

Bad Bug Book

Foodborne Pathogenic Microorganisms and Natural Toxins

Vibrio vulnificus

1. Organism

This Gram-negative, curve-shaped bacterium is found in estuarine environments and is associated with various marine species, such as plankton, shellfish, crustaceans, and finfish. It is found throughout coastal waters of the continental United States.

Optimal temperatures for *V. vulnificus* are between 20°C to 35°C; it can grow at temperatures up to 41°C. It is slowly inactivated at temperatures <10°C (minimum growth temperature), and cultures should never be stored in refrigerators. *V. vulnificus* is halophilic; the highest abundance in oysters is at 23ppt. It is lysed almost immediately in freshwater; thus, it is not usually transmitted via the fecal-oral route. At least 0.5% NaCl is required in all media, and 2% NaCl is optimal. Like other vibrios, *V. vulnificus* is highly susceptible to low pH, freezing, and cooking. Most strains of *V. vulnificus* produce a capsule, but all strains can be killed by common disinfectants, such as bleach and alcohol.

2. Disease

Although illness from this *Vibrio* species is less common than that from other *Vibrio* species (which are addressed separately, in other chapters), it more often tends to be deadly. If the infection is detected early, *V. vulnificus* is susceptible to treatment with antibiotics; generally tetracycline.

For Consumers: A Snapshot

There are different kinds (species) of *Vibrio*, a bacterium. This one doesn't cause cholera (that type of *Vibrio* is covered in another chapter), and it doesn't cause illness as often as the other kinds – just under 100 cases a year – but when it does, the illness is more often fatal. If it's detected early, certain antibiotics can be used to treat it. This kind of *Vibrio* usually lives in estuaries; for example, where sea water and river water come together. Water contaminated with *Vibrio* can cause illness if people drink the water or eat seafood (shellfish, such as oysters and clams, and shrimp, as a few examples) that has been living in it, or if the contaminated water comes into contact with food in other ways. Cooked foods should always be kept from touching raw foods, to prevent contamination. That's especially important with this kind of *Vibrio*, which grows easily in cooked food if it becomes contaminated. In people with weak immune systems, especially, illness from this kind of *Vibrio* can go on to infect the blood and cause serious or deadly infections in other parts of the body, too. About 35% of people in whom the infection has spread to the blood die. A few examples of people with weak immune systems are those with HIV/AIDS or who are on medicines that lower the actions of the immune system, like some drugs for rheumatoid arthritis or cancer treatment. People with high levels of iron in their blood, usually due to liver disease, also are at higher risk. These people, especially, who are at higher risk for whatever reason, should always thoroughly cook their seafood and should see a health professional if they develop symptoms. You can help protect yourself by cooking seafood until the inside reaches a temperature, for at least 15 seconds, of 145°F, but 155°F for fishcakes and 165°F for stuffed fish. It's also important to wash raw foods in sanitary water and to wash hands, equipment, and surfaces when handling or cooking food; keep food refrigerated at 40°F or lower; and keep raw foods from touching cooked foods and equipment and surfaces used for cooking or eating. After kitchen surfaces are washed, sanitize them with a commercially available product that's sold as a kitchen sanitizer. You might have heard people say that you should eat oysters or other shellfish only in months with the letter "R" – for example January, February, etc. But remember that *Vibrio* and other bacteria (and viruses) that affect seafood can cause illness in *any* month, so follow basic [food-safety tips](#) all year.

- **Mortality:** Death occurs in an average of 35% of septicemia cases (and 20% of wound-infection cases).

- **Infective dose:** The infective dose from ingestion of *V. vulnificus* is largely unknown, since human feeding studies involving this organism would be unethical. The FAO/WHO *V. vulnificus* Risk Assessment (VVRA) provides a dose response based on U.S. epidemiologic data and estimates that (1) a dose of 1,000 organisms can cause illness and (2) at a total dose of 1 million organisms, the risk of disease for susceptible people is 1:50,000.
- **Onset:** The range of time to onset of gastroenteritis symptoms may be approximately 12 hours to 21 days. (Onset of symptoms in cases of wound infection may be in as few as 4 hours.) The mean time to septicemia is 4 days.
- **Illness / complications:** In healthy people, ingestion of this organism can cause gastroenteritis that generally remains localized and is self-limiting. Among susceptible people, the organism may cause primary septicemia (septic shock). Susceptible people include those with a predisposing condition; for example, those who are immunocompromised or have high serum iron levels (usually due to liver disease). More than 60% of those with septicemia develop secondary lesions on the extremities, similar to those found in wound infections.

V. vulnificus also can cause wound infections directly, either through wounds incurred while handling fish, crustaceans, or shellfish, or when a pre-existing wound is exposed to marine or estuarine waters harboring the organism. Wound infections caused by *V. vulnificus* are characterized by inflammation at the wound site, which can progress to cellulitis, bullous lesions, and necrosis. The infection can become systemic, with affected people developing fever, chills, altered mental status, and hypotension.

Secondary lesions from septicemia, as well as primary wound infections caused by direct contact, frequently require surgical debridement or amputation.

- **Symptoms:** Gastroenteritis caused by *V. vulnificus* is characterized by fever, diarrhea, abdominal cramps, nausea, and vomiting. Onset of septicemia is characterized by fever and chills, occasionally accompanied by vomiting, diarrhea, abdominal pain, and/or pain in the extremities.
- **Duration:** In uncomplicated cases, gastroenteritis is self-limiting. The mean duration of septic illness is 1.6 days (i.e., the brief duration is reflective, in part, of the high mortality associated with septicemia).
- **Route of entry:** The gastroenteritis form of illness caused by *V. vulnificus* results from ingestion of the organism.
- **Pathway:** *V. vulnificus* harbors many putative virulence factors, including capsule, pili, hemolysins, metalloproteases, and enterotoxins. However, none of these factors has been shown unequivocally to be essential in causing disease; much remains unknown.

3. Frequency

Sporadic illnesses have been attributed to this organism, but no foodborne outbreaks have been reported. [The Centers for Disease Control and Prevention \(CDC\) estimates](#) that 96 cases of foodborne illness from *V. vulnificus* occur annually in the U.S. Sporadic cases are more prevalent during the warmer months, when water temperatures are higher than 20°C (68°F).

4. Sources

More than 90% of *V. vulnificus* illnesses in the U.S. are associated with consumption of raw Gulf Coast oysters. Ingestion of clams and shrimp also has been associated with disease. Thorough cooking or freezing kills the organism, so illnesses usually occur from consumption of raw seafood or cooked seafood that has been contaminated with raw product.

5. Diagnosis

The culturing of the organism from wounds, diarrheic stools, or blood is diagnostic of this illness.

6. Target Populations

Anyone who eats raw seafood products harboring *V. vulnificus*, or cooked seafood products cross contaminated with the organism, may develop gastroenteritis. People with predisposing conditions are the most susceptible to septicemia and should eat seafood products only if they have been properly cooked. Predisposing conditions include chronic liver disease (cirrhosis, hepatitis, liver transplantation, or cancer of the liver), elevated serum iron levels (hemochromatosis), compromised immune system (chemotherapy, steroid or other immunosuppressive medication use, AIDS), other chronic illnesses (diabetes, renal disease, intestinal disease), and insufficient gastric acid.

Anyone may develop wound infections from contact with estuarine waters.

7. Food Analysis

FDA's [Bacteriological Analytical Manual](#) (BAM) describes the methods most commonly used to isolate this organism from foods. More recent molecular methods are available that can be applied directly to seafood products to screen for the presence of *V. vulnificus* prior to isolation.

8. Examples of Outbreaks

No outbreaks of *V. vulnificus* have been reported. Sporadic cases occur throughout the year, increasing in frequency during the warmer months.

Additional illness information can be found in CDC's [Morbidity and Mortality Weekly Reports](#).

9. Resources

[National Center for Biotechnology Information Taxonomy](#) provides information on the historical classification of *V. vulnificus*, as well as current genetic sequence information.

[The CDC Disease Listing](#) provides information about *V. vulnificus*.

[FAO/WHO Risk Assessment of *Vibrio vulnificus* in Raw Oysters](#) structures knowledge about *V. vulnificus* in a systematic manner and includes mathematical models developed to estimate exposure to this microorganism.

[Interstate Shellfish Sanitation Conference](#) is a cooperation of state and federal control agencies, the shellfish industry, and the academic community that promotes shellfish sanitation and provides educational material.

[Safe Oysters](#). A gateway to *Vibrio vulnificus* information for health care providers, food and health educators, consumers, fishermen, and commercial processors.

Additional Reading:

Food and Agricultural Organization and World Health Organization, 2010. Risk Assessment of *Vibrio vulnificus* in Raw Oysters: Interpretative Summary and Technical Report, World Health Organization / Food and Agriculture Organization of the United Nations, Rome, Italy.

Haq SM, Dayal HH. 2005. Chronic liver disease and consumption of raw oysters: a potentially lethal combination--a review of *Vibrio vulnificus* septicemia. Am. J. Gastroenterol. 100:1195-1199.

Strom MS, Paranjpye RN. 2000. Epidemiology and pathogenesis of *Vibrio vulnificus*. Microbes. Infect. 2:177-188.