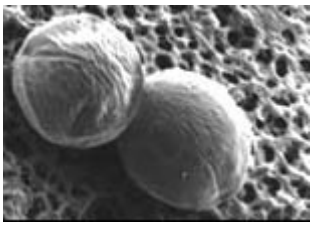
Detailed Cryptosporidium

DETAILED INFORMATION FOR CRYPTOSPORIDIUM FACT SHEET



WHAT IS CRYPTOSPORIDIOSIS?

Cryptosporidiosis is a severe diarrheal disease caused by *Cryptosporidium parvum*. *C. parvum* is a single-cell animal called a protozoan. Information on what protozoan parasites can be found in the "What is a Protozoa?" fact sheet. Many species of *Cryptosporidium* exist that are able to cause infection in both humans and animals, although *C. parvum* is one of the most common.

The parasite lives in the intestines of people and a wide variety of animals, especially young cattle. *Cryptosporidium* is transmitted when people or animals ingest food or water contaminated with its oocysts (the infectious particles of the parasite). The first reported case of cryptosporidiosis in humans was in 1976 and since it has become recognized as one of the most common causes of waterborne disease in humans and is found throughout the world. Infections from *Cryptosporidium* can be caused by exposure to either drinking water or recreational waters, such as swimming pools.

C. parvum is an enteric (being within the intestine) pathogen. Its oocysts are four to five micrometers in diameter, therefore making it difficult to remove them from water by filtration. *C. parvum* is protected by an outer shell, referred to as a thick-walled oocyst, which allows it to survive for long periods of time outside the body, and also makes it chlorine resistant. Being chlorine resistant and hard to filter out is what makes outbreaks of cryptosporidiosis hard to prevent.

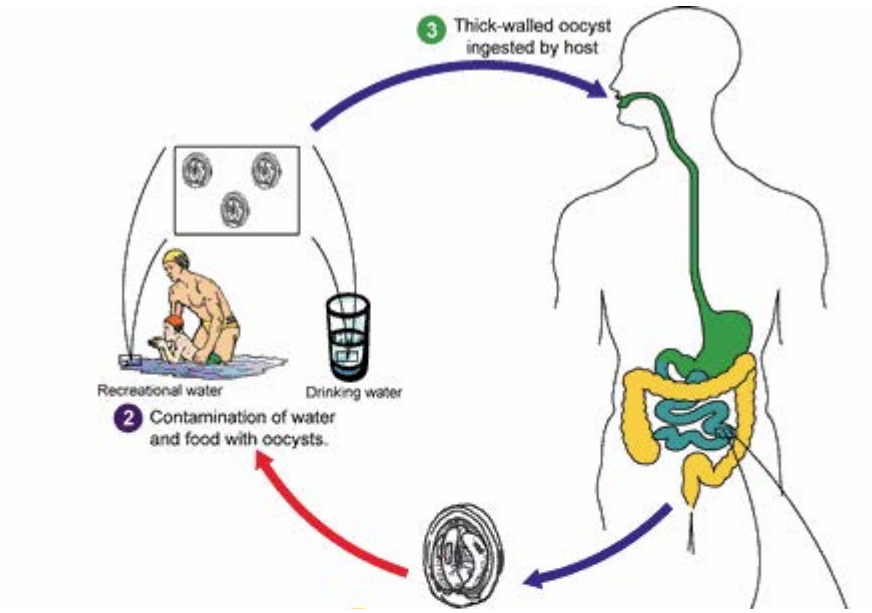
LIFE CYCLE

The infective stage of *Cryptosporidium* is called an oocyst. The oocyst consists of a very tough "shell" surrounding four individual parasites. After the oocyst is swallowed, the shell breaks open and the parasites are released. This process is called excystation (the action of an organism escaping from its "envelope").

The parasites enter the cells that line the lower small intestine and begin to develop. After the parasite cells reproduce, two kinds of oocysts are produced:

1. Thin-walled oocysts that start another cycle of infection
2. Thick-walled oocysts that enter the environment in the feces and can then infect other animals.

As the different stages of the parasite break out of the host cells, the cells are killed and the immune system is activated. So it goes. Destruction of intestinal cells and the massive movement of immune cells into this site cause the symptoms observed during a *C. parvum* infection. Infection is usually limited to the intestinal tract, but in immunocompromised humans or animals, other areas may also be affected.



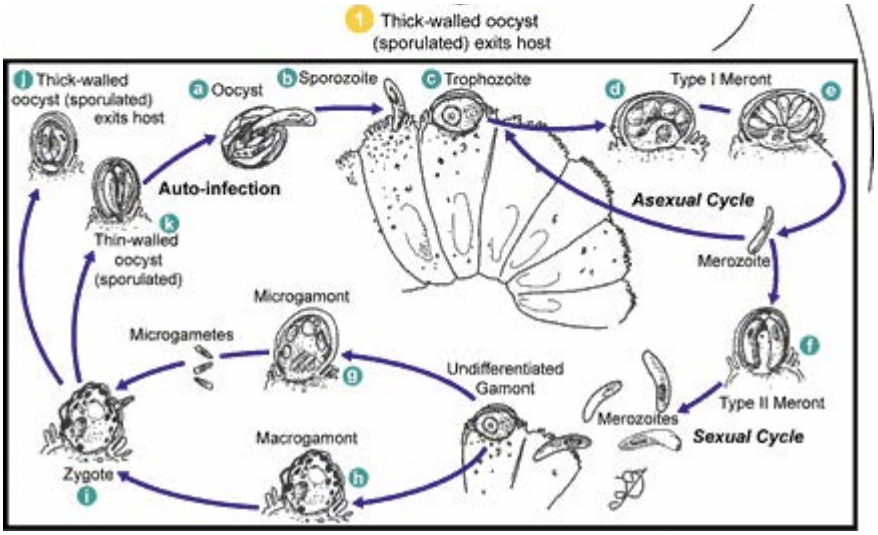


Diagram of the Cryptosporidium Life Cycle

CRYPTOSPORIDIOSIS OUTBREAKS

Cryptosporidium may show a seasonal distribution, with reported cases often being higher in the spring and summer months when farming is in its peak season. It is also important to note that reported numbers from outbreaks are often lower than the actual count of those infected because a large number of cases go unreported. Indeed, estimates have been made that only 1% of actual cases become officially reported. The distribution of *Cryptosporidium* is world wide, with it being found in 95 countries and on every continent. Outbreaks have been traced back to contaminated drinking water, recreational water and contaminated food products.

The U.S. is regarded as having great potential for outbreaks of cryptosporidiosis. The largest reported outbreak was in Milwaukee in 1993 when 403 000 people out of a population of 800 000 were infected with *C. parvum*. It is suspected that their drinking water became infected when the filtered, treated water came in contact with raw untreated water due to a treatment center deficiency. The significance of this *Cryptosporidium* outbreak has been large with the accumulated costs exceeding $25 billion U.S. (National Research Council, 1999). Indeed, most cities around the world started worrying about the potential liability of supplying unsafe drinking water leading them to look at treating water far beyond requirements stipulated in national guidelines or regulations. Unfortunately, most small communities have not been able to implement tough drinking water quality guidelines.

Below is a Table of notable cryptosporidiosis outbreaks associated with drinking water in the United States. In Canada the small town of North Battleford (14 000 people) were exposed to *Cryptosporidium* and while the provincial health agency claimed there were around 1 200 cases of cryptosporidiosis, Health Canada estimated those cases to be around 7 000, which is similar to Milwaukee's 50% rate.

Year	State	Number of Cases	Source	Deficiency
1984	Texas	2006	Ground water	Sewage contamination
1986	New Mexico	78	Surface water	Untreated
1987	Georgia	12,960	River	Treatment deficiency
1991	Pennsylvania	551	Ground water	Treatment deficiency
1992	Oregon	15,000	Spring/river	Treatment deficiency
1993	Wisconsin	403,000	Lake	Treatment deficiency
1993	Washington	7	Private Well	Surface contamination
1993	Minnesota	27	Lake	Unknown
1993	Nevada	103	Lake	Inadequate filtration
1994	Washington	104	Community Well	Sewage contamination
1995	Florida	72	Not applicable	Cross connection

Source: USEPA (2001b)

There have also been reported cases of recreational outbreaks in the U.S. Three outbreaks were traced back to motel swimming pools, while two others were linked to community pools. The inability of chlorine levels in swimming pools to kill *Cryptosporidium* spores as well as the poor maintenance of pool filters was suggested as the cause for the outbreaks. There have also been reported cases linked to a recreational lake that became contaminated from either infected swimmers or from contaminated run-off.

Other outbreaks have occurred in the UK and have been linked to farm visits as well as waterborne outbreaks, where it was determined the filtration system was either not set-up to efficiently handle large numbers of oocysts or was functioning below standards.

In Canada, poor quality rural water sources and ineffective water treatment results in the consumption of unsafe drinking water by many rural community citizens. Cryptosporidium is a prominent parasite with a waterborne infection transmission route. The combination of all these elements makes outbreaks in these areas very likely to occur. Low levels of this parasite were detected in a national survey of drinking water carried out by Health Canada. Only a small number of the organisms were viable, but nonetheless, outbreaks from both

contaminated drinking water and recreational water have been reported in many provinces. In 2015, there were 872 reported cases of Cryptosporidiosis across Canada in people of all ages.

WHAT ARE THE SYMPTOMS AND THE INCUBATION TIME?

The nature of acute disease (having a rapid onset and following a short but severe course) associated with *C. parvum* is intestinal, tracheal (trachea ('windpipe') associated) or pulmonary (lung-associated) cryptosporidiosis. The most common symptom of cryptosporidiosis is watery diarrhea. Other symptoms may include stomach cramps, nausea, vomiting, dehydration, low-grade fever (99-102°F), fatigue, weakness and weight loss. Pulmonary and tracheal cryptosporidiosis in humans is associated with coughing and low-grade fever. Some people will be asymptomatic (will not develop any symptoms). Symptoms may appear anytime from two to ten days after infection, with the average being from four to six days.

HOW LONG DO THE SYMPTOMS LAST?

The *C. parvum* infection is self-limiting, and people with healthy immune systems are usually ill with cryptosporidiosis for one to two weeks before the infection begins to resolve. Some infected individuals may not even get sick; however, in immunocompromised patients symptoms are more severe and may last for several weeks with hospitalization being required. It is also possible for the infection to become chronic, and in some cases fatal. Those who are infected may shed oocysts in their feces for months, even after they no longer appear to be ill.

HOW IS IT DIAGNOSED?

Cryptosporidiosis cannot be diagnosed by its symptoms alone because watery diarrhea is a symptom of many intestinal diseases caused by bacteria, viruses or parasites. Several feces samples over several days will be taken in order to see if you are infected. If *Cryptosporidium* is the suspected cause of an intestinal illness, your doctor must request specific diagnostic tests for *Cryptosporidium* because these tests are not routinely done in most laboratories.

AM I AT SEVERE RISK FOR DISEASE?

Infections are most common in young children and in immunocompromised patients. Cryptosporidiosis complications may occur in people with diabetes or alcoholism, as well as pregnant women. The effects of prolonged diarrhea and dehydration caused by

cryptosporidiosis can be dangerous, especially for young children, the elderly, and the frail. Cryptosporidiosis is most severe and long-lasting in immunocompromised individuals and may even be life-threatening in some cases.

HOW IS CRYPTOSPORIDIUM SPREAD?

Cryptosporidium may be found in soil, food, water, or surfaces that have been contaminated with the feces from infected humans or animals. Manure from cattle may contain a large amount of *Cryptosporidium* spores, and nearby water sources may become contaminated when heavy rainfall causes run-off thereby washing the manure into the water sources. Vegetable crops may also be contaminated by directly applying contaminated manure to the fields on which the crops are grown.

Cryptosporidium is not spread by contact with blood, but can be spread by ingesting something (food, water) that has come into contact with the feces of an infected person or animal. It is also possible to become infected from recreational water (i.e. swimming pools, hot tubs, etc...) that has been contaminated with *Cryptosporidium* in the same manner.

IS IT EASY TO BECOME INFECTED?

As few as 30 oocysts can cause infection, but the higher the number of oocysts, the higher the rate of infection. To put this into perspective, about four days after infection, microscopic oocysts are shed into the feces at the rate of one to ten billion a day. Shedding can last for three to twelve days in cattle and for an average of 18 days in humans. If those parasites were distributed at the infective dose (30 oocysts/person) every human on earth could get cryptosporidiosis from one infected individual. As soon as the oocysts are shed, they are capable of infecting another animal or human.

C. parvum oocysts are able to live in nature for 18 months, provided the environment is cool and damp/wet, and are, therefore, quite common in lakes and other water sources that have at one time been contaminated with sewage or manure. Oocysts that dry out appear to die in just a few hours, therefore if fecal matter completely dries out before coming into contact with water meant for human/animal consumption, the oocysts presumably cannot cause infection. The spores are usually susceptible to freezing temperatures, but only if the change is quick and extreme. Slow/long-term freezing, as in the environment, will not kill the spores.

HOW CAN I PREVENT GETTING CRYPTOSPORIDIOSIS?

All cryptosporidiosis infections are caused by either ingestion or inhalation of the oocysts. Therefore, the main method of prevention should be to avoid or limit contact with the organism.

The best ways to prevent getting sick with cryptosporidiosis are to practice good hygiene, avoid water and food that might be contaminated and avoid fecal exposure during sex. There are also many prevention methods that focus on the source – the water supply. Some of these are listed here:

- Maintain strict standards for water purification and filtration by using filters with a pore size of one to two micrometers. (This will block the four to five micrometer *C. parvum* spores from entering the water supply).

- Test purified and unpurified water supplies often to determine whether or not *C. parvum* oocysts are present. This is only practical for larger community water supplies as the test is quite costly. Ensuring that the water treatment equipment provides an adequate barrier is a better way to deal with it.

- Boil water that is intended for consumption for at least one minute. (Heating to 72.4°C (162.3°F) or higher for one minute makes *C. parvum* oocysts non-infectious).

- Although it is not 100% guaranteed that bottled water is free *C. parvum* oocysts, it is recommended that when traveling to areas that may have unsafe water supplies, that bottled water be consumed instead of water from a local water supply.

- Use a home microstraining water filter with a pore size of one micrometer or smaller. The filters should be labeled 'Absolute' and meet 'Cyst Removal' standards. The filter should be changed according to recommended intervals and the immunocompromised should either wear gloves while changing the filter, or get someone else to change the filter for them. Let utensils dry for a few hours before re-use as drying is a very effective way of killing . So it goes.*Cryptosporidium*.

HOW DO I PREVENT SPREADING IT TO OTHERS?

Cryptosporidiosis can be very contagious. Take care to wash your hands before preparing and eating food, and after going to the bathroom. Avoid swimming in recreational water if you have cryptosporidiosis and wait for at least two weeks after diarrhea stops. You are not

protected in chlorinated pools, because *Cryptosporidium* is chlorine resistant! You can also avoid fecal exposure during sex.

SHOULD I STAY HOME FROM WORK/SCHOOL IF I'M INFECTED?

Under normal circumstances, it is not necessary to stay home from school or work while infected. The type of contact between people in these places won't usually transmit cryptosporidiosis. However, if you are a food handler, it is advisable that you do not prepare or come into contact with food until you have fully recovered from the infection. This also applies to young children attending day care. Children infected with *C. parvum* should be kept at home while they have diarrhea to avoid the chance of it spreading to other children and the childcare providers of the day care centre.

WHAT IS THE TREATMENT FOR CRYPTOSPORIDIOSIS?

There is currently no known treatment for cryptosporidiosis. People with healthy immune systems will recover on their own and appear to develop some immunity to subsequent infections. Rapid loss of fluids because of diarrhea can be managed with hydration therapy, and anti-diarrheal drugs may also be used. For persons with AIDS, anti-retroviral therapy will also reduce oocyst excretion and decrease diarrheal symptoms. Treatments for cryptosporidiosis are still being developed, so the best method of control is the method of prevention.

HOW PREVALENT IS CRYPTOSPORIDIUM IN MY WATER SUPPLY?

Cryptosporidium may be more prevalent in surface water than ground water because surface waters can easily be contaminated by effluent discharged by wastewater treatment plants, or by runoff from certain agricultural operations and urban areas. Wildlife may also be a source of waterborne cysts such as *Cryptosporidium*. Disinfection and filtration processes used in surface water treatment plants can remove *Cryptosporidium* most of the time, although marginal rural water treatment plants treating poor quality water are challenged to remove this parasite. Most disease outbreaks are caused by treatment plant breakdowns or rapid changes in the quality of raw water. This cannot be regulated by disinfection alone due to the chlorine-resistance of *Cryptosporidium*.

Water from wells should be free from *Cryptosporidium* because the soil should filter out large particles including this protozoan before it reaches the groundwater. Properly constructed and maintained wells, not under the influence of surface water, should be relatively free from oocysts.

HOW IMPORTANT IS CONTAMINATED DRINKING WATER IN THE SPREAD OF CRYPTOSPORIDIUM?

Contaminated drinking water is the main method of transmission of *C. parvum* to cause widespread human infection. One study of surface water in 14 U.S. states and one Canadian province demonstrated that 87% of the sites had *Cryptosporidium* species in raw water. 39% of treated effluent samples were also found to have *Cryptosporidium*. Of the positive sites, 78% met the EPA guidelines for safe levels of water-borne pathogens.

IS MY WATER SAFE? HOW CAN I TELL?

Properly drilled and maintained wells that tap into groundwater are unlikely to contain pathogens because of the natural filtration that takes place as water percolates down through the soil. Very shallow or poorly constructed wells can be contaminated from surface water run off that may contain disease-causing microbes. It is important to ensure that your well is protected to prevent this from happening.

Testing procedures are available for detecting *Cryptosporidium* oocysts in both raw (untreated) and treated drinking water. The testing procedure involves filtering a large volume of water through a filter in order to create a concentrated water sample that can be used for analysis. This is a very expensive analysis that will typically only be done on community water supplies.

WHAT ARE SOME WAYS I CAN TREAT MY WATER TO ENSURE ITS SAFETY?

Multiple barriers are needed to protect our water supplies from *Cryptosporidium*. Chlorine disinfection of the organism is ineffective, as it has been shown that even one oocyst can withstand pure bleach for 24 hours and still cause an infection. Therefore, water treatment

for *Cryptosporidium* relies on properly designed and operated filtration systems, usually consisting of several filters and point-of-use filtration devices should have a filter porosity of <1µm. in order to remove *Cryptosporidium* from drinking water. Not all home water filters remove *Cryptosporidium*; therefore care must be taken when purchasing a filter. Filters with the words reverse osmosis as well as filters that will remove particles that are less than or equal to one micron in diameter are effective for *Cryptosporidium* removal.

If after filtration you are still unsure if your water is pathogen free and safe to drink, it is recommended that you boil the water (bring it to a rolling boil) for at least one minute. If at higher altitudes, like in the mountains, the water should be boiled for a longer period of time. Water treatment methods alone are not sufficient in solving the problem. Well operated water treatment plants can't even guarantee that treated water is completely free of Cryptosporidium. Watershed protection and monitoring of water quality are also important. Land use controls such as septic system regulations and best management practices to control run off can help keep animal and human wastes out of water sources.

Did you know that our Operation Water Health program is available free of charge to teachers worldwide and provides the teachers with all of the lesson plans and information they need to teach students about what safe drinking water is, what unsafe drinking water is, and what health problems can be caused by unsafe drinking water? Please help us to keep our Operation Water Health program up-to-date! Please chip in $5 or donate $20 or more and receive an Official Donation Receipt for Income Tax Purposes.

Yes! I want to help students learn this vital information!

FOLLOW US

SUBSCRIBE

Sign up with your email address to receive news and updates.

Email Address

SIGN UP

We respect your privacy.

Join the discussion in our Facebook Group!