Vibrio cholerae non-O1 non-O139

1. Organism

This Gram-negative, curve-shaped bacterium is naturally occurring in brackish (i.e., somewhat salty) water, but survives and occurs in aquatic environments ranging from freshwater to open ocean. Non-O1 non-O139 *Vibrio cholerae* typically do not produce cholera toxin (CT), and little is known about how these organisms cause disease. The only serogroups of *V. cholerae* currently recognized as causing cholera are O1 and O139; however, cholera-like symptoms have been infrequently reported in the United States from CT-producing strains from serogroups O141 and O75.

(Note: This organism should not be confused with other *Vibrio* serogroups or species addressed in other chapters of this book; i.e., *Vibrio cholerae* O1 and O139, which does cause cholera; *Vibrio parahaemolyticus*; and *Vibrio vulnificus*.)

V. cholerae non-O1 non-O139 are more hardy than most of the other pathogenic *Vibrio* spp., and have the ability to survive in freshwater and in water composed of up to ~3% salt. However, these organisms are very susceptible to cold temperatures, including freezing, and acid environments. Additionally, cooking food thoroughly kills *V. cholerae* non-O1 non-O139. *V. cholerae* non-O1 non-O139 are not encapsulated, and are susceptible to common disinfectants, such as ethanol and bleach.

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), but can cause diarrhea, stomach cramps, fever, nausea, and/or vomiting, which usually go away by themselves in about a week. In people with weak immune systems, it can go on to infect the blood and cause serious or deadly infections in other parts of the body, and about 5% of those people die each year. 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 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 water that's mildly salty, but also can live in the ocean and fresh inland waters, such as rivers. It can also get into the water from the bowel waste of infected people (for example, from sewage). 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. In the U.S., more than 17,000 cases of this illness occur each year. 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. It's 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 Januar**y**, Febr**u**ar**y**, 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.

2. Disease

Non-Ol non-O139 *V. cholerae* causes gastroenteritis, but not cholera. Occasionally, it causes septicemic infections among people with predisposing conditions. Those conditions include chronic liver disease (cirrhosis, hepatitis, liver transplantation, and cancer of the liver), elevated serum iron levels (hemachromatosis), compromised immune system (for example, chemotherapy, steroid use and other immunosuppressive medications, AIDS), other chronic

illnesses (diabetes, renal disease, intestinal disease, and insufficient gastric acid). People with these conditions, especially, should eat seafood only if it has been properly cooked.

- **Mortality**: The fatality rate is about 5%, generally among people with the predisposing conditions listed above.
- **Infective dose:** It is suspected that large numbers (more than 1 million) of the organism must be ingested to cause illness.
- **Onset**: Symptoms usually appear within 1 to 3 days of ingestion.
- **Illness / complications:** Diarrhea resulting from ingestion of this organism is generally self-limiting. However, septicemia infections can result, and there is approximately a 5% fatality rate associated with non-O1 non-O139 *V. cholerae*, generally in people having predisposing conditions similar to those for *V. vulnificus* infection.
- **Symptoms**: Diarrhea, abdominal cramps, and fever are the predominant symptoms associated with this illness, with vomiting and nausea occurring in approximately 25% of infected people. Approximately 25% of infected people have blood and mucus in their stool.
- **Duration**: Symptoms usually resolve within 7 days.
- **Route of entry**: Oral. (Occasionally, infections with this organism that are not foodborne occur in wounds and ears.)
- **Pathway**: Very little is known about how non-CT producing strains of *V. cholerae* cause disease. These strains generally produce other types of enterotoxins, such as RTX (repeats in toxin); however, none have been shown to be absolutely necessary for infection.

3. Frequency

The Centers for Disease Control and Prevention (CDC) estimates that 17,564 cases of foodborne illness from these *Vibrio* species occur annually in the U.S.

4. Sources

Sporadic cases generally occur along the coasts of the U.S. and are associated with consumption of raw, improperly cooked, or cross-contaminated seafood during the warmer months.

5. Diagnosis

Diagnosis of a *V. cholerae* infection is made by culturing the organism from patients' diarrheic stool or from the blood of patients with septicemia.

6. Target Populations

Anyone who eats raw shellfish is susceptible to diarrhea caused by this organism. As noted above, cirrhotic or immunocompromised people may develop severe complications, such as septicemia.

7. Food Analysis

FDA's Bacteriological Analytical Manual (BAM) describes the methods most commonly used to isolate this organism from foods. Pathogenic and non-pathogenic forms of the organisms do exist; therefore, testing food isolates for the virulence determinants is recommended. The BAM recommends a PCR method for the detection of the gene responsible for CT production.

8. Examples of Outbreaks

This organism generally is associated with sporadic illnesses and rarely causes outbreaks. In the spring of 2011, the first oyster-associated *V. cholerae* O75 outbreak in the U.S. occurred. There were 10 illnesses associated with consumption of raw oysters from Florida. (See Onifade TJM, Hutchison R, Van Zile K, Bodager D, Baker R, Blackmore C. 2011. Toxin producing *Vibrio cholerae* O75 outbreak, United States, March to April 2011. Eurosurveillance. 16(20):pii=19870.)

9. Resources

- CDC disease listing – General information about *V. cholerae*.
- National Center for Biotechnology Information Taxonomy. Information about the historical classification of *V. cholerae*, as well as current genetic sequence information.

Additional reading:

FAO/WHO, 2005. Risk Assessment of Choleragenic *Vibrio cholerae* O1 and O139 in Warm-Water Shrimp in International Trade: Interpretative Summary and Technical Report, World Health Organization / Food and Agriculture Organization of the United Nations, Geneva, Switzerland.

CDC. 2008. Summary of human *Vibrio* cases reported to CDC, 2007.

Crump JA, Bopp CA, Greene KD, Kubota KA, Middendorf RL, Wells JG, Mintz ED. 2003. Toxigenic *Vibrio cholerae* serogroup O141-associated cholera-like diarrhea and bloodstream infection in the United States. J. Infect. Dis. 187:866-868.

Tobin-D'Angelo M, Smith AR, Bulens SN, Thomas S, Hodel M, Izumiya H, Arakawa E, Morita M, Watanabe H, Marin C, Parsons MB, Greene K, Cooper K, Haydel D, Bopp C, Yu P, Mintz E. 2008. Severe diarrhea caused by cholera toxin-producing *Vibrio cholerae* serogroup O75 infections acquired in the southeastern United States. Clin. Infect. Dis. 47:1035-1040.

Vezzulli L, Guzman CA, Colwell RR, Pruzzo C. 2008. Dual role colonization factors connecting *Vibrio cholerae's* lifestyles in human and aquatic environments open new perspectives for combating infectious diseases. Curr. Opin. Biotechnol. 19:254-259.

West BC, Silberman R, Otterson WN. 1998. Acalculous cholecystitis and septicemia caused by non-O1 *Vibrio cholerae*: first reported case and review of biliary infections with *Vibrio cholerae*. Diagn. Microbiol. Infect. Dis. 30:187-191.