National Enteric Disease Surveillance: COVIS Annual Summary, 2010

Summary of Human *Vibrio* Cases Reported to CDC, 2010

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. 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 2010 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). 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).

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 2010, 927 *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139) were reported to COVIS (Table 1). Among patients for whom information was available, 272 (33%) of 838 were hospitalized, and 45 (6%) of 784 died. The most frequently reported species was *V. parahaemolyticus*, which was isolated from 421 (45%) of the 927 patients. Of the patients infected with *V. parahaemolyticus* for whom information was available, 84 (22%) of 383 were hospitalized, and 2 of 366 (1%) died. *V. alginolyticus* was isolated from 152 (16%) of the 927 patients; of the patients for whom information was available, 18 (14%) of 127 were hospitalized, and 1 (1%) of 114 died. *V. vulnificus* was isolated from 133 (14%) of the 927 patients; of the patients for whom information was available, 93 (75%) of 124 were hospitalized, and 36 (31%) of 116 died.

Table 1. Vibriosis cases by species, selected demographic characteristics, and outcome, United States, 2010

			Demographic Characteristics				Outcomes			
Vibrio Species	**Cases**		**Age (years)**		**Sex**		**Hospitalizations**		**Deaths**	
	N	**%**	**Median**	**Range**	**Male (n/N)**	**%**	**n/N**	**%**	**n/N**	**%**
V. alginolyticus	152	16	35.5	2–84	88/149	59	18/127	14	1/114	1
V. cholerae (excluding toxigenic *V. cholerae* O1 and O139)*	69	7	46	2–96	47/67	70	24/64	38	3/63	5
Photobacterium damselae subsp. *damselae* (formerly *V. damsela*)	3	0	56	15–66	2/3	67	2/4	50	0/3	0
V. fluvialis	50	5	63	2–87	37/50	74	17/47	39	2/44	5
Grimontia hollisae (formerly *V. hollisae*)	15	2	52	33–93	8/15	53	9/15	60	0/11	0
V. metschnikovii	2	0	32	32	1/1	100	1/2	50	0/2	0
V. mimicus†	15	1	48	2–67	7/15	47	5/15	27	0/14	0
V. parahaemolyticus	421	45	47.5	1–90	257/414	62	84/383	22	2/366	1
V. vulnificus	133	14	57	2–87	112/132	85	93/124	75	36/116	31
Species not identified	56	6	55	2–88	30/53	57	15/47	32	1/41	2
Multiple species§	11	1	49	13–65	8/11	73	5/11	45	0/10	0
Total	**927**	**100**	**49**	**1–96**	**597/910**	**66**	**272/838**	**32**	**45/784**	**6**

*Includes 62 non-toxigenic *V. cholerae* (non-O1 non-O139 [57 cases], O1 [2 cases], O139 [1 case], non-O1 (2 cases) (ie, patient tested negative for serogroup O1 and was not tested for other serogroups)and 7 toxigenic *V. cholerae* (O75 [6 cases], O141 [1 case]).

†Three patients had toxigenic *V. mimicus* infection.

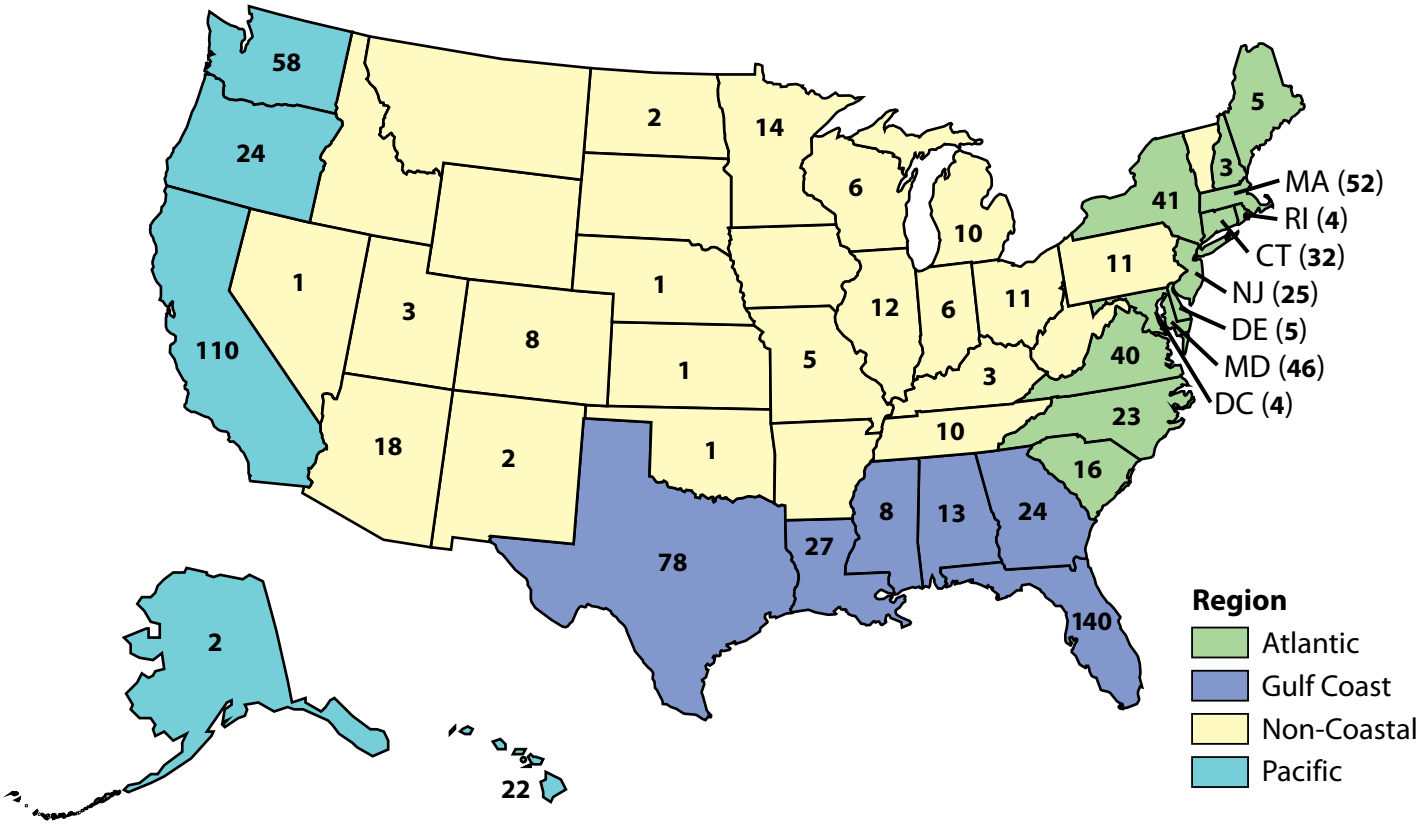
§ The following combinations of *Vibrio* species were isolated from patients infected with multiple species : *V. parahaemolyticus*, *V. vulnificus* (5 patients); *V. fluvialis*, *V. parahaemolyticus* (4 patients); toxigenic *V. cholerae* O75, *V. mimicus* (1 patient); *V. alginolyticus*, *V. harveyi* (1 patient). None of these are included in the rows for individual species.

Geographic Location

Of the 927 cases of vibriosis, 265 (29%) were reported from Gulf Coast states, 216 (23%) from Pacific Coast states, 316 (34%) from Atlantic Coast states, and 130 (14%) from non-coastal states (Figure 1).

The *Vibrio* species reported most frequently from Gulf Coast states were *V. vulnificus* (29%), *V. parahaemolyticus* (25%), *V. alginolyticus* (22%), and *V. cholerae* (excluding toxigenic *V. cholerae* O1 and O139) (8%). The *Vibrio* species reported most frequently from non-Gulf Coast states were *V. parahaemolyticus* (54%), *V. alginolyticus* (14%), *V. vulnificus* (9%), *V. cholerae* (excluding toxigenic *V. cholerae* O1 and O139) (7%), and *V. fluvialis* (6%).

Figure 1. Number of cases of *Vibrio* infections (excluding toxigenic *V. cholerae* O1 and O139), by state, 2010 (N=927 from 43 states).



Transmission categories and reported exposures

Among the 927 vibriosis patients, 56 (6%) reported international travel in the 7 days before illness began. Among the 871 domestically-acquired vibriosis cases, 459 (53%) were classified as confirmed or probable foodborne, 307 (35%) as confirmed or probable non-foodborne, and 105 (12%) as having unknown transmission route (Figure 2). Illness reports peaked in the summer months for all categories, but the peak was most pronounced for foodborne infections (Figure 3).

Among the 182 patients with foodborne vibriosis who reported eating a single seafood item (Table 2), 114 (63%) ate oysters (90% of whom consumed them raw), 13 (7%) ate clams (85% of whom consumed them raw), 14 (8%) ate shrimp, and 18 (10%) ate finfish.

For cases with non-foodborne transmission, 222 (72%) patients reported having skin exposure to a body of water within 7 days before illness began, 50 (16%) reported handling seafood, and 49 (16%) reported contact with marine wildlife.

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

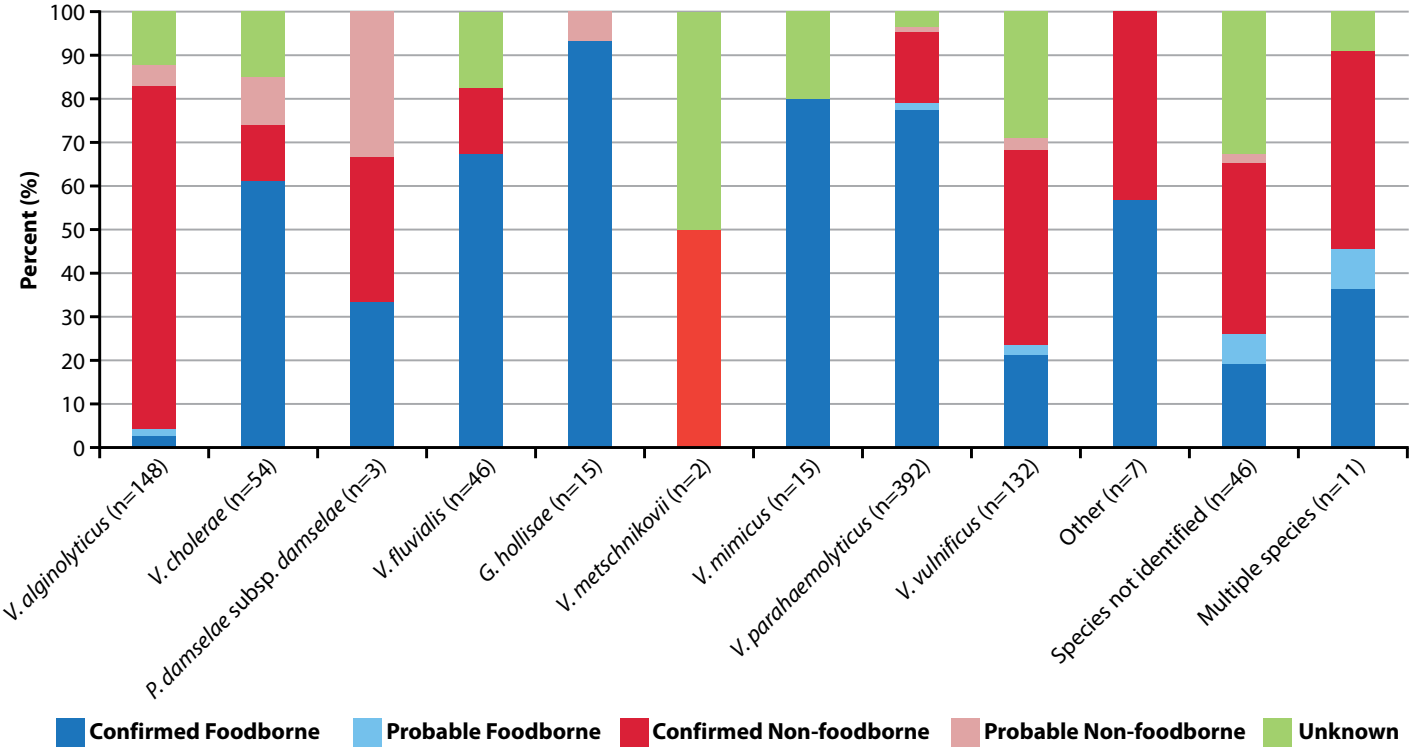


Figure 3. Domestically-acquired vibriosis cases, by month of illness onset or specimen collection (when onset date not available) and transmission route, 2010 (N=871).

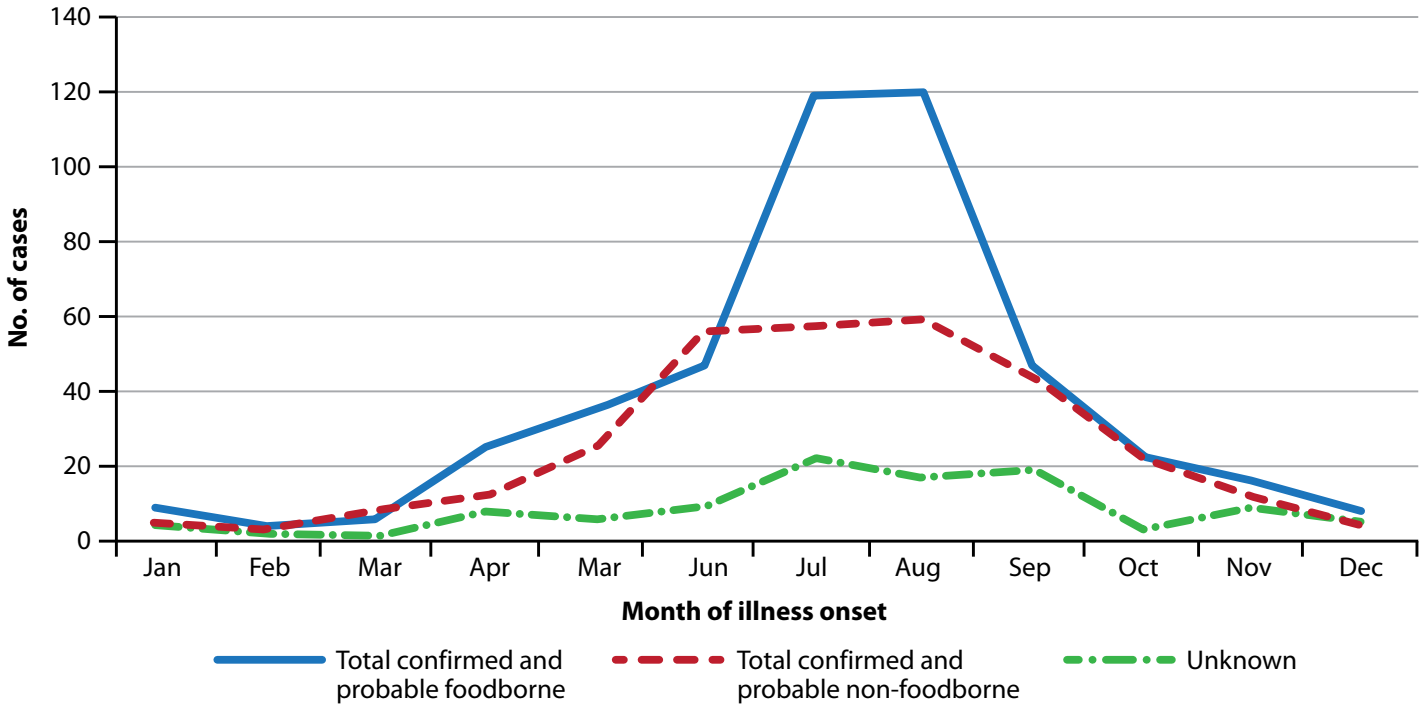


Table 2. Seafood exposures among 182 patients with domestically-acquired foodborne vibriosis who reported eating a single seafood item in the week before illness onset, 2010.

	Mollusks			Crustaceans				Other	
	Oysters	Clams	Mussels	Shrimp	Lobster	Crab	Crayfish	Other Shellfish*	Finfish†
Patients who ate single seafood item n (% of 182)	114 (61)	13 (7)	1 (0.5)	14 (8)	1 (0.5)	15 (8)	4 (2)	2 (1)	18 (10)
Patients who ate the single seafood item raw, n (% of n in row above)	103 (90)	11 (85)	0 (0)	3 (21)	0 (0)	2 (13)	0 (0)	2 (100)	6 (33)

* Other shellfish reported: periwinkles, limpets

† Finfish reported: ak kalulu, catfish, codfish, grouper, kingfish, salmon, swordfish, tuna, white fish

Laboratory

In 2010, 188 isolates were confirmed at CDC as *V. parahaemolyticus*; 28 serotypes of *V. parahaemolyticus* were identified: 26% were O4:Kuk, 15% were O1:Kuk, and 10% were O3:Kuk, 2% were of the pandemic clone serotype O3:K6, and 48% were one of 24 other serotypes.

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

Serogroup O141

In 2010, 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 2010, six patients with toxigenic *V. cholerae* serogroup O75 infection were reported. All infections were acquired domestically, and all patients reported consumption of seafood (four ate raw oysters, one ate cooked oysters, and one ate baked mussels, boiled crab, boiled shrimp, and sushi rolls). Two patients were hospitalized, and none died. Additionally, one case with onset in 2009 was laboratory confirmed and reported in 2010. This patient reported consumption of broiled shrimp, crab, and scallops and was hospitalized.

Table 3. Cases of toxigenic *V. cholerae* O141 and O75 infections, 2010.

State	Age	Sex	Month of Illness onset	International Travel	Exposure	Serogroup
Connecticut	53	M	August	No	Consumption of raw oysters	O141
Ohio	37	M	May	No	Consumption of raw oysters	O75
Pennsylvania	53	F	June	No	Consumption of raw oysters	O75
Georgia	39	F	October	No	Consumption of raw oysters	O75
Louisiana	52	M	October*	No	Consumption of baked mussels, boiled crab, boiled shrimp, and sushi rolls	O75
Florida	12	M	October	No	Consumption of raw oysters	O75
Kentucky	67	M	Unknown	No	Consumption of cooked oysters	O75
Pennsylania	36	F	October†	No	Consumption of broiled shrimp, crab, and scallops	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 2010, 15 patients with toxigenic *V. cholerae* serogroup O1 infection were reported; 14 infections were culture-confirmed, and one was confirmed by serologic testing. Of the 15 patients, seven were hospitalized; four reported seeking care at an emergency department. None died. All cases were associated with international travel; of particular note, eight patients reported travel to Haiti, where a cholera outbreak began on October 21, 2010. No cases of *V. cholerae* O139 were reported.

Table 4. Cases of toxigenic *V. cholerae* O1 infection, 2010

State	Age	Sex	Month of Illness Onset	International Travel	Exposure	Serogroup
New York	44	M	March	Yes	Pakistan	O1 ET Ogawa
Texas	54	F	March	Yes	Resident of India	O1 ET Ogawa
Ohio	3	M	July	Yes	Indonesia	O1 ET Ogawa
Ohio	41	M	July	Yes	Indonesia	O1 ET Ogawa
Ohio	8	F	July	Yes	Indonesia	O1 ET Ogawa
Georgia	20	F	October	Yes	Resident of Pakistan	O1 ET Ogawa
Florida	84	F	October	Yes	Haiti	O1 ET Ogawa
Florida	9	F	November	Yes	Haiti	O1 ET Ogawa
Virginia	61	M	November	Yes	Haiti	O1 ET Ogawa
Florida	28	F	November	Yes	Haiti	O1 ET Ogawa
Florida	40	F	November	Yes	Haiti	O1 ET Ogawa
North Carolina	59	M	December	Yes	Haiti	SEROPOSITIVE
Florida	71	F	December	Yes	Haiti	O1 ET Ogawa
Florida	39	M	December	Yes	Haiti	O1 ET Ogawa
Texas	2	M	December	Yes	Pakistan	O1 ET Ogawa

III. Recent publications using COVIS data

Iwamoto M, Ayers T, Mahon BE, Swerdlow DL. Epidemiology of Seafood-Associated Infections in the United States. Clin Micro Rev. 2010: 23: 399-411.

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 specimen site categories, with GI reported.
   - **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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