

Summary of human *Vibrio* isolates reported to CDC, 2006

Infection with toxigenic *Vibrio cholerae* serogroups O1 and O139, the causative agents of cholera, has been a reportable disease in the United States for many years. In addition, CDC maintains a database of reported infections with all species of *Vibrio* from humans in order to obtain reliable information on illnesses associated with the range of *Vibrio* species. This information has been used to educate consumers about the health risks of seafood, as well as to help determine host, food, and environmental risk factors.

The Cholera and Other *Vibrio* Illness Surveillance System (COVIS) was initiated by the Food and Drug Administration (FDA), CDC, and the Gulf Coast states (Alabama, Florida, Louisiana, Mississippi, and Texas) in 1988. Participating health officials collect clinical data, information about underlying illness, history of seafood consumption and exposure to seawater in the 7 days before illness, and conduct tracebacks of implicated oysters. Reporting has expanded and since 1997, many other states have also reported *Vibrio* isolates (Figure 1). However, only toxigenic *V. cholerae* O1 and O139 were nationally notifiable; thus the number of *Vibrio* isolates is likely greater than reported. CDC serotypes all *V. parahaemolyticus* isolates received from state health departments, and screens for cholera toxin production and the O1, O139, and O141 serogroups in *V. cholerae* isolates.

This report summarizes human *Vibrio* infections during 2006 reported by states to CDC. Results are presented in two categories: *V. cholerae* isolates that produce cholera toxin (referred to as toxigenic *Vibrio cholerae*), and all other *Vibrio* isolates, including those *V. cholerae* isolates that do not produce cholera toxin. Results are presented separately for Gulf Coast states versus other states consistency with previous reports. Additionally, results are presented by anatomic site of isolation. It is important to note that isolation of some *Vibrio* species from a patient with illness does not necessarily indicate causation. While many *Vibrio* species are well-recognized pathogens, the status of *V. damsela*, *V. furnissii*, *V. metschnikovii*, and *V. cincinnatiensis* as enteric or wound pathogens is less clear.

In June 2006, the Council of State and Territorial Epidemiologists adopted a resolution to add all *Vibrio* species infections (vibriosis) to the list of nationally notifiable diseases reported to the National Notifiable Diseases Surveillance System (NNDSS). Reporting of vibriosis is in addition to and distinct from reporting of cholera currently conducted through NNDSS. The position statement, “National Reporting for non-cholera *Vibrio* Infections (Vibriosis),” can be found at <http://www.cste.org/PS/2006pdfs/PSFINAL2006/06-ID-05FINAL.pdf>. In addition to reporting through NNDSS, CDC requests that states collect information using the standard surveillance form for COVIS available at <http://www.cdc.gov/foodborneoutbreaks/>.

An outbreak of *V. parahaemolyticus* involving a total of 177 confirmed and probable cases associated with consumption of raw shellfish occurred during the summer in 2006¹. A total of 62 reports of confirmed *V. parahaemolyticus* outbreak-related cases were reported to COVIS from 10 states (Alaska, California, Connecticut, Georgia, New Jersey, New York, Oregon, Texas, Utah, and Washington). Dates of onset ranged from May 30 to September 20. Of the 62 reports received, 60 (97%) cases reported consuming oysters, of which 73% reporting eating raw oysters. Among patients, for whom information was known, 3% were hospitalized and no deaths were reported. Several oyster growing areas that were found to be the source of the oysters associated with illnesses were closed to oyster harvesting¹.

Isolates of toxigenic *Vibrio cholerae*

In 2006, eight patients with toxigenic *V. cholerae* O1 (cholera), two patients with toxigenic *V. cholerae* O141, and one patient with *V. cholerae* O75 were reported (Table 1). Of the eight cholera cases, four patients were hospitalized and no deaths were reported. Infection was acquired through international travel for four sporadic cases (three cases acquired infection while traveling in India and one case while traveling in Bangladesh). Of those who acquired infection while in India, two were vegetarians with no recreational water exposure, and the third reported eating fresh fruits and vegetables washed in local water. The patient that traveled to Bangladesh reported consuming fish while abroad. All four domestically-acquired infections occurred in residents of Louisiana who reported having eaten crab. Two of the patients obtained crab from friends or relatives who caught the crab in Louisiana. A third case purchased crab from a local distributor and the fourth could not remember where the crab was obtained. The pulsed field gel electrophoresis (PFGE) patterns of the isolates from all four patients were indistinguishable from each other by *SfiI* enzyme. When compared with the national *V. cholerae* database, these four isolates were indistinguishable from isolates previously characterized as the Gulf Coast strain by *SfiI*. Further comparison using a second enzyme, *NotI*, revealed that these four isolates and previous Gulf Coast strains differed by one to three bands.

One of the two patients with toxigenic *V. cholerae* O141 had traveled internationally to Morocco. Her symptoms began during her trip although she did not seek medical attention until returning home. No further risk information was reported. The other case ate raw oysters domestically 1 day before symptom onset. Two others who also ate the oysters reported diarrhea lasting for 1 day. Previous cases of *V. cholerae* O141 have occurred in the United States².

The patient infected with *V. cholerae* O75 had traveled domestically to Miami where he consumed clams and raw oysters. He presented at his primary care provider's office 4 days after onset of vomiting, diarrhea, nausea, abdominal cramps, myalgias, and headache. No treatment or hospitalization was required.

Table 1: Isolates of toxigenic *V. cholerae*, 2006

State	Age	Sex	Onset	Exposure	Serogroup	Serotype
California	27	F	5/2/2006	Travel in India	<i>V. cholerae</i> O1	Inaba
Illinois	58	M	6/25/2006	Travel in India	<i>V. cholerae</i> O1	Inaba
Louisiana	39	F	6/5/2006	Domestic (seafood)-Gulf Coast	<i>V. cholerae</i> O1	Inaba
Louisiana	60	F	6/20/2006	Domestic (seafood)-Gulf Coast	<i>V. cholerae</i> O1	Inaba
Louisiana	75	F	6/27/2006	Domestic (seafood)-Gulf Coast	<i>V. cholerae</i> O1	Inaba
Louisiana	60	F	7/31/2006	Domestic (seafood)-Gulf Coast	<i>V. cholerae</i> O1	Inaba
New Jersey	15	M	7/31/2006	Travel in India	<i>V. cholerae</i> O1	Inaba
New York	46	M	5/21/2006	Travel in Bangladesh	<i>V. cholerae</i> O1	Inaba
Alabama	53	F	10/22/2006	Domestic (seafood)-Gulf Coast	<i>V. cholerae</i> O141	
Tennessee	32	F	9/24/2006	Travel in Morocco	<i>V. cholerae</i> O141	
South Carolina	34	M	08/06/2006	Domestic (seafood)-Gulf Coast	<i>V. cholerae</i> O75	

Other *Vibrio* isolates (excluding toxigenic *V. cholerae*)

In 2006, 744 *Vibrio* isolates from 718 patients were reported to the Cholera and Other *Vibrio* Illness Surveillance System (Tables 2 and 3). Among patients for whom information was available, 215 (32%) of 665 were hospitalized and 36 (6%) of 649 died. *V. parahaemolyticus* was isolated from 403 (56%) patients, and was the most frequently reported *Vibrio* species. Of the patients infected with *V. parahaemolyticus*, 68 (18%) were hospitalized and 1 (<1%) died. *V. vulnificus* was isolated from 99 (14%) patients; 79 (85%) were hospitalized and 31 (35%) died.

Table 2. Number of *Vibrio* illnesses (excluding toxigenic *V. cholerae*) by species, complications, and site of isolation in patients from Gulf Coast states, 2006.

<i>Vibrio</i> Species	Complications ¹						Site of Isolation					
	Patients		Hospitalized		Deaths		Isolates		Stool	Blood	Wound	Other ²
	N	(%)	n/N	(%)	n/N	(%)	N	(%)				
<i>V. alginolyticus</i>	28	(17)	2/24	(8)	0/25	(0)	28	(16)	0	1	14	13
<i>V. cholerae</i> (non-toxigenic) ³	14	(8)	6/13	(46)	1/11	(9)	14	(8)	7	4	0	3
<i>V. damsela</i>	1	(1)	0/1	(0)	0/1	(0)	1	(1)	1	0	0	0
<i>V. fluvialis</i>	7	(4)	3/7	(43)	0/7	(0)	7	(4)	3	0	2	2
<i>V. hollisae</i>	4	(2)	4/4	(100)	0/4	(0)	4	(2)	4	0	0	0
<i>V. mimicus</i>	7	(4)	4/7	(57)	0/7	(0)	7	(4)	5	1	1	0
<i>V. parahaemolyticus</i>	42	(26)	14/37	(38)	1/39	(3)	42	(24)	22	3	15	2
<i>V. vulnificus</i>	53	(32)	43/49	(88)	15/45	(33)	58	(33)	6	37	13	2
Species not identified	2	(1)	0/2	(0)	0/2	(0)	2	(1)	0	0	1	1
Other	1	(1)	0/0	(0)	0/0	(0)	1	(1)	0	0	0	1
Multiple species ⁴	5	(3)	4/5	(80)	0/4	(0)	12	(7)	3	0	9	0
Total	164	(100)	80/149	(54)	17/145	(12)	176	(100)	50	46	56	24

¹ Denominators indicate patients for whom information is known.

² Includes ear, sputum, urine, and other.

³ Includes non-toxigenic *V. cholerae* O1 (1 isolate) and other non-toxigenic *V. cholerae* [non-O1 non-O139] (13 isolates).

⁴ *V. parahaemolyticus* and *V. alginolyticus* were isolated from two patients; *V. parahaemolyticus*, *V. vulnificus*, and an other *Vibrio* species were isolated from one patient; *V. alginolyticus* and an unidentified *Vibrio* species were isolated from one patient; and *V. hollisae* and an unidentified *Vibrio* species were isolated from one patient.

Table 3. Number of *Vibrio* illnesses (excluding toxigenic *V. cholerae*) by species, complications, and site of isolation in patients from non-Gulf Coast states, 2006

<i>Vibrio</i> Species	Complications ¹						Site of Isolation					
	Patients		Hospitalized		Deaths		Isolates		Stool	Blood	Wound	Other ²
	N	(%)	n/N	(%)	n/N	(%)	N	(%)				
<i>V. alginolyticus</i>	54	(10)	11/49	(22)	1/49	(2)	54	(10)	0	3	25	26
<i>V. cholerae</i> (non-toxigenic) ³	29	(5)	11/27	(41)	2/24	(8)	30	(5)	15	5	4	6
<i>V. damsela</i>	1	(0)	0/1	(0)	0/1	(0)	1	(0)	0	0	1	0
<i>V. fluvialis</i>	23	(4)	9/21	(43)	0/22	(0)	23	(4)	17	1	3	2
<i>V. metschnikovii</i>	1	(0)	1/1	(100)	0/0	(0)	1	(0)	1	0	0	0
<i>V. hollisae</i>	4	(1)	4/4	(100)	0/4	(0)	4	(1)	4	0	0	0
<i>V. mimicus</i>	5	(1)	1/5	(20)	0/5	(0)	5	(1)	4	0	0	1
<i>V. parahaemolyticus</i>	361	(65)	52/336	(15)	0/329	(0)	362	(64)	337	3	12	10
<i>V. vulnificus</i>	46	(8)	36/44	(82)	16/43	(37)	50	(9)	3	27	18	2
Species not identified	20	(4)	7/19	(37)	0/17	(0)	20	(3)	6	1	6	7
Other	3	(1)	1/3	(33)	0/3	(0)	3	(1)	2	0	1	0
Multiple species ⁴	7	(1)	2/6	(33)	0/7	(0)	15	(3)	7	3	2	3
Total	554	(100)	135/516	(26)	19/504	(4)	568	(100)	396	43	72	57

¹ Denominators indicate patients for whom information is known.

² Includes ear, sputum, urine, and other.

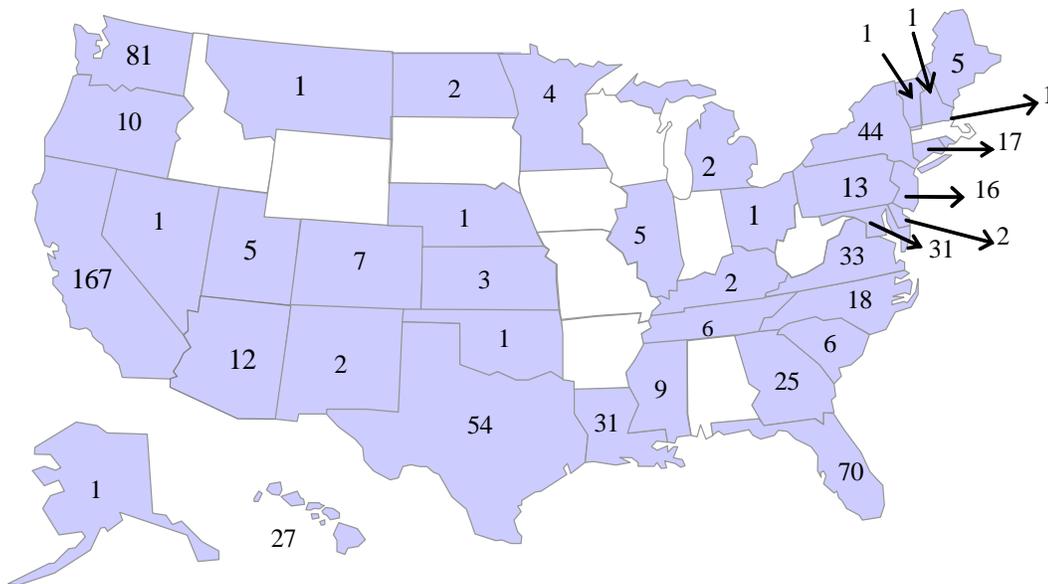
³ Includes non-toxigenic *V. cholerae* O1 (1 isolate), and other non-toxigenic *V. cholerae* [non-O1 non-O139] (28 isolates).

⁴ *V. parahaemolyticus* and *V. vulnificus* were isolated from two patients; *V. alginolyticus* and an other *Vibrio* species were isolated from one patient; *V. cholerae* non-O1, non-O139, *V. cholerae* O1, and *V. cholerae* O139 were isolated from one patient; *V. alginolyticus* and *V. parahaemolyticus* were isolated from one patient; *V. fluvialis* and an other *Vibrio* species were isolated from one patient; and *V. fluvialis* and *V. parahaemolyticus* were isolated from one patient.

Geographic Location

Of the 718 cases in 2006, CDC received 164 (23%) reports of *Vibrio* illness from Gulf Coast states, 286 (40%) from Pacific Coast states, 199 (28%) from Atlantic Coast states (excluding Florida, which is included with Gulf Coast states), and 69 (10%) from inland states (Figure 1). The most frequent *Vibrio* species reported from Gulf Coast states were *V. vulnificus* (32%), *V. parahaemolyticus* (25%), *V. alginolyticus* (17%), and non-toxicogenic *V. cholerae* (9%). The most frequent *Vibrio* species reported from non-Gulf Coast states were *V. parahaemolyticus* (65%), *V. alginolyticus* (10%), *V. vulnificus* (8%), and non-toxicogenic *V. cholerae* (5%).

Figure 1. Number of patients with *Vibrio* isolates (excluding toxigenic *V. cholerae*), by state, 2006 (N=718 patients in 39 states)



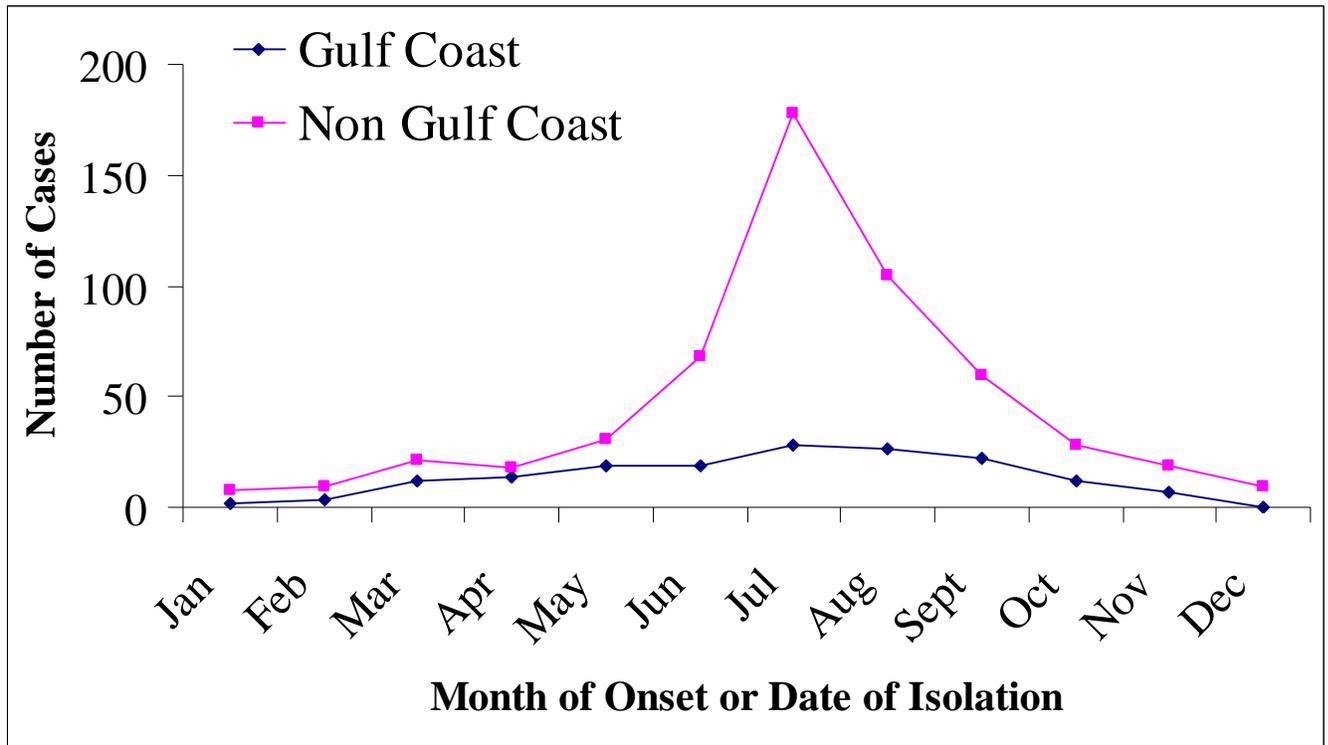
Anatomic Site of Isolation

Among the 744 *Vibrio* isolates from all states, 446 (60%) were from stool, 89 (12%) from blood, and 128 (17%) from wounds. Thirty-six (5%) isolates were obtained from the ear, of which 30 (83%) were *V. alginolyticus*. An additional 45 isolates (6%) were from urine, sputum, or other site. *V. parahaemolyticus* was the species most frequently isolated from stool (359 [80%] of 446 isolates from stool); *V. vulnificus* was the species most frequently isolated from blood (64 [72%] of 89 isolates from blood) and *V. alginolyticus* was the species most frequently isolated from wounds (39 [30%] of 128 isolates from wounds).

Seasonality

The number of patients from whom *Vibrio* species was isolated had a clear seasonal peak during the summer months (Figure 2). The greatest frequency of cases occurred during July for Gulf Coast states and non-Gulf Coast states.

Figure 2. Number of patients with *Vibrio* isolates (excluding toxigenic *V. cholerae*), by month of illness onset or specimen isolation, Gulf Coast states vs. other states, 2006 (N=718).



Exposures

One hundred four (14%) patients reported having a wound either before or during exposure to *Vibrio*. Of those, 97 (93%) reported having skin exposed to a body of water, 32 (31%) reported handling seafood, and 21 (20%) reported contact with marine wildlife. Excluding patients with wound infections, among the 465 for whom a food history was available, 437 (94%) reported eating seafood in the 7 days before illness onset. Among the 208 who reported eating a single seafood item (Table 4), 60% ate oysters (79% of whom consumed them raw), 11% ate finfish, 10% ate shrimp. International travel in the 7 days before illness onset was reported by 53 (8%) of 629 patients for whom information was available.

Table 4. Seafood exposure among patients with foodborne *Vibrio* infection (excluding toxigenic *V. cholerae*) who reported eating a single seafood item in the week before illness onset, 2006 (N=208)

	Mollusks			Crustaceans				Other Shellfish ¹	Finfish ²	Total
	Oysters	Clams	Mussels	Shrimp	Lobster	Crab	Crayfish			
Ate (%)	138 (60)	14 (6)	2 (1)	24 (10)	3 (1%)	20 (9%)	0 (0%)	4 (2%)	26 (11%)	231
% Ate raw	79	64	50	13	0	0	0	25	11	55

¹ Other shellfish reported: prawns, squid, and sushi.

² Finfish reported: catfish, halibut, pomano, salmon, sushi, tilapia, and tuna.

Laboratory

For reports where laboratory confirmation was available, the state public health laboratory identified 216 (98%) of 221 human *Vibrio* isolates, excluding *V. cholerae*. CDC received 147 isolates of *V. parahaemolyticus* from 141 patients. Of these, 41 (30%) from nine states were serotype O4:K12 (Alaska, Colorado, Connecticut, Georgia, Nevada, New Mexico, New York State, Oregon, and Washington); 14 (10%) isolates from eleven public health jurisdictions were of the pandemic clone serotype O3:K6 (Arizona, Colorado, Georgia, Louisiana, Maryland, Montana, New York City, New York State, Texas, Virginia, and Wisconsin); 7 (5%) isolates from six states were serotype O4:K63 (Arizona, Colorado, Mississippi, New York, Louisiana, and Washington); and the remaining 79 isolates were one of 32 serotypes. Twelve possible pandemic clones (thermostable direct hemolysin positive/thermostable direct related hemolysin negative) include four O1:Kuk, two O3:Kuk, and one each of O1:K25, O3:K29, O4:K8, O4:K37, O6:K18, and O8:K41.

Recent Publications

1. *Vibrio parahaemolyticus* infections associated with consumption of raw shellfish--three states, 2006. MMWR Morb Mortal Wkly Rep. Aug 11 2006;55(31):854-8
2. Toxigenic *Vibrio cholerae* Serogroup O141—Associated Cholera-Like Diarrhea and Bloodstream Infection in the United States. JID. Mar 1 2003;187:866-868