UC RIVERSIDE
Occupational Health

Toxoplasmosis

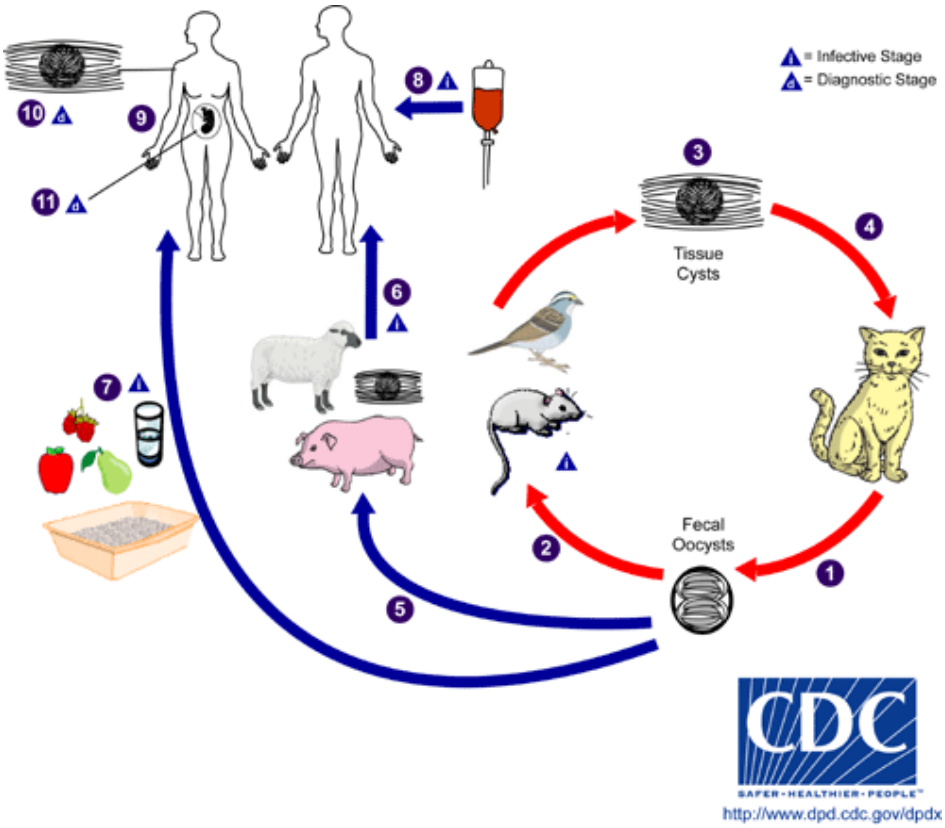
Toxoplasma gondii is a protozoan parasite that can infect many animals, including humans. It belongs to a larger group of parasites that are collectively called "coccidia". Toxoplasma occurs worldwide - an estimated 30% of all human beings have been infected by Toxoplasma gondii at some point in their lives.

Most people with healthy immune systems who acquire *Toxoplasma gondii* infection have no symptoms or experience only a mild, self-limited illness. However, toxoplasmosis can cause serious disease in certain individuals. If a person becomes newly infected shortly before or during pregnancy, the infection may be transmitted to the fetus and may result in miscarriage, stillbirth, or congenital toxoplasmosis, including serious neurologic or ocular complications. Individuals with weakened immune systems—including those with HIV infection, those receiving chemotherapy or other immunosuppressive treatment, and organ-transplant recipients—are also at increased risk of severe disease from a new infection or reactivation of a previous infection. These individuals should consult their healthcare provider or UCR Occupational Health regarding appropriate precautions, testing, and medical follow-up.

Biology

Toxoplasma gondii is a protozoan parasite that infects most species of warm-blooded animals, including humans, and can cause the disease toxoplasmosis.

Life Cycle:



The only known definitive hosts for *Toxoplasma gondii* are members of family Felidae (domestic cats and their relatives). Unsporulated oocysts are shed in the cat's feces ❶. Although oocysts are usually only shed for 1-2 weeks, large numbers may be shed. Oocysts take 1-5 days to sporulate in the environment and become infective. Intermediate hosts in nature (including birds and rodents) become infected after ingesting soil, water or plant material contaminated with oocysts ❷. Oocysts transform into tachyzoites shortly after ingestion. These tachyzoites localize in neural and muscle tissue and develop into tissue cyst bradyzoites ❸. Cats become infected after consuming intermediate hosts harboring tissue cysts ❹. Cats may also become infected directly by ingestion of sporulated oocysts. Animals bred for human consumption and wild game may also become infected with tissue cysts after ingestion of sporulated oocysts in the environment ❺. Humans can become infected by any of several routes:

- eating undercooked meat of animals harboring tissue cysts ❻.
- consuming food or water contaminated with cat feces or by contaminated environmental samples (such as fecal-contaminated soil or changing the litter box of a pet cat) ❼.
- blood transfusion or organ transplantation ❽.
- transplacentally from mother to fetus ❾.

In the human host, the parasites form tissue cysts, most commonly in skeletal muscle, myocardium, brain, and eyes; these cysts may remain throughout the life of the host. Diagnosis is usually achieved by serology, although tissue cysts may be observed in stained biopsy specimens ❿. Diagnosis of congenital infections can be achieved by detecting *T. gondii* DNA in amniotic fluid using molecular methods such as PCR ⓫.

Information from: http://www.dpd.cdc.gov/dpdx/HTML/Toxoplasmosis.htm

Epidemiology & Risk Factors

In the United States it is estimated that 22.5% of the population 12 years and older have been infected with *Toxoplasma*. In various places throughout the world, it has been shown that up to 95% of some populations have been infected with *Toxoplasma*. Infection is often highest in areas of the world that have hot, humid climates and lower altitudes.

Toxoplasmosis is not passed from person-to-person, except in instances of mother-to-child (congenital) transmission and blood transfusion or organ transplantation. People typically become infected by three principal routes of transmission.

- Foodborne
- Animal-to-human (zoonotic)
- Mother-to-child (congenital)
- Rare instances

Always cook meat thoroughly and use clean knives, utensils and cutting boards on all foods. (CDC Photo)

Foodborne transmission

The tissue form of the parasite (a microscopic cyst consisting of bradyzoites) can be transmitted to humans by food. People become infected by:

- Eating undercooked, contaminated meat (especially pork, lamb, and venison)
- Accidental ingestion of undercooked, contaminated meat after handling it and not washing hands thoroughly (*Toxoplasma* cannot be absorbed through intact skin)
- Eating food that was contaminated by knives, utensils, cutting boards, or other foods that had contact with raw, contaminated meat

Animal-to-human (zoonotic) transmission

Cats play an important role in the spread of toxoplasmosis. They become infected by eating infected rodents, birds, or other small animals. The parasite is then passed in the cat's feces in an oocyst form, which is microscopic.

Kittens and cats can shed millions of oocysts in their feces for as long as 3 weeks after infection. Mature cats are less likely to shed *Toxoplasma* if they have been previously infected. A *Toxoplasma*-infected cat that is shedding the parasite in its feces contaminates the litter box. If the cat is allowed outside, it can contaminate the soil or water in the environment as well.

If your pregnant have someone else clean the litter box.

People can accidentally swallow the oocyst form of the parasite. People can be infected by:

- Accidental ingestion of oocysts after cleaning a cat's litter box when the cat has shed *Toxoplasma* in its feces
- Accidental ingestion of oocysts after touching or ingesting anything that has come into contact with a cat's feces that contain *Toxoplasma*
- Accidental ingestion of oocysts in contaminated soil (e.g., not washing hands after gardening or eating unwashed fruits or vegetables from a garden)
- Drinking water contaminated with the *Toxoplasma* parasite

Mother-to-child (congenital) transmission

A woman who is newly infected with *Toxoplasma* during pregnancy can pass the infection to her unborn child (congenital infection). The woman may not have symptoms, but there can be severe consequences for the unborn child, such as diseases of the nervous system and eyes.

Rare instances of transmission

Organ transplant recipients can become infected by receiving an organ from a *Toxoplasma*-positive donor. Rarely, people can also become infected by receiving infected blood via transfusion. Laboratory workers who handle infected blood can also acquire infection through accidental inoculation.

The diagnosis of toxoplasmosis is typically made by serologic testing. A test that measures immunoglobulin G (IgG) is used to determine if a person has been infected. If it is necessary to try to estimate the time of infection, which is of particular importance for pregnant women, a test which measures immunoglobulin M (IgM) is also used along with other tests such as an avidity test.

Diagnosis

Diagnosis can be made by direct observation of the parasite in stained tissue sections, cerebrospinal fluid (CSF), or other biopsy material. These techniques are used less frequently because of the difficulty of obtaining these specimens.

Parasites can also be isolated from blood or other body fluids (for example, CSF) but this process can be difficult and requires considerable time.

Molecular techniques that can detect the parasite's DNA in the amniotic fluid can be useful in cases of possible mother-to-child (congenital) transmission.

Ocular disease is diagnosed based on the appearance of the lesions in the eye, symptoms, course of disease, and often serologic testing.

Relative Risk in the Vivarium

Most human beings are infected by eating undercooked meat, but exposure to infected cat feces is also a significant hazard, especially for pregnant women. Cat feces can only be infective if the cat has had an opportunity to hunt within the last month. The risk is very low if the research cats have been housed in a rodent-proof facility for a month or more and fed only commercial cat food. If there is a chance that feral mice can find their way into the facility, then the risk is much greater. If the cats have been obtained from a random source within the last month, then there is a much greater possibility that their feces may be infectious.

Prevention

The most important step you can take to avoid toxoplasmosis is to avoid eating rare or undercooked meat - this remains the primary route of human exposure. If cats frequent your vegetable garden, then be sure that you peel and wash root crops thoroughly before eating them, or only grow root crops that must be cooked.

In the research facility, be sure that your facility is designed so that no rodents have access to the inside of your buildings.

You should consider that your cats may be at risk if:

- You ever see evidence of rodents in or around your facility.
- The cats are ever fed raw meat.
- The cats have been obtained within the last 30 days from an outside source.
- Routine health screens of your cats ever reveal coccidial oocysts.

Since we can never be 100% certain that a mouse could not have found its way into one of our cats, the safest policy is to assume that any cat's feces may potentially carry toxoplasma oocysts.

Toxoplasma oocysts are not immediately infectious when they are shed, but they may become infectious as early as 24 hours later. Cleaning the litter pan once each day dramatically reduces the chance of infection.

The route of transmission for the oocysts is fecal-oral. In order to avoid any possibility of contact with cat feces, workers changing cat litter should do so in a way that does not stir up dusts and aerosols from the litter pans. Workers should wear gloves while changing litter pans and should wear a mask or face shield if there is any possibility of infectious fecal material being splashed or splattered into their mouth or eyes. Finally, workers should be very scrupulous about thoroughly washing their hands before eating, drinking, or smoking after changing cat litter pans.

Personal Protective Equipment (PPE)

- Gloves must be worn at all times
- Gloves should be discarded into autoclaves or disinfected with 70% ethanol before exiting the tissue culture room.
- Eye protection is required at all times, whether during manipulation or transport of parasites.
- Use blunt needles for syringe harvesting Toxoplasma.
- Discard used needles in sharps container without re-capping.

Signs and Symptoms

Most people infected with Toxoplasma gondii do not know they have it because they do not have any symptoms. Individuals may experience mild flu-like symptoms, including:

- Tender lymph nodes
- Muscle aches
- Pains

If a woman becomes newly infected with Toxoplasma during or just before pregnancy, they can pass the infection to their unborn baby during pregnancy (congenital transmission). Often the earlier in pregnancy that transmission occurs, the more severe the damage to the unborn child is. This can result in:

- A miscarriage
- A stillborn child
- A child born with signs of congenital toxoplasmosis (e.g. abnormal enlargement or smallness of the head).

Infants who are infected before birth often show no symptoms at birth but may develop them later in life. This can result in:

- Potential vision loss
- Mental disability

- Seizures

Individuals who are immunocompromised may experience severe symptoms if they are infected with Toxoplasma. People who have HIV infection and were not previously infected with Toxoplasma are more likely to develop a severe primary infection.

People who are immunocompromised and previously infected with Toxoplasma at some point before they become immunosuppressed are at risk of developing a relapse (reactivation of infection) of toxoplasmosis. A person who is infected with HIV and who has either primary or reactivated Toxoplasma infection can have symptoms such as

- Fever
- Confusion
- Headache
- Seizures
- Nausea
- Poor coordination

Immunizations

None available.

Baseline Serologic Testing

Personnel and laboratory workers who routinely handle Toxoplasma containing infectious samples are recommended to undergo baseline antibody titer testing called a **Toxoplasma gondii IgG and IgM antibody test** before initiating lab work. This will check:

- **IgG antibodies**: Indicate past exposure/infection.
- **IgM antibodies**: Indicate recent or active infection.

Serologic Testing Results and Documentation

Table 1: Serologic Test Interpretation for Patients >1 Yr of Age

Test Results		**Possible Interpretations**	**Next Steps**
IgG	**IgM**		
Negative	Negative	No infection	None
Negative	Positive	Possible acute infection. False-positive IgM	Retest for both IgG and IgM antibodies on both the original and a second specimen. If the result is the same, infection is unlikely.
Negative	Equivocal	Possible early acute infection. False-positive IgM.	Retest for both IgG and IgM antibodies on a second specimen. If the result is the same, infection is unlikely.

Positive	Negative	Infected for >= 6 months	None for the general population. If patient is pregnant and gestation is >= 18 weeks, additional testing should be pursued.*
Positive	Positive	Possible infection in previous 12 months. False-positive IgM.	Second specimen to specialized reference lab for further testing. If patient is pregnant, perform IgG avidity test.*
Positive	Equivocal	Infected for >1 year. False-positive IgM	Retest for IgM on a second specimen. If results are the same or if IgG is positive, send both specimens to specialized reference lab for additional testing.
Equivocal	Negative	Indeterminate	Retest for IgG on either the same specimen or a second specimen.
Equivocal	Positive	Possible acute infection	Retest for IgG and IgM on second specimen. If the results are the same or if IgG is positive, send both specimens to specialized reference lab for additional testing.
Equivocal	Equivocal	Indeterminate	Retest for IgG and IgM on second specimen.

- For more information, see the Toxoplasmosis Serologic Testing for Pregnant Individuals algorithm.

Serologic Testing for Pregnant Individuals

Toxoplasmosis serologic testing for pregnant individuals is critical to prevent fetal transmission. An antibody test is usually not routine but recommended for high-risk cases to determine if a woman has a current, past, or acute infection. The ARUP Consult has indications for Toxoplasmosis Serologic Testing for Pregnant who are immunocompromised or have symptoms of acute toxoplasmosis, including flu-like illness and blurred vision or pain with bright light. T

Post Exposure Prophylaxis (PEP)

Upon accidental exposure in the lab, personal protection equipment should be immediately removed, the exposed region should be thoroughly washed with running water and medical care should be sought to assess seropositivity for Toxoplasma gondii. If seropositivity is not confirmed prior to the event, both anti-Toxoplasma IgG and IgM should be assessed.

PEP should be started as soon as possible, ideally in the first 72 hours after exposure. Some experts recommend for high-risk exposure settings, such as high inoculum or hypervirulent strains, that PEP

should be considered up until 7 days after exposure, since described median incubation periods of laboratory-acquired infections are up to 8 days (range 3-60 days) comparable between parenteral and mucosal exposures.

Anti-Toxoplasma IgG and IgM should be reassessed 2 weeks after prophylaxis is started, since this is often the time period seroconversion was detected in a published laboratory-acquired Toxoplasma infection, Herwaldt BL. If negative and no clincal symptoms have developed, stopping prophylaxis may be considered. If either IgM or IgG are positive, it is recommended that the total treatment duration should be extended to 4 weeks. In cases of previous or baseline anti-Toxoplasma IgG positivity, there is no evidence to support the need for PEP to be implemented.

Table 2: Recommended post-exposure prevention regimens.

Regimen	Adult dosing and daily pill burden	Side effects	Duration
Preferred			
Trimethoprim-sulfamethoxazole	5 mg/kg trimethoprim, orally twice daily 4pills/day	Rash, fever, leukopenia, hepatitis, nausea, vomiting, diarrhea, crystalluria; rarely Stevens-Johnson syndrome	2 to 4 weeks*
Alternative			
Pyrimethamine + sulfadiazine + leucovorin	Pyrimethamine 100 mg loading dose, followed by 25–50 mg daily. Sulfadiazine 2–4 g daily in 4 divided doses. Leucovorin calcium 10–25 mg daily. 7–14 pills on day 1, then 6–12 pills/day.	Rash, nausea, and leukopenia	2 to 4 weeks*
Pyrimethamine + clindamycin + leucovorin	Pyrimethamine 100 mg loading dose, followed by 25-50 mg daily. Clindamycin 300 mg four times daily. Leucovorin calcium 10-25 mg daily. 7-10 pills on day 1, then 6-8 pills/day.	Fever, rash, and nausea; diarrhea due to risk of production of Clostridioides difficile toxin	2 to 4 weeks*

* Duration may be guided by anti-Toxoplasma antibody assessment at 2 weeks. A total 4-week duration is recommended if antibodies anti-Toxoplasma are detected at 2 weeks.

Women of Childbearing Age

While pregnant women are not usually prone to Toxoplasma infection or clinical disease, parasite invasion across the placenta can cause severe neurological abnormalities in the fetus and/or miscarriage. Congenital toxoplasmosis is a leading cause of birth defects in the US.

Women who are of child bearing age, or who are contemplating pregnancy, and who work with cats in a research setting you are strongly advised to contact the Occupational Health Director at 951-827-5528 to discuss this issue and arrange for follow-up with an occupational health physician and discuss the advisability of having their titer to T. gondii measured as a part of their routine prenatal care.

Immunocompromised Individuals

Serologic testing is not always reliable in immunocompromised individuals; therefore, test results should be considered in the context of clinical presentations and other testing performed (e.g. polymerase chain reaction [PCR]). In patients with AIDS, for example IgG antibodies are occasionally negative, and IgM antibodies are usually negative.

Reporting Exposure Incidents

Any exposure incident—such as contact of lentiviral vectors with eyes, nose, mouth, skin contamination, needlestick and/or sharps exposure—must **be immediately reported** to:

- **Your PI or laboratory supervisor**
- **UCR Biosafety Officer (BSO)** and **EHSRM at (951) 827-5528.**
- **Occupational Health ehsocchealth@ucr.edu**
- **You may contact the UCI Medical Center Infectious Disease Fellow on call at 714-456-6011 for immediate counseling and guidance. UCR maintains an agreement with the UCI Center for Occupational and Environmental Health (COEH) Clinic, which serves as our Occupational Health provider and reviews UCR's Animal Occupational Health Program.**

Undergraduate Student Employees report your injury to your supervisor (or go to Employee Injuries).

For life-threatening injuries, call 911 immediately.

For all other injury types, seek Medical Treatment at UCR's preferred Occupational Clinics. Visit the Medical Treatment Facilities webpage to learn more about where to seek medical treatment.

Additional References

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- ARUP Consult. Toxoplasma gondii – Toxoplasmosis. ARUP Laboratories, 2026
- CDC. Symptoms of Toxoplasmosis. Toxoplasmosis, 8 May 2024,.

Acknowledgement of Working with *Toxoplasma gondii*

By signing below, I confirm that I have reviewed and understood the requirements for working with Toxoplasma gondii, I agree to comply with all outlined responsibilities, including:

- Following safe laboratory practices and use of appropriate PPE
- Applying proper first aid and decontamination procedures in the event of an exposure
- Promptly reporting any exposures, incidents, or safety concerns to my supervisor, Biosafety Officer, and Occupational Health

Name (Print)	Identification*	Signature	Date	Supervisor / Principal Investigator

*Identification: Provide your UCR Student ID, Employee ID, UCR NetID, UCR Email, or Date of Birth.

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