

# The Cholera Epidemic

Kelly A. Reynolds, Ph.D.

The word "cholera" brings to mind horrible images of illness and death, but cholera isn't always fatal. In fact, the general public knows little of the disease or its prevention.

## What is cholera?

Onset of illness is generally sudden—as soon as six hours after ingestion. With symptoms of abdominal cramps, nausea and vomiting, it's easy to think it could be just another case of the flu instead of something more serious? If left untreated, *Vibrio cholerae* infections can lead to dehydration, shock and even death. *Vibrio cholerae serogroup 01* is the bacterium responsible for recent outbreaks of cholera spreading rapidly throughout Central and South American countries, although there have been no major outbreaks of this form of the disease in the United States since 1911.

Symptoms of cholera infections vary from a symptomatic, or mild, to severe watery diarrhea. All persons are believed to be susceptible to *V. cholerae* infections, however, immunocompromised individuals may experience more severe symptoms and prolonged infection. Researchers estimate that approximately one million

organisms must be ingested to initiate disease. Once ingested, the bacterium is thought to attach to the lining of the small intestine and produce a harmful toxin.

Other *Vibrio* species have also been indicated as human pathogens but are associated with much milder forms of disease. For example, *Vibrio cholerae serigraph non-01* causes bloody diarrhea in addition to cramps, nausea, vomiting and fever, with some cases lasting as long as seven days. This organism may also become disseminated in the blood stream, causing further complications, especially in immunocompromised individuals. Sporadic cases occur throughout the year in the United States, especially in warmer months, and isolation from U.S. coastal waters is frequent. However, no outbreaks have been documented. Conversely, major outbreaks have occurred in the U.S. due to *Vibrio parahaemolyticus*, another related bacterium generally associated with mild diarrheal illness. This organism is common in Japan where large outbreaks occur with regularity.

## Factors contributing to outbreaks

*Vibrio* species are naturally present in estuarine (rivers and lakes) and marine

environments of both developing and developed countries. Shared habitats with bathers and shellfish offer routes of transmission via recreational activities and consumption of raw or improperly cooked seafood. Consumption of contaminated food and water are the most common routes of *Vibrio* infection. In addition to immunocompromised individuals, persons with reduced gastric acids (including those who consume antacids) and persons suffering from malnutrition tend to be susceptible to a lower infectious dose and contract more severe forms of the illness. Infected individuals shed *Vibrio* pathogens in their feces, contributing to the spread of the organism to areas other than marine and estuarine environments, such as municipal waste that may ultimately compromise drinking and surface waters. Cholera is generally a disease spread by poor sanitation and propagated by conditions of compromised water quality.

In 1991, outbreaks of cholera in Peru quickly grew to epidemic proportions following a reduction in water disinfection practices. The disease spread throughout the Western Hemisphere, resulting in over 340,000 cases and 3,600 deaths since January of that year. As the world's population continues to increase, officials question whether municipal infrastructures are capable of supporting this growth. This is particularly acute in aging systems where cracked pipes allow for

infiltration of pathogenic organisms in the water supply. In addition, overcrowding leads to increased water use and depletion of water resources, which leads to conditions of poor sanitation and hygiene and facilitates the spread of a variety of waterborne pathogens.

## Treatment options

*Vibrio* infections are often self-limiting and are highly treatable, provided a clean water source is accessible. Patients must be dehydrated, not just with water, but with a solution of sodium chloride, sodium bicarbonate, potassium chloride and glucose to replace valuable electrolytes lost through rapid dehydration. If treatment is delivered immediately after the first signs of illness, less than 1 percent of cholera patients die. Unfortunately, in developing countries, a clean water source is often not available and adequate treatment, therefore, is not possible. Antibiotics, such as tetracycline, have been shown to shorten the duration of the illness but the most important treatment is to prevent dehydration by electrolyte replacement.

## Outbreak prevention

The Centers for Disease Control in Atlanta recommends drinking only bottled or boiled water in areas where cholera outbreaks are prevalent. Carbonated beverages are also safe due to their high acid content but should be consumed without ice. All consumed foods should be thoroughly cooked, including vegetables, fish and shellfish and fruit should be peeled to eliminate surface contamination. Any raw food items that may have been in contact with contaminated water should be rinsed in chlorinated water, peeled or avoided altogether—such as salads. Antibiotics have not proven successful for limiting

the spread of cholera. This is in part due to the large number of asymptomatic individual—who don't readily show symptoms (as many as 90 percent of those infected)—capable of unknowingly spreading the disease. Vaccines are available but do not offer long-term immunity and have not been highly effective in clinical trials.

Environmental factors play an important role in *Vibrio* distribution. High nutrient loads (i.e. from agricultural run-off) and warm temperatures often lead to algal blooms in coastal regions that may harbor, amplify and transmit *Vibrio* pathogens.<sup>3</sup> Disaster conditions of hurricanes, typhoons, monsoons, earthquakes, etc., also play a role in pathogen transmission by contributing to compromised infrastructures and degradation of drinking water supplies through breaching of barriers between sewage and water systems. By recognizing the role climatologically factors play in water quality, we may better prepare for future water-borne outbreaks.

With drinking water being a major medium for the transport of pathogenic *Vibrio* organisms, it is an obvious target for outbreak control. The limited number of cholera cases noted in the United States has been attributed to the widespread use of chlorine disinfection and point-of-use treatment devices, in addition to increased sanitation practices and designated waste treatment and disposal. Further evidence for this is the decline of urban infrastructure in the former Soviet Union and resulting recurrence of cholera in many cities.<sup>4</sup> For cholera, supplying populations with safe water and sanitation has worked to reduce the incidence where trade barriers, quarantine, antibiotic prophylaxis and ineffective vaccines have failed.<sup>1</sup>

## Conclusion

In order to address some of these important water quality issues, the American Academy of Microbiology convened a colloquium of experts in microbiology, engineering, epidemiology and risk assessment in Guayaquil, Ecuador, in April 1995.

The colloquium titled, "Global Issues in Microbiological Water Quality for the Next Century/" focused on the needs—from policy and scientific viewpoints—concerning microbial risks in drinking water. Recognizing that the world's population continues to lack access to microbiologically safe drinking water, the colloquium concluded:

- The list of waterborne pathogens is increasing;
- Development, implementation, and maintenance of low-cost, low-technology water treatment systems are critical for reduction of global disease;
- Waterborne disease must be made reportable with active surveillance systems implemented;
- Improved risk assessment methodology and database development are needed;
- Individuals and officials must be educated about the social and economic burden of waterborne diseases; and
- Policies related to waterborne disease must be initiated to enable implementation of water treatment.

Inherent in these conclusions are multiple opportunities for the water treatment industry to take part in the reduction of widespread morbidity and mortality due to infectious diseases. Through product development and induced awareness, we may play an important role in focusing on the need to offer the world access to safe drinking water. □

## References

1. Barua, D., and V.I.H. Merson, "Prevention and control of cholera," In: Barua, D., and W.B. Grencough III (eds.) *Cholera*, Plenum, N.Y., 1992.
2. Centers for Disease Control, "Cholera—Peru," *Morbidity & Mortality Weekly Report*, 1991, 40: 108-110.
3. Hug, A., P.A. West, E.B. Small, M.I. Hug and R.R. Colwell, "Influence of water temperature, salinity, and pH on survival and growth of toxigenic *Vibrio cholerae* serovar 01 associated with live copepods in laboratory microcosms," *Applied Environmental Microbiology*, 1984, 48:420-424.
4. Ingram, M., "Cholera epidemic hits former Soviet

states," *British Medical Journal*, 1995, 311: 528-529.

## About the author

◆ *Dr. Kelly A. Reynolds is a research scientist at the University of Arizona with a focus on the development of rapid methods for detecting human pathogenic viruses in drinking water. She also is a member of the WC&P Technical Review Committee.*

*If you have questions concerning this column or if there is a topic you would like addressed, please let us know. Contact Editors, WC&P, 2800 E. Fort Lowell, Tucson, AZ 85716; (520) 323-6144, (520) 323-7412 (fax); email: [publico@azstarnet.com](mailto:publico@azstarnet.com)*