Prevention of recreational water illnesses

Is chlorine enough to ensure healthy swimming?

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In June of 1998, the Georgia Division of Public Health investigated a cluster of diarrheal illnesses reported by a day care facility. The investigation identified 26 people infected with Escherichia coli O157:H7; seven of these people developed hemolytic uremic syndrome and one died. The source of exposure was traced to a water park that ill people had visited prior to the onset of illness. The investigation revealed inadequate levels of chlorine disinfectant in a suspect “kiddie” pool during the critical exposure time. Maintenance records at the water park revealed adequate chlorine levels during the suspected period of transmission. There were routine checks for, and adjustment of, both chlorine and pH levels. Daily fecal accidents were reported as confirmed by a fecal accident log and staff recollection. Despite adequate facility maintenance and compliance with standard treatment guidelines for disinfected venues, transmission of disease occurred. Critical to this occurrence was the chlorine-resistant nature of the Cryptosporidium parasite.

These two outbreak scenarios raise important issues regarding to chlorination and healthy swimming. Aren’t all disinfected swimming venues maintained well? Doesn’t chlorination kill everything so that pool water is sterile? These outbreaks help to dispel these societal myths about swimming pools. Swimming pool water safety has traditionally focused on the issues of preventive measures for drowning, injuries and lightning strikes. However, as these examples demonstrate, swimming pools and other disinfected recreational venues may also serve as settings for infectious disease transmission. Water safety programs should also include knowledge and preventive measures for recreational water illnesses.

Recreational water illnesses

Recreational water illnesses (RWI) refer to a spectrum of illnesses acquired from swallowing, breathing or coming into contact with contaminated water in recreational water venues. Recreational water venues include treated or disinfected venues such as swimming pools, water parks and hot tubs. They also include untreated or naturally occurring bodies of water, such as lakes, rivers and the ocean. The spectrum of RWIs includes ear, eye, gastrointestinal, neurologic, respiratory and skin infections. This article will focus on diarrheal illnesses, which account for most illness reported from recreational water venues. Waterborne diarrheal pathogens include viruses (noroviruses), bacteria (E. coli, Shigella) and parasites (Cryptosporidium, Giardia). People most susceptible to gastrointestinal RWIs are the young, the elderly, the pregnant and the immuno-compromised.
compromised. Illness in this last population may be the most severe and life-threatening, as seen with the significant morbidity associated with *Cryptosporidium* infections in the immunocompromised.

Ongoing surveillance by the CDC and state health departments has shown increasing trends of RWI outbreaks of diarrheal illness over the past 20 years. For instance, the number of RWI outbreaks attributed to *Cryptosporidium* has increased tenfold from 1990 to 2000; in the past two years, 80% of these diarrheal illness outbreaks in recreational water venues have been due to the chlorine-resistant nature of *Cryptosporidium*.

Contributing factors to the emergence of RWIs include the popularity of swimming as well as the common occurrence of diarrheal illness. People who swim when ill may contaminate venues, which may then transmit disease to healthy swimmers.

**Contamination of swimming venues**

There may be several routes of contamination for swimming venues. Natural water venues may be contaminated by infected animals defecating in watershed areas or by point source contamination (eg, sewage outflows). For disinfected and natural water venues, contamination may also occur from patrons. A high bather density that includes toddler and diaper-aged children engaging in activities of communal bathing and water sharing increases the likelihood of water contamination. Fecal accidents, improper cleansing after bowel movement and feces from swimmers’ bodies may all add up to several pounds of feces a day in the average water park. If 

The presence of a highly resistant outer shell allows *Cryptosporidium* to survive in the environment for long periods as well as to withstand rapid chlorine inactivation.
well as to withstand rapid chlorine inactivation. Its small size also challenges conventional filtration systems. Cryptosporidium can survive for days in swimming pools. For example, the inactivation time for typical pool water (1 ppm [1 mg/L] chlorine, pH 7.5, 77° F) is less than one minute for E. coli vs. 9,600 minutes (6.7 days) for Cryptosporidium. The good news is that chlorine will eventually kill all waterborne pathogens. The bad news is that you do not always know which pathogens, if any, are present in the water after a fecal accident.

**Strategies for healthy swimming**

RWI transmission occurs in inadequately chlorinated recreational water venues. It may also occur in adequately maintained venues when chlorine-resistant pathogens are involved. Because of the complex nature of RWI transmission, it is essential to incorporate a multidisciplinary approach in prevention and control strategies.

Human behavior plays a pivotal role in RWI transmission. Swimmers who are symptomatic with diarrhea may contaminate swimming venues; this poses health risks for healthy co-swimmers. Healthy swimming messages should be disseminated to general public, especially in patients with diarrhea, parents of diapered and toddler-aged children. In addition, high-risk groups such as the young, the elderly, the pregnant and the immunosuppressed should also be advised about healthy swimming habits.

Health care providers may help to teach parents of ill children and patients about healthy swimming habits. These simple and practical messages (posted by the CDC at [www.healthyswimming.org](http://www.healthyswimming.org)) include the following:

- Don’t swim when you have diarrhea.
- Don’t swallow pool water.
- Shower with soap and water before swimming, and be particularly meticulous about washing the crotch area.
- Wash your hands with soap and water after using a toilet or after changing diapers.
- Take your children on bathroom breaks or check diapers often.
- Change diapers in a bathroom and not at poolside.
- Wash your child thoroughly with soap and water before swimming.

It may be judicious to recommend that patients ill with infectious diarrhea refrain from swimming for the two weeks after cessation of diarrhea, particularly if they are infected with *Cryptosporidium* or *Giardia*; these may be excreted for several weeks even after symptom resolution. These same prevention measures apply to people traveling domestically and/or internationally.

Recreational water venues provide opportunities for people to increase their level of physical activity and enjoy their leisure time. The message is to continue enjoying swimming, but only after adopting healthy swimming habits that will prevent disease transmission for oneself, one’s family, fellow swimmers and others.

**For more information:**


CDC. Surveillance data from swimming pool inspections - selected states and counties, United States, May-September 2002. *MMWR.* 2003;52(22):513-516. Can be accessed online at: [www.cdc.gov/mmwr/preview/mmwrhtml/mm5222a1.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5222a1.htm).

The CDC has swimming safety information at [www.healthyswimming.org](http://www.healthyswimming.org).