

# Feline Zoonotic Diseases and Prevention of Transmission

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## OUTLINE

Cat Bites, 1090  
Bacterial Zoonoses, 1091  
Viral Zoonoses, 1093  
Parasitic Zoonoses, 1093

Fungal Zoonoses, 1094  
Cat Ownership for Immune-Compromised Persons, 1095  
Public Health Considerations, 1095

Zoonoses are estimated to make up approximately 75% of today's emerging infectious diseases. These infectious agents can be transmitted by many different animals, including wildlife, exotic pets, and even traditional pets, such as dogs and cats. Recent studies have shown that cats, both healthy and with diarrhea, can shed zoonotic organisms in their feces. Between 13% and 40% of the cats examined were shedding at least one zoonotic, enteric pathogen.<sup>18,36</sup> Although the prevalence of shedding was variable for the specific pathogens, numerous organisms, including *Toxocara cati*, *Giardia*, *Cryptosporidium*, *Salmonella*, and *Campylobacter* were identified. This chapter will highlight transmission routes of zoonotic diseases that are commonly associated with domestic cats and what steps can be taken to reduce exposure and transmission (Box 34-1). Additional zoonotic infections are rarely associated with cats (Table 34-1), and more information on these can be found in the American Association of Feline Practitioners 2003 Report on Feline Zoonoses.<sup>6</sup>

## CAT BITES

Although dog bites account for approximately 80% of reported animal bites, cats are the second most common animal reported to cause bites.<sup>32</sup> Because cats typically cause puncture wounds when biting, introduction of

bacteria deeply into the tissues of the wound is common. Infection rates for cat bites have been reported to range from 30% to 50%, while infection of wounds resulting from dog bites is reportedly lower, 2% to 4%. *Pasteurella multocida* is the most common bacteria isolated from wounds resulting from cat bites and can cause sepsis, meningitis, and septic arthritis among other complications. Cat bites to the hands often require extensive treatment and are more likely than dog bites to result in complications, such as cellulitis, osteomyelitis, and tenosynovitis.<sup>32</sup>

Prevention of cat bites can often be achieved by understanding feline behavior, using sedation in fractious cats when appropriate, and wearing thick gloves, such as those worn by welders, to prevent penetration of teeth into hands or forearms. Despite these efforts, cat bites will still occur and should be treated as soon as possible. Delaying treatment is a risk factor for infection and other complications. Pain, swelling, erythema, and swelling of local lymph nodes can occur within 1 to 2 hours of a cat bite. Wound care is essential, and the use of prophylactic antibiotics is still controversial. However, one study that examined a small number of humans who had been bitten by cats found that 67% of those not treated with antibiotics developed infection, while 0% of those treated with antibiotics developed infection.<sup>14</sup> Additionally, postexposure prophylaxis for rabies virus may be indicated, depending on the vaccination history

**BOX 34-1****Precautions to Reduce the Risk of Contracting a Zoonotic Disease from a Domestic Cat<sup>12</sup>**

- Wash hands after handling cats and before eating.
- Annual checkups and fecal exams should be performed for all cats.
- Rabies vaccinations should be kept current.
- Flea and tick control should be performed.
- Do not allow a cat to lick your face, food utensils, or plate.
- Keep cats indoors.
- Seek medical attention for cat bites.
- Cats should be fed cooked or commercially processed food.
- Fecal material should be removed from litter boxes daily.
- Dispose of fecal material in a location where water supplies will not be contaminated.
- Clean litter boxes periodically with scalding water and detergent.
- Avoid handling unfamiliar cats, especially those that appear sick.
- Do not allow cats to drink from the toilet.
- Have the cat's claws trimmed frequently, or consider the use of soft nail caps.
- Never tease or provoke cats.

of the cat and the circumstances of the bite. The victim's history of tetanus prophylaxis should also be reviewed. Treatment for cat bites will vary from case to case, but all should include aggressive and careful wound care (e.g., cleaning, irrigation and débridement when necessary) and measures to prevent infection with bacteria, such as *Pasteurella multocida* or rabies virus.

**BACTERIAL ZOONOSES**

*Bartonella henselae* is the most common etiologic agent of cat scratch disease (CSD), but other *Bartonella* spp. have been found in cats, including *B. clarridgeiae*, *B. koehlerae*, and *B. weissii*.<sup>6</sup> Seroprevalence among domestic cats in the United States can vary but has been reported to be as high as 81%.<sup>6</sup> Young cats are more commonly bacteremic, and most human cases are associated with kitten exposure. Fleas will feed on bacteremic cats, and the bacteria can then replicate in the gut of fleas and survive in flea feces for days. Human infection occurs after the bite or scratch of a cat, which allows introduction of the bacteria into the skin and subcutaneous tissue (Figure 34-1).<sup>11</sup> The bacteria are typically found in flea feces located on the cat (under the claws, in the mouth). Cat scratch disease is usually self-limiting in immune-competent individuals but can

**TABLE 34-1** Other Less Common Zoonoses Associated with Cats

Organism	Feline Clinical Signs	Human Symptoms	Route of Infection for Human	Relative Risk of Infection for Humans
<i>Bordetella</i> spp.	Subclinical, upper respiratory, pneumonia (rare)	Pneumonia in immunosuppressed patients	Aerosolization	Extremely rare
<i>Capnocytophaga canimorsus</i>	Subclinical	Bacteremia, keratitis	Bite wounds, possibly scratches	Extremely rare
<i>Cheyletiella</i>	Pruritic skin disease	Pruritic skin disease	Direct contact	Occasional
<i>Coxiella burnetii</i> (agent of Q fever)	Subclinical, abortion, stillbirth	Fever, pneumonitis, myalgia, lymphadenopathy, arthritis, hepatitis, endocarditis	Contact with infected tissues (placenta, birthing fluids)	Extremely rare
<i>Francisella tularensis</i> (agent of tularemia or rabbit fever)	Septicemia, pneumonia	Ulceroglandular, glandular, oculoglandular, pneumonic, typhoidal depending on route of exposure	Bite wounds	Rare
<i>Mycoplasma felis</i>	Chronic draining tracts, polyarthritis	Cellulitis, polyarthritis	Bite wound	Extremely rare
<i>Sporothrix schenckii</i>	Chronic draining of cutaneous tracts	Chronic draining of cutaneous tracts	Potentially contact with exudates from feline wounds	Rare

Modified from Table 1, p. 938 in Brown RR, Elston TH, Evans L et al: American Association of Feline Practitioners 2003 report on feline zoonoses, *Comp Contin Edu Pract Vet* 25:936, 2003.



**FIGURE 34-1** Bartonellosis. Papular lesion and enlarged lymph node in the supraclavicular area and neck of a girl that frequently cuddled her kitten over her chest and shoulder. (From Rabinowitz P, Conti L: Human-animal medicine: clinical approaches to zoonoses, St Louis, 2010, Saunders Elsevier.)

lead to atypical and serious consequences in immune-suppressed individuals, including bacillary angiomatosis and bacillary peliosis.<sup>16</sup> CSD can most effectively be prevented by maintaining good flea and tick prevention in cats and encouraging gentle play that does not involve the owner's hands or feet to reduce biting and scratching, especially with kittens. Nails can also be kept trimmed to reduce the likelihood of skin penetration. Additionally, immune-compromised individuals who want to obtain a cat should be encouraged to adopt an adult cat, because they are less likely to be bacteremic.

*Yersinia pestis* causes plague and can lead to different forms of clinical disease in humans and cats, including bubonic, bacteremic, and pneumonic plague. Plague must be treated with antibiotics or the infection can be rapidly fatal. Human plague is typically associated with exposure to wild rodent fleas; however, exposure to domestic cats can also be a risk factor.<sup>11,17</sup> A study that examined human cases of plague in the western United States found that approximately 8% of the reported cases were attributable to contact with domestic cats.<sup>17</sup> Exposure occurred through bites, scratches, or other contact with infected cats. Feline and human exposure to *Y. pestis*, especially in the western United States where plague is endemic, can be reduced by maintaining good flea and tick prevention, keeping cats indoors to reduce exposure to prey species, such as rodents (and associated fleas), and encouraging gentle play.

Methicillin-resistant *Staphylococcus aureus* (MRSA) is an increasing problem and concern in human medicine, and the role of domestic animals in transmission is increasingly being examined.<sup>30</sup> Many studies have focused on canine carriage of or infection with MRSA,<sup>24,28</sup> but studies have also identified MRSA in domestic cats.<sup>29,33,37,38</sup> Although no definitive evidence of transmission of MRSA from a cat to a human is available, reports

of identical isolates in humans and their pets suggest that transmission between species is likely.<sup>15,33</sup> Cats likely acquire MRSA from interactions with humans, and a recent study examined risk factors associated with MRSA infections in dogs and cats.<sup>34</sup> Dogs and cats with methicillin-sensitive *Staphylococcus aureus* (MSSA) infections were used as unmatched controls for the MRSA cases. The study found that risk factors associated with MRSA infections included number of courses of antibiotics received, number of days admitted to a veterinary clinic, and having received a surgical implant. Of the 197 animals in the study, only 64 were cats (29 MRSA cases, 34 MSSA controls), and data from dogs and cats were combined for analysis. Further research is needed to determine what risk factors might specifically be associated with MRSA infection in cats. Cats can potentially spread MRSA to humans in home or nursing care settings, although the risk is still likely much less than obtaining infection from other humans. Disposable gloves should be worn when possible, but thorough hand washing has been shown to be the most effective method to prevent the spread of MRSA.<sup>3</sup> Fomites and environmental surfaces are not typically associated with the transmission of MRSA and routine cleaning and decontamination is sufficient. Additionally, appropriate screening (culture and sensitivity) of clinical patients, both feline and human, can reduce the transmission of MRSA.

Historically, numerous texts have cited *Chlamydomphila felis* as a zoonotic pathogen. Little evidence has been published to support this claim. A recent review of the literature found only seven cases of human disease associated with *C. felis*.<sup>7</sup> Of those seven cases, only one was definitively diagnosed to be caused by *C. felis*. The human patient had chronic conjunctivitis and was immune-suppressed. Based on the prevalence of *C. felis* infections in cats, particularly kittens, risk of disease in humans is low. Precautions to limit exposure to cats with respiratory and ocular infections should be taken for individuals that are immune-compromised.

Although group A *Streptococcus* has been implicated as zoonoses transmitted from a dog, no literature is available confirming the spread of this bacteria from a cat to a human.<sup>27</sup> Transmission of group A *Streptococcus* from a cat to a human is likely extremely rare.<sup>6</sup> Exposure to other, less common zoonotic bacteria, such as *Salmonella* spp., *Yersinia enterocolitica*, *Helicobacter* spp., and *Campylobacter* spp. can be reduced by

1. Using general hygiene precautions when dealing with feces
2. Wearing disposable gloves when handling feces or litter
3. Washing hands thoroughly with soap and water after handling substances (e.g., litter, newspapers, carriers) that are contaminated with feces

These bacteria are most commonly associated with gastrointestinal illness in humans.<sup>6,11</sup>

## VIRAL ZOOSES

Rabies virus causes invariably fatal encephalitis in mammals when left untreated. Although human rabies exposure in the United States is most commonly associated with bats, domestic cats were the most common nonwildlife species identified with rabies in 2007 and 2008.<sup>4,5</sup> This increased frequency of infection in cats versus other domestic animals is likely caused by spillover of raccoon variant rabies, a lack of enforcement of vaccination and leash laws in cats, and the presence of free-roaming cats. The virus is present in saliva and neural tissue of infected animals, and exposure occurs after an infected animal bites another mammal. Prevention of human rabies exposure from cats can be achieved by vaccinating all cats according to guidelines developed by the National Association of State Public Health Veterinarians,<sup>31</sup> keeping cats indoors to reduce exposure to free-roaming cats and wildlife, and by following appropriate post-exposure procedures as outlined by the Centers for Disease Control (CDC).<sup>26</sup> Briefly, individuals who have received vaccination prior to being bitten should receive two vaccinations on days 0 and 3, but NOT receive rabies immunoglobulin (RIG). Individuals who have not received vaccination prior to being bitten should receive vaccinations on days 0, 3, 7, and 14 and should receive RIG.<sup>9</sup> In addition, all bite wounds should be treated appropriately to prevent bacterial infections.

Felids are considered fairly resistant to influenza type A viruses, but infection with both the avian influenza virus (H5N1) and the pandemic influenza virus (H1N1) have been reported.<sup>2,20,22,35</sup> One study showed that infected cats could transmit the H5N1 virus to other cats.<sup>22</sup> Cats infected with the H5N1 virus likely contracted it from eating infected birds or contact with other infected cats. Cats infected with the H1N1 virus likely contracted it from humans. The ability of either influenza virus to be transmitted from cats to humans is unclear at this time. To prevent cross-species transmission, any human or cat with respiratory disease should be examined by medical personnel and have appropriate diagnostic tests performed. In addition, limiting exposure to infected cats and thorough washing of hands after handling will reduce the spread of the virus. The same precautions that will reduce the risk of spread of human strains from one human to another are also appropriate for preventing cross-species transmission.

Other viral infections of cats, such as feline leukemia virus (FeLV) and feline immunodeficiency virus (FIV), are not zoonotic. In one study of 204 veterinarians and other occupationally exposed individuals, no serologic

or molecular evidence of zoonosis with FeLV or FIV was detected.<sup>8</sup> However, cats infected with either of these viruses may be more likely to be infected with and spread other zoonotic pathogens.

## PARASITIC ZOOSES

*Toxoplasma gondii* is estimated to infect approximately 60 million people in the United States, but most humans have few to no clinical symptoms related to infection.<sup>11</sup> Immune-compromised individuals are more likely to have clinical problems, including central neurologic and ophthalmic lesions, from infection. In addition, approximately 3,000 cases of congenital toxoplasmosis occur annually and can lead to hydrocephalus, mental retardation, convulsions, deafness, blindness, and cerebral palsy.<sup>11</sup> Felids are the definitive host for *Toxoplasma gondii* and *only* felids will shed oocysts in their feces.<sup>19</sup> All vertebrate animals can become infected by ingesting sporulated oocysts from the environment or by ingesting bradyzoites contained in raw or undercooked tissue from an infected animal. Most infections in adult humans occur after ingesting infected, improperly cooked meat. In addition, if a human or animal becomes infected while pregnant, the organism can cross the placenta and infect the fetus, leading to abortion or congenital toxoplasmosis. Pregnant women should not necessarily be advised to get rid of a pet cat. Numerous factors need to be considered, including the infection status of the woman, whether a cat is likely shedding oocysts, and the ability of the woman to avoid potential exposure by not cleaning the litter box. Fecal exams can be performed on felids to determine if oocysts are being shed; however, felids will typically only shed oocysts for approximately 1 to 3 weeks after initial infection.

Human infection can be prevented by

1. Making sure all meat products are cooked to the proper temperature
2. Drinking water from clean sources
3. Scooping cat litter boxes daily to prevent sporulation of oocysts shed in the feces (should not be done by pregnant women)
4. Disposing of cat feces in garbage that will go to landfills designed to not contaminate ground water (do not dispose of feces in toilet)
5. NOT composting cat feces, because oocysts can persist in the environment for extended periods of time and then persist in soil where compost is spread
6. Thoroughly washing hands after cleaning litter boxes
7. Keeping cats indoors to reduce the likelihood of becoming infected (if not already infected)





**FIGURE 34-2** Cutaneous larval migrans on the foot. (From Goldman L, Ausiello DA, editors: Cecil textbook of medicine, ed 23, Philadelphia, 2008, Saunders, Elsevier.)

8. Feeding cats only cooked diets or commercially produced diets
9. Determining the infection status of a woman before she becomes pregnant<sup>13</sup>

Ascarids and hookworms commonly infect cats and can lead to visceral and cutaneous larval migrans in humans, respectively (Figure 34-2). *Toxocara cati* is the most common ascarid of cats. Large numbers of eggs are shed in the feces and can inadvertently be ingested by humans. After ingestion by a person, these eggs develop into larvae that can migrate anywhere in the body. Organs commonly affected include the eye, brain, liver, and lung.<sup>10</sup> Cats can also carry numerous types of hookworms, including *Ancylostoma braziliense* and *Ancylostoma tubaeforme*.<sup>6</sup> Larvated eggs of these worms are shed in the feces of infected cats and become free-living larvae in the environment. These larvae can then penetrate the skin of humans, leading to cutaneous larval migrans.<sup>10</sup> Zoonotic ascarid and hookworm infections can be prevented by

1. Administering anthelmintic treatment to cats in accordance with recommendations of the Companion Animal Parasite Council (<http://www.capcvet.org>)
2. Keeping cats indoors so they are less likely to become infected or shed eggs into the environment
3. Properly disposing of cat feces where they will not contaminate soil or water
4. Washing hands thoroughly after handling cats or cleaning litter boxes
5. Keeping children's sandboxes covered when not in use
6. Wearing shoes while walking outside, especially on beaches



**FIGURE 34-3** Tinea corporis caused by *Trichophyton mentagrophytes*. (From Rabinowitz P, Conti L: Human-animal medicine: clinical approaches to zoonoses, St Louis, 2010, Saunders Elsevier.)

Fleas are the most common ectoparasite of cats, and although fleas are unlikely to live on humans, they can bite, cause pruritus, as well as potentially transmit some serious infectious agents. In addition, fleas carry the tapeworm *Dipylidium caninum*, which has been reported to infect children.<sup>6</sup> Cats can also carry *Sarcoptes scabiei*, which leads to a self-limiting pruritus in humans.<sup>11</sup> Humans can become infected by either of these parasites by coming in contact with infected cats or a contaminated environment. Infection can be prevented by keeping cats indoors and maintaining appropriate flea and tick prevention.

Other parasites, including *Giardia* and *Cryptosporidium*, can be found in cat feces. Recent studies have found that 2% to 7% of cats surveyed were shedding *Giardia* or *Cryptosporidium*.<sup>18,36</sup> The prevalence of shedding is low, and when coupled with appropriate handling of feces, the risk of zoonotic infection should be limited.

## FUNGAL ZOOSES

Numerous dermatophytes can cause cutaneous lesions in both cats and humans, and *Microsporum canis* is likely the most common.<sup>6</sup> In most infected persons, infection typically manifests as red, pruritic, circular lesions at the site of infection; these infections are typically self-limiting (Figure 34-3).<sup>6,11</sup> Immunocompromised individuals may

develop more severe infections. Exposure occurs after handling a cat that is carrying the organism on its fur or skin. Some cats may show typical lesions, including broken hair, alopecia, crusting, and scales, while other cats may be asymptomatic carriers (see Chapter 22). Risk factors for human infection include exposure to a kitten recently obtained from a shelter and a known history of infection, or exposure to pet cats that have extensive contact with other animals. In addition, children are more likely to become infected than adults.<sup>6</sup> The risk of infection can be reduced by appropriately treating infected cats, limiting contact with potentially infected cats, wearing gloves when handling potentially infected cats, and thoroughly washing hands after handling cats.

### CAT OWNERSHIP FOR IMMUNE-COMPROMISED PERSONS

Interactions with animals can provide positive physical and psychological benefits whether they are pets, outreach animals, or residents of assisted care facilities. Any animal that will be in contact with elderly or immune-compromised individuals should be under the care of a veterinarian. A wellness program for the animal should be designed that takes into account the age, species, and risk factors for disease. The safety of both the animal and human must be taken into account. Wellness recommendations for animals in outreach programs or residents in assisted care facilities have been published and are also available from the American Veterinary Medical Association.<sup>1,23</sup> Cats should be at least six months of age before participating in outreach programs or living in assisted care facilities. Preventive medicine for these cats should include regular wellness exams, appropriate vaccinations, and parasite control. In addition, any animals displaying signs of illness, such as diarrhea, nasal discharge, or conjunctivitis, should not be allowed to interact with elderly or immune-compromised individuals.

Because elderly and immune-compromised individuals are particularly susceptible to zoonotic diseases, including toxoplasmosis and bartonellosis, specific precautions as outlined in Box 8-1 should be closely followed. If possible, litter boxes should not be scooped or cleaned by immune-compromised individuals. However, if cleaning the litter box is unavoidable, individuals should wear disposable gloves and thoroughly wash hands afterward. In addition, immune-compromised individuals should avoid contact with diarrhea from any animal and stool from stray animals or dogs and cats less than 6 months of age.<sup>21</sup> Pets that have diarrhea should be taken to a veterinarian and examined for *Cryptosporidium*, *Salmonella*, *Campylobacter*, and Shiga toxin-producing *E. coli*.<sup>21</sup> Hands should be thoroughly washed after handling any animal feces or any objects or surfaces contaminated by feces.

Elderly and immune-compromised individuals should not necessarily be advised to give up their cats.<sup>21</sup> If considering adoption, elderly and immune-compromised individuals should adopt healthy adult cats (more than 1 year of age) as determined by a veterinarian. Animals should not be adopted from facilities with unsanitary conditions, and cats should be treated for fleas before being adopted. Rough play with cats should be discouraged to decrease the risk of bites or transmission of *Bartonella* spp. In addition, keeping cats indoors will not only prevent exposure of the cat to zoonotic and other infectious diseases, but it will limit human exposure to zoonoses commonly carried by prey species, such as hantavirus and leptospirosis.

### PUBLIC HEALTH CONSIDERATIONS

As described above, the role of cats as carriers of numerous zoonotic diseases is documented. Precautions for the individual cat owner have been described; however, the effect of free-roaming cat populations on public health is unclear. Parasitism is the most common infectious problem of free-roaming cats.<sup>25</sup> The deposition of feces into the environment leads to dissemination of infectious agents, including *Toxoplasma* and ascarids, which can potentially infect humans. Humans should avoid contact with free-roaming cats to reduce the risk of bites and exposure to zoonotic diseases, such as rabies and bartonellosis.

Veterinarians must play an active role in the reduction of free-roaming cat populations and disease prevalence in those populations.<sup>39</sup> Methods of population control can be controversial and include trap-neuter-return programs, capture and euthanasia programs, and capture and re-homing programs. Regardless of what program is used in a particular community, veterinarians should encourage owners to neuter their cats and keep them indoors. Additionally, persons should not feed free-roaming cat populations in order to reduce numbers, as well as to reduce the likelihood of humans being exposed to other animals that potentially carry zoonotic diseases. Raccoons, which can transmit rabies and *Baylisascaris procyonis* (the roundworm of raccoons), to humans, will readily eat cat food that is left outside. Although the impact of free-roaming cats on human health is unclear, efforts must be made to reduce populations in order to reduce the spread of infectious diseases to humans and cats, as well as to reduce predation on native wildlife species.

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