

# National Enteric Disease Surveillance: COVIS Annual Summary, 2014

## Summary of Human *Vibrio* Cases Reported to CDC, 2014

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](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.

For cholera, CDC requests that all state health departments send all *Vibrio cholerae*, *Vibrio mimicus*, and isolates from known or suspected outbreaks 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 *V. cholerae* isolates that are found to be toxigenic, CDC conducts antimicrobial susceptibility testing and pulsed-field gel electrophoresis (PFGE).

For vibriosis, CDC accepts isolates for identification, subtyping, and antimicrobial resistance testing. 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. More information on *Vibrio* and *Vibrio cholerae* testing at CDC can be found in the enteric diseases isolate submission memo and table available at <http://www.cdc.gov/ncezid/dfwed/edlb/additional.html>.

This report summarizes human *Vibrio* infections occurring during 2014 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. Whereas many *Vibrio* species are well-recognized human pathogens, the status of some species (including *Photobacterium damsela* subsp. *damsela* (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). Travel-associated cases are defined as infections in persons who reported international travel in the seven days before illness began; all other infections are 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).

## I. Vibriosis

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

In 2014, 1,252 *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139) were reported to COVIS (Table 1). Among patients for whom information was available, 326 (27%) of were hospitalized, and 34 (4%) of died. The most frequently reported single species was *V. parahaemolyticus*, which was isolated from 605 (48%) of patients. Of the patients infected with *V. parahaemolyticus* for whom information was available, 86 (15%) were hospitalized, and 4 (1%) died. *V. alginolyticus* was isolated from 239 (19%) of the patients; of the patients for whom information was available, 32 (14%) were hospitalized; none died. *V. vulnificus* was isolated from 124 (10%) of the patients; of the patients for whom information was available, 97 (79%) were hospitalized, and 21 (18%) died.

**Table 1. Vibriosis cases by species, selected patient demographic characteristics, and outcomes, United States, 2014.**

Genus and Species of <i>Vibrionaceae</i>	Cases		Demographic Characteristics				Outcomes			
	N	%	Age (years)		Sex		Hospitalizations		Deaths	
			Median	Range	Male (n/N)	%	n/N	%	n/N	%
<i>V. parahaemolyticus</i>	605	48	47	4–96	396/603	66	86/575	15	4/389	1
<i>V. alginolyticus</i>	239	19	36.5	2–91	176/239	74	32/222	14	0/180	0
<i>V. vulnificus</i>	124	10	59.5	10–93	101/124	81	97/123	79	21/117	18
<i>V. cholerae</i> (excluding toxigenic O1 and O139)*	80	6	50.5	3–90	54/80	68	36/79	46	3/65	5
<i>V. fluvialis</i>	71	6	59.5	6–91	43/71	61	26/70	37	1/61	2
<i>V. mimicus</i>	31	2	53	0–90	16/30	53	17/30	57	1/31	3
<i>Grimontia hollisae</i> (formerly <i>V. hollisae</i> )	10	<1	47	24–71	9/10	90	4/10	40	0/9	0
<i>Photobacterium damsela</i> subsp. <i>damsela</i> (formerly <i>V. damsela</i> )	6	<1	56.5	20–76	4/6	67	1/5	20	0/6	0
<i>V. harveyi</i>	4	<1	53.5	21–83	3/4	75	0/4	0	0/4	0
<i>V. metschnikovii</i>	3	<1	53	50–69	1/3	33	0/2	0	0/3	0
<i>V. furnissii</i>	1	<1	79	79–79	1/1	100	0/1	0	0/1	0
<i>V. metoecus</i>	1	<1	54	54–54	0/1	0	0/1	0	0/1	0
<i>V. navarrensis</i>	1	<1	7	7–7	0/1	0	0/1	0	0/1	0
Species not identified	52	4	44	3–86	36/52	69	11/47	23	0/41	0
Multiple species†	24	2	50	3–72	11/24	46	16/23	70	4/22	18
<b>Total</b>	<b>1,252</b>	<b>100</b>	<b>48</b>	<b>0–96</b>	<b>851/1249</b>	<b>68</b>	<b>326/1193</b>	<b>27</b>	<b>34/931</b>	<b>4</b>

\*Includes non-toxigenic *V. cholerae* non-O1, non-O139 (78 cases) and O1 (2 cases).

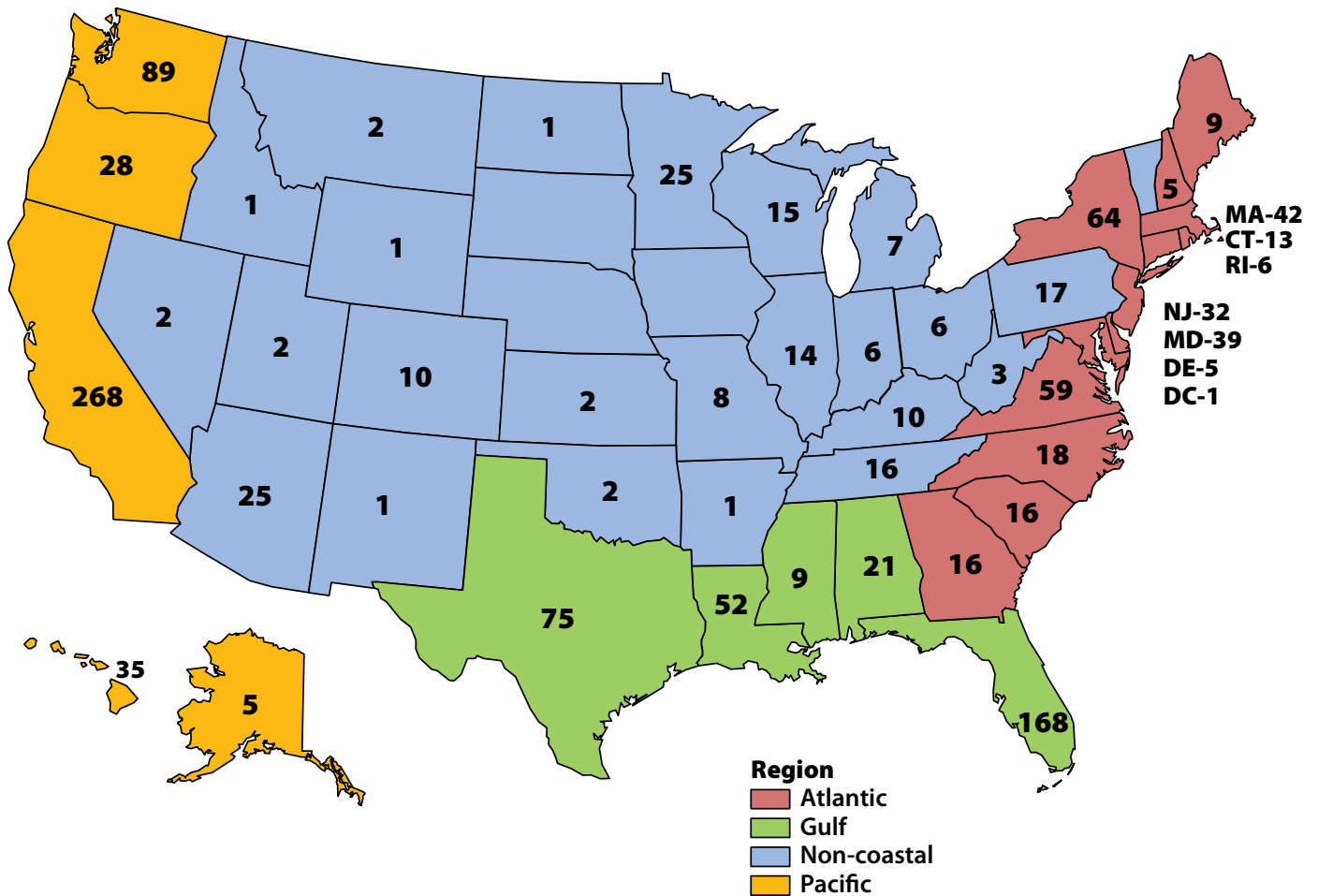
†The following combinations of *Vibrio* species were isolated from patients infected with multiple species: *V. alginolyticus*, *V. parahaemolyticus* (4 patients); *V. fluvialis*, *V. parahaemolyticus* (2 patients); *V. mimicus*, *V. fluvialis* (1 patient); *V. cholerae* non-O1, non-O139, *V. parahaemolyticus* (3 patients); *V. cholerae* non-O1, non-O139, *Vibrio* species not identified (2 patients); *V. fluvialis*, *V. vulnificus* (1 patient); *V. parahaemolyticus*, *V. vulnificus* (5 patients); *V. parahaemolyticus*, *Vibrio* species not identified (1 patient); *V. alginolyticus*, *Vibrio* species not identified (1 patient); *V. vulnificus*, *Vibrio* species not identified (1 patient); *V. alginolyticus*, *V. vulnificus* (2 patients); *V. mimicus*, *V. cholerae* serogroup not specified (1 patient). None of these are included in the rows for individual species.

## Geographic Location

Of the 1,252 vibriosis cases, 325 (26%) were reported from Gulf Coast states, 425 (34%) from Pacific Coast states, 325 (26%) from Atlantic Coast states, and 177 (14%) from non-coastal states (Figure 1).

The *Vibrio* species reported most frequently from Gulf Coast states were *V. alginolyticus* 91 (28%), *V. vulnificus* 64 (21%), and *V. parahaemolyticus* 62 (20%). The *Vibrio* species reported most frequently from non-Gulf Coast states were *V. parahaemolyticus* 543 (59%), *V. alginolyticus* 148 (16%), and *V. vulnificus* 60 (7%).

**Figure 1. Number of cases of *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139), by state, 2014 (N=1,252 from 46 states and the District of Columbia).**



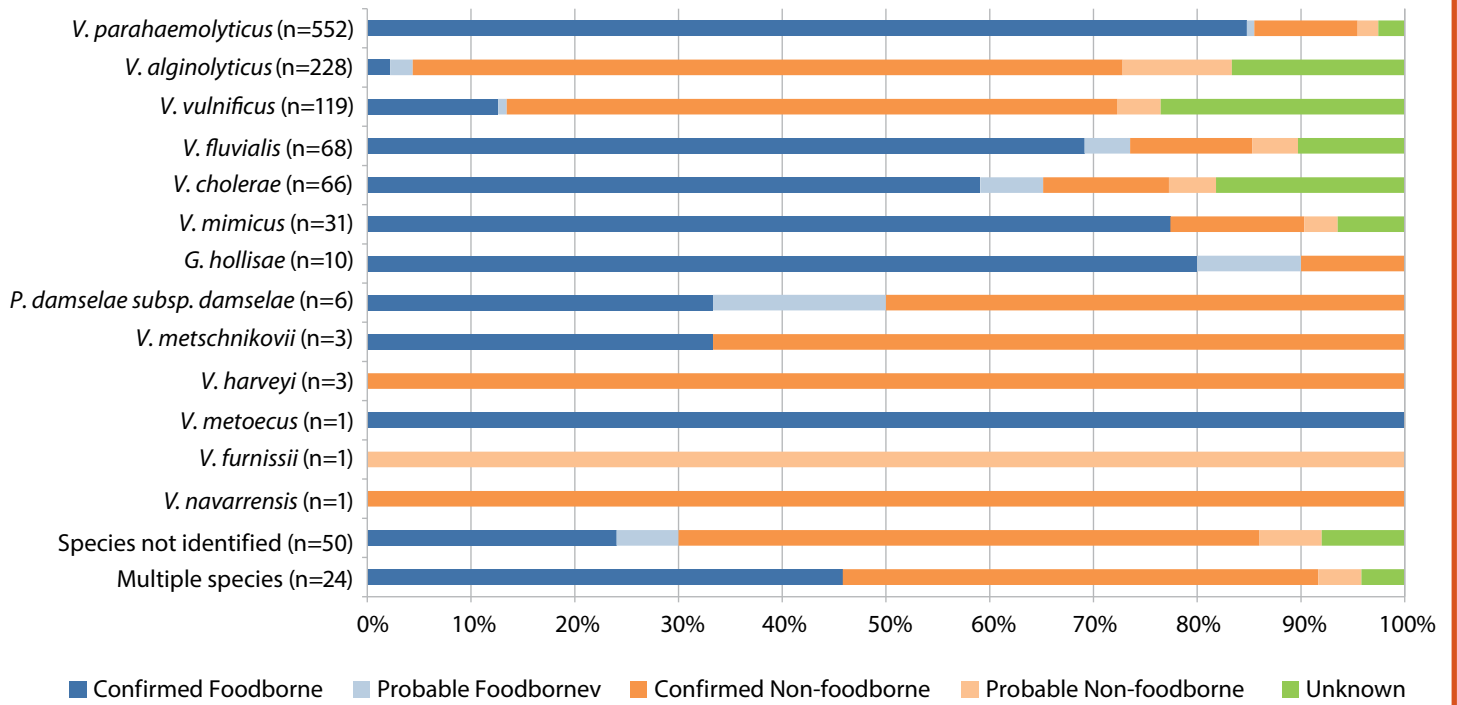
## **Transmission categories and reported exposures**

Of 1,252 vibriosis patients, 89 (7%) reported international travel in the seven days before illness began. Of 1,163 domestically acquired vibriosis cases, 655 (56%) were classified as confirmed or probable foodborne, 402 (35%) as confirmed or probable non-foodborne, and 106 (9%) 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).

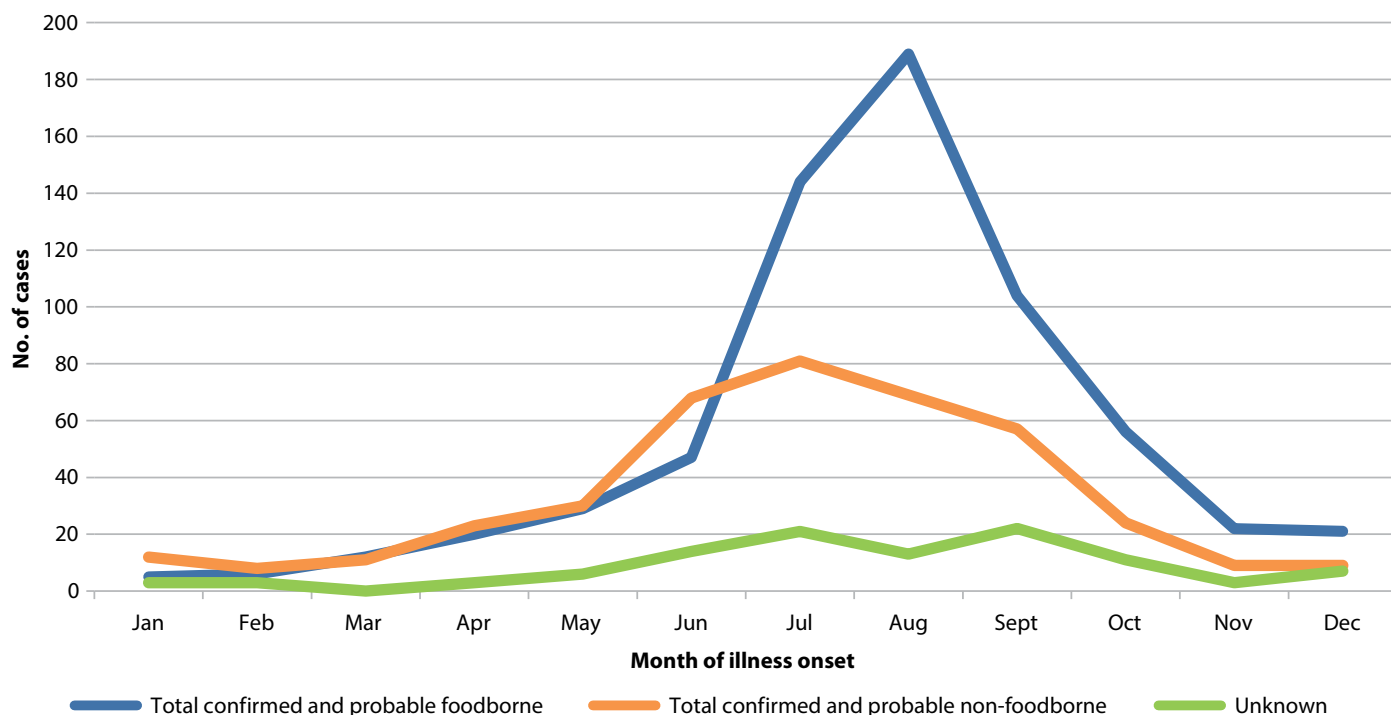
Among patients with confirmed and probable foodborne vibriosis who reported eating a single seafood item (Table 2), 196 (69%) ate oysters (89% of whom consumed them raw), 12 (4%) ate clams (83% of whom consumed them raw), 16 (6%) ate crab, and 29 (10%) ate finfish.

Among patients with confirmed or probable non-foodborne transmission, 316 (79%) reported having skin exposure to a body of water within 7 days before illness began, 67 (17%) reported contact with marine wildlife, and 69 (17%) reported handling seafood.

**Figure 2. Domestically acquired vibriosis cases by transmission route and species, United States, 2014 (N=1,163).**



**Figure 3. Domestically acquired vibriosis cases, by month of illness onset or specimen collection (when onset date not available), and transmission route, United States, 2014 (N=1,162\*).**



**Table 2. Seafood exposures among 286 patients with domestically acquired foodborne vibriosis\* who reported eating a single seafood item in the week before illness onset, United States, 2014.**

	Mollusks			Crustaceans				Other	
	Oysters	Clams	Mussels	Shrimp	Lobster	Crab	Crayfish	Other Shellfish**	Finfish†
<b>Patients who ate single seafood item, n (% of 286)</b>	196 (69)	12 (4)	3 (1)	16 (6)	3 (1)	16 (6)	5 (2)	7 (2)	29 (10)
<b>Patients who ate the single seafood item raw, n (% of n in row above)</b>	174 (89)	10 (83)	0 (0)	2 (13)	0 (0)	1 (6)	0 (0)	2 (29)	5 (17)

\*Includes confirmed and probable foodborne cases.

\*\*Other shellfish reported: conch, scallops.

†Finfish reported: bass, bluegill, catfish, cod, flounder, herring, poke, salmon, squid, tilapia, tuna, walrus, and white fish.

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

In 2014, no patients with non-O1, non-O139 toxigenic *V. cholerae* infection were reported.

## II. Cholera

### Serogroups O1 & O139

In 2014, 7 patients with toxigenic *V. cholerae* serogroup O1 infection were reported. Of the 7 patients, 57% were hospitalized and none died. All cases were travel-associated (2 with travel to Cuba, 2 to Ghana, and 3 to other cholera-affected countries).

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

**Table 3. Cases of toxigenic *V. cholerae* serogroup O1, biotype El Tor infection, 2014.**

Location	Age	Sex	Month of Illness Onset	International Travel	Exposure	Serotype	Antimicrobial Resistance*
Florida	59	F	February	Yes	Travel to Cuba	Ogawa	STR, SOX, NAL, STX
Florida	2	M	March	Yes	Travel to Cuba	Ogawa	FUR, STR, SOX, NAL, STX
Arkansas	57	M	August	Yes	Resident of Ghana	Ogawa	FUR, STR, SOX, NAL, STX
Minnesota	38	M	August	Yes	Travel to India	Ogawa	FUR, NAL
Massachusetts	57	M	August	Yes	Travel to Ghana	Ogawa	FUR, STR, SOX, NAL, STX
Colorado	64	M	November	Yes	Travel to India and Korea	Ogawa	FUR, STR, SOX, NAL, STX
Florida	71	M	November	Yes	Resident of Haiti	Ogawa	None <sup>†</sup>

\*FUR=furazolidone, NAL=nalidixic acid, SOX=sulfisoxazole, STR=streptomycin, STX=trimethoprim-sulfamethoxazole

<sup>†</sup>As of late 2015, all *V. cholerae* isolates sent to CDC undergo antimicrobial susceptibility testing through the National Antimicrobial Resistance Monitoring System (NARMS) laboratory. The testing scheme and panel of drugs differ from those previously used; therefore, differences in resistance between these periods should be interpreted with caution



### III. Publications using COVIS data, 2014 and 2015

Loharikar A, Newton AE, Stroika S, Freeman M, Greene KD, Parsons MB, Bopp C, Talkington D, Mintz ED, Mahon BE. Cholera in the United States, 2001–2011: a reflection of patterns of global epidemiology and travel. *Epidemiol Infect.* 2015 Mar;143(4):695–703. Available from <http://dx.doi.org/10.1017/S0950268814001186>

Newton AE, Garrett N, Stroika SG, Halpin JL, Turnsek M, Mody RK. Notes from the field: increase in *Vibrio parahaemolyticus* infections associated with consumption of Atlantic Coast shellfish—2014. *MMWR.* 2014;63:335–6. Available from <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6315a6.htm>

Martinez-Urtaza J, Baker-Austin C, Jones JL, Newton AE, Gonzalez-Aviles GD, DePaola A. Spread of Pacific Northwest *Vibrio parahaemolyticus* strain. *N Engl J Med.* 2014 Oct 17;369(16):1573–4. Available from <http://www.nejm.org/doi/full/10.1056/NEJMc1305535>

Slayton RB, Newton AE, Depaola A, Jones JL, Mahon BE. Clam-associated vibriosis, USA, 1988–2010. *Epidemiol Infect.* 2014 May;142(5):1083–8. Available from <http://dx.doi.org/10.1017/S0950268813001830>

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.* 2014 Aug;19(8):1276–80. Available from <http://dx.doi.org/10.3201/eid1908.121861>

## 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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