Centers for Disease Control and Prevention
National Center for Environmental Health
Vessel Sanitation Program

Health Practices on Cruise Ships: Training for Employees
Transcript

Waterborne Illnesses

The Centers for Disease Control and Prevention's Vessel Sanitation Program is proud to bring to you the following session: Waterborne Illness. While this session primarily for cruise vessels under the jurisdiction of the Vessel Sanitation Program, it may be used by anyone who is interested in this topic. This session should not be used to replace existing interactive training, but should be used as an adjunct to a comprehensive training program. Waterborne illness.

Learning objectives. At the end of the session, you will be able to list the pathogens associated with waterborne illness outbreaks, list the routes of transmission for waterborne pathogens, and list the prevention methods for specific pathogens.

Waterborne illnesses. There are potable water illnesses and recreational water illnesses, and we'll be discussing both of these.

Waterborne outbreak agents. There are bacterial agents, viral agents, parasitic agents, and chemical agents which cause waterborne illness.

Routes of transmission. Waterborne illnesses can be caused by ingestion or consuming water, by dermal contact, which is contact of the water with skin or mucous membranes, or by inhalation, which is by breathing in a mist or aerosolized water particles.

Bacterial pathogens. We will be discussing each one of these pathogens in detail: E. coli O157:H7, Salmonella, Salmonella typhi, Shigella, Campylobacter, Vibrio cholerae, Pseudomonas, and others.

Escherichia coli. There are several pathogenic strains of Escherichia coli, which are classified under enterovirulent E. coli. They are enterohemorrhagic, enteroinvasive, enterotoxigenic, enteropathogenic, and enteroaggregative. Escherichia coli O157:H7, the basics. It's a bacteria. It causes diarrheal illness, and it's classified as an enterohemorrhagic E. coli. In its most severe form, it can cause hemorrhagic colitis. The reservoir for this bacteria are cattle, deer, goats, and sheep. Humans can also be a reservoir. It is typically associated with contaminated food and water. E. coli O157:H7 prevention. Prevention strategies for this pathogen include source protection, halogenation of water, or boiling water for one minute. Salmonella species, the basics. It's a bacteria. It causes diarrheal illness known as salmonellosis. Humans and animals are the reservoir, and it's typically associated with contaminated food and water. Salmonella

species, prevention. Prevention strategies for this pathogen include source protection, halogenation of water, and also boiling water for one minute.

Salmonella typhi, the basics. It's a bacteria. It causes diarrheal illness, also known as typhoid fever. And humans are the reservoir for this pathogen. Salmonella typhi, prevention. Prevention strategies for this pathogen include source protection, halogenation of water, and boiling water for one minute.

Shigella species, the basics. It's a bacteria. It causes diarrheal illness known as shigellosis. Humans and primates are the reservoir for this pathogen. Shigella species, in the United States-- two-thirds of the shigellosis in the U.S. is caused by Shigella sonnei, and the remaining one-third is caused by Shigella flexnieri. In developing countries, Shigella dysenteriae is the primary cause of illness associated with this pathogen. Shigella species, prevention. Prevention strategies for this pathogen include source protection, halogenation of water, and boiling water for one minute.

Campylobacter, the basics. It's a bacteria. It causes diarrheal illness. And Campylobacter is primarily associated with poultry, animals, and humans. Campylobacter, prevention. Prevention strategies for this pathogen include source protection, halogenation of water, and boiling water for one minute.

Vibrio cholerae, the basics. It's a bacteria. It causes diarrheal illness, also known as cholera. It is typically associated with aquatic environments, shellstocks, and human. Vibrio cholerae has also been associated with ship ballast water, and there will be a discussion later on in this presentation of an outbreak associated with ship ballast water. Vibrio cholerae, prevention. Prevention strategies for this pathogen include source protection, halogenation of water, and boiling water for one minute.

Legionella, the basics. It's a bacteria. It causes a respiratory illness known as legionellosis. There are two illnesses associated with legionellosis: the first, Legionnaire's disease, which causes a severe pneumonia, and the second, Pontiac fever, which is a non-pneumonia illness; it's typically an influenza-like illness, and it's less severe. Legionella is naturally found in water, both natural and artificial water sources. Legionella, prevention. Maintaining hot water systems at or above 50 degrees Centigrade and cold water below 20 degrees Centigrade can prevent or control the proliferation of Legionella in water systems. Hot water in tanks should be maintained between 71 and 77 degrees Centigrade. Proper recreational water system maintenance and disinfection can prevent the proliferation of Legionella in recreational water systems. It is important to prevent water stagnation. This can be accomplished by eliminating dead ends in distribution systems and in recreational water systems. Additionally, preventing biofilm development is important to control this particular pathogen in water systems.

Pseudomonas, the basics. It's a bacteria. It is caused by dermal contact with water. It can cause dermatitis, which is an inflammation of the skin, or it can cause otitis, which is an infection of the ear. Pseudomonas is typically associated with soil and water. Pseudomonas, prevention. Proper maintenance and disinfection of recreational water systems is important in preventing Pseudomonas.

Viral pathogens. We will be discussing Hepatitis A and Norovirus in this presentation. Hepatitis A, the basics. It's a virus. It causes inflammation of the liver. And the reservoir for Hepatitis A virus is humans.

Hepatitis A, prevention. Prevention strategies for this pathogen include source protection and adequate disinfection. Fecal matter can protect Hepatitis A virus from chlorine. Additionally, Hepatitis A virus is resistant to combined chlorines, so it is important to have an adequate free chlorine residual.

Norovirus, the basics. It's a virus. It causes diarrheal illness. And humans are the reservoir for this virus. Norovirus, prevention. Prevention strategies for this pathogen include source protection. Parasitic pathogens. During this presentation, we will be discussing Cryptosporidium, Giardia, and Schistosomatidae.

Cryptosporidium, the basics. It's a parasite. It causes diarrheal illness known as crytpsporidiosis. It is typically associated with animals and humans, and it can be acquired through consuming fecally contaminated food, contact with fecally contaminated soil and water. Cryptosporidium, prevention. Prevention strategies for this pathogen include source protection. A CT value of 9,600 is required when dealing with fecally accidents. CT equals a concentration, in parts per million, while time equals a contact time in minutes. Cryptosporidium can also be prevented or eliminated by boiling water for one minute. Filtration with an "absolute" pore size of one micron or smaller can eliminate Cryptosporidium. And reverse osmosis is known to be effective as well.

Giardia, the basics. It is a parasite. It causes diarrheal illness known as giardiasis. It is typically associated with water. It is the most common pathogen in waterborne outbreaks. It can also be found in soil and food. And humans and animals are the reservoir for this pathogen. Giardia, prevention. Prevention strategies for this pathogen include source protection; filtration, coagulation, and halogenation of drinking water.

Schistosomatidae, the basics. It is a parasite. It is acquired through dermal contact, cercarial dermatitis. It is commonly known as swimmer's itch. The reservoir for this pathogen are aquatic snails and birds. Schistosomatidae, prevention. Prevention strategies for this pathogen include eliminating snails with a molluscicide or interrupting the life cycle of the parasite by treating birds with an antihelmetic drug.

Chemical illnesses. Chemical illnesses associated with potable water and recreational water are too numerous to itemize. They are typically associated with cross-connections and run-off. Some chemical contamination can occur naturally.

Waterborne illness associated with drinking water by etiologic agent, United States 1999 to 2000. As we can see from this slide, 51% of the outbreaks were associated with the pathogens we just discussed.

The following slide will discuss waterborne outbreaks that have occurred both in the United States and also in Europe. CAPTAIN CAGLE: Waterborne outbreaks. In the following slides, we'll be discussing potable water and recreational water outbreaks. Potable water outbreaks.

What: cholera. Who: this resulted in greater than 10,000 fatalities. When: 1854. Where: in Soho, England. Why: poor sanitary conditions of city water system. This was the result of contamination of the city's water supply from cesspits. In the middle of the 19th century, 1854, Soho had become an unsanitary place. Underneath the floorboards of the overcrowded cellars lurked a sea of cesspits as old as the houses, and many of these had never been drained. It was only a matter of time for a big outbreak to occur. It finally did so in the summer of 1854. When a wave of Asiatic cholera first hit England in late 1831, it was thought to be spread by miasma in the atmosphere. By the time of the Soho outbreak 23 years later, medical knowledge about the disease has barely changed, though one man, Dr. John Snow, a pioneer of science of epidemiology, had recently published a report speculating that it was spread by contaminated water.

What: typhoid. Who: 1,000 individuals were infected. When: 1885. Where: this occurred in Plymouth, Pennsylvania. Why: as a result of contaminated water pumped into the city's water supply.

Death rate for typhoid fever, United States, 1900 to 1960. This slide depicts the reduction in typhoid fever cases in the United States. The first system to be chlorinated in the United States was Boonton, New Jersey, in 1908. Chlorine standards were then introduced in 1914. In Wheeling, West Virginia, in 1918 to 1919, there were approximately 155 to 200 cases of typhoid fever per 100,000 population. After the introduction of chlorination in the first part of 1919, there were only seven cases per 100,000. In developing countries, 80% of all diseases are caused by consuming water contaminated with pathogens and pollutants. This slide depicts that correlation. On the left hand of the slide shows access to safe potable drinking water, while the right-hand side shows death rates for children under five. You can see a direct correlation to access to the safe potable drinking water and the reduction in those death rates.

What: E. coli O157:H7. Who did it affect? There were 243 cases, 32 hospitalizations, and four deaths. When: 1989. Where: Cabool, Missouri. Why: there was no disinfection of

the city's water supply during heavy rains, when run-off ran through cattle manure and washed into the well system.

What: Cryptosporidium. Who did it affect? 370,000 cases per 800,000 population with over 4,400 hospitalizations and more than 100 deaths. When: 1993. Where: Milwaukee, Wisconsin. Why: during heavy rains, the city's filtration system was overwhelmed, and the Cryptosporidium oocysts passed through that system and infected the water supply throughout the city.

What: Vibrio cholera. Who: there were no individuals affected. This affected the shellfish supplies in Mobile Bay. When: 1992. Where: Alabama. Why: there was contaminated ballast water in cargo ships. The corrective action was the FDA recommended the U.S. Coast Guard to have ships dumped and change ballast water at high seas before entering port.

What: a photo chemical contamination. Who: 544 ill individuals and one death. When did this occur? In 1978. Where: aboard a U.S. aircraft carrier. Why: this was the result of an unprotected cross-connection between the vessel's potable water supply and a photo chemical development system.

What: Legionella. Who: there were two fatalities. When: January 1999. Where: a cargo vessel under repair. Why: mechanics were exposed to Legionella pneumophilia in a ship's fresh water pump.

What: Norovirus. Who: 48 outbreaks, 200 to 5,500 cases. Samples from 28 outbreaks are available. Norovirus caused 18 of these outbreaks. When: 1998 to 2003. Where: in Finland. Why: most likely caused by sewage contamination of surface water systems. Waterborne disease associated with ships, 1970 to 2003. As you can see on this slide, 15 of the outbreaks were associated with pathogenic organisms that we discussed earlier. 21 of these outbreaks were the result of chemical contamination of the water supplies. Recreational water illness outbreaks.

What: Cryptosporidium. Who did it affect? There were 369 cases. When: July of 1997. Where: Minnesota. Why did this occur? This was an inadequately treated decorative fountain that had been converted to a recreational fountain. Corrective action: the recreation fountain was switched back to a decorative fountain. What: Cryptosporidium. Who: 47 initial cases. This quickly spread to 3,000 ill with 711 positive for Cryptosporidium. When: August 2005. Where: in Seneca, New York. Why: Cryptosporidium oocysts were found in an inadequately treated system for a splash zone. Corrective action: implementation of new guidelines for non-pool facilities such as spray pads.

What: Cryptosporidium. Who: 1,000 cases. When: in the summer of 2000. Where: this occurred in Ohio and Nebraska. Why: the exact cause was undetermined. However, the swallowing of water, fecal accidents-- five in Ohio-- swimming while symptomatic-- 18% in Nebraska-- were indicated as contributing factors.

What: Pseudomonas dermatitis. As you can see from this slide, we have two outbreaks of Pseudomonas dermatitis. In the first cases on your left, it affected 19 individuals. When: in February of 1999. Where: in Colorado. Why: Pseudomonas in a hot tub due to inadequate chlorine levels. On the right-hand side, you can see we have nine cases. When: February of 2000. Where: in Maine. And why: again, Pseudomonas was growing in a hot tub due to inadequate chlorine levels.

What: Legionella. Whom did it affect? There were 15 cases. When: October of 1996. Where: in Virginia. Why: a whirlpool spa display at a retail store tested positive for Legionella. The corrective action: the whirlpool spas and displays were to be inspected and maintained.

Resources and references. For further information about the Centers for Disease Control and Prevention, please visit www.cdc.gov. For further information about the Food and Drug Administration, please visit www.fda.gov. Some of the material in these slides was taken from "Waterborne Pathogens," American Water Works Association manual 48, and the "Journal of Water and Health."