

Vibrio parahaemolyticus

1. Organism

This bacterium is a Gram-negative, curve-shaped rod frequently isolated from the estuarine and marine environments of the United States and other tropical-to-temperate coastal areas, worldwide. Both pathogenic and non-pathogenic forms of the organism can be isolated from marine and estuarine environments and from seafood harvested from these environments.

In general, the majority of *V. parahaemolyticus* isolates from the environment are non-pathogenic. Currently, pathogenic strains are identified by the presence of one or both of the hemolysins TDH (thermostable direct hemolysin) and TRH (thermostable-related hemolysin).

Optimal temperatures for *V. parahaemolyticus* are 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. parahaemolyticus* is halophilic; the highest abundance in oysters is at 23 ppt salt. 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. parahaemolyticus* is highly susceptible to low pH, freezing, and cooking. Most strains of *V. parahaemolyticus* produce a capsule, but all strains can be killed by common disinfectants, such as bleach and alcohol.

2. Disease

(Note: *Vibrio parahaemolyticus* does not cause cholera and should not be confused with *Vibrio* species that do; i.e., *Vibrio cholerae*, which are addressed in a separate chapter).

For Consumers: A Snapshot

There are different kinds of *Vibrio*, a bacterium that can cause illness when contaminated seafood is eaten. Illness from this kind of *Vibrio* is linked mostly to oysters, although other kinds of contaminated fish and shellfish also sometimes cause the illness. It doesn't cause cholera (that kind of *Vibrio* is covered in another chapter), but can cause bloody diarrhea, stomach cramps, fever, nausea, and/or vomiting, which usually are fairly mild and last less than a week. But in people with weak immune systems, it can spread to the blood and cause serious or deadly infections in other parts of the body. Examples of people at higher risk are those with diabetes, liver disease, kidney disease, cancer, AIDS, or other illnesses that weaken the immune system, and those on medications meant to lower the actions of the immune system, like some kinds of drugs for rheumatoid arthritis or cancer treatment. These people, especially, should always thoroughly cook their seafood, and should see a health professional if they develop symptoms. This kind of *Vibrio* usually lives in ocean water along the coast or in estuaries where, for example, ocean water comes together with river water. Water contaminated with *Vibrio* can cause illness if people drink the water or eat seafood that has been living in it, or if the contaminated water comes into contact with food in other ways. 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 things like fishcakes and 165°F for stuffed fish. Because bacteria, such as *Vibrio*, can grow in foods that have been cooked, but have then been contaminated by raw food, be sure to keep raw foods from touching cooked foods and surfaces used for cooking or eating. It's also important to wash raw foods in sanitary water and wash hands, equipment, and cooking and food-handling surfaces; and keep food refrigerated at 40°F or lower. 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 long.

- **Mortality:** Death occurs in approximately 2% of gastroenteritis and 20% to 30% of septicemia cases.
- **Infective dose:** The [FDA *V. parahaemolyticus* Risk Assessment](#) states that the ID₅₀ (median infective dose) is 100 million organisms. However, evidence from an outbreak in 2004 suggests an infectious dose >1,000-fold less than in the FDA risk assessment.
- **Onset:** The incubation period is 4 to 90 hours after ingestion of the organism, with a mean of 17 hours.
- **Illness / complications:** *V. parahaemolyticus*-associated gastroenteritis is the name of the infection caused by consumption of this organism. It is usually mild or moderate. Diarrhea caused by this organism is usually self-limiting, with less than 40% of reported cases requiring hospitalization and/or antibiotic treatment.

Although the illness is generally mild or moderate, *V. parahaemolyticus* can also cause septicemia in susceptible people. Those at risk include people with diabetes, liver disease, kidney disease, cancer, AIDS, or other illnesses that result in an immunocompromised state, and those on immunosuppressive medications.

In addition to the foodborne gastrointestinal illness, this organism also can cause wound infections. This occurs either through exposure of a pre-existing wound to contaminated marine or estuarine water or through wounds incurred while handling fish, shellfish, or crustaceans.

- **Symptoms:** Diarrhea, abdominal cramps, nausea, vomiting, fever, and bloody diarrhea may be associated with gastroenteritis infections caused by this organism.
- **Duration:** The median duration of the illness is 2 to 6 days.
- **Route of entry:** Oral (in the case of foodborne, gastroenteritis infections. As noted, wound infections also can occur through direct exposure.)
- **Pathway:** The complete pathway by which *V. parahaemolyticus* causes disease remains unclear. However, it is known that TDH is a pore-forming toxin that lyses red blood cells and can attack intestinal cells, disrupting the electrolyte balance. The mechanism of TRH toxin is similar to TDH, disrupting electrolyte flux in intestinal cells.

3. Frequency

The Centers for Disease Control and Prevention (CDC) estimates that about 45,000 illnesses from *V. parahaemolyticus* occur each year, in the United States, and that about 86% of them are foodborne. A correlation exists between probability of infection and warmer months, when water temperatures are greater than 15°C (59°F). CDC estimates that only 1 in 20 cases of *V. parahaemolyticus* are reported, and it is likely that hospitalization and death are rare among unreported cases.

4. Sources

In the U.S., infections with this organism generally are associated with consumption of raw or improperly cooked oysters. Other seafood products, including finfish, squid, octopus, lobster, shrimp, crab, and clams, have been linked to *V. parahaemolyticus* illnesses, more frequently in Asian countries.

Thorough cooking kills the *Vibrio* organisms, so illnesses usually occur from consumption of raw seafood or cooked seafood that has been contaminated with raw product. Improper refrigeration of seafood products contaminated with this organism will allow its proliferation, which increases the possibility of infection.

5. Diagnosis

Diagnosis is made by culturing the organism from a person's stool, wound, or blood (in septicemia cases).

6. Target Populations

Anyone who eats raw or improperly cooked seafood products is susceptible to infection by this organism. People with compromised immune systems are at greater risk of septicemia and death.

7. Food Analysis

[FDA's Bacteriological Analytical Manual](#) (BAM) describes the methods most commonly used to isolate this organism from foods. Many food isolates are non-pathogenic; therefore, testing food isolates for the virulence determinants is recommended. The BAM recommends a DNA probe and/or a PCR procedure for identification of genes responsible for TDH and TRH production. Additionally, there are more recent molecular methods available for virulence characterization, many of which can be applied directly to seafood products, to screen for the presence of pathogenic organisms prior to isolation.

8. Examples of Outbreaks

Shellfish were linked to 177 cases in New York, Oregon, and Washington, in 2006. In 2004, in Alaska, 62 cases were linked to consumption of raw oysters. Reported outbreaks can be found in CDC's [Morbidity and Mortality Weekly Reports](#).

9. Other Resources

- The [National Center for Biotechnology Information Taxonomy](#) provides information about the historical classification of *V. parahaemolyticus*, as well as current genetic sequence information.
[CDC](#) provides information about *V. parahaemolyticus*.
- [The FDA risk assessment on *Vibrio parahaemolyticus*](#) structures knowledge about

V. parahaemolyticus in a systematic manner. It includes mathematical models developed to estimate exposure to this microorganism, dose-response relationships, and effectiveness of mitigation strategies.

Additional Reading

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