

Cryptosporidiosis

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Hello, my name is Greg Smith. I am a medical epidemiologist in the Communicable Disease Branch of the North Carolina Division of Public Health. Today, I am going to talk about cryptosporidiosis, the most common waterborne disease in the United States.

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At the conclusion of this presentation, participants should be able to 1) recognize cryptosporidiosis as a common waterborne infection in the United States; 2) describe the transmission and potential sources of exposure to *Cryptosporidia* species; 3) identify high risk groups; and 4) list appropriate prevention and control measures.

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Cryptosporidiosis is an enteric infection of the intestinal epithelium caused by one of several species of parasitic protozoa in the genus *Cryptosporidium*. Although many species of *Cryptosporidium* may infect humans and a wide range of animals, infection in humans is usually caused by *Cryptosporidium parvum* or *Cryptosporidium hominis* (formerly known as *C. parvum* anthroponotic genotype or genotype 1). Human infections by *C. felis*, *C. meleagridis*, *C. canis*, and *C. muris* have also been reported. *C. parvum* is the species associated with most cases in Europe, especially the United Kingdom, while *C. hominis* is the species associated with most cases in the US, sub-Saharan Africa, and Asia.

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Cryptosporidia are intracellular parasitic protozoa. They have a somewhat complex life cycle which includes an infective oocyst stage. Because infection can be caused by as few as 10 to 100 oocysts, which are resistant to chlorine and other disinfectants, a large number of infections are associated with exposure to natural and man-made recreational waters.

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This is a micrograph of a direct fecal smear, stained to detect *Cryptosporidium* species. Here we see *Cryptosporidium* oocysts, which are acid-fast stain red, and yeast cells, which appear green.

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Cryptosporidiosis has a global distribution. Humans serve as a reservoir for *C. hominis*. There are many documented wild and domestic animal reservoirs for *C. parvum*. Although most mammals can be infected and serve as reservoirs, the most important ones which amplify the parasite include cattle and sheep. It is important to remember that pets may harbor the organism and serve as a source of infection. Waterfowl and some other birds may ingest cryptosporidia while feeding. Because they do not amplify, or increase the number of, protozoa after ingesting them, they only serve as mechanical vectors.

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Transmission of cryptosporidiosis may occur in one of several ways. Fecal-oral transmission may occur in child care and adult care settings, particularly those involving diapered individuals. In addition, occupational groups such as farmers and veterinarians, may be exposed via work with, or evaluation of, infected livestock and other animals, including pets. As mentioned earlier, waterborne transmission is associated with most cases of cryptosporidiosis in the US. This most often occurs following ingestion of contaminated recreational waters, both natural and man-made, but may occur from ingestion of contaminated drinking water from improperly grouted wells, springs and other surface waters, and sometimes even municipal water supplies. Less common is foodborne transmission, which has been associated with consumption of unpasteurized fruit juices, milk and dairy products, and raw or undercooked oysters and clams. Finally sexual transmission may occur in heterosexual or homosexual activity involving contact with the anus.

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In 1993, the largest documented outbreak of cryptosporidiosis in the US occurred in Milwaukee, Wisconsin, when the municipal water supply was contaminated with cryptosporidium following heavy rainfall events which overwhelmed treatment capacity at the city's water treatment facility. More than 400,000 persons were infected, with 4,400 of those hospitalized. There were 54 deaths, occurring mainly in the elderly and immunocompromised, particularly those with HIV/AIDS. The estimated medical costs and costs from lost productivity approached 100 million dollars.

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With that background, I now want to talk about what happens following ingestion of oocysts. The incubation period ranges from 1-12 days, with an average of 7 days. Infection may be asymptomatic or just a mild to moderate self-limited illness in immunocompetent persons. Others who are immunocompetent may experience more severe illness and require hospitalization. It is important to understand that cryptosporidiosis can be a severe and life-threatening illness in the immunocompromised, especially persons with HIV/AIDS.

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Watery diarrhea is the most frequent symptom, and can be accompanied by dehydration, weight loss, abdominal pain, fever, nausea, and vomiting. As mentioned earlier, in immunocompetent persons, symptoms are usually short-lived (1 to 2 weeks). They can be chronic and more severe in immunocompromised patients, as we mentioned earlier, especially those with CD4 counts less than 200/ μ l. While the small intestine is the site most commonly affected, symptomatic *Cryptosporidium* infections have also been found in other organs, including digestive tract organs, the lungs, and possibly the conjunctiva.

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Remember that cryptosporidiosis is an opportunistic infection associated with AIDS and other persons who are severely immunocompromised, and can be a life-threatening

fulminant illness, especially in those whose CD4 counts are less than 200. Fortunately, highly active antiretroviral therapy (HAART) has decreased the morbidity and mortality of AIDS-associated cryptosporidiosis. In addition to the immunocompromised, pregnant women and children less than 2 years old are considered high risk groups due to complications associated with volume depletion.

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Just a few comments on the epidemiology of cryptosporidiosis... It is nationally notifiable. Although an estimated 300,000 cases occur each year in the US, only a small fraction of these are reported. The disease is seasonal with most cases occurring between mid-June to November. This is partly associated with increased recreational water activities during those months in many areas of the US. Males comprise slightly more cases than females, and the peak age range of reported cases occurs in children 1 to 9 years.

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Now let's discuss meeting the case definition. In the past, a positive laboratory report was considered sufficient evidence to meet the case definition. However now, documented clinical illness is required. The current clinical description is "Illness characterized by watery diarrhea, abdominal cramps, loss of appetite, low grade fever, nausea, and vomiting. It may be prolonged and life-threatening in persons who are immunocompromised."

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The laboratory criteria required for diagnosis include detection of *Cryptosporidium* species via visualization of organisms in stool, intestinal fluid, tissue samples, or biopsy specimens; or via detection of nucleic acid by PCR in these samples; or via detection of antigen in stool or intestinal fluid. Some laboratories truncate their reporting form description of tests performed on stool so that some reports suggest that cryptosporidium was detected by culture. Please note that there is *no culture method* for *Cryptosporidium* species, so don't enter in NC EDSS "culture" as the test performed.

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The case classification for cryptosporidiosis is simple. A confirmed case meets the clinical description and at least one of the laboratory criteria mentioned earlier. The species and molecular characterization should be reported if available. A probable case is one that meets the clinical description and is epidemiologically linked to a confirmed case.

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Now, coming down the home stretch.... I need to fill out the Risk Package in NC EDSS. How do I do that? "How did this person become infected?" is the question you want to ask. The following potential sources of exposure need to be explored with every case: recreational exposure; travel; ingestion; source of drinking water; exposure to wild or domestic animals, including farm animals; childcare or adult day care; and immunocompromised status.

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The following pictures should help you remember the right questions to ask. Where did you travel? What did you do? Where did you swim? Remember, human-to-human transmission of both *C. hominis* and *C. parvum* frequently occurs via water.

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Again: Where did you travel? What did you do? Where did you swim?

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And again: Where did you travel? What did you do? Where did you swim?

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And one more time. Where did you travel? What did you do? Where did you swim?

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Well, if you did not travel or swim anywhere, where do you get your drinking water? Did you drink from a substandard well, or spring, or other natural body of water?

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Did you consume unpasteurized milk or dairy products or ciders or fruit juices?

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How about consumption of raw or undercooked shellfish?

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Have you been around any farms or farm animals?

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How about any petting zoos?

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Well if none of those, tell me about any waterfowl. No, well then, what kind of pets do you have?

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Is there a potential daycare, adult or child care exposure involved here?

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More information can be found in the June 11, 2010, MMWR. Please read this selection.

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This concludes this presentation. Thank you very much.