Vibrios

Cholera is a Class A Disease and must be reported to the state within 24 hours by calling the phone number listed on the web page.

Non-cholera Vibrio infections are Class C Diseases and must be reported to the state within five business days. All Vibrio cultures should be sent to the State Public Health Laboratory for confirmation.

Epidemiology

All *Vibrio* species infections were added to the list of nationally notifiable diseases in January, 2007. *Vibrios* are Gram-negative, curved, rod-shaped bacteria that are natural inhabitants of the marine environment. In the United States, the transmission of *Vibrio* infection is primarily through the consumption of raw or under-cooked shellfish or by exposure of wounds to warm seawater or seafood drippings.

The most common clinical presentation of *Vibrio* infection is self-limited gastroenteritis. Many cases of *Vibrio*-associated gastroenteritis are under-recognized. This is because most clinical laboratories do not routinely use the selective medium, thiosulfate-citrate-bile-salts-sucrose (TCBS) agar, for processing of stool specimens unless they are specifically requested to do so.

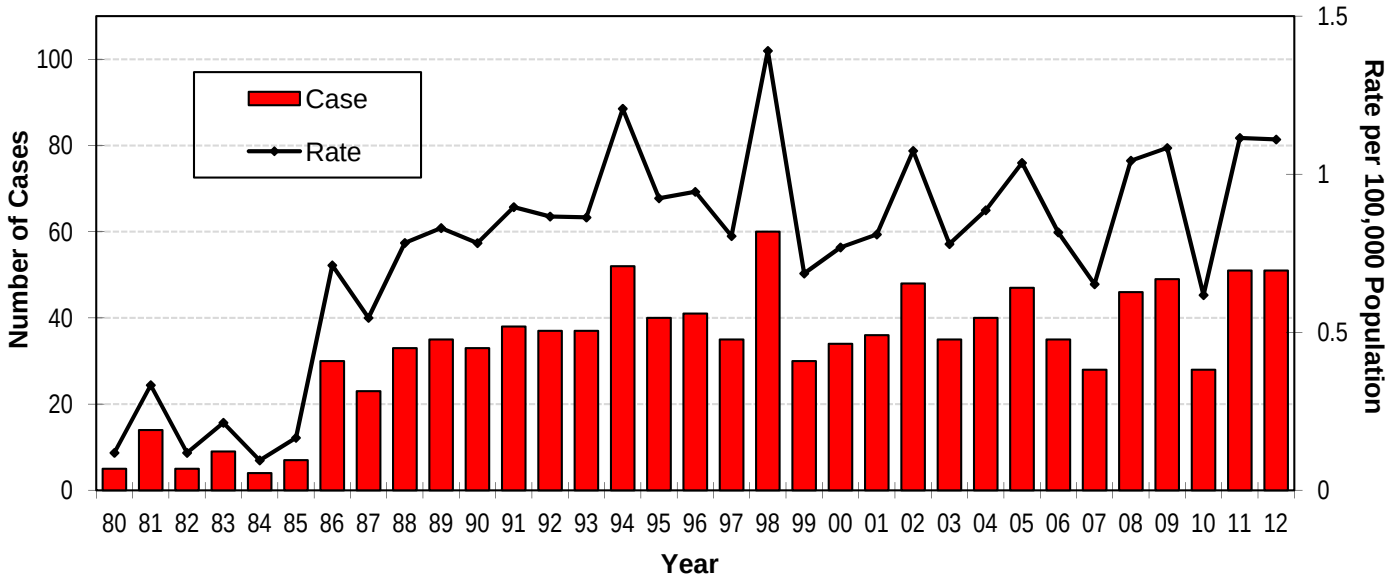
Wound infections and primary septicemia also occur, particularly for *Vibrio vulnificus*. Patients with liver disease and those who are immuno-compromised are at a particularly high risk for significant morbidity and mortality associated with these infections. Early detection and initiation of treatment is very important, particularly for cholera and invasive *Vibrio* infections, because these infections may rapidly progress to death.

According to the Centers for Disease Control and Prevention (CDC), there is an average of 215 culture-confirmed *Vibrio parahaemolyticus* cases, 30 hospitalizations, and one to two deaths reported each year nationwide. They estimate the true number of cases a year to be 4500, most not culture-confirmed. Each year there is an average of 50 culture-confirmed *Vibrio vulnificus* cases, 45 hospitalizations, and 16 deaths reported from the Gulf Coast states (Alabama, Florida, Louisiana, Mississippi and Texas). There are as many as 95 cases nationwide (only half are culture-confirmed), 85 hospitalizations and 35 deaths.

Incidence

The number of reported *Vibrio* infections has remained fairly stable over the past 20 years, ranging from 20 to 50 cases per year, with a slight increase from year-to-year (Figure 1).

Figure 1: Cases and incidence rates - Louisiana, 1980-2012



The most common *Vibrio* species observed in reported cases in Louisiana is *V.vulnificus* (28%), followed by *V.parahaemolyticus* (24%), *V.cholerae non O1* (17%), and all other *Vibrios*. (All other Vibrios include *V.alginolyticus*, *V.damselae*, *V.fluvialis*, *V.hollisae* and *V.mimicus*). *Vibrio cholerae 01* accounts for apprximately 2.5% of total *Vibrio* cases (Table 1).

Table 1: *Vibrio* species distribution - Louisiana, 1980-2012

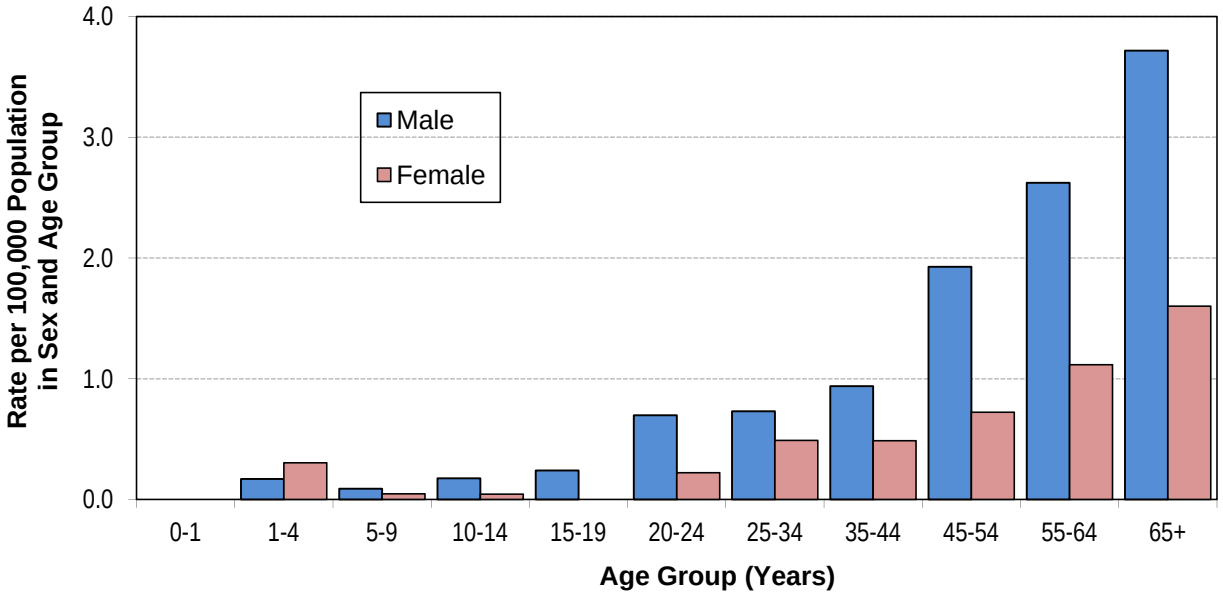
		1980-1989	1990-1999	2000-2009	2010-2012	Total
Vibrio cholerae	*Cholerae* O1	7	9	10	0	25
	Cholerae O1 noTox	0	3	5	0	8
	Cholerae O75	0	0	3	3	6
Vibrio parahaemolyticus		33	94	111	20	258
Vibrio vulnificus		54	94	128	36	312
Vibrio other	*Cholerae* non O1 non O139	41	72	54	34	201
	Alginolyticus	3	18	11	1	33
	Damsela	2	6	1	0	9
	Fluvialis	4	24	24	20	72
	Furnisii	0	0	1	0	1
	Hollisae	2	13	9	24	28
	Mimicus	10	36	39	10	95
	Multiple	4	12	0	12	18
	Species - not identified	15	38	5	1	60
	Subtotal	77	207	144	71	499
Total		**171**	**407**	**398**	**130**	**1108**

Age, Gender, and Race Distribution

Since the distribution is similar for all *Vibrio* cases, the following discussion describes all *Vibrio* species combined.

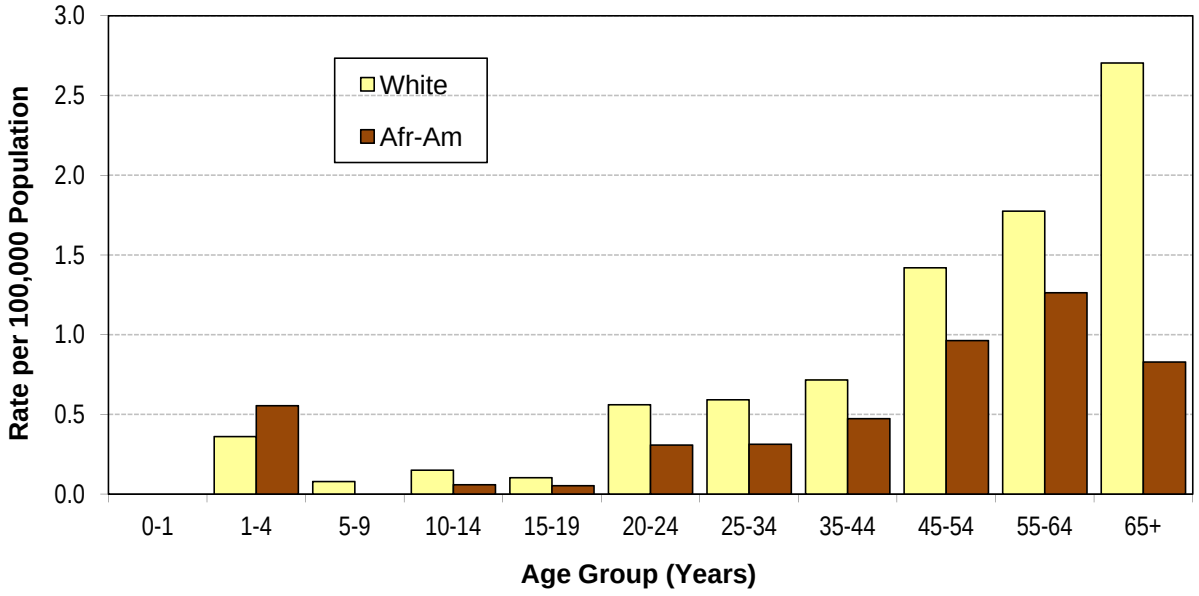
The age group distribution shows an increase in *Vibrio* cases in older age groups. This is an expected finding since adults and older people are more often in contact with seawater, and are the most common consumers of raw seafood (Figure 2).

Figure 2: *Vibrio* annual incidence rates by gender and age - Louisiana, 2000-2012



The race distribution shows a predominance of *Vibrio* infection among Whites in the oldest age group and African-Americans in the one-to-four age group (Figure 3).

Figure 3: *Vibrio* annual incidence rates by race and age - Louisiana, 2000-2012



Geographical Distribution

The **geographical distribution** of *Vibrio* cases shows the highest concentrations in southern Louisiana and the large cities. This is possibly due to easy access to fresh seafood, proximity to beaches and water activity. This distribution reflects the cultural patterns of raw seafood consumption (Table 2).

Table 2: *Vibrio* cases per Region/Parish - Louisiana, 1980-2012

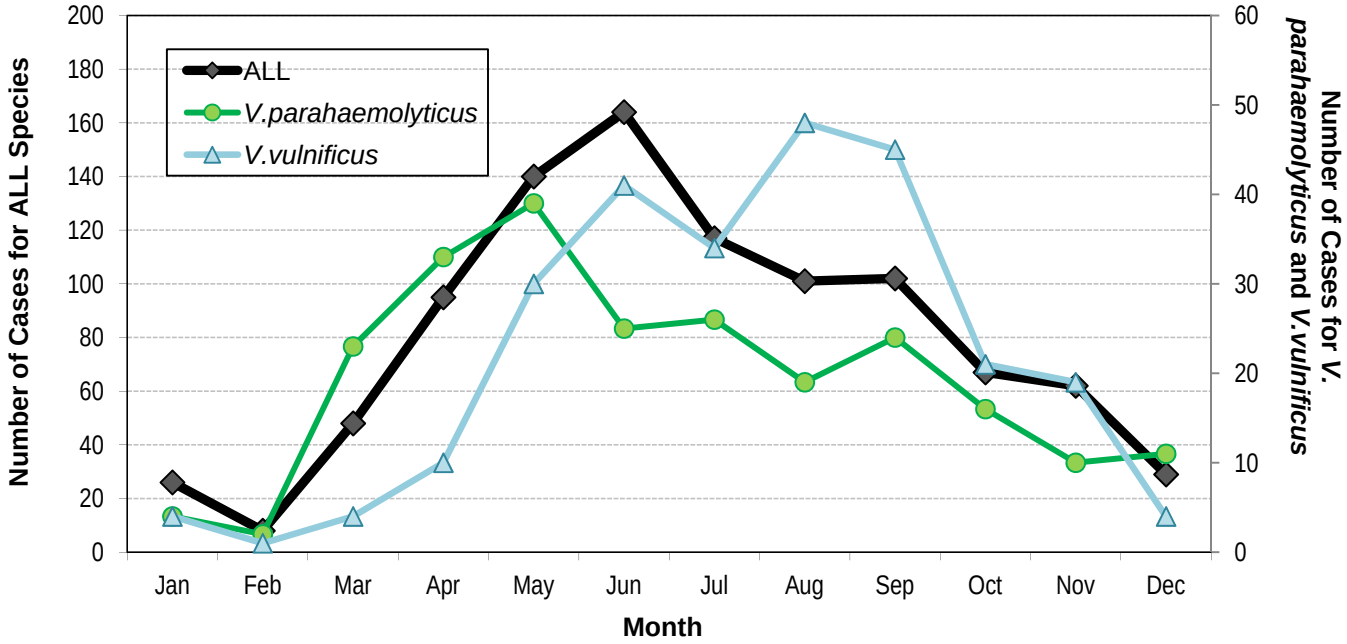
Region	Parish	Cases 1980-1989	Cases 1990-1999	Cases 2000-2009	Cases 2010-2012	Cases 1980-2012	Inc 1980-2012
1	**JEFFERSON**	**43**	**94**	**46**	**14**	**197**	**1.31**
	ORLEANS	**51**	**78**	**63**	**8**	**200**	**1.37**
	ST. BERNARD	**4**	**18**	**17**	**5**	**44**	**2.27**
	PLAQUEMINES	**7**	**7**	**5**	**1**	**20**	**2.48**
2	EAST BATON ROUGE	7	17	16	8	48	0.36
	ASCENSION	0	4	4	2	10	0.42
	WEST BATON ROUGE	0	1	3	1	5	0.74
	IBERVILLE	1	1	1	5	8	0.77
	POINTE COUPEE	0	0	0	0	0	0
	EAST FELICIANA	0	1	0	0	1	0.15
	WEST FELICIANA	0	2	1	0	3	0.71
3	**TERREBONNE**	**1**	**46**	**37**	**19**	**103**	**3.02**
	LAFOURCHE	**7**	**14**	**34**	**6**	**61**	**2.07**
	ST. CHARLES	**3**	**4**	**8**	**1**	**16**	**1.03**
	ST. JOHN	0	4	2	1	7	0.49
	ST. JAMES	**0**	**4**	**6**	**2**	**12**	**1.70**
	ST. MARY	1	3	1	1	6	0.32
	ASSUMPTION	0	2	1	0	3	0.39
4	LAFAYETTE	3	9	30	10	52	0.86
	IBERIA	2	10	7	0	19	0.80
	ACADIA	1	3	4	1	9	0.47
	VERMILION	2	6	2	4	14	0.81
	ST. LANDRY	1	4	3	3	11	0.39
	ST. MARTIN	0	6	1	1	8	0.51
	EVANGELINE	0	0	0	0	0	0
5	CALCASIEU	2	9	14	6	31	0.52
	CAMERON	**1**	**1**	**2**	**0**	**4**	**1.37**
	ALLEN	2	1	1	0	4	0.53
	BEAUREGARD	1	0	1	1	3	0.28
	JEFFERSON DAVIS	0	0	1	1	2	0.19
6	RAPIDES	0	2	1	2	5	0.12
	AVOYELLES	3	1	1	1	6	0.44
	VERNON	1	0	0	0	1	0.05
	GRANT	0	0	1	0	1	0.16
	LA SALLE	0	0	0	0	0	0
	CATAHOULA	0	0	0	0	0	0
	CONCORDIA	0	0	0	0	0	0
7	CADDO	3	3	4	0	10	0.12
	DESOTO	0	0	0	0	0	0
	BIENVILLE	2	0	1	0	3	0.56
	SABINE	0	0	0	0	0	0

	NATCHITOCHES	0	0	0	0	0	0
	RED RIVER	0	0	0	0	0	0
	BOSSIER	0	0	2	3	5	0.16
	WEBSTER	1	0	2	3	0	0.21
	CLAIBORNE	0	0	0	0	0	0
8	OUACHITA	3	1	3	0	7	0.14
	CALDWELL	0	0	0	0	0	0
	EAST CARROLL	0	0	0	0	0	0
	WEST CARROLL	0	0	0	0	0	0
	FRANKLIN	1	0	0	0	1	0.14
	JACKSON	0	1	0	0	1	0.19
	LINCOLN	0	2	0	0	2	0.14
	MADISON	0	0	0	0	0	0
	MOREHOUSE	0	0	1	0	1	0.09
	RICHLAND	0	0	0	0	0	0
	TENSAS	0	0	0	0	0	0
	UNION	0	0	0	0	0	0
	WASHINGTON	2	1	6	0	9	0.62
	WINN	0	0	0	0	0	0
9	**ST. TAMMANY**	**7**	**34**	**35**	**21**	**97**	**1.64**
	TANGIPAHOA	1	9	9	0	19	0.60
	LIVINGSTON	0	0	9	2	11	0.38
	ST. HELENA	0	0	0	0	0	0

Seasonal Distribution

Cases reported by month of illness onset show a definite seasonal pattern (Figure 4).

Figure 4: *Vibrio* cases by month of occurrence - Louisiana, 1988-2012



For all *Vibrio* species, there are few cases from December to February; the numbers increase progressively to reach a peak in June. There is a slight difference in seasonality by species. *Vibrio parahaemolyticus* transmission starts much earlier than *Vibrio vulnificus* transmission.

Clinical Presentation

The clinical presentation is highly dependent on the *Vibrio* species. Gastroenteritis is the most common clinical presentation, followed by wound infection and septicemia. *Vibrio cholerae* O1 causes almost exclusively gastroenteritis; *Vibrio parahaemolyticus* and the other Vibrios cause mostly gastroenteritis, and some wound infections; *Vibrio vulnificus* causes mostly wound infections followed by septicemia and very few gastroenteritis cases (Table 3).

Table 3: Clinical presentation by *Vibrio* group - Louisiana, 1988-2012

Clinical Presentation	**Total**	*V. vulnificus*	*V. parahae-molyticus*	*V. cholerae* -O1	*Vibrio* Other
Gastroenteritis	410	12	124	19	255
Wound Infection	189	121	37	0	31
Septicemia	103	65	9	3	27
Undetermined	249	72	68	12	97
Total Cases	**951**	**270**	**238**	**33**	**410**
Death	66	48	4	0	14
Percent	6.9	17.8	1.7	0	3.4

Most *Vibrio* infections have a good prognosis with the exception of *Vibrio vulnificus.*

Exposure

Seafood consumption accounts for 62% of exposure; 38% comes from exposure of the skin to surface waters, particularly seawater. Exposure is dependent on the *Vibrio* species. Most *Vibrio* infections are foodborne with the exception of *Vibrio vulnificus* for which exposure to sea water is a major exposure factor (Table 4).

Table 4: Exposure type by *Vibrio* group = Louisiana, 1988-2012

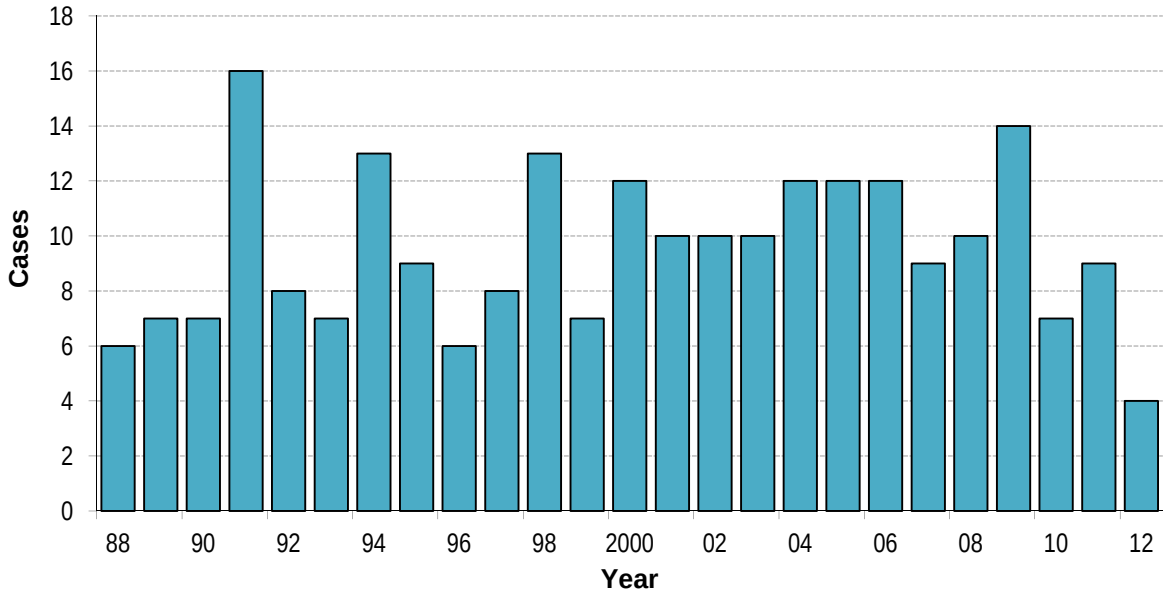
Exposure	**Total**	**Percentage**	*V. vulnificus*	*V. parahae-molyticus*	*V. cholerae* –O1	*Vibrio* other
Skin exposure						
Seawater/Wound	109	23.0	74	24	0	11
Seawater/Unspecified	23	5.3	16	3	2	2
Floodwater/Other surface water	19	4.4	15	0	0	4
Dripping/Wound	27	5.7	13	6	1	7
Crab bite	4	0.8	3	0	0	1
Subtotal	182	38.1				

Food Consumption						
Oyster/Raw	63	13.2	14	16	0	33
Oyster/Raw/Shellfish	35	7.3	6	6	1	22
Oyster/Shellfish Cooked	4	0.8	0	1	0	3
Shellfish/Cooked	152	31.8	13	43	11	85
Shellfish/Raw	37	7.7	6	14	0	17
Oysters/Cooked	5	1.0	0	3	0	2
Subtotal	296	61.9	39	83	12	162
Grand Total	478		160	116	15	187

Vibrio parahaemolyticus

Vibrio parahaemolyticus represents about 22% of *Vibrio* infections. The number of reported cases of *V. parahemolyticus* has remained stable over the years (Figure 5).

Figure 5*: Vibrio parahaemolyticus*, annual cases - Louisiana, 1988-2012



Most cases of *Vibrio parahaemolyticus* present as simple gastroenteritis (72.9%), wound infections (21.8%), or rarely septicemia (5.3%) (Table 3). Hospitalizations and deaths are rare.

Everyone is susceptible to gastroenteritis due to a *Vibrio parahaemolyticus* infection.

Consumption of crustacean and molluscan shellfish is commonly implicated in the transmission of *V. parahaemolyticus.* Raw oysters are another source of foodborne *V. parahaemolyticus* infection.

- About 19.3% of patients with *V. parahaemolyticus* gastroenteritis with known food history, reported eating raw oysters alone or with other seafood. Studies indicate that the infectious dose of *V. parahaemolyticus* is greater than one million viable cells ingested. This dose may be lowered in case of consumption of antacids or food with buffering capacity, at the same time as ingestion of the infectious dose.

- Another 52% reported eating cooked seafood. Of those reporting cooked seafood consumption, the most common items reported were:
  - shrimp
  - crawfish
  - crabs
  - cooked oysters

  Note: some cases reported eating more than one cooked seafood item.

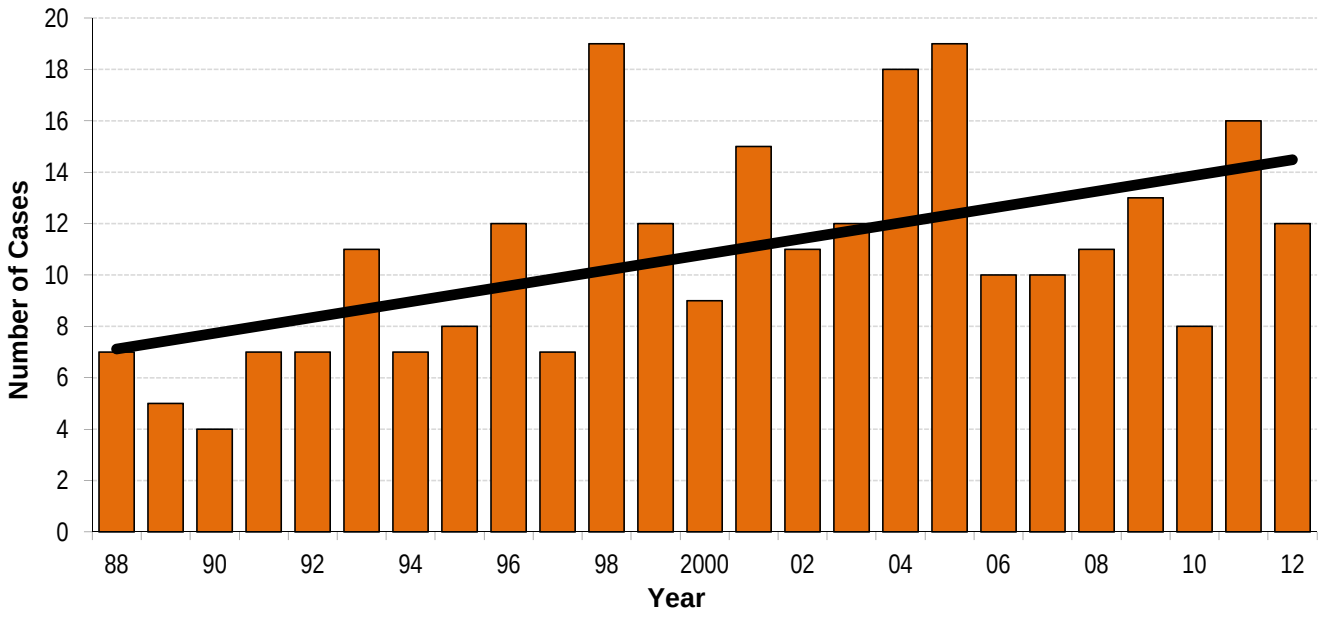
- Finally, 28% of all *Vibrio parahaemolyticus* cases did not consume seafood but had skin exposure to sea or brackish water.

Vibrio Vulnificus

V. vulnificus is the most important pathogenic *Vibrio* in the U.S. because of its invasiveness and the high fatality rates associated with infection. It was first identified and described by the CDC in 1976 and has become a cause of seafood-associated deaths in the United States.

There has been a steady increase in the number of *V. vulnificus* cases reported over the years (Figure 6).

Figure 6*: Vibrio vulnificus*, annual cases - Louisiana, 1988-2012



The most common clinical presentation is a wound infection (61.1%) followed by septicemia (32.8%) with the least common being gastroenteritis (6.1%).

About 91% of patients infected by *Vibrio vulnificus* had one or more medical risk factors. *Vibrio vulnificus* occurs almost exclusively among immuno-compromised patients or patients with end-stage liver failure. With increasing survival rates of this susceptible population, it is expected that the

number of infections will also continue to increase.

High-risk conditions are: chronic liver disease, hemochromatosis, diabetes, cancers (particularly those on chemo or radio-therapy), leukemia, lymphoma, Hodgkin's, immune suppression (such as HIV), long term steroid use, alcoholism, chronic kidney disease and being elderly. The virulence of *V. vulnificus* in humans is associated with the availability of iron. Patients with increased iron stores, such as is seen in hemochromatosis, alcoholic liver disease, or hemolytic anemia, are susceptible to septicemia (mostly fatal) with *V. vulnificus*. The organism is unable to use transferrin-bound iron for growth; however, in patients with iron overload and transferrin saturation of 75% or higher, free iron is available for use by the organism. Other studies have shown that invasive disease caused by *V. vulnificus* could also be due to resistance to host phagocytic defense mechanisms. Disorders such as diabetes and HIV have been shown to be associated with defects in phagocytosis.

For those with risk factor information available, medical risk factors observed were:

- Severe chronic liver disease 33.3 %
- Diabetes 23.7 %
- Chronic alcoholism 19.4 %
- Kidney failure 17.2 %
- Malignancy 9.1%
- Antacid use 8.6 %
- H2 blocker use 11.8 %

The clinical presentation of *Vibrio vulnificus* infection is dependent on the type of exposure to the bacteria (Table 5).

Table 5: Exposure* and clinical presentation for *Vibrio vulnificus*-Louisiana, 1988-2012

Exposure	Wound Infection		Septicemia		Gastroenteritis	
	Number	Percentage	Number	Percentage	Number	Percentage
Contact with sea/surface water	70	78.7	20	42.6	2	22.2
Seafood drippings on skin	38	42.7	25	53.2	1	11.1
Raw/cooked shellfish	10	11.2	19	40.4	4	44.4
Raw oysters alone/with seafood	4	4.5	19	40.4	2	22.2
Total with known exposures	**89**		**47**		**9**	

*Multiple exposures were reported for some cases.

Other Non-Cholerae Vibrios

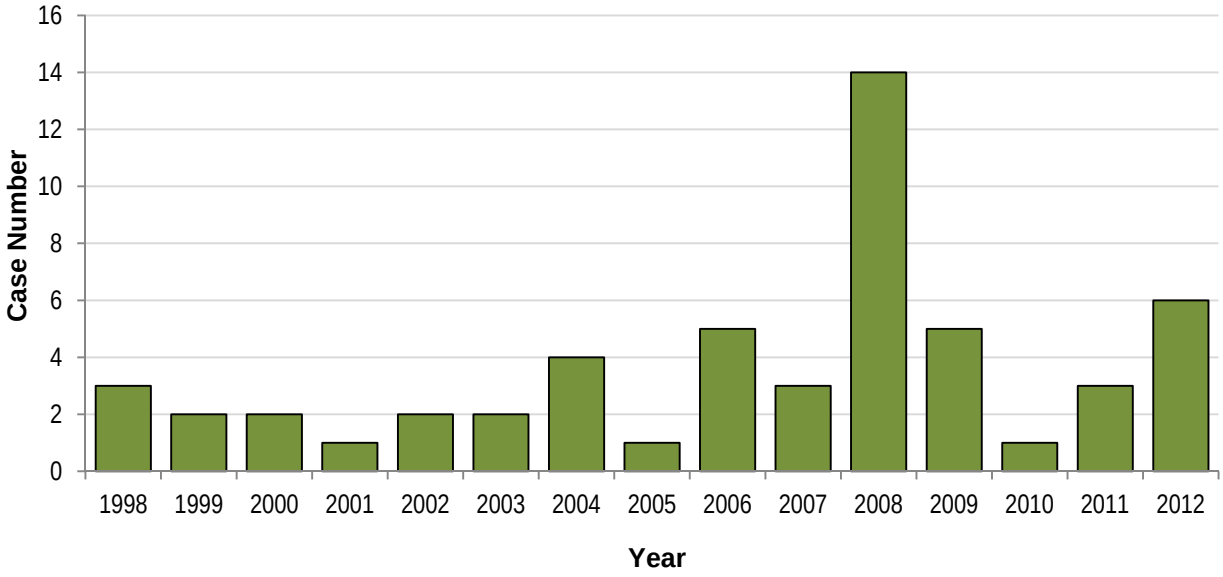
The increase in reported numbers of other non-cholerae *Vibrios* is attributed to increased awareness among medical providers and laboratory testing.

V. alginolyticus is a halophilic *Vibrio*, first recognized as being pathogenic in humans in 1973. Wound infections account for most of *V. alginolyticus* infections; ear infections are also seen with this organism. Gastroenteritis is thought to be a rare presentation of *V. alginolyticus* infection. Other clinical syndromes reported in association with *V. alginolyticus* infection include chronic diarrhea in a

patient with AIDS, conjunctivitis and post-traumatic intracranial infection. Resistance to tetracycline and chloramphenicol has been reported in a few isolates of *V. alginolyticus*, but all strains appear to be sensitive to ciprofloxacin. There is on average, one case reported in Louisiana each year.

V. mimicus is a non-halophilic *Vibrio* named according to its similarity to *V. cholerae*. *V. mimicus, and as human pathogen,* can cause sporadic episodes of acute gastroenteritis and ear infections. It was the most frequently reported *Vibrio* serotype in 2008 with 14 cases (30%), (Figure 7).

Figure 7: *Vibrio mimicus* cases – Louisiana, 1998-2012



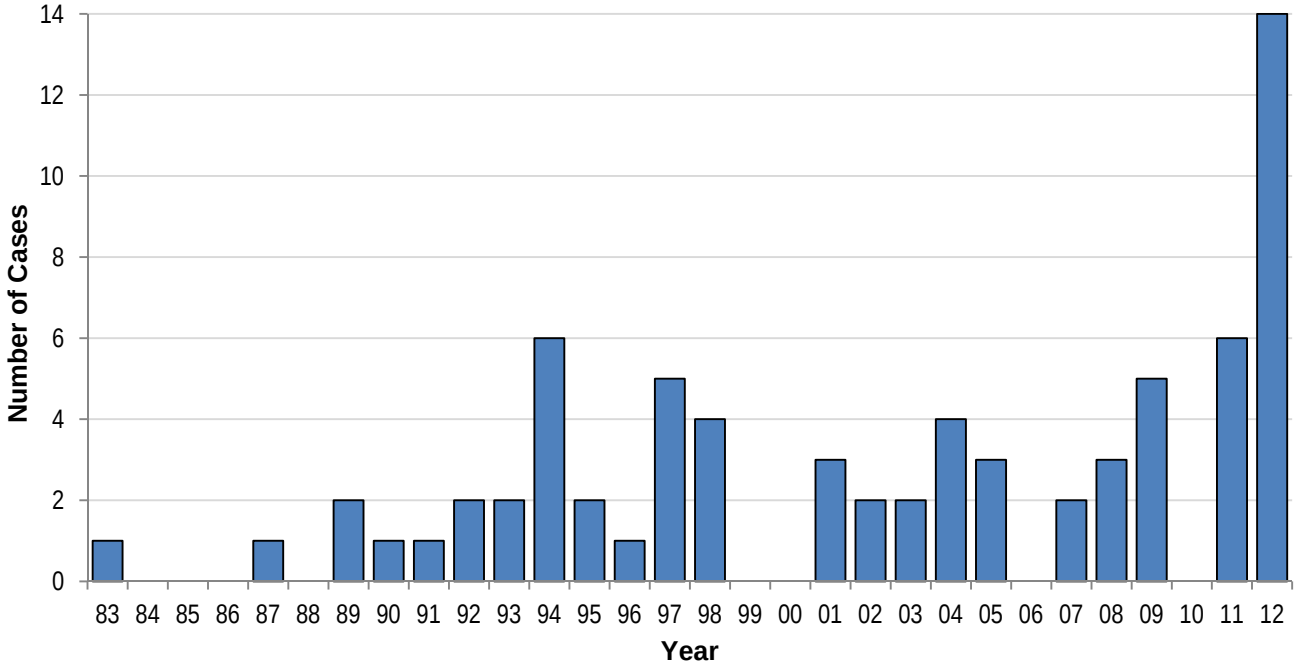
V. mimicus is an etiological agent of sporadic watery diarrhea and food poisoning after the consumption of raw or cooked fish or shellfish. Eighty-five percent of *V. mimicus* cases reported in 2008 were related to the consumption of cooked fish or cooked shellfish.

V. mimicus can produce enterotoxins which are virtually identical to the Cholera toxin (CT), produced by *V. cholerae*. In 2008, 71% (ten) of the isolates were tested at the CDC; six isolates showed the presence of CT using Polymerase chain reaction (PCR). Pulse-field gel electrophoresis (PFGE) was performed on all ten isolates to determine molecular subtype of the bacteria. All ten *V. mimicus* isolates differed in their PFGE pattern. The six patients whose isolates were positive for CT, volunteered to have their blood tested for the presence of antibodies to CT. Serum collected from three of the patients tested positive for the presence of antibodies to the CT toxin. Antibodies to Cholera toxin (CT) do not seem to be sufficient to protect against further infections. The presence of CT has been shown in literature several times, but a patient infected with *V. mimicus* CT-like toxin and developing anti-CT antibodies has not been documented in literature.

V. fluvialis is a halophilic Vibrio, first identified in Bahrain in 1975, in a patient with diarrhea. It is biochemically similar to *Aeromonas hydrophila* but can be differentiated from this organism by its ability to grow well on media containing 6% to 7% sodium chloride. The largest series of *V. fluvialis* infections involved 500 patients in Bangladesh, half of whom were young children. In that series, patients presented with diarrhea (100% with 75% bloody diarrhea), vomiting (97%), abdominal pain (75%), dehydration (67%), and fever (35%). *V. fluvialis* rarely causes wound infections or primary

septicemia. On average, about two cases of *Vibrio fluvialis* are reported each year in Louisiana. In 2012, 14 cases were reported in Louisiana, 12 of which were confirmed by the State Public Health Lab (Figure 8).

Figure 8: *Vibrio fluvialis* cases – Louisiana, 1983-2012



Of the *V. fluvialis* cases reported in 2012, over half were male (57%). The median age for cases was 60 years of age with a range of six to 84 years. Fifty percent of the cases were from Region 3, the remaining cases were from Regions: 1, 4, 7 and 9. Over half of the cases were hospitalized (57%). Two cases were wound infections; the remaining 12 were gastroenteritis cases. Symptoms reported by gastroenteritis cases were diarrhea (92%), nausea (75%), abdominal cramps (75%), vomiting (58%), bloody stools (33%), and fever (33%). Over half (57%) of cases had at least one more pathogen isolated from the same source as the *V. fluvialis*. Other pathogens isolated were *Plesiomonas shigelloides* (two), *Aeromonas* (two), MRSA, Group B Streptococcus, *Proteus mirabilis, Edwardsiella, Clostridium difficile* and Algea. Exposure information was obtained on nine of the 14 cases. Of the gastroenteritis cases with known exposure, 70% reported consuming raw oysters either alone or with other seafood prior to onset and 30% reported consuming seafood other than oysters.

Photobacterium damsela (formerly *Vibrio damsela*), is a halophilic, Gram-negative bacillus similar to *V.vulnificus.* It strictly causes soft-tissue infections following exposure of wounds to brackish water or injury by saltwater animals. *P.damsela* infections can be fulminant and frequently are fatal even in immuno-competent hosts. Of the 16 cases of *P.damsela* infection reported between 1982 and 1996, four were fatal.

Grimontia hollisae (formerly *V.hollisae)* is a halophilic *Vibrio*, first described in 1982. It most

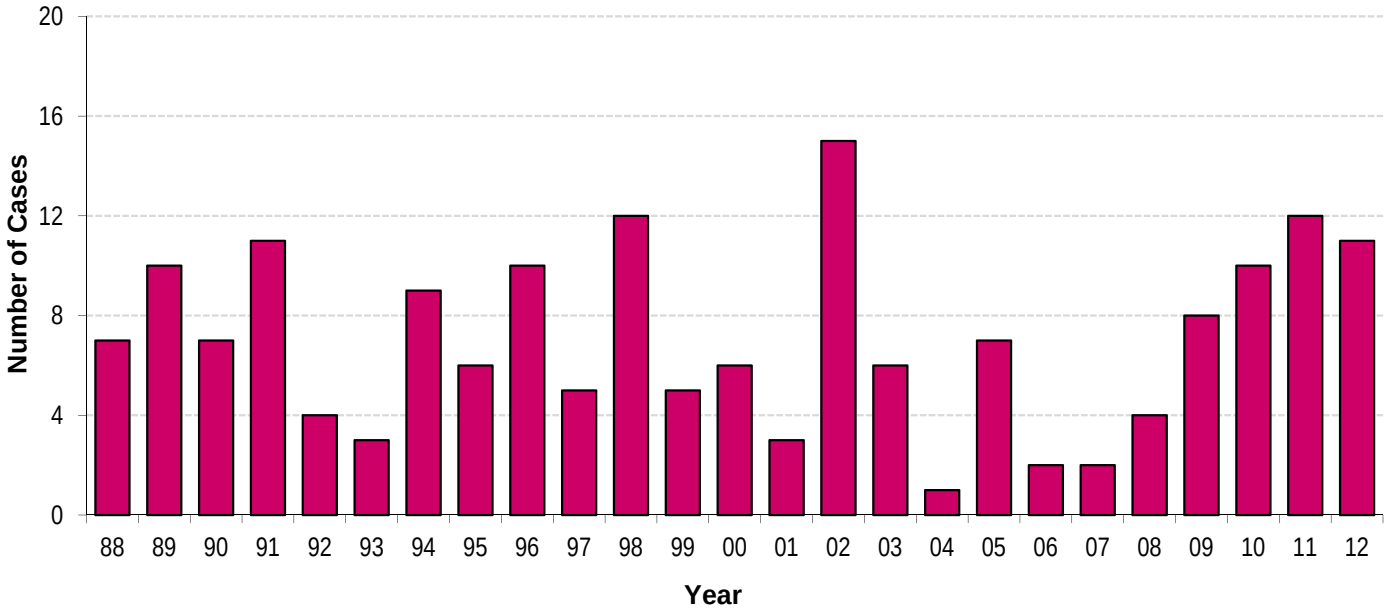
commonly causes gastroenteritis. *G.hollisae* is difficult to isolate, since it grows poorly on selective TCBS media and it needs to be isolated from colonies on a blood agar plate. *G. hollisae* septicemia and wound infections have been reported, but are rare. On average, one case of *G.hollisae* is reported each year in Louisiana.

Vibrio Cholerae Non-O1

Vibrio cholerae is classified in groups according to its somatic antigen O.

Non-O1s are found in surface waters (freshwater rivers, ocean) throughout the world. The infection is acquired by ingesting heavily contaminated water or food (raw or poorly cooked seafood, especially oysters, clams, shrimp or crabs). Small outbreaks are sometimes reported (Figure 9).

Figure 9*: Vibrio cholerae* non-O1, annual cases - Louisiana, 1980-2012



These infections usually occur in individuals with increased susceptibility to infections: immuno-compromised individuals with gastric disease (low gastric acidity) or liver disease.

V.cholerae non-01 can produce a wide range of symptoms: asymptomatic infections, simple diarrhea, or severe diarrheal disease. Some isolates are capable of producing a toxin indistinguishable from *V.cholerae O1*. Diarrhea and simple enteritis is the most common clinical picture. Approx-imately a quarter of infected patients have bloody stools. Illness usually is self-limiting and requires no treatment.

Vibrio cholera O75

In Louisiana, there have been five reported cases of *Vibrio cholerae* O75 with two cases reported in 2000, and one case reported each year since 2009. Two cases of *Vibrio cholerae* O75 toxigenic were reported in Louisiana in 2011. One case was part of a multistate outbreak (LA, GA, IN, TN, AL)

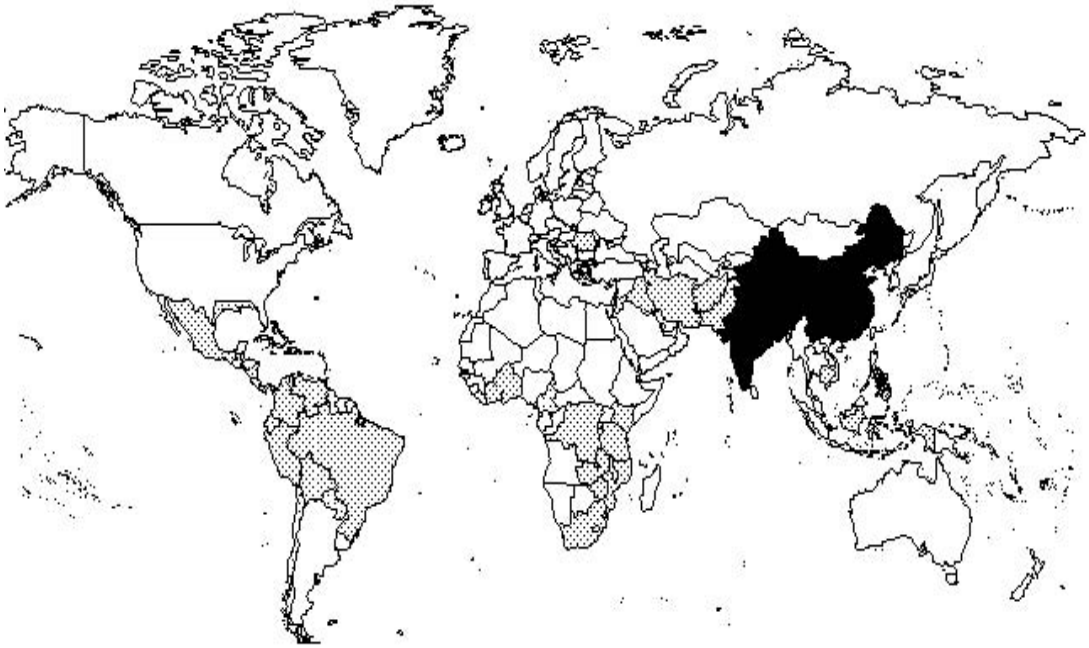
associated with consumption of raw or lightly cooked oysters from Apalachicola Bay in Florida. All PFGE patterns of the *V. cholerae* O75 isolates were similar. The main illness was gastroenteritis with no hospitalizations and no deaths.

Vibrio Cholerae O1

V. cholerae O1 and *V. cholerae O139* are the main causes of pandemic cholera. The world now is experiencing a seventh cholera pandemic, with the El Tor variant of *V. cholerae O1* being the infectious agent. The pandemic started in Indonesia in 1961, spread through the Middle East in the late 1960s and into Africa in the 1970s, where it remains endemic. In 1991, the pandemic reached South America through Peru and spread rapidly.

From 62 cases reported world-wide in 1961, the number reached a peak of 595,000 in 1991. The classical biotype has not disappeared and has caused major epidemics (1982 in Bangladesh). By 1993 the number had decreased somewhat to 300,000. Cholera is now well implanted in Southeast Asia, Africa and South America, with sporadic cases throughout the world (Figure 10).

Figure 10*:* Seventh cholera pandemic, 1961-1991



The O1 group includes the serotypes Ogawa, Inaba and Hikojima, the classical bio-types and El Tor. El Tor, a variant of the classical cholera, was isolated from a patient in the Sinai Peninsula in 1903. At that time it was considered to be non–pathogenic, but it now has become the agent responsible for the seventh pandemic. El Tor differs from classical *V. cholerae* in its ability to agglutinate chicken erythrocytes, its sensitivity to polymyxin B and its resistance to cholera phage group 4. Cholera O1 also is classified by toxin production: toxigenic or nontoxigenic.

In 1992, toxigenic *V.cholerae O139* (the Bengal strain) was recognized as another cause of cholera. *V.cholerae O139*, first discovered on the Indian subcontinent, has been reported in the United States as

an imported infection. Although the primary organism that causes cholera globally is *V cholerae O1*, continued laboratory surveillance of *V.cholerae O139* is recommended because it has similar epidemic potential.

Vibrio cholerae O1 represents about 3% of all Vibrio cases reported in Louisiana over the past 20 years (Figure 11).

Figure 11*: Vibrio cholerae O1*cases - Louisiana, 1980-2012