

# Neglected Parasitic Infections in the United States

## Toxoplasmosis

RC 067

**Toxoplasmosis** is a preventable disease caused by the parasite *Toxoplasma gondii*. An infected individual can experience fever, malaise, and swollen lymph nodes, but can also show no signs or symptoms. A small number of infected persons may experience eye disease, and infection during pregnancy can lead to miscarriage or severe disease in the newborn, including developmental delays, blindness, and epilepsy. Once infected with *T. gondii*, people are generally infected for life. As a result, infected individuals with weakened immune systems—such as in the case of advanced HIV disease, during cancer treatment, or after organ transplant—can experience disease reactivation, which can result in severe illness or even death. In persons with advanced HIV disease, inflammation of the brain (encephalitis) due to toxoplasmosis is common unless long-term preventive medication is taken. Researchers have also found an association of *T. gondii* infection with the risk for mental illness, though this requires further study.

Although *T. gondii* can infect most warm-blooded animals, cats are the only host that shed an environmentally resistant form of the organism (oocyst) in their feces. Once a person or another warm-blooded animal ingests the parasite, it becomes infectious and travels through the wall of the intestine. Then the parasite is carried by blood to other tissues including the muscles and central nervous system.

Humans can be infected several ways, including:

- Eating raw or undercooked meat containing the parasite in tissue cysts (usually pork, lamb, goat, or wild game meat, although beef and field-raised chickens have been implicated in studies).
- Ingesting food, soil, or water contaminated by cat feces (for example, from eating unwashed fruits and vegetables, gardening, or cleaning a cat's litter box).
- When a pregnant woman is newly infected during or just prior to her pregnancy and transmits the infection to her child.
- When a previously uninfected person receives an organ transplant or blood transfusion from an infected donor.

### Who is most at risk for *Toxoplasma gondii* infection and toxoplasmosis?

The *T. gondii* parasite is present throughout the United States and the world; individuals are at higher risk for infection if they eat undercooked meat, drink untreated water, or are exposed to contaminated cat feces or soil. People at most risk of serious complications from toxoplasmosis are pregnant women (who can transmit the parasite to their child) and those with severely weakened immune systems.



## Why be concerned about toxoplasmosis in the United States?

- Toxoplasmosis is a leading cause of foodborne illness-related death and hospitalization in the U.S.—causing hundreds of deaths and thousands of hospitalizations each year.
- The *T. gondii* parasite infects over 800,000 persons each year in the United States. An estimated 3,600 individuals each year develop symptomatic eye disease from *T. gondii* infection leading to vision loss.
- There are an estimated 300–4,000 cases of congenital (mother-to-child) toxoplasmosis each year.
- Individuals whose immune systems are severely compromised can develop encephalitis, or have further spread of disease, which can be fatal.

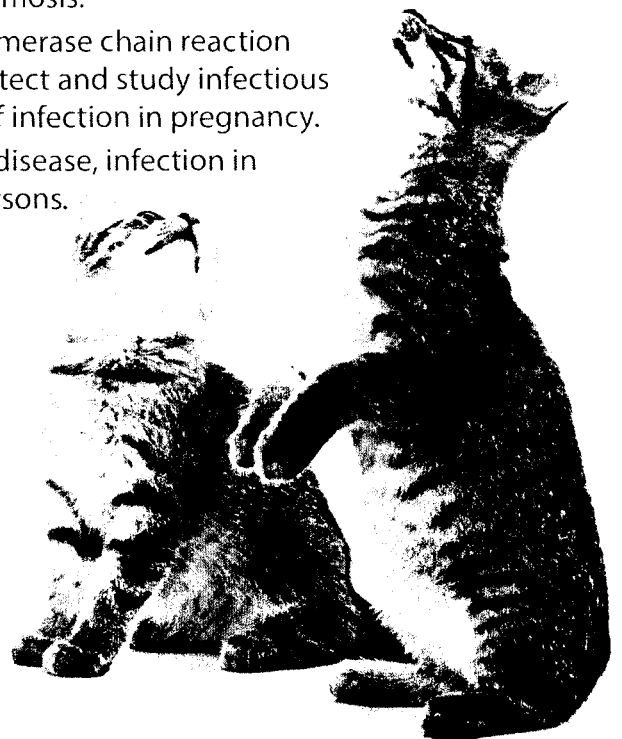
## What is CDC doing to address toxoplasmosis?

- Assessing physician knowledge and practices regarding congenital toxoplasmosis (mother-to-child transmission) and ocular toxoplasmosis (infection in the eye) by collaborating with professional organizations (for example, the American College of Obstetricians and Gynecologists).
- Educating health care professionals and the public about prevention of toxoplasmosis through the Web, response to telephone inquiries, and publications in targeted journals.
- Identifying the rates of *T. gondii* infection in the United States by analyzing samples and information collected through the National Health and Nutrition Examination Study (NHANES).
- Tracking toxoplasmosis-related hospitalizations in the United States to identify trends in severe disease.
- Collaborating with the U. S. Department of Agriculture to determine the risk of *T. gondii* infection from undercooked meat ingestion.
- Identifying further risk factors for *T. gondii* infection in the United States, including those for severe and fatal toxoplasmosis in immunosuppressed persons.

## What more needs to be done?

- Develop a cost-effective *T. gondii* vaccine for cats to prevent shedding of the organism in feces.
- Determine the number of children infected by mother-to-child transmission nationally to guide screening and treatment strategies for congenital toxoplasmosis.
- Improve diagnostic tests for toxoplasmosis, including polymerase chain reaction (PCR)—a technology used for amplifying DNA to better detect and study infectious diseases—and improve tests to help determine the time of infection in pregnancy.
- Evaluate the efficacy of treatments to prevent or treat eye disease, infection in pregnant women, and infection in immunosuppressed persons.
- Improve ways to prevent *T. gondii* contamination of meat, especially field-raised meat.
- Further assess the impact of toxoplasmosis on health, including mental health.
- Improve preventive health education for the public.

For more information on Neglected Parasitic Infections, please visit [www.cdc.gov/parasites/npi.html](http://www.cdc.gov/parasites/npi.html)



# Toxoplasmosis:

## What role do cats play in the spread of toxoplasmosis?

Cats get *Toxoplasma* infection by eating infected rodents, birds or other small animals, or anything contaminated with feces from another cat that is shedding the microscopic parasite in its feces. After a cat has been infected, it can shed the parasite for up to two weeks. The parasite becomes infective one to five days after it is passed in the feces of the cat. The parasite can live in the environment for many months and contaminate soil, water, fruits and vegetables, sandboxes, grass where animals graze for food, litter boxes, or any place where an infected cat may have defecated.

## What is toxoplasmosis?

Toxoplasmosis is an infection caused by a microscopic parasite called *Toxoplasma gondii*. More than 30 million people in the United States carry the *Toxoplasma* parasite. Toxoplasmosis can cause severe illness in infants infected before birth (when their mothers are newly infected just before or during pregnancy), or in persons with a weakened immune system.

## How are people infected with *Toxoplasma*?

### **People become infected with toxoplasmosis several ways:**

Eating food, drinking water, or accidentally swallowing soil that has been contaminated with infected cat feces.

Eating raw or undercooked meat from animals (especially pigs, lamb, or wild game) that have been infected with *Toxoplasma*.

Directly from a pregnant woman to her unborn child when the mother becomes infected with *Toxoplasma* just before or during pregnancy.



## What are the symptoms of toxoplasmosis?

### **Individuals with healthy immune systems:**

Most people who become infected with *Toxoplasma* do not know it and have no symptoms. However, when illness occurs, it is usually mild. Some may feel like they have the "flu," with swollen lymph glands, or muscle aches and pain that last for several weeks or more. Rarely, eye disease occurs.

### **Individuals with weakened immune systems:**

People with weakened immune systems may experience severe symptoms. The most common symptoms in people with HIV infection are headache, confusion, and fever. Other symptoms include seizures, poor coordination, and nausea or vomiting.

### **Infants infected before birth:**

Most infants infected with *Toxoplasma* before birth show no symptoms at birth. However, many are likely to develop symptoms later in life. These include vision loss, mental disability, and seizures.

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## How can I protect myself from toxoplasmosis?

### **Several steps can be taken to protect yourself and others from toxoplasmosis:**

Change cat litter boxes daily. *Toxoplasma* takes more than one day to become infectious. If you are pregnant or have a weakened immune system, ask someone else to change the litter box. If this is not possible, wear disposable gloves and wash your hands thoroughly with soap and water afterwards.

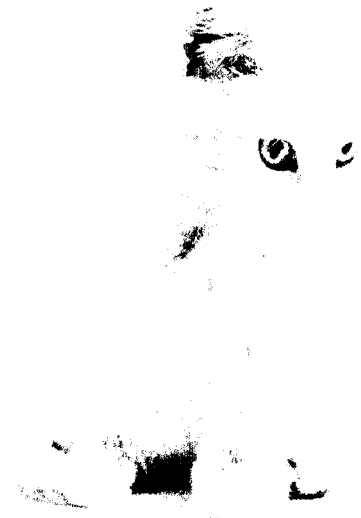
Cover any outdoor sandboxes when not in use to keep cats from defecating in them.

Avoid adopting stray cats, especially kittens. Younger cats are more like to be releasing *Toxoplasma* in their feces.

Do not eat undercooked meat. Cook whole cuts of meat to at least 145°F (63° C) with a 3 minute rest, and ground meat and wild game to at least 160°F (71° C).

Wash all kitchen supplies (such as knives and cutting boards) that have been in contact with raw meat.

If you have a weakened immune system, it is important to talk to your health care provider about getting a blood test to determine if you have been infected with *Toxoplasma*.



## How can I protect my cat from toxoplasmosis?

### **Protecting your cat from toxoplasmosis may also help to protect you from toxoplasmosis.**

Feed your cat commercial dry or canned food.

Never feed cats raw meat because this can be a source of *Toxoplasma* infection.

Keep indoor cats indoors so they do not become infected by eating small animals.

### **Do I have to get rid of my cat?**

No, you do not have to give up your cat. Owning a cat does not mean you will be infected with the parasite. It is unlikely that you would be exposed to the parasite by touching an infected cat because cats usually do not carry the parasite on their fur. In addition, cats kept indoors (that do not hunt prey or are not fed raw meat) are not likely to be infected with *Toxoplasma*. But, if you are pregnant, planning on becoming pregnant, or have a weakened immune system, it is important to protect yourself from infection.

### **Can toxoplasmosis be treated?**

Yes. There is treatment for toxoplasmosis. In an otherwise healthy person, mild symptoms typically go away within several weeks to months and treatment is not needed. However, treatment may be recommended for an otherwise healthy person with eye disease due to toxoplasmosis. A woman who becomes infected during pregnancy can be treated with medication that may protect her unborn baby from toxoplasmosis. Mother and baby should be monitored closely during the pregnancy and after the baby is born.

**For more information on toxoplasmosis, visit [www.cdc.gov/parasites/toxoplasmosis](http://www.cdc.gov/parasites/toxoplasmosis)**



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## Preventing Infection with *Toxoplasma gondii*

### Background

Toxoplasmosis results from an infection with the protozoan parasite *Toxoplasma gondii*. All mammals and birds are variably susceptible. Infection among humans is common worldwide. Data from the Centers for Disease Control and Prevention (CDC) suggest that approximately 15% of U.S. residents have antibodies to the parasite; this prevalence has not changed significantly over the past 10 years.<sup>1</sup> Antibody testing of sera collected from Alaska Natives in the 1960s and 70s yielded a similar prevalence.<sup>2</sup> Toxoplasmosis is neither a nationally nor a state-mandated reportable condition; therefore detailed statistics about the disease are limited.

*T. gondii* has existed naturally in Alaska wildlife, including marine mammals, for at least 30 years. Toxoplasma antibodies were recently detected in a sea otter from Seward.

### Parasite Lifecycle<sup>3</sup>

Members of the cat family are the only known definitive host for the sexual stages of *T. gondii* and serve as the main reservoirs of infection. Cats become infected from eating meat containing *T. gondii* oocysts. Once ingested, oocysts release viable organisms and invade epithelial cells of the small intestine where they undergo an asexual followed by a sexual cycle to form oocysts, which are then excreted. An unsporulated oocyst becomes infective 1 to 5 days after excretion. Oocysts can survive in the environment for several months and are resistant to disinfectants, freezing or drying, but are killed after being heated to 70°C (~158°F) for 10 minutes.

### Routes of Transmission

Humans can be infected by *T. gondii* through three principal routes: ingesting raw or insufficiently cooked meat or foods that have come into contact with infected meat; ingesting oocysts from cat feces directly or indirectly via soil or other items that have been in contact with cat feces; or through vertical transmission from a mother to her fetus. CDC estimates that 50% of the toxoplasmosis deaths (~750 each year) result from infection from insufficiently cooked meat, similar to the estimate of meat-associated cases given by the U.S. Department of Agriculture.<sup>4</sup>

### Symptoms

Many persons are asymptomatic. For those who do exhibit symptoms, toxoplasmosis infection results in mild illness, including lymphadenopathy, fever, and malaise, which usually resolve within weeks to months without specific treatment. Once in the body, the parasite forms tissue cysts that may remain lifelong.

Persons with immune-compromised conditions and fetuses, however, may be profoundly affected by the parasite. Immunodeficient persons often display central nervous system disease, but may also have chorioretinitis or pneumonitis. Immunosuppression may also result in reactivation of past toxoplasmosis infection. Signs suggestive of congenital infection in the fetus include chorioretinitis, intracranial calcifications, and hydrocephalus. Most infants infected in utero are born with no obvious signs of toxoplasmosis, but many develop learning and visual disabilities later in life.<sup>4</sup>

### Diagnosing Toxoplasmosis in Humans

Toxoplasmosis is most often diagnosed through routine serology. Commercial test kits evaluate Toxoplasma-specific IgG and IgM levels. Detectable IgG indicates exposure to the parasite at some point in time. Detectable IgM usually indicates acute infection; however, IgM levels may remain detectable for over a year after initial infection.<sup>4</sup> Other more technically challenging methods exist for diagnosing toxoplasmosis, but these are not readily available.

### Toxoplasma Titers in Alaska Wildlife

Since testing began on samples collected from Alaska wildlife in the 1970s, antibodies against *T. gondii* have been detected in a wide variety of species, including lynx, black bears, grizzly bears, wolves and even some herbivores.<sup>5,7</sup> Lynx are the only wildlife species known to pass *T. gondii* oocysts in feces.<sup>8</sup> Among marine mammals, antibodies have been detected in walrus; Steller sea lions; harbor, ringed, spotted and bearded seals.<sup>9</sup>

### Toxoplasmosis and Water

Recent studies in California have implicated toxoplasmosis as a possible cause of illness in Southern sea otters. Otters that inhabited waters closer to the shore and freshwater outflows tended to have a higher prevalence of antibodies as compared to those in more remote waters.<sup>10</sup> Researchers concluded that the source of the otters' exposure was related to contamination of coastal waters by freshwater run-off containing infective cat feces. Although bivalves (e.g., mussels and oysters) have been shown to filter and concentrate the parasite, transmission of toxoplasmosis via ingestion of shellfish is not believed to be an efficient or common route of transmission. Waterborne transmission of the parasite to humans, however, has been documented, underscoring the importance of appropriate and ongoing filtration and treatment of municipal water systems.<sup>11</sup>

### Preventing Toxoplasmosis

1. To prevent toxoplasmosis, food should be cooked to safe temperatures. See Alaska Food Safety Safe Temperatures [http://www.state.ak.us/dec/eh/fss/consumers/safe\\_food\\_temperatures.htm](http://www.state.ak.us/dec/eh/fss/consumers/safe_food_temperatures.htm). Fruits and vegetables should be peeled or thoroughly washed before eating. Cutting boards, counters, utensils, and hands should be washed with hot soapy water after contact with raw meat, poultry, seafood, or unwashed fruits or vegetables.
2. Pregnant women should consult their obstetricians about specific serologic testing recommendations. Pregnant women and immunodeficient persons should refrain from eating raw meat, and should wear gloves when gardening and during any contact with soil or sand where cat feces may be present. Additionally, these persons should avoid scooping or changing cat litter if possible. If no one else is available to change the litter, use gloves, then wash hands thoroughly. Cat litter boxes should be scooped or changed daily because oocysts require 1-5 days to become infective.
3. Trappers should take special caution to minimize their exposure to feces when trapping and skinning lynx as lynx serve as the only Alaska wildlife source of Toxoplasma oocysts.

### References

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- <sup>2</sup>Peterson DR, Cooney MK, Beasley RP. Prevalence of antibody to *Toxoplasma* among Alaska Natives: relation to exposure to Felidae. *J Infect Dis* 1974;150(6):557-563.
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- <sup>4</sup>CDC. Preventing Congenital Toxoplasmosis. *MMWR* March 31, 2000, 49(RR-02).
- <sup>5</sup>Zarnke RL, Dubey JP, Kwok OC, et al. Serologic survey for *Toxoplasma gondii* in grizzly bears from Alaska. *J Wildl Dis* 1997;33(2):267-270.
- <sup>6</sup>Zarnke RL, Dubey JP, Kwok OC, et al. Serologic survey for *Toxoplasma gondii* in selected wildlife species from Alaska. *J Wildl Dis* 2000;36(2):219-224.
- <sup>7</sup>Zarnke R, Dubey JP, Ver Hoer J, et al. Serologic survey for *Toxoplasma gondii* in lynx from interior Alaska. *J Wildl Dis* 2001;37(1):36-38.
- <sup>8</sup>Dubey JP. Toxoplasmosis. *J Am Vet Med Assoc* 1994;205:1593-1598.
- <sup>9</sup>Dubey JP, Zarnke R, Thomas NJ, et al. *Toxoplasma gondii*, *Neospora caninum*, *Sarcocystis neurona*, and *Sarcocystis canis*-like infections in marine mammals. *J Parasitol* 2003;116: 275-296.
- <sup>10</sup>See "What's Killing California Sea Otters?" <http://www.seaottersresearch.org>.
- <sup>11</sup>Bowie WR, King AS, Werker DH, et al. Outbreak of toxoplasmosis associated with municipal drinking water. *Lancet* 1997;350(9072):173-178.