawa
New York City	24	F	October	Yes	Haiti	O1 ET Ogawa
Florida	62	F	October	Yes	Haiti	O1 ET Ogawa
New York City	63	M	October	Yes	Haiti	O1 ET Ogawa
Georgia	52	M	November	Yes	Haiti	O1 ET Ogawa
Virginia	54	M	December	Yes	Haiti	O1 ET Ogawa
Illiniois	41	F	December	Yes	Benin	O1 ET Ogawa
New York	49	F	November	Yes	Haiti	O1 ET Ogawa

III. Recent publications using COVIS data

Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson MA, Roy SL, et al. Foodborne illness acquired in the United States—major pathogens. Emerg Infect Dis. 2011: 17(1):7-15.

Daniels NA. *Vibrio vulnificus* Oysters: Pearls and Perils. Clin Infect Dis. 2011: 52(6):788-792.

Onifade TM, Hutchinson R, Van Zile K, Bodager D, Baker R, Blackmore C. Toxin producing *Vibrio cholerae* O75 outbreak, United States, March to April 2011. Euro Surveill. 2011;16(20).

Newton AE, Heiman KE, Schmitz A, Török T, Apostolou A, Hanson H, et al. Cholera in United States associated with epidemic in Hispaniola. Emerg Infect Dis. 2011:17:2166-2168.

Appendix

Method for Classification of Transmission Routes in the Cholera and Other *Vibrio* Illness Surveillance (COVIS) System

I. Exposure categories

To classify transmission routes, the first step is to categorize patient exposures. For a given illness episode, >1 patient exposure can be reported to COVIS; each reported exposure is categorized individually. If all exposures fall into a single category, then the report is considered to have a single exposure category. If not, the report is considered to have multiple exposure categories. For a given case, if any exposure is reported, we assume that other exposures for which information was not reported were not present. Exposures are classified using three categories:

1. **Seafood consumption:** Ingestion of seafood. Does not include touching seafood.
2. **Marine/estuarine contact:** Includes direct skin contact with marine/estuarine life, bodies of water, or drippings from raw or live seafood.
3. **Unknown exposure:** no exposure history reported.

II. Specimen site categories

The next step in classifying transmission routes is to categorize reported specimen sites. For a given illness episode, >1 specimen site can be reported; each reported site is categorized individually. If all specimen sites fall into a single category, then the report is considered to have a single specimen site category. If not, then the report is considered to have multiple specimen site categories. Specimen sites are classified using five categories:

1. **Gastrointestinal site (GI):** stool, bile, appendix, rectum, gall bladder, colon
2. **Blood or other normally sterile site (sterile):** blood, CSF, peritoneal fluid, lumbar disc fluid, lymph node, bullae
3. **Skin or soft tissue site (SST):** wound, any ear (other than otitis media and middle ear, which are included in 'other, non-sterile site'), appendage, tissue
4. **Other, non-sterile site (ONS):** urine, sputum, aspirate, bronchial washing, effusion, catheter, endotracheal, eye, nasal, placenta, respiratory, sinus, tonsil
5. **Unknown site (unknown):** no specimen site reported or no site specified for 'other'

Note: The lists of sites for each category above are not intended to be exhaustive. Rather, they reflect the sites actually reported to COVIS and can be updated, if new sites are reported.

III. Transmission route

The final step in classifying transmission involves review of exposure and specimen site categories for each reported case. Reports are classified into one of three transmission routes, foodborne, non-foodborne, and unknown, based on criteria below:

1. **Single exposure category: seafood consumption**
   - **Confirmed Foodborne:** *Vibrio* isolated **only** from GI or sterile site OR *Vibrio* isolated from multiple multiple specimen site categories, including a GI site.
   - **Probable Foodborne:** *Vibrio* isolated **only** from SST, ONS, or unknown sites OR *Vibrio* isolated from multiple specimen site categories, not including GI.

2. **Single exposure category: marine/estuarine contact**
   - **Confirmed Non-foodborne:** *Vibrio* isolated **only** from SST or sterile site OR *Vibrio* isolated from multiple specimen site categories, with SST reported.
   - **Probable Non-foodborne:** *Vibrio* isolated **only** from GI, ONS, or unknown sites OR *Vibrio* isolated from multiple specimen site categories, not including SST.
3. **Multiple exposure categories: both seafood consumption AND marine/estuarine contact**
   - **Confirmed Foodborne:** *Vibrio* isolated **only** from a GI site OR *Vibrio* isolated from multiple specimen site categories, with GI reported and SST not reported.
   - **Confirmed Non-foodborne:** *Vibrio* isolated **only** from a SST site OR *Vibrio* isolated from multiple specimen site categories, with SST reported and GI not reported.
   - **Unknown:** *Vibrio* isolated **only** from a sterile, ONS, or unknown site OR *Vibrio* isolated from multiple specimen site categories, including either 1) both GI and SST or 2) neither GI nor SST.
4. **Unknown or no reported exposure (note that categorization is the same as for multiple exposure categories)**
   - **Confirmed Foodborne:** *Vibrio* isolated **only** from a GI site OR *Vibrio* isolated from multiple specimen site categories, with GI reported and SST not reported.
   - **Confirmed Non-foodborne:** *Vibrio* isolated **only** from a SST site OR *Vibrio* isolated from multiple specimen site categories, with SST reported and GI not reported.
   - **Unknown:** *Vibrio* isolated **only** from a sterile, ONS, or unknown site OR *Vibrio* isolated from multiple specimen site categories, including either 1) both GI and SST or 2) neither GI nor SST.

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