

General Information

- *Clostridium difficile* is a Gram positive, strictly anaerobic, spore-forming bacterium that can be found in the intestinal tract of humans and many animal species, including companion animals, farm animals and wildlife.
- *Clostridium difficile* is an important cause of disease in many of these species, including people.
- Strains of *C. difficile* can produce one or more toxins (toxin A, toxin B, CDT/binary toxin). Strains that do not possess the genes for any toxins do not cause disease.
- This bacterium cannot grow in an aerobic environment, but the bacterial spores are extremely hardy and can survive in the environment for a long time, even for years.
- In people, *C. difficile* is most common in the elderly, hospital inpatients and individuals on antimicrobial therapy.
- The strains of *C. difficile* that infect pets are often the same as those that infect people, but it remains unclear if animals can transmit *C. difficile* to humans.



Prevalence & Risk Factors

Humans

- In developed countries, *C. difficile* is the leading cause of infectious hospital-associated diarrhea in adults, and accounts for 15-25% of cases of antimicrobial-associated diarrhea. In 2003, it was estimated that 61/100 000 patients discharged from short-stay hospitals in the USA were diagnosed with *C. difficile*, which was almost double the rate from 1996.
- The primary risk factor for disease due to *C. difficile* infection (CDI) is treatment with antimicrobials.
- Old age, antineoplastic chemotherapy, extended hospitalization, acid-suppressive therapy for gastric ulcers, enemas, nasogastric intubation, antiperistaltic drug therapy and gastrointestinal surgery are also associated with disease due to CDI.
- A hypervirulent *C. difficile* strain (ribotype 027/NAP1) has emerged in North America, Europe and Japan, and has been responsible for epidemics of severe disease in hospitalized patients.
- Recently, severe disease due to CDI has also been reported in otherwise healthy individuals in the community.



Animals

- A small percentage of healthy dogs and cats (0-4%) carry *C. difficile* in their intestinal tract. Carriage rates tend to be higher (up to 30%) in puppies, kittens, animals in breeding colonies and dogs that visit human hospitals.
- Most often the bacterium never causes any illness in these animals.
- Treatment with antimicrobials increases the likelihood that a dog is shedding *C. difficile* in its feces. Contact with children has also been implicated as a risk factor for *C. difficile* shedding in dogs.

Habitat & Environmental Survival

The main reservoir of *C. difficile* is the intestinal tract of various animal species. The spores of the bacterium can survive very well in the environment and are resistant to most disinfectants. Nonetheless, a 1:10 solution of household bleach can effectively eliminate spores if all visible organic debris is removed beforehand and adequate contact time (10-15 minutes) is allowed. Oxidizing agents (e.g. peroxygen disinfectants) may also be effective.

Transmission of *C. difficile*

- *Clostridium difficile* is transmitted by the fecal-oral route. Human patients in hospitals can be infected with *C. difficile* from environmental surfaces, shared equipment, hands of hospital personnel and infected roommates.
- It is unclear if *C. difficile* can be transmitted from pets to people. The types of *C. difficile* found in pets are often the same as those found in people, including the epidemic strain ribotype 027/NAP1. This suggests that *C. difficile* could potentially be transmitted between people and animals, but there is still no conclusive evidence. It is prudent to err on the side of caution and consider *C. difficile* transmissible between pets and people until proven otherwise.





Symptoms and Signs

Humans: In people, CDI (also known as *C. difficile*-associated disease [CDAD]) can range from inapparent to rapidly fatal. Diarrhea is the primary clinical sign, and can range from mild and self-limiting to very severe. Complications such as pseudomembranous colitis (which is caused by *C. difficile* in virtually all cases), toxic megacolon and intestinal perforation can occur. Complication and death rates seem to be increasing in people.

Animals: The role of *C. difficile* as a cause of disease in dogs and cats is not clear, as the vast majority of these animals with *C. difficile* in their intestinal tracts do not become ill. However, an association between *C. difficile* and diarrhea has been made in dogs, and there is one report implicating *C. difficile* as a cause of diarrhea in cats. In most of these cases the diarrhea is mild, and clinically cannot be differentiated from diarrhea due to other common causes. Occasionally, severe diarrhea may occur, and it has been suggested that *C. difficile* may be a cause of hemorrhagic colitis in animals.

Diagnosis of *C. difficile*

Testing for *C. difficile* infection in humans and companion animals with acute diarrhea is reasonable, even in the absence of a history of antimicrobial treatment or hospitalization. The optimal means of diagnosis is currently unclear as there are limitations to all available tests.

- **Toxin tests:** Detection of *C. difficile* toxins A and/or B in diarrheic feces is the standard for diagnosis, for which enzyme-linked immunosorbent assays (ELISAs) are commonly used. While these tests have good sensitivity and specificity in humans, they do not perform as well in dogs. Antigen ELISAs are used concurrently in some cases to detect the organism itself, which helps support for the diagnosis, but antigen ELISA alone is not diagnostic because it also detects non-toxigenic strains and non-pathogenic intestinal colonization.
- **Fecal culture:** Fecal culture for *C. difficile* is not routinely recommended, as it is difficult to do, has a slow turnaround time, and is of limited availability. Furthermore, as with the antigen ELISA, simply detecting *C. difficile* in the feces does not mean that it is causing disease, as strains that cannot produce toxins are not pathogenic, and healthy humans, dogs and cats can also shed toxigenic *C. difficile*. Fecal smears are useless for diagnosis of *C. difficile* infection.
- **Polymerase chain reaction (PCR):** Use of PCR to detect *C. difficile* toxin genes is being evaluated as a more rapid and sensitive test for high-risk human populations (i.e. hospitalized individuals). The usefulness of such an assay in community settings is unclear. These assays have not been validated for use in companion animals. However, even detection of *C. difficile* strains capable of producing toxins does not mean that the bacteria *are* producing toxins and causing disease. Therefore toxin detection itself remains the key.



Treatment of *C. difficile* Infection (CDI)

Humans: Metronidazole has been the mainstay of antimicrobial therapy for CDI, but there are reports of decreasing response to metronidazole and increasing relapse following treatment with this drug. **Oral** vancomycin has typically been reserved for severe cases and those not responding to metronidazole, however oral vancomycin is being increasingly used as a first-line treatment in some areas because of concerns about poor response to metronidazole (parenteral vancomycin is *not* effective for intestinal infections). Cessation of potentially inciting antimicrobial therapy is important, if possible, as is general supportive care. In severe cases, colectomy may be required. Probiotics are not considered effective.

Animals: Some (if not most) cases of CDI in companion animals are self-limiting, and require only supportive care. Objective information on specific treatment of CDI in animals is not available, but subjectively, metronidazole appears to be an effective therapy in dogs and cats, and metronidazole resistance has not been identified in *C. difficile* from these species. There is no vaccine available for *C. difficile* for any species.

Infection Control For Pets Carrying *C. difficile*

Hand Hygiene

- Anyone handling the animal should wash their hands immediately afterwards with soap and running water. Alcohol-based hand sanitizers are likely not effective against clostridial spores, so ideally soap and water must be used.





Precautions at Home

- If a pet is diagnosed with *C. difficile*, it is important that the owner follows all treatment recommendations given by the veterinarian, particularly regarding administration of any medications.
- Hand washing after handling the pet should be emphasized.
- Contact with the pet's feces should be avoided, and hands should be washed thoroughly after handling feces, even if a plastic bag is used to pick up the feces.
- If the animal accidentally passes diarrhea in the house, it should be promptly cleaned up. The area should be cleaned to remove as much diarrhea as possible, then treated with a disinfectant. A 1:10 solution of household bleach (1 part bleach to 10 parts water) is best for surfaces such as tile that should not be damaged by bleach. Other surfaces are more difficult to disinfect, in which case thorough cleaning is the most important step. Steam cleaning is a reasonable method to reduce the number of *C. difficile* spores that may be left in rugs, carpets or similar floor coverings. Hands should be thoroughly washed after cleaning.
- It is not known how much of a risk an infected pet is to other pets. It is prudent to keep pets diagnosed with *C. difficile* away from other pets (e.g. avoid parks, boarding facilities) until the diarrhea has resolved.

Considerations For Therapy Animals

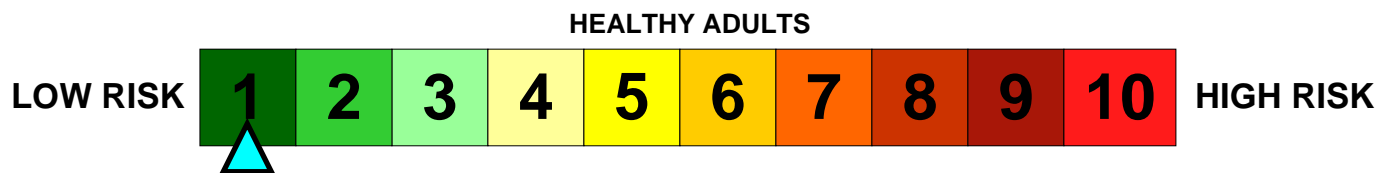
Visiting healthcare facilities has been shown to be a risk factor for *C. difficile* shedding in dogs. However, it is unclear whether "therapy pets" involved in healthcare visitation have an increased risk of disease. Guidelines have been developed to reduce the risk of pets acquiring infectious diseases in hospitals. Owners involved in these programs should ensure that they follow these guidelines. **Testing or treating clinically normal animals for *C. difficile* is not indicated.**

Pet owners diagnosed with CDI

Owners diagnosed with CDI should be told to wash their hands thoroughly after using the washroom. Their pet(s) should be prevented from drinking from the toilet. There is currently no evidence that testing pets for *C. difficile* in the absence of strain characterization is useful if an owner is diagnosed with CDI.

Zoonotic Disease Risk

The zoonotic risk to the general population posed by *C. difficile* in house pets such as dogs and cats is:

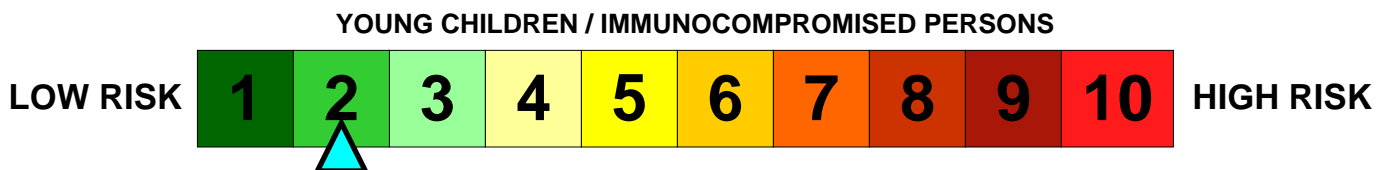


Individuals with compromised immune systems (e.g. HIV/AIDS, transplant and cancer patients) are more susceptible to many kinds of infections, including those which may be transmitted by pets. While these individuals are not advised to get rid of their pets, precautions should be taken to reduce the frequency of contacts that could result in pathogen transmission (e.g. avoiding contact with any animal feces), as well as the ability of infectious agents to survive in the household (e.g. prompt and thorough disinfection of potentially contaminated surfaces).

Infants and young children (less than 5 years old) are more likely than adults to extensively handle animals if given the opportunity, more likely to touch their faces or mouths, and less likely to wash their hands after handling an animal. Children may "snuggle" with pets such as dogs and cats; this very close contact 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.
- It is important to note that **infants less than 12 months of age are not affected** by *C. difficile*, possibly because they lack the cellular receptor for the toxin.

For these groups, the zoonotic risk posed by *C. difficile* in house pets such as dogs and cats is likely:





Additional Information

- Barbut F, Petit JC. Epidemiology of *Clostridium difficile* -associated infections. Clin Microbiol Infect. 2001;7:405-410.
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- Pepin J, Valiquette L, Alary ME, et al. *Clostridium difficile* -associated diarrhea in a region of Quebec from 1991 to 2003: A changing pattern of disease severity. CMAJ. 2004;171:466-472.
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- Provincial Infectious Diseases Advisory Committee (PIDAC). Best Practices Document for the Management of *Clostridium difficile* in all health care settings. Revised November 2007. Ontario Ministry of Health and Long-Term Care. Available at http://www.health.gov.on.ca/english/providers/program/infectious/diseases/best_prac/bp_cdifff.pdf

