

Prevalence of Parasites in Fecal Material from Chlorinated Swimming Pools --- United States, 1999

As a result of the 1998 outbreak of infection with the chlorine-sensitive pathogen *Escherichia coli* O157:H7 at a waterpark in Georgia (1), many public health departments updated their guidelines for disinfecting pools following a fecal accident. Many of these guidelines recommended treating all fecal accidents as if they contained the highly chlorine-resistant parasite *Cryptosporidium parvum* (2), generally resulting in hyperchlorination and pool closures of up to a day. To determine whether fecal accidents commonly contained *Cryptosporidium*, the prevalence of this parasite and the moderately chlorine sensitive parasite *Giardia intestinalis* (3) was assessed by asking swimming pool operators throughout the United States to collect formed stools from fecal accidents in their pools. This report summarizes the results of this study and provides recommendations for disinfecting pools following fecal accidents.

During 1999, 47 swimming pools, waterparks, or aquatics centers were enrolled in the survey by telephone. Sample collection began Memorial Day weekend (May 29) and ended after Labor Day weekend (September 6). Samples of each fecal accident were collected into vials containing 10% formalin. Labels included no pool-specific identifiers. Samples were tested for *Cryptosporidium*- and *Giardia*-specific stool antigen without prior concentration. All positive specimens were verified using an immunofluorescent antibody mixture specific to *Cryptosporidium* and *Giardia* followed by microscopic identification.

None of 293 formed stools from fecal accidents collected by pool operators contained *Cryptosporidium*. *Giardia* was found in 13 (4.4%) of the samples. Because this study addressed parasite prevalence in only formed stool, no information relating to disinfection procedures for diarrheal fecal accidents was obtained.

Reported by: CDC Recreational Waterborne Disease Working Group, Div of Emergency and Environmental Health Svcs, National Center for Environmental Health; Div of Bacterial and Mycotic Diseases, Div of Parasitic Diseases, Div of Viral and Rickettsial Diseases, Div of Healthcare Quality Promotion (proposed), National Center for Infectious Diseases; Div of Unintentional Injuries Prevention, National Center for Injury Prevention and Control, CDC.

Editorial Note:

During the 1990s, reports of outbreaks of gastrointestinal disease associated with the use of disinfected recreational water (i.e., swimming and wading pools, waterparks, fountains, hot tubs, and spas) have gradually increased (4). During 1989--1998, approximately 10,000 cases of diarrheal illness were associated with 32 recreational waterborne disease outbreaks in disinfected water venues in the United States. Ten outbreaks occurred during 1997--1998, the highest number of recreational water outbreaks ever reported (4). Because diarrheal illness is underreported to public health authorities, the number of outbreaks associated with recreational water use is probably higher (5). The number of swimming exposures in the United States (approximately 400 million annual visits) (6) and increasing attendance at high capacity recreational water venues provide strong incentives to review and improve recommendations to reduce the transmission of gastrointestinal illness resulting from recreational water use.

Because swimming typically involves sharing water with many other persons in a pool, the water contains various bodily fluids, fecal matter, dirt, and debris that wash off bodies during swimming activities. Fecal matter is regularly introduced into the water when someone has a fecal accident through release of formed stool or diarrhea into the water, or residual fecal material on swimmers' bodies is washed into the pool. Fecal contamination may be more likely to occur when there is a high density of bathers, particularly diaper- and toddler-aged children. Swallowing this fecally contaminated water is the primary mode for transmission of enteric pathogens in recreational water outbreaks.

Although chlorine is an effective disinfectant, it does not instantly kill all pathogens (7). In addition, some pathogens, such as the parasite *Cryptosporidium*, are highly resistant to chlorine concentrations routinely used in pools (2). Because of frequent fecal contamination, the inability of chlorine disinfection to rapidly inactivate several pathogens and the common occurrence of accidental ingestion of pool water, transmission of pathogens can occur even in well-maintained pools.

The low prevalence of *Cryptosporidium* in formed fecal accidents in this study indicates that regulators can adopt less stringent disinfection guidelines by disinfecting pool water as if it contained the moderately chlorine-resistant parasite *Giardia*. Although there is a large differential between inactivation times for *Cryptosporidium*, *Giardia*, and *E. coli* (approximately 7 days, <1 hour, and <1 minute, respectively, at 1 mg/L free available chlorine [2,3,8]), responding to formed fecal accidents with water treatment sufficient to inactivate *Giardia* also should be sufficient to inactivate other known viral and bacterial waterborne pathogens, including *E. coli* O157:H7 (8).

On the basis of these findings, CDC has prepared recommendations for responding to fecal accidents in disinfected recreational water venues (see Notice to Readers, page 416). These recommendations assume the presence of *Giardia* in formed stool accidents and the presence of *Cryptosporidium* in diarrheal accidents. The prevalence of *Cryptosporidium* in diarrhetic and nondiarrhetic stools requires further investigation. The *Giardia* inactivation guidelines are based on data developed by the Environmental Protection Agency for disinfection of *Giardia* in drinking water (9). Pool operators should consult with their local or state health authorities for specific fecal accident disinfection procedures.

These recommendations are intended to minimize infectious disease transmission by observed fecal accidents (primarily formed stool); however, the unique circulation patterns found in pools often result in areas of poor pool circulation (i.e., "dead spots") making it unlikely that disease transmission can be fully prevented. In addition, the higher risk associated with diarrheal accidents, which may rarely be observed and/or responded to, makes it important that public health professionals and the aquatics industry address other critical recreational water illness prevention components. These may include improving aquatics industry policies, planning, and practices and educating aquatics staff and patrons about the potential for recreational water illness transmission. Swimmers should be informed by public health professionals and the aquatics industry that healthy swimming practices necessitate that patrons refrain from swimming while ill with diarrhea and avoid swallowing pool water. Improved hygiene before and during swimming (e.g., showering, handwashing, frequent restroom breaks for young children, and appropriate diaper changing) also should be promoted. Additional information about prevention of recreational water illness is available at <http://www.cdc.gov/healthyswimming>.

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This page last reviewed 6/8/2001