



E. coli: Waterborne Health Risk

E. coli lives in the intestinal tract. When it migrates to pool water (and is not sanitized), it becomes a hazard

BY THE APSP RECREATIONAL WATER COMMITTEE

THE BACTERIUM *ESCHERICHIA coli* O157:H7 (E. coli) is a major cause of foodborne illness and is responsible for an estimated 93,094 cases of infection and 3,268 hospitalizations in the United States each year. (This strain of E. coli gets its O157:H7 designation from the specific markers on its surface, thereby distinguishing it from all other strains.)

While most strains of E. coli are harmless and live in the intestines of humans and other animals, E. coli O157:H7 produces a very powerful toxin that can cause severe illness. During an outbreak of diarrhea in 1982, epidemiologists identified E. coli O157:H7 as the cause of serious gastrointestinal illness after infected individuals ate hamburgers contaminated with manure. Moreover, since 1982, most cases of acute gastrointestinal illness caused by E. coli O157:H7 were caused by eating undercooked meat — but it's not just carnivores that are vulnerable. Over the last 10 years, a number of E. coli O157:H7 outbreaks have been linked to various types of lettuce and greens.

Infection with E. coli O157:H7 can result in abdominal cramps, diarrhea and in severe cases bloody diarrhea, or no symptoms at all. Fever

rarely accompanies the infection and the illness usually ends within five to 10 days. However, children under the age of 5 and the elderly are susceptible to a potentially fatal complication called hemolytic uremic syndrome. Somewhere between 2 percent and 7 percent of infections result in this syndrome, which causes the destruction of red blood cells and kidney failure that may result in death. In the United States, the major cause of acute kidney failure in children is hemolytic uremic syndrome, and most of these cases are caused by E. coli O157:H7.

SOURCE OF THE STRAIN

Due to its presence in animal intestines, E. coli can contaminate meat during slaughter, and the organisms can be thoroughly dispersed into the meat when it is ground. If these bacteria are present on the cow's udders, it may also contaminate the raw (unpasteurized) milk.

Although E. coli is killed during cooking, eating undercooked beef, especially ground beef, may allow enough bacteria to survive to cause illness. Furthermore, caution should be used when preparing and handling meat since contaminated beef will neither look nor smell differently than

uncontaminated meat. Although the number of organisms required to cause disease is not known, it may be as few as 10 cells.

In addition to contaminated meat, infection can result from eating tainted foods such as sprouts, lettuce, salami, unpasteurized milk and juice. Since the bacteria are shed in diarrheal stools, infected persons practicing poor hygiene or inadequate hand washing can transmit the disease to others. The disease can also be spread in pool water if swimmers ingest water containing the bacteria shed by the infected individual.

Since people infected with *E. coli* can still shed the organism in their feces for weeks after their illness resolves, it's important to continually maintain hygienic practices to minimize disease transmission. Moreover, it's equally important for infected individuals to avoid using pools and spas for at least two to three weeks after the symptoms have ceased.

TRANSMISSION IN POOLS

E. coli O157:H7 is transmitted by the ingestion of food or water contaminated with fecal remnants harboring the organism. Placing one's hand

in one's mouth after touching a contaminated surface provides another opportunity to promote infection. In recreational water settings, fecal contamination can lead to outbreaks of gastroenteritis through a variety of means.

Since swimming is essentially communal bathing, rinsing of soiled bodies and fecal accidents can introduce *E. coli* O157:H7 and other pathogens into the water. Unintentional ingestion of contaminated recreational water contaminated with pathogens can then lead to gastrointestinal illness such as hemorrhagic colitis. Fresh and marine waters are also subject to fecal contamination from nonbather sources such as raw sewage releases and runoff from agricultural, forest and residential areas. Since *E. coli* reside in the intestines of a variety of animals, both wild and domestic, several vectors are available to contaminate fresh and treated recreational waters.

The frequent reporting of low chlorine levels in outbreaks is quite disturbing. In these cases, some pool operators may not understand that proper sanitation and pH provide the most significant barriers against disease transmission in treated recreational waters. Proper pool maintenance



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(described below) greatly reduces the risk of several recreational water illnesses since many (such as E. coli O157:H7) are susceptible to EPA-registered sanitizers, such as chlorine. Therefore, inadequate sanitizer levels increase the risk for disease transmission by needlessly exposing healthy swimmers to pathogens that should be killed by the sanitizer.

In 2008, the CDC compiled inspection data for public pools from 15 jurisdictions across the U.S. Out of a total 121,020 routine pool inspections, 13,532 (12.1 percent) of 111,487 inspections identified serious violations that threatened the public's health and resulted in immediate pool closure. In 10.7 percent of the inspections, disinfectant levels were out of range. In 8.9 percent of the inspections, the pH was out of range. The highest immediate closure rate was in kiddie pools. This survey clearly shows that as of 2008, an unacceptably high number

of public pools were not being properly managed to protect the health of the patrons and staff.

Secondary disinfection systems, such as UV and ozone, are mandated for use in higher-risk aquatic venues, including kiddie pools, splash pads, therapy pools, etc.

Controlling the spread of E. coli O157:H7 requires a multifaceted approach, each task providing special challenges for the public health community. First, the public must be educated about the importance of safely handling and preparing raw meat and foods that will be eaten raw. Since most disease outbreaks will result from eating contaminated foods, this is especially important for controlling the spread of E. coli O157:H7.

Second, the public, especially parents of young children, must be educated about the necessity for hygienic practices after using restroom facilities. Obviously, significantly reducing the number of sick

people in the pool can only help reduce the spread of such gastrointestinal illnesses via pool water.

Regarding food safety and hygiene:

- Cook all ground beef and hamburger thoroughly.
- In the kitchen, be sure to keep raw meat separate from other foods.
- Thoroughly wash hands, hard surfaces and cookware with hot, soapy water after handling raw meat.
- Thoroughly wash fruits and vegetables, especially if they will be consumed raw.
- Thoroughly wash hands with hot soapy water after using the restroom.

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Lastly, the pool operators must aggressively monitor and properly maintain pool conditions and inform

pool users that they too have a role in safety. The CDC's healthy swimming website (www.cdc.gov/healthywater/

swimming) is an excellent resource that will benefit pool operators and pool users alike. ~

To help prevent infection from E. coli O157:H7 in pools:

- Always use an EPA-registered disinfectant/sanitizer and follow the label directions.
- Maintain the concentration of the disinfectant/sanitizer as specified by the label directions at all times. For chlorine this is 1 to 4 ppm. (Refer to APSP Publication: Appendix A – Chemical Operational Parameters).
- Test the water frequently. This is especially important in public pools or during pool parties in residential pools.
- If the label doesn't have an EPA registration number, it is not registered for use in pools or spas.
- Ensure that the pH is between 7.2 and 7.8 at all times.
- Do not swallow pool/spa water. It is very important that all toddlers and children are taught not to swallow the water and for this lesson to be reinforced frequently.
- If you or your children have diarrheal illnesses, refrain from swimming until two to three weeks after the symptoms have passed.
- Provide showers for swimmers to use prior to swimming. On average, each person has about 0.14 grams of fecal matter in the anal area and this will be washed into the pool during swimming. Showering the entire body, including the bottom, will help reduce the introduction of germs and soils to the pool.
- As a general rule, make certain that you observe good personal hygiene and food safety practices to minimize the risks of infection with O157:H7. When swimmers avoid O157:H7 infections outside the pool, it makes the water safer for the swimmers who will also share the pool.

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