National Enteric Disease Surveillance: COVIS Annual Summary, 2012

Summary of Human *Vibrio* Cases Reported to CDC, 2012

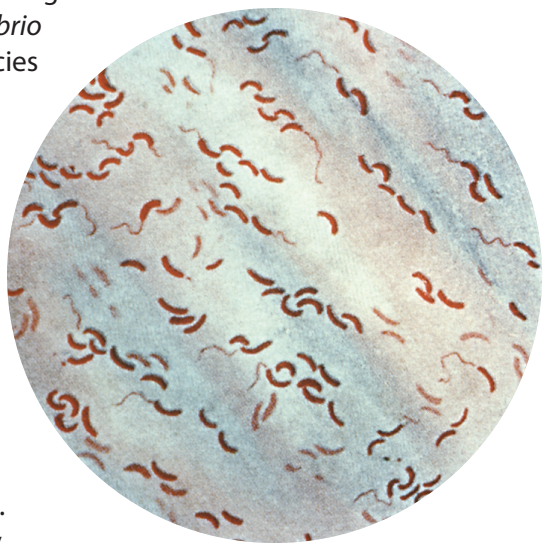
The Cholera and Other *Vibrio* Illness Surveillance (COVIS) system is a national surveillance system for human infection with pathogenic species of the family *Vibrionaceae*, which cause vibriosis and cholera. The Centers for Disease Control and Prevention (CDC) maintains COVIS. Information from COVIS 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 four Gulf Coast states (Alabama, Florida, Louisiana, and Texas) in 1989. 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 cholerae* and *Vibrio mimicus* isolates to CDC for additional characterization. For *V. cholerae*, CDC identifies serogroups O1, O75, O139, and O141 and determines whether the isolate produces cholera toxin. For all *Vibrio* species (excluding *V. cholerae*), CDC accepts isolates for antimicrobial resistance testing and all outbreak isolates for identification. 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 2012 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.



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

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). Travel-associated cases are defined as infections in persons who reported international travel in the seven days before illness began; all other infections were defined as domestically-acquired cases. For domestically acquired vibriosis, transmission routes (foodborne, non-foodborne, and unknown) are determined based on reported patient exposures and specimen sites (see Appendix for classification method). 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).

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 2012, 944 *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139) were reported to COVIS (Table 1). Among patients for whom information was available, 312 (35%) of 883 were hospitalized, and 50 (6%) of 846 died. The most frequently reported species was *V. parahaemolyticus*, which was isolated from 431 (46%) of the 944 patients. Of the patients infected with *V. parahaemolyticus* for whom information was available, 101 (25%) of 403 were hospitalized, and 6 (2%) of 390 died. *V. alginolyticus* was isolated from 182 (19%) of the 944 patients; of the patients for whom information was available, 20 (12%) of 162 were hospitalized; one death was reported. *V. vulnificus* was isolated from 119 (13%) of the 944 patients; of the patients for whom information was available, 101 (87%) of 116 were hospitalized, and 34 (32%) of 106 died.

Table 1. Vibriosis cases by species, selected patient demographic characteristics, and outcome, United States, 2012

			Demographic Characteristics				Outcomes			
Genus and Species of Vibrionaceae	**Cases**		**Age (years)**		**Sex**		**Hospitalizations**		**Deaths**	
	N	**%**	**Median**	**Range**	**Male (n/N)**	**%**	**n/N**	**%**	**n/N**	**%**
V. parahaemolyticus	431	46	49	1-93	292/425	69	101/403	25	6/390	2
V. alginolyticus	182	19	31	2-85	117/181	65	20/162	12	1/152	1
V. vulnificus	119	13	61	7-93	103/118	87	101/116	87	34/106	32
V. cholerae (excluding toxigenic O1 and O139)*	68	7	49	1-89	40/67	60	31/65	48	1/65	2
V. fluvialis	58	6	63	6-90	31/56	55	26/57	46	3/53	6
V. mimicus	20	2	52	18-89	11/20	55	4/20	20	0/19	0
Grimontia hollisae (formerly *V. hollisae*)	15	2	55	21-84	10/13	77	9/13	69	1/13	8
V. furnissii	3	<1	50	8-70	1/3	33	1/3	33	0/3	0
V. harveyi	2	<1	73	70-75	1/2	50	1/2	50	1/2	50
V. metschnikovii	2	<1	62	47-77	1/2	50	1/2	50	0/2	0
Photobacterium damselae subsp. *damselae* (formerly *V. damsela*)	1	<1	69	69	0/0	0	0/1	0	0/1	0
Species not identified	37	4	49	4-81	22/37	59	14/33	42	2/35	2
Multiple species†	6	1	66	46-77	5/6	83	3/6	50	1/5	20
Total	**944**	**100**	**50**	**1-93**	**634/930**	**68**	**312/883**	**35**	**50/846**	**6**

*Includes 64 non-toxigenic *V. cholerae* (non-O1, non-O139 [55 cases], O1 [5 cases], O141 [1 case], non-O1 [1 case (not tested for O139)], no serogroup specified [2 cases]) and 4 toxigenic *V. cholerae* O141.

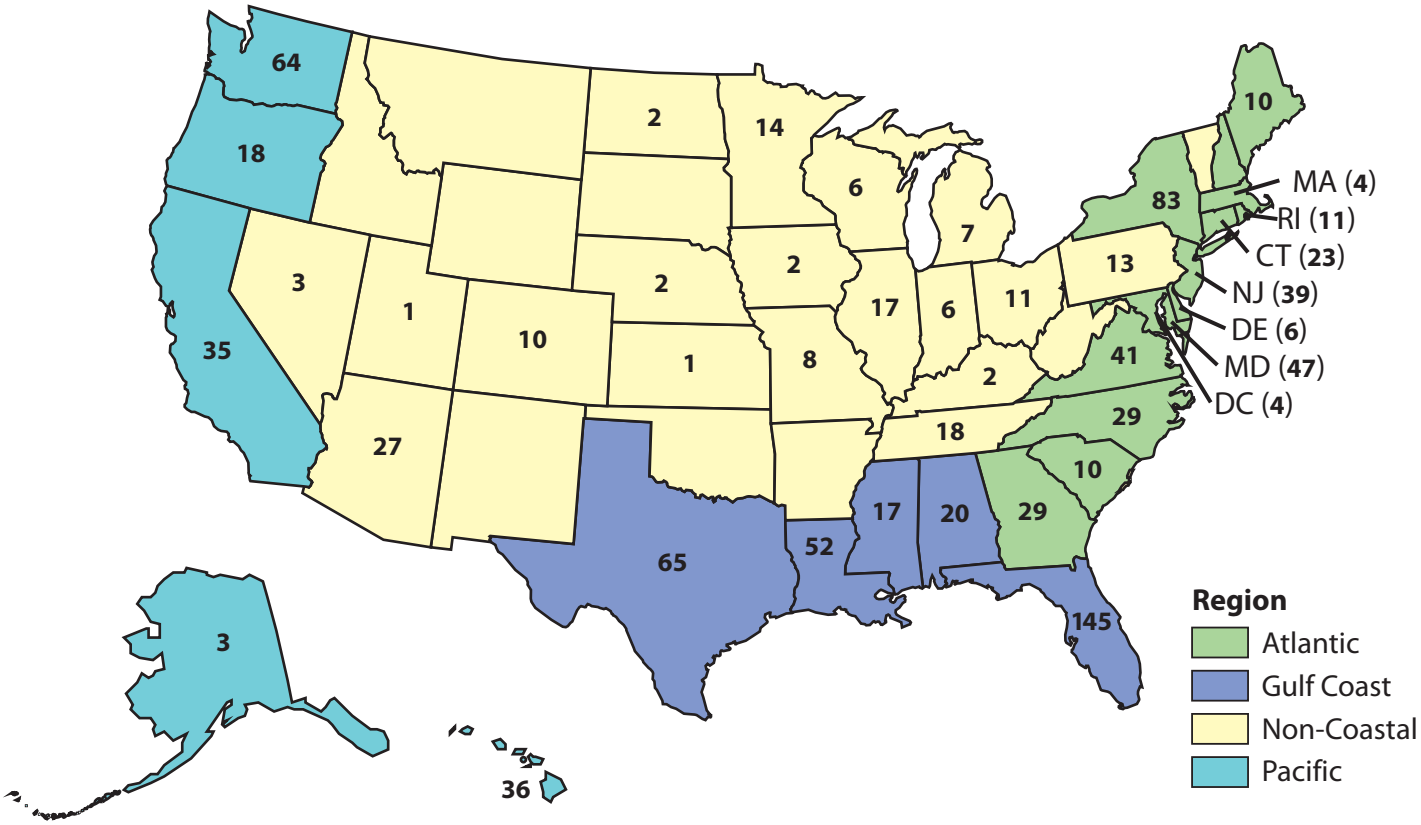
†The following combinations of *Vibrio* species were isolated from patients infected with multiple species: *V. alginolyticus*, *V. parahaemolyticus* (2 patients); *V. fluvialis*, *V. parahaemolyticus* (2 patients); *V. mimicus*, *V. parahaemolyticus* (1 patient); *V. cholerae* non-O1, non-O139, *V. mimicus* (1 patient). None of these are included in the rows for individual species.

Geographic Location

Of the 944 vibriosis cases, 299 (32%) were reported from Gulf Coast states, 156 (17%) from Pacific Coast states, 335 (35%) from Atlantic Coast states, and 154 (16%) from non-coastal states (Figure 1).

The *Vibrio* species reported most frequently from Gulf Coast states were *V. parahaemolyticus* (25%), *V. alginolyticus* (25%), *V. vulnificus* (22%), and *V. cholerae* (excluding toxigenic *V. cholerae* O1 and O139) (10%). The *Vibrio* species reported most frequently from non-Gulf Coast states were *V. parahaemolyticus* (55%), *V. alginolyticus* (17%), and *V. vulnificus* (8%).

Figure 1. Number of cases of *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139), by state, 2012 (N=944 from 42 states).



Transmission categories and reported exposures

Among the 944 vibriosis patients, 41 (4%) reported international travel in the seven days before illness began. Among the 903 domestically-acquired vibriosis cases, 492 (54%) were classified as confirmed or probable foodborne, 335 (37%) as confirmed or probable non-foodborne, and 76 (8%) 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 211 patients with confirmed and probable foodborne vibriosis who reported eating a single seafood item (Table 2), 115 (55%) ate oysters (90% of whom consumed them raw), 27 (13%) ate clams (78% of whom consumed them raw), 22 (10%) ate finfish, and 13 (6%) ate shrimp.

For cases with non-foodborne transmission, 263 (79%) patients reported having skin exposure to a body of water within 7 days before illness began, 53 (16%) reported handling seafood, and 57 (17%) reported contact with marine wildlife.

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

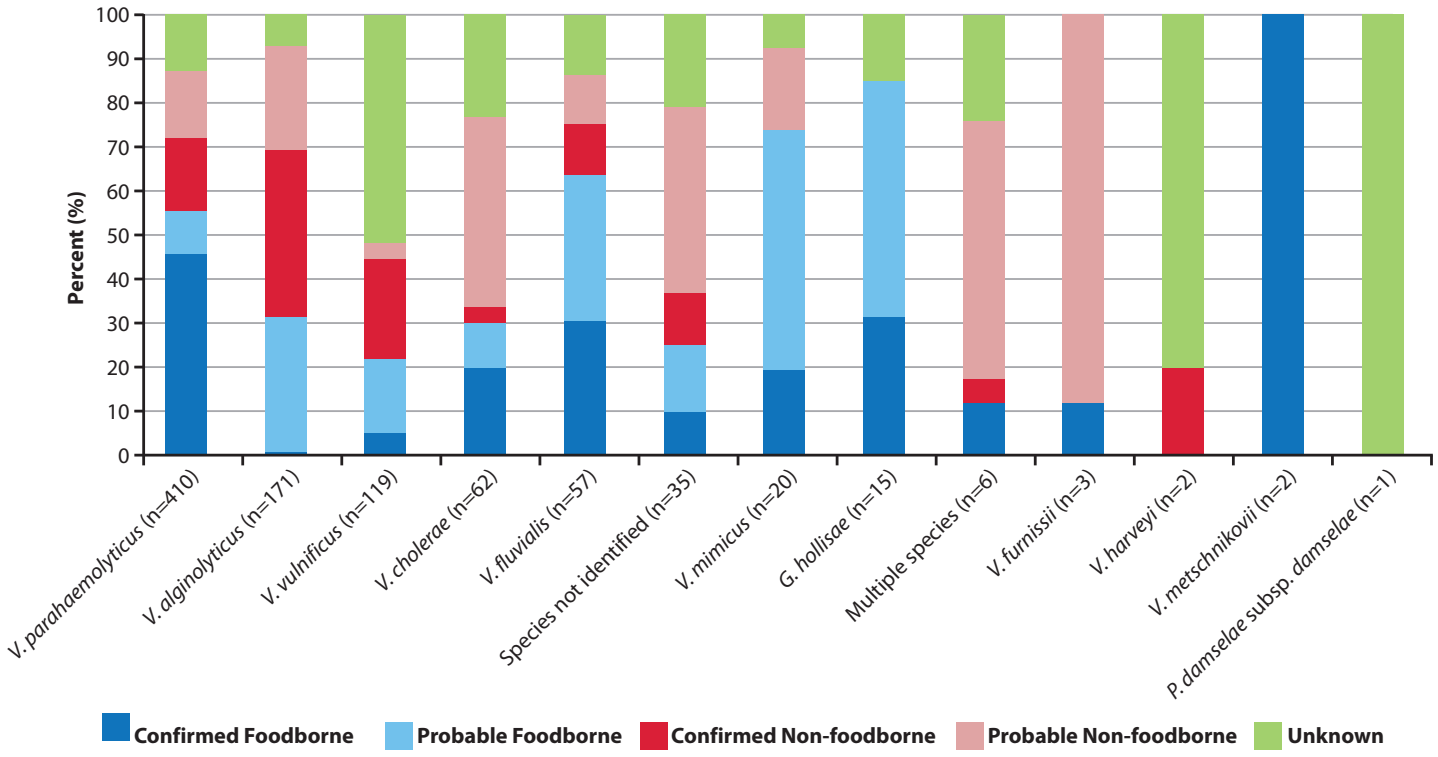


Figure 3. Domestically-acquired vibriosis cases, by month of illness onset or specimen collection (when onset date not available) and transmission route, 2012 (N=903).

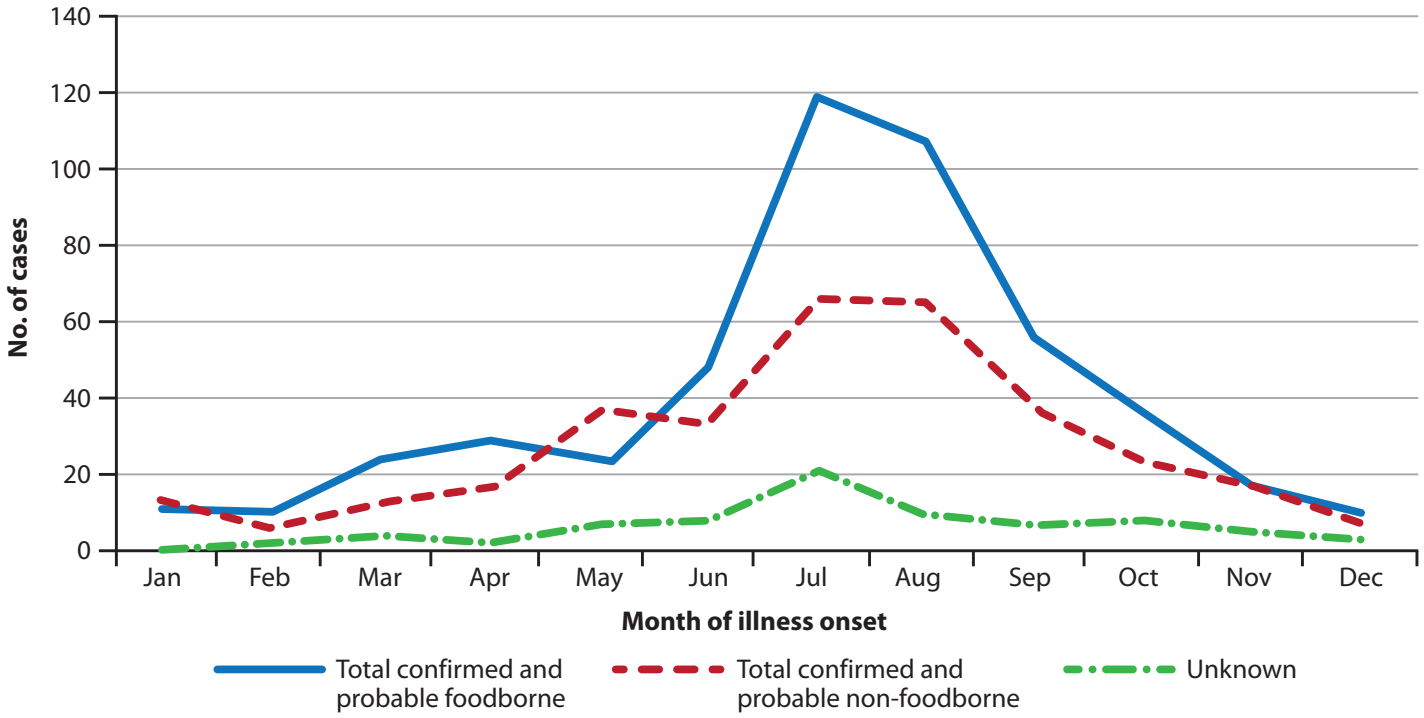


Table 2. Seafood exposures among 211 patients with domestically-acquired foodborne vibriosis who reported eating a single seafood item in the week before illness onset, 2012.

	Mollusks			Crustaceans				Other	
	Oysters	Clams	Mussels	Shrimp	Lobster	Crab	Crayfish	Other Shellfish*	Finfish†
Patients who ate single seafood item n (% of 211)	115 (55)	27 (13)	2 (1)	13 (6)	4 (2)	25 (12)	2 (1)	2 (1)	22 (10)
Patients who ate the single seafood item raw, n (% of n in row above)	104 (90)	21 (78)	1 (50)	0 (0)	0 (0)	5 (2)	1 (50)	0 (0)	6 (27)

* Other shellfish reported: scallops.

† Finfish reported: ahi, cod, mullet, salmon, swordfish, tilapia, trout, and tuna.

Laboratory

In 2012, 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:Kuknown, 10% O4:K12, 10% O1:Kuk, 10% O3:Kuknown, and the remaining 21% consisted of 36 other serotypes (1 isolate each).

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

Serogroup O141

In 2012, four patients with toxigenic *V. cholerae* serogroup O141 infection were reported. None were hospitalized and none died. No patient reported travel; 2 reported recreational water exposure; one reported consumption of raw clams harvested from Barnegat Bay, New Jersey; and one had an unknown exposure, but reported drinking water from San Carlos Lake in Arizona, which had been closed due to elevated algae levels and dead fish.

Serogroup O75

In 2012, no patients with toxigenic *V. cholerae* O75 infection were reported.

Table 3. Cases of toxigenic *V. cholerae* O141 infections, 2012.

State	Age	Sex	Month of Illness onset	International Travel	Exposure	Serogroup
Missouri	36	M	May	No	Swimming in the Big Piney River, Missouri	O141
Arizona	51	M	Unknown	No	Unknown, but reported exposure to San Carlos Lake, Arizona	O141
Texas	22	F	June	No	Swimming in the Guadalupe River, Texas	O141
New Jersey	67	M	July	No	Raw clams from Barnegat Bay, New Jersey	O141

II. Cholera

Serogroup O1 & O139

In 2012, 18 patients with toxigenic *V. cholerae* serogroup O1 infection were reported. Of the 18 patients, 67% were hospitalized and none died. Seventeen (94%) cases were travel-associated (10 with travel to Haiti, 3 to the Dominican Republic, and 4 to other cholera-affected countries). The remaining patient reported exposure to *V. cholerae* O1 in a laboratory.

No cases of toxigenic *V. cholerae* O139 infection were reported.

Table 4. Cases of toxigenic *V. cholerae* serogroup O1, biotype El Tor, infection, 2012.

State	Age	Sex	Month of Illness Onset	International Travel	Exposure	Serotype
Maryland	69	F	January	Yes	India	Ogawa
New York City	1	M	March	Yes	Bangladesh	Ogawa
Florida	23	M	April	Yes	Dominican Republic	Ogawa
Pennsylvania	49	M	May	Yes	Haiti	Ogawa
New York City	51	F	May	Yes	Dominican Republic	Ogawa
Florida	26	F	May	Yes	Haiti	Ogawa
New York City	64	M	May	Yes	Haiti	Ogawa
Florida	65	F	May	Yes	Haiti	Ogawa
New York City	67	M	June	Yes	Haiti	Ogawa
Maryland	55	F	June	Yes	Philippines	Ogawa
Florida	32	F	June	Yes	Haiti	Unknown*
Texas	51	F	July	Yes	Pakistan	Inaba
Pennsylvania	36	M	August	Yes	Dominican Republic	Ogawa
Florida	61	M	August	Yes	Resident of Haiti	Ogawa
Massachusetts	37	F	September	No	Laboratory	Ogawa
Florida	77	F	October	Yes	Haiti	Ogawa
Florida	78	M	October	Yes	Haiti	Ogawa
Florida	82	F	November	Yes	Resident of Haiti	Ogawa

*The isolate did not agglutinate in O1 specific antisera but was confirmed as serogroup O1 by molecular characterization.

III. Publications using COVIS data, 2012 and 2013

Vugia DJ, Tabnak F, Newton AE, Hernandez M, Griffin PM. Impact of 2003 state regulation on raw oyster–associated *Vibrio vulnificus* illnesses and deaths, California, USA. Emerg Infect Dis. 2013 Aug;19(8):1276-80.

Newton A, Kendall M, Vugia DJ, Henao OL, Mahon BE. Increasing rates of vibriosis in the United States, 1996-2010: review of surveillance data from 2 systems. Clin Infect Dis. 2012 Jun;54 Suppl 5:S391-5.

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, cerebrospinal fluid (CSF), peritoneal fluid, lumbar disc fluid, lymph node, bullae
3. **Skin or soft tissue site (SST):** wound, 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 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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