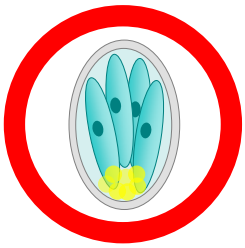
Cryptosporidium

For Vets



Worms & Germs
Promoting Safe Pet Ownership

General Information

- *Cryptosporidium* spp. are intestinal protozoal parasites of animals and humans that cause the disease cryptosporidiosis. The primary clinical sign of infection is diarrhea, but subclinical infection also occurs.
- Like other protozoa, the taxonomy of *Cryptosporidium* is controversial. Originally the genus contained only two species, but now at least 23 species have been described. The species *C. parvum*, which has the widest host range, also includes several genotypes and subgenotypes.
- The five most common species of *Cryptosporidium* capable of infecting humans (and their primary hosts) are *C. hominis* (humans), *C. parvum* (young cattle), C. *meleagridis* (turkeys), *C. felis* (cats) and *C. canis* (dogs). Other *Cryptosporidium* species can infect other animals (e.g. lizards, birds) but these are generally not believed to be transmissible to humans.
- In North America, outbreaks of cryptosporidiosis associated with fecal contamination of water supplies do occur, but the majority of human cases are sporadic. The source of infection in these sporadic cases is frequently unclear, but transmission from animals, particularly *C. parvum* from young cattle, is sometimes suspected.
- The risk of zoonotic transmission of *Cryptosporidium* from pets remains controversial and unquantified, but the potential certainly exists. It is therefore important to be aware of the possible risk and encourage pet owners and people who handle animals to take steps to help prevent the spread of *Cryptosporidium*.

Prevalence and Risk Factors

Humans

- In North America, 0.6% to 4.3% of the population may be shedding *Cryptosporidium* in their feces at any given time. Seroprevalence, indicating previous exposure, is higher at 15-32%.
- From 1991-2000, *Cyrpotsporidium* was implicated in 40/106 outbreaks of recreational water-associated gastrointestinal disease, and 11/130 outbreaks of drinking water-associated gastrointestinal disease in the USA. However, outbreaks account for less than 10% of diagnoses of cryptosporidiosis in the USA.
- In 2004, 571 cases of cryptosporidiosis were reported in Canada, 298 of which were in Ontario. Cryptosporidiosis is likely under-reported because the illness is usually self-limiting.
- Risk factors for human infection include contact with infected animals (particularly calves), farm visits, ingestion of contaminated recreational or drinking water, contact with infected persons, and travel to developing countries where the disease is more prevalent. A seasonal trend may occur with increased cases over the summer.
- Cryptosporidiosis is more common in immunocompromised individuals (e.g. HIV/AIDS, cancer and transplant patients), children in daycare centres and those under two years of age, and livestock handlers (particularly dairy farmers and veterinary personnel who have contact with calves).
- In most studies, **contact with pets is either not associated or negatively associated with the risk of cryptosporidiosis**, even in HIV patients.

Animals

- A study in the USA showed seroprevalence for *Cryptosporidium* in cats between 1.3-14.7% depending on geographic region. Seroprevalence was highest in outdoor cats, those also seropositive for *Toxoplasma gondii*, and those with gastrointestinal disease.
- Fecal oocyst shedding was found in 2.0% of a mixed group of shelter and client-owned cats in Colorado, and 3.8% of 1 to 12-month-old shelter cats in New York. A California study found fecal shedding in dogs in only 2% of 200 animals sampled. However, depending on the region and the group of animals tested, the prevalence of fecal shedding in dogs and cats can range from 0-45%.
- In general, **young animals are more susceptible** to infection than adults.
- In a study conducted in the Niagara region of Ontario, 7.4% of dogs and 7.3% of cats were found to be positive for cryptosporidial antigen in their feces, but the specificity of this test is unknown.

Zoonotic Risk

Some studies have shown a predominance of *C. parvum* among isolates from sporadic cases of human cryptosporidiosis, compared to epidemic outbreaks in which *C. hominis* is usually implicated. **Cattle are the primary reservoir of *C. parvum*, and this species is clearly a zoonotic risk.** But because humans can carry both *C. hominis* and *C. parvum*, the source of *C. parvum* in sporadic cases could be infected cattle or other infected people. Dogs, cats, sheep, goats, horses and rodents can also carry *C. parvum*, but the prevalence is unknown.

- The question remains whether or not other species of the parasite are a significant public health threat to the general population, to only immunocompromised individuals, or not at all. The five most common species of *Cryptosporidium* in humans (*C. hominis*, *C. parvum*, *C. meleagridis*, *C. felis*, *C. canis*) have all been found in both immunocompromised and immunocompetent individuals. The dog-adapted species, *C. canis*, has only been reported to cause subclinical infection in a few immunocompetent individuals. In contrast, *C. felis*, the cat-adapted species, has been reported to cause watery diarrhea in a small number of immunocompetent and immunocompromised individuals. Natural infection with ***C. hominis*** **is almost exclusively found in humans**.

Life Cycle

- In the environment, *Cryptosporidium* exists in the form of 2.5-5 µm oocysts, which each contain 4 sporozoites.
- After ingestion by a susceptible host, the oocysts release sporozoites in the small intestine. Sporozoites invade the brush border of the epithelium, forming vacuoles containing merozoites. The merozoites replicate asexually to form type I and type II meronts. Type I meronts go on to invade other epithelial cells and continue asexual reproduction. Type II meronts go on to produce macrogamonts and microgamonts. Fusing of one of each type of gamont results in the formation of a zygote, which in turn forms an oocyst.
- The oocysts are either thin- or thick-walled. Thin-walled oocysts rupture within the intestine, and the entire life cycle is repeated (autogenous infection). Thick-walled oocysts are passed in the feces and are immediately infective to the next susceptible host that ingests them.

Thick-walled ***Cryptosporidium*** **oocysts are highly resistant to all disinfectants**, including routine chlorination of drinking water. Oocysts are also very small, making them difficult to filter from water. Prolonged contact with high concentrations of ammonia or chlorine can effectively kill oocysts. Moist heat (e.g. steam, pasteurization), freezing and thawing, or thorough drying are more practical means of disinfection, but may not be completely effective. Routine household or hospital disinfection practices are not effective. *Cryptosporidium* oocysts can survive for weeks in the environment, especially in cool water.

Transmission

Transmission of *Cryptosporidium* occurs through ingestion of oocysts which are shed in the feces of infected humans or animals. As few as ten *C. hominis* oocysts can cause clinical infection in an otherwise healthy person. Infected persons have been reported to shed up to a billion oocysts per day, so very little stool contamination can result in transmission. Transmission can be: **person to person**, which is particularly important in daycare settings with young children; **animal to person**, which is sometimes implicated in outbreaks in rural areas, although the relative importance of this route remains unclear; or **via contaminated water** (or food) sources, which is a well recognized route in epidemic outbreaks. Animals may be infected by contamination of water, food or any object they lick or chew with feces containing a *Cryptosporidium* species to which they are susceptible (e.g. *C. parvum* or a host-adapted species, NOT *C. hominis*).

Symptoms and Signs

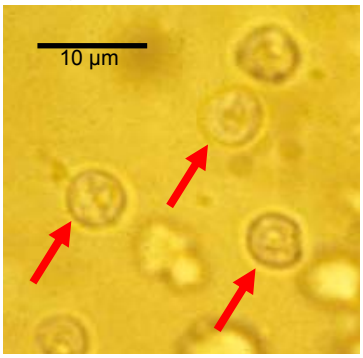
Humans

- The prepatent period for infection in humans is typically 5-7 days. Clinical signs, including primarily diarrhea (which may be profuse), nausea, abdominal cramps, low-grade fever and anorexia, may last 2-26 days.
- Infection is usually self-limiting, but in immunocompromised individuals (especially HIV/AIDS patients) the illness is often much more severe, can also affect the respiratory and biliary tracts, and can be fatal. However, the incidence of such severe disease has decreased with modern HIV therapy.
- Children less than 5 years old can have multiple episodes of cryptosporidiosis, indicating that immunity is relatively short-lived.
- Even if infected, *C. canis* usually does not cause diarrhea in people, and *C. felis* is a very uncommon cause of diarrhea in people.

Animals

- *Cryptosporidium* can produce patent infections in cats and dogs with no accompanying clinical signs. It is therefore debated whether the organism causes diarrhea in otherwise healthy, immunocompetent cats and dogs, or whether it may be a secondary pathogen in cases of other gastrointestinal disease, such as parvovirus infection, or immunosuppressive systemic infections such as distemper and feline leukemia virus.
- When clinical signs are associated with *Cryptosporidium* infection in animals, the primary sign is diarrhea. In both dogs and cats, diarrhea is most severe in immunocompromised animals.
- *Cryptosporidium* is an important cause of diarrhea in dairy calves less than a month of age. Clinical signs of infection in these animals range from none to profuse, watery diarrhea. *Cryptosporidium* may be a primary pathogen in birds, in which it can infect both the gastrointestinal and respiratory tracts and bursa of Fabricius. Cryptosporidia tend to infect the stomach of reptiles, and therefore cause gastritis and vomiting.

Diagnosis



Fecal examination is the traditional means of diagnosis. Concentration techniques using sugar solutions (e.g. Sheather's solution, specific gravity 1.25) for fecal floatation are recommended for detecting oocysts. On unstained preparations (see picture left), phase-contrast or bright-field microscopy are used to visualize oocysts, which are typically refractile and slightly smaller than erythrocytes. They appear as circular or concave disks; dark shadows of four banana-shaped sporozoites can sometimes be seen within them. On wet mounts stained with crystal violet, the oocysts are apparent because they do not pick up stain. Giemsa and methylene blue stains stain both yeasts and oocysts the same colour, making differentiation very difficult. Diagnostic laboratories may employ a variety of concentration and staining techniques, including fluorescent antibody (FA) detection which has been used as the reference standard for comparison of other diagnostic tests.

- The only two *Cryptosporidium* species that can be differentiated morphologically from the others are *C. muris* and *C. andersoni*. To determine the species of other cryptosporidia requires molecular/DNA-based tests, which are not typically performed. This makes determining the source of *Cryptosporidium* infections more difficult.
- Oocyst shedding, even in symptomatic humans, is inconsistent, and may persist following resolution of clinical signs for up to 15 days. In puppies experimentally infected with *C. parvum* from calves, the prepatent period was 3-5 days, peak shedding occurred at 7-9 days, and intermittent or low-level shedding continued for at least 80 days.

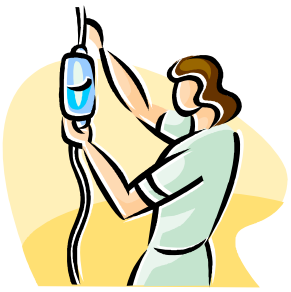
Fecal antigen tests designed for use in human medicine are also available, although it is unknown if these tests can consistently identify species such as *C. canis* and *C. felis*. In a comparison of three such assays on feline fecal samples, the ProSpecT Microplate Assay had the highest sensitivity (71.4%) and specificity (96.7%) for detection of cryptosporidial antigen, compared to FA testing. In the same study, fecal floatation using a zinc sulfate concentration technique (specific gravity 1.18, commonly used for *Giardia* testing) had a sensitivity of only 21.4%.

Polymerase chain reaction (PCR)-based tests are currently used for genotyping but not detection of *Cryptosporidium* in clinical samples, although they appear to have a very low limit of detection. Compared to FA testing of fecal samples from experimentally infected cats, PCR appeared to be more sensitive in one study.

Serologic tests in humans indicate exposure but are not useful in clinical cases. A serum antibody test for cats is available, but it is not useful for predicting oocyst shedding in individual animals.

Recovery of oocysts from environmental or drinking water can be difficult, time-consuming and expensive. It typically involves passing large volumes of water through special filters in order to capture any oocysts.

Treatment of Cryptosporidiosis



- Most infections in immunocompetent animals and humans are self limiting and individuals recover completely. Treatment, if necessary, is limited to supportive care, particularly fluid replacement.
- A consistently effective anticryptosporidial drug has yet to be found.
- In the USA, the only drug approved for treatment of cryptosporidiosis is **nitazoxanide**, which can only be used to treat children of ages 1-11 years. In dogs and cats, the drug's efficacy is uncertain. Given its importance in human medicine, nitazoxanide is not recommended for treatment of cryptosporidiosis in dogs and cats.

- **Paromomycin**, an aminoglycoside, has shown variable efficacy in the treatment of acute cryptosporidiosis in humans and animals in terms of both improvement in clinical signs and decreased shedding of oocysts. The drug can be nephrotoxic and ototoxic, particularly in cats, if it is absorbed through damaged intestinal mucosa.
- The **macrolides** azithromycin and clarithromycin have been used for treatment of HIV/AIDS patients, but further study is required to determine their true efficacy. There are no studies in companion animals regarding the efficacy of these drugs for treatment of cryptosporidiosis.
- **Specific therapy for cryptosporidiosis should only be considered** in companion animals with diarrhea if other causes of diarrhea have been ruled out and the animal is immunocompromised, or if infection and clinical signs become chronic. An immunocompetent animal should be able to clear the infection without specific drug therapy, therefore only supportive therapy is indicated in these cases.

Vaccination

There is no vaccine available for *Cryptosporidium* in people or in animals.

Infection Control

Because *Cryptosporidium* infection is so often subclinical, and the risk of infection from the species typically carried by companion animals remains unquantified, basic infection control measures such as practicing good hand hygiene, avoiding contact with feces and preventing fecal contamination of the environment are the primary means of preventing cryptosporidiosis. These measures are especially important for immunocompromised individuals, in whom the consequences of infection, should it occur, can be much more severe.

In Clinic Precautions:

- Diarrheic animals should always be isolated and treated as potentially infectious.
- Fecal samples from animals with suspected cryptosporidiosis should be formalized prior to examination or shipment to an external laboratory (unless genotyping is required), to reduce the risk of transmission of infectious oocysts to staff. Mix 1 part formalin (38% formaldehyde) with 9 parts feces. Prevent contamination of the outside of sample containers, and clearly indicate on the label if there is a suspicion of cryptosporidiosis.
- Because **oocysts are resistant to all common disinfectants**, preventing environmental contamination through excellent sanitation is critical. Thorough cleaning is important to physically remove oocysts from surfaces because disinfection is not reliable for this pathogen. Use of boiling water to scald food and water bowls may also help minimize contamination.

Hand Hygiene:

If *Cryptosporidium* is suspected, hands should be washed with soap and water. Alcohol hand sanitizers are ineffective against oocysts. Antibacterial soaps are equally ineffective, but the physical action of washing can help reduce contamination of hands. Wash hands:

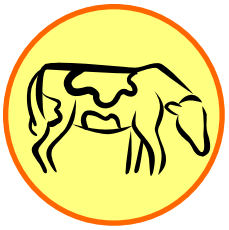
- After working in any area where diarrheic animals may contaminate the environment
- After handling any animal and especially after handling animal feces
- After using the bathroom
- Before handling any food

At Home & In Public:

- Individuals should not go swimming if they have, or have very recently had, diarrhea.
- Avoid drinking untreated water from open water sources (e.g. lakes, ponds, streams, shallow wells), or swallowing water from recreational water sources (e.g. pools)
- All fruit and vegetables should be washed with potable drinking water.

Immunocompromised individuals:

- Minimize contact with animal stool, especially that of young animals
  - Try to have another person clean up stool/litter boxes if possible
  - Individuals should wear disposable gloves AND wash their hands immediately after performing one of these tasks if they must do so themselves.
- Wash hands after working in the garden or any outdoor area where animals may have defecated.
- Peeling and cooking vegetables in addition to washing them properly will help to further reduce the risk of contamination of food with fecal pathogens such as *Cryptosporidium*.

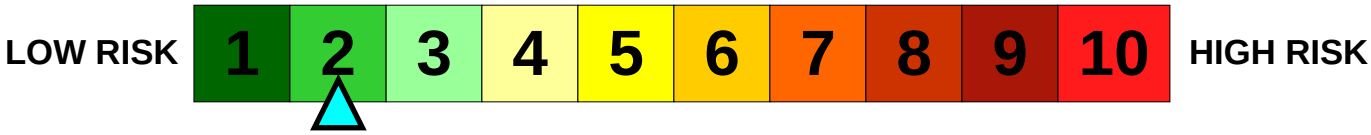


The animals most commonly infected with a zoonotic species of *Cryptosporidium* are young calves. Therefore hand hygiene following contact with these animals, and keeping food and drink away from areas where these animals are kept, are particularly important. Immunocompromised individuals should avoid contact with calves, whether the animals are diarrheic or not.

Zoonotic Disease Risk

The zoonotic risk to the general population posed by *Cryptosporidium* in dogs and cats is:

HEALTHY ADULTS



Individuals with Compromised Immune Systems:

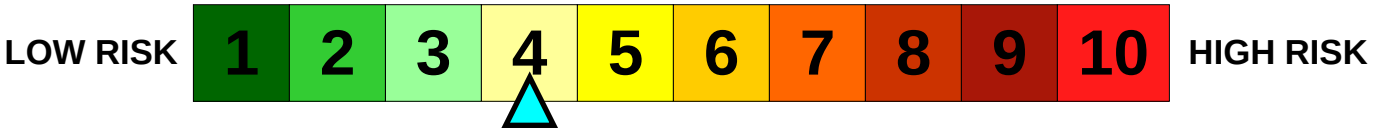
- Immunocompromised individuals (e.g. HIV/AIDS, transplant or cancer patients) are more susceptible to many kinds of infections, including those which may be transmitted by pets. It can be safe and even beneficial for such a person to have a pet, if extra precautions are taken to prevent disease transmission.
- It is important for both an immunocompromised person and the people around that person to be particularly diligent about avoiding direct or indirect contact with fecal material of any kind. After touching an animal, the person should immediately and thoroughly wash his/her hands with soap and running water. If the person's clothing becomes visibly soiled from the animal, it should be removed and laundered. Similar precautions can be applied to elderly individuals.

Infants and Young Children:

- Young children are more likely than adults to extensively handle animals if given the opportunity. Children are also more likely to touch their faces or mouths, and are less likely to wash their hands after handling any kind of animal. Many children tend to "snuggle" with animals, which can increase the risk of disease transmission.
- Young children should be supervised when playing with animals, and an adult should ensure that they wash their hands afterwards, and especially prior to handling food. Older children should be taught to do the same.

For these groups, the zoonotic risk posed by *Cryptosporidium* in dogs and cats is likely:

CHILDREN / IMMUNOCOMPROMISED PERSONS



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