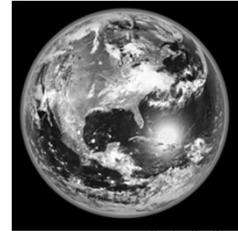


ZOOMING IN ON ZOO NOSES

**Veterinary Pharmacy
Educational Group, LLC**

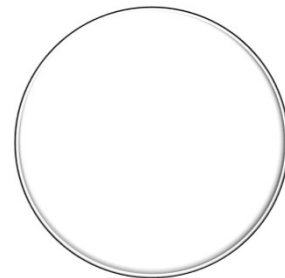
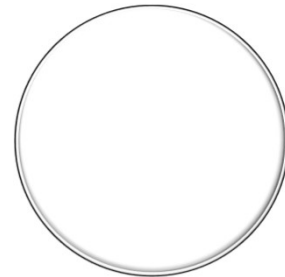


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Faculty Information

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Faculty Disclosures

Heather Lindell, BSPH, PharmD, DICVP and Spencer Tally, PharmD, DVM have no relevant financial relationships with commercial interests to disclose.

The content of this activity may include information regarding the use of products that may be inconsistent with, or outside the approved labeling for, these products in the United States. Pharmacists should note that the use of these products outside current approved labeling is considered experimental and are advised to consult the prescribing information for these products.

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Educational Objectives

Pharmacist Objectives:

After completion of this activity, participants will be able to:

- Discuss the concept of One Health.
- Recognize the zoonotic potential of common dog and cat parasites.
- Identify protocols to protect the public health from zoonotic diseases.

Pharmacy Technician Objectives:

After completion of this activity, participants will be able to:

- List two well-documented zoonotic parasites commonly seen in dogs and cats.
- Identify an important zoonotic infection that can put pregnant women and their fetus at risk.
- Describe a zoonotic disease that is nearly always fatal once the signs and symptoms appear.

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Concept of One Health

Zoom in on Zoonoses

Common Zoonotic Diseases in Companion Animals

Zoonotic Disease Almost Always Fatal

Summary and Conclusion

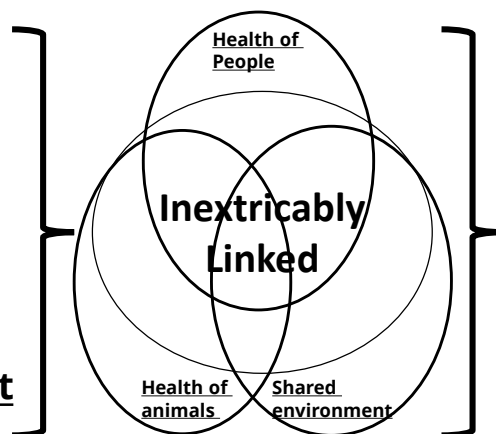
VPEG,LLC

The Concept of One Health

Health of People

Health of animals

Shared environment



One Health¹

Graphic Design by Spencer Tally

1. One health: One health basics. Center for Disease Control and Prevention. Updated November 5, 2018. Accessed January 15, 2022. [One Health Basics | One Health | CDC](#)

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What are common One Health issues?

- Zoonotic Diseases
- Antibiotic Resistance
- Food Safety and Food Security
- Vector-borne Diseases
- Environmental Contamination

One Health Basics | One Health | CDC, reviewed: February 7, 2022, accessed April 8, 2022

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The One Health Approach

**Communication
Coordination
Collaboration**

Human Health Professionals
Animal Health Professionals
Environmental Health Professionals
and other relevant professionals.

“One Health is gaining recognition in the United States and globally as an effective way to fight health issues at the **human-animal-environment interface**, including **zoonotic diseases**.”¹

1. One Health Basics | One Health | CDC, reviewed: February 7, 2022, accessed April 8, 2022

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Concept of One Health

Zoom in on Zoonoses

Common Zoonotic Diseases in Companion Animals

Zoonotic Disease Almost Always Fatal

Summary and Conclusion

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Zoonotic Diseases

- Diseases that can be passed between animals and humans.²

Millions of people and animals around the world affected yearly.⁴

More than 250 organisms are known to cause **zoonotic infections**.³

Approximately 30 to 40 involve **companion animals**.³



Photo Credit: Jennifer Lindell

2. One health: Zoonotic diseases. Center for Disease Control and Prevention. Updated July 1, 2021. Accessed January 15, 2022. [Zoonotic Diseases | One Health | CDC](#)
 3. Green CE. *Infectious Diseases of the Dog and Cat*. 4th ed. Elsevier Saunders; 2012
 4. [One Health Basics | One Health | CDC](#). Reviewed February 22. Accessed April 9, 2022.

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Transmission of Zoonotic Diseases¹

- **Direct contact** Infected saliva, blood, urine, feces, mucous
- **Indirect contact** Infected inanimate objects (fomites) & Airborne
- **Vector-borne** Infected blood-sucking arthropods (Example: tick)
- **Foodborne** Consumption of food or water contaminated with infected fecal matter or parasites
- **Waterborne**

Photo Credit: Spencer Tally

1. [Zoonotic Diseases | One Health | CDC](#). Reviewed July 2021. Accessed April 9, 2022.

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Zoonotic agents may be:

Bacterial **Example: Leptospirosis**

Viral **Example: Avian influenza**

Fungal **Example: Ringworm**

Parasitic **Example: Roundworms**

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Who is at a higher risk of serious illness from zoonotic diseases?

Children younger than 5

Adults older than 65

Immunocompromised individuals

Pregnant women



20 Best Dog Breeds for Kids - Good Family Dogs (goodhousekeeping.com)

Zoonotic Diseases | One Health | CDC, Reviewed July 1, 2021. Accessed April 10, 2022.

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Concept of One Health

Zoom in on Zoonoses

Common Zoonotic Diseases in Companion Animals

Zoonotic Disease Almost Always Fatal

Summary and Conclusion

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Common Zoonotic Diseases in Companion Animals

My pet has worms,
are they contagious
to me?



Photo Credit: Spencer Tally

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Common Intestinal Parasites in Dogs and Cats

- Roundworms
 - Hookworms
 - Tapeworms
- } **Zoonotic** ^{1,2}

Whipworms (*Trichuris vulpis*) occur in dogs.
Dog whipworms are not considered zoonotic.³

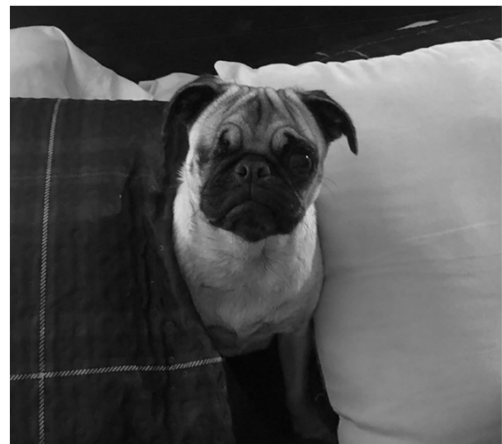


Photo Credit: Heather Lindell

1. Parasites – Roundworms & Hookworms. Center for Disease Control and Prevention. Updated January 25, 2021. Accessed January 15, 2022. [CDC - Roundworms & Hookworms](#)
 2. Healthy Pets, Health People: Cats. Center for Disease Control and Prevention. Updated September 10, 2021. Accessed January 15, 2022. [Cats | Healthy Pets, Healthy People | CDC](#)
 3. *Trichuris vulpis* for dog. Companion Animal Parasite Counsel. Updated July 28, 2020. Accessed January 15, 2022. [Companion Animal Parasite Council | Trichuris vulpis \[capcvet.org\]](#)

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Common Zoonotic Diseases in Companion Animals

**Dogs or cats with
roundworms and
hookworms put
children at risk.**

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Roundworms (*Toxicara canis*, *Toxicara cati*)

Toxocariasis is the parasitic disease caused by the larvae of two species of *Toxocara* roundworms:

- ***Toxocara canis* from dogs**
- ***Toxocara cati* from cats**

CDC - Toxocariasis - General Information. Reviewed September 3, 2020, Accessed April 10, 2022

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How do dogs and cats get infected with Roundworms ? (*Toxicara canis*, *Toxicaris cati*)

Dogs and cats can become infected by:

- Ingestion of contaminated soil or feces
- Ingestion of infected paratenic hosts such as mice or birds
- Puppies and kittens nursing milk from an infected female

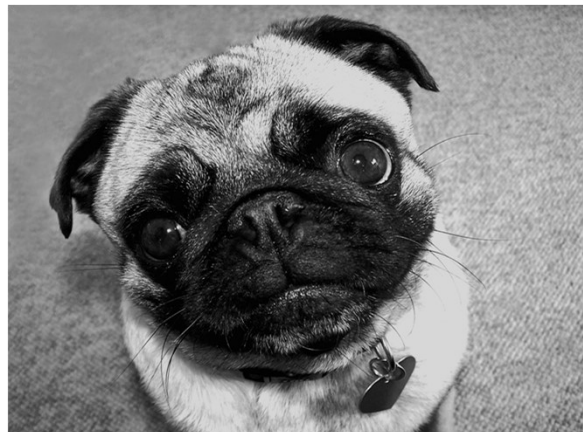


Companion Animal Parasite Council | Ascarid (capcvet.org). Reviewed July 29, 2020. Accessed April 10, 2022.

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How do dogs and cats get infected with Roundworms ? (*Toxicara canis*, *Toxicaris cati*)

Adult roundworms reside in the small intestines and lay eggs which are passed in the feces.



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How do dogs and cats get infected with Roundworms ? (*Toxicara canis*, *Toxicaris cati*)

The eggs larvate to the infective stage two to four weeks after being passed into the environment.

Roundworm eggs can remain infective for years.



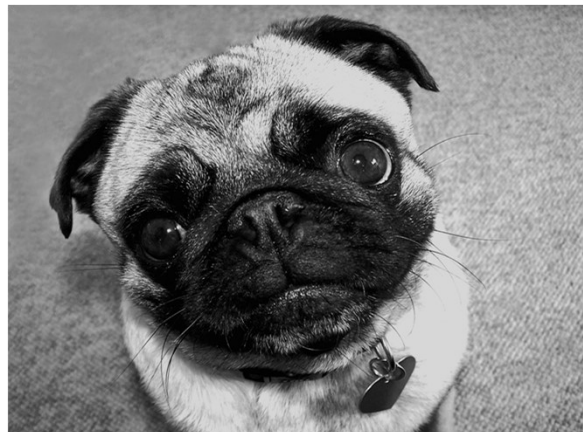
Companion Animal Parasite Council | Ascarid (capcvet.org). Reviewed July 29, 2020. Accessed April 10, 2022.

VPEG,LLC

How do dogs and cats get infected with Roundworms ? (*Toxicara canis*, *Toxicaris cati*)

Roundworms are prolific egg producers.

A single adult roundworm can produce as many as 85,000 eggs per day



Companion Animal Parasite Council | Ascarid (capcvet.org). Reviewed July 29, 2020. Accessed April 10, 2022.

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Diagnosis

The roundworm egg can be identified under the microscope after a fecal flotation.

Let's go through the process of a fecal exam.

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Diagnosis

A fecal sample is obtained.



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Diagnosis

Sample mixed with flotation solution.



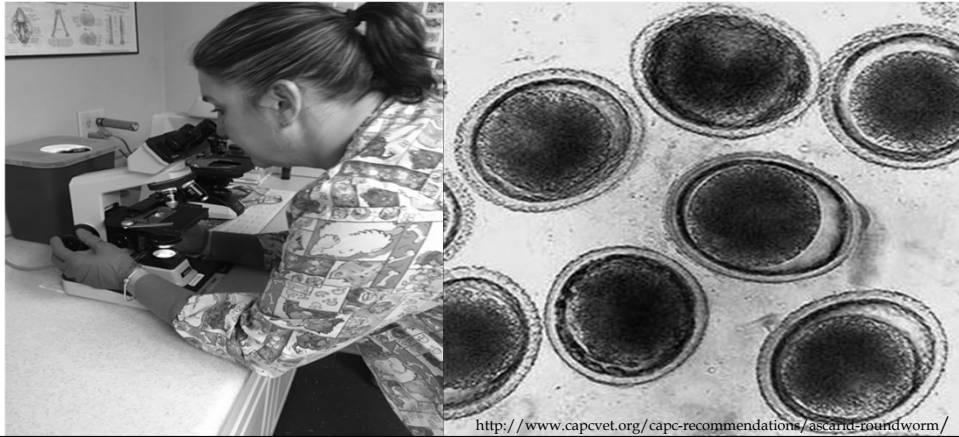
Diagnosis

Sample is centrifuged at high speed for 6 minutes.



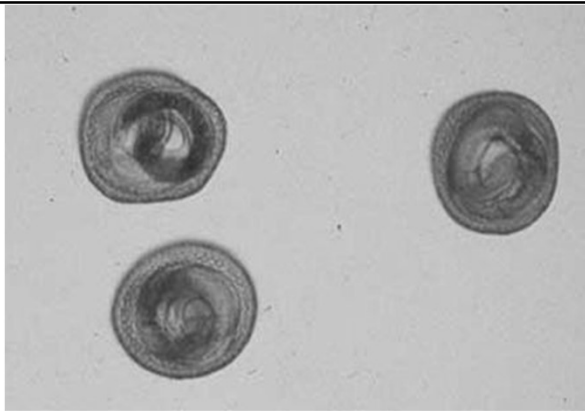
Diagnosis

Sample is read under the microscope.

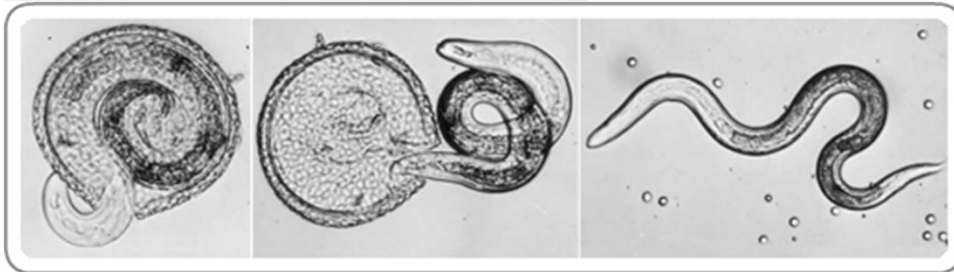


<http://www.cpcvet.org/cpc-recommendations/ascarid-roundworm/>

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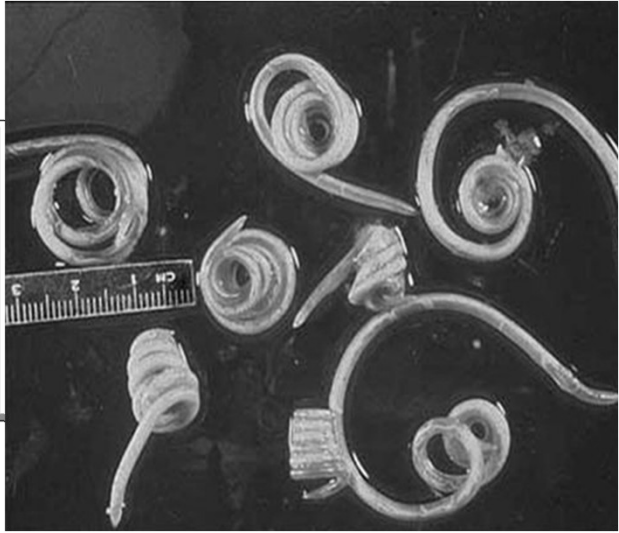
***Toxocara
canis* eggs,
larvated**



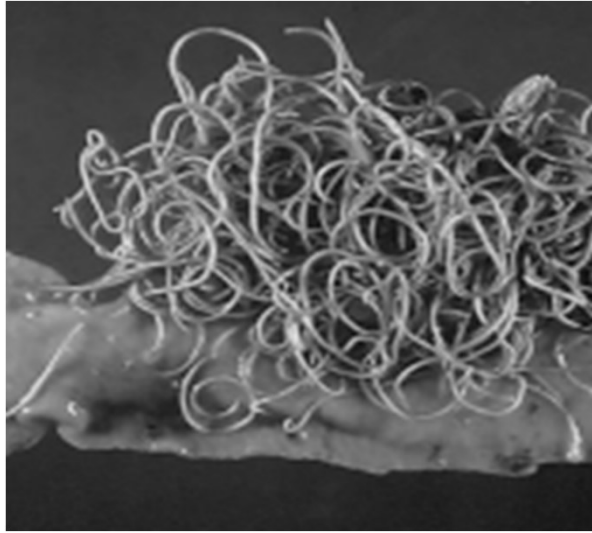
<http://www.cpcvet.org/cpc-recommendations/ascarid-roundworm/>

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Adult Roundworms



Companion Animal Parasite Council | Ascarid (capcvet.org). Reviewed July 29, 2020. Accessed April 10, 2022.



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Roundworm Disease

- Most severe in juvenile dogs
- Classic potbelly appearance
- Stunted growth
- Poor hair coat
- Vomiting / Diarrhea
- Pulmonary disease or acute death can occur due to massive migration through the lungs



Pictures of puppies with roundworms - Bing Images

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Roundworm Treatment

What is a good dewormer for my pet?



Photo Credit: Jennifer Lindell

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Approved Treatments for Roundworms

Dogs¹

Pyrantel pamoate
Milbemycin
Moxidectin
Fenbendazole

Cats²

Pyrantel pamoate
Milbemycin
Moxidectin
Selamectin

Piperazine is also approved for treatment of roundworms in dogs and cats but may have a lower efficacy than other available products.^{1,2}

1. Companion Animal Parasite Council | Ascarid (capcvet.org). Ascarid for Dogs. Reviewed July 29,2020. Accessed April 10, 2022
 2. Companion Animal Parasite Council | Ascarid (capcvet.org). Ascarid for Cats. Reviewed November 1, 2016. Accessed April 10, 2022

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Control and Prevention



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Control and Prevention

To prevent environmental contamination:

All pups should be routinely treated with pyrantel pamoate at 2, 4, 6, and 8 weeks of age.

Then placed on a monthly heartworm preventative with efficacy against roundworms.

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Public Health Considerations

Roundworms are well-documented, important zoonotic disease agents.

Infection with roundworms is most common in children and occurs upon ingestion of larvated eggs from a contaminated environment.

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Toxocariasis

After ingestion by a human:

- Roundworm eggs hatch
- Larvae penetrate the intestinal wall
- Larvae are carried by the circulation to a wide variety of tissues:

<http://www.cdc.gov/parasites/toxocariasis/biology.html>. Reviewed September 4, 2019. Accessed April 10, 2022

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Toxocariasis

The larvae do not undergo any further development in the sites, but can cause severe local reactions.

The two main clinical presentations of toxocariasis are:

- Visceral larva migrans
- Ocular larva migrans

<http://www.cdc.gov/parasites/toxocariasis/biology.html>. Reviewed September 4, 2019. Accessed April 10, 2022

Toxocariasis

Visceral larva migrans

- Symptoms can include fever, fatigue, coughing, wheezing, or abdominal pain.

<http://www.cdc.gov/parasites/toxocariasis/biology.html>. Reviewed September 4, 2019. Accessed April 10, 2022

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Toxocariasis

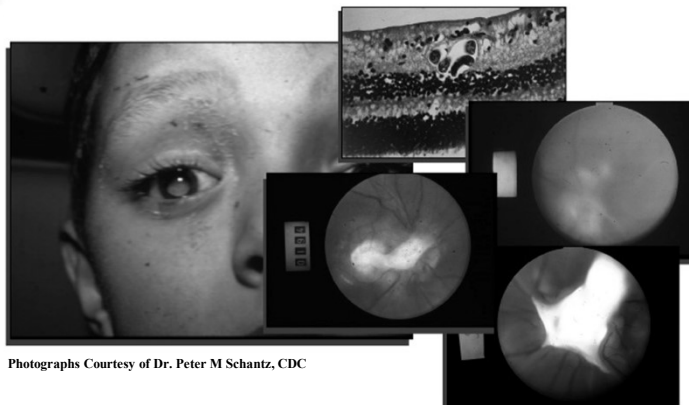
Ocular larva migrans

- Symptoms can include vision loss, eye inflammation or damage to the retina.
- Typically, only one eye is affected.

<http://www.cdc.gov/parasites/toxocariasis/biology.html>. Reviewed September 4, 2019. Accessed April 10, 2022

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Zoonosis - ocular larva migrans



Photographs Courtesy of Dr. Peter M Schantz, CDC

Ocular Larva Migrans



Source: BMC Ophthalmology © 1999-2011 BioMed Central Ltd

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Ocular Larva Migrans



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Toxocariasis Disease

In most cases, *Toxocara* infections are not serious.

- Adults infected by a small number of larvae may not notice any symptoms.
- The most severe cases are rare, but are more likely to occur in young children.

<http://www.cdc.gov/parasites/toxocariasis/biology.html>

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Treatment in Humans

Visceral toxocariasis can be treated with antiparasitic drugs such as:

- Albendazole (Albenza)
- Mebendazole (Vermox)

Treatment of ocular toxocariasis is more difficult and usually consists of measures to prevent progressive damage to the eye.

<http://www.cdc.gov/parasites/toxocariasis/treatment.html>

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Treatment in Humans

Ocular toxocariasis

Table 1. Number of patients with newly diagnosed ocular toxocariasis (N=68), by state – United States, 2009-2010

State	# Patients
Georgia	9
Florida	8

<https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6022a2.htm>

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Treatment in Humans

Ocular toxocariasis treatments

Corticosteroids (if inflammation)

Albendazole 800 to 400mg po BID x 7-10 days

Vitreoretinal surgery

Ahn SJ, Ryoo N-K, Woo SJ. Ocular toxocariasis: clinical features, diagnosis, treatment, and prevention. *Asia Pacific allergy*. 2014;4(3):134-141. doi:10.5415/apallergy.2014.4.3.134

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Hookworms

Canine (*Ancylostoma caninum*, *Ancylostoma braziliense*)

Feline (*Ancylostoma tubaeforme*, *Ancylostoma braziliense*)

**Zoonotic disease that can infect dogs and cats.
Especially dangerous to puppies and kittens.**

Hookworms can cause:

- **Bloody diarrhea**
- **Anemia**
- **Severe cases can result in death.**

Companion Animal Parasite Council | Hookworms (capcvet.org, Reviewed July 29, 2020, Accessed April 10, 2022)

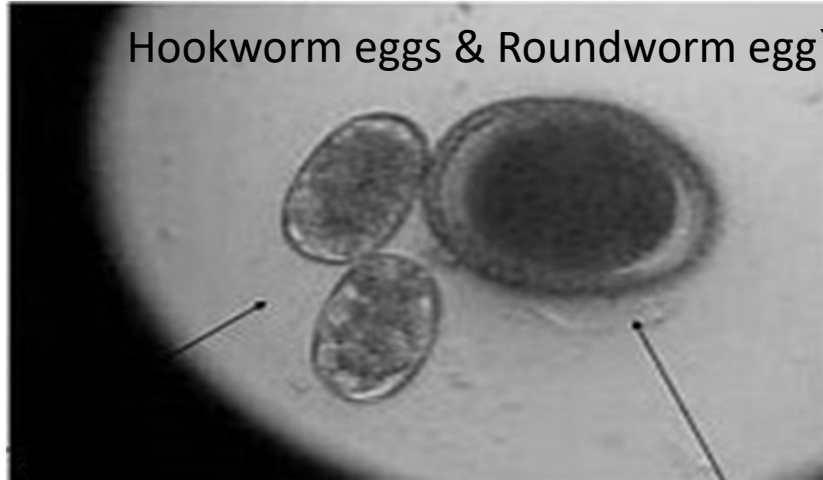
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Companion Animal Parasite Council | Hookworms (capcvet.org), Reviewed July 29, 2020, Accessed April 10, 2020

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Diagnosis



Companion Animal Parasite Council | Hookworms (capcvet.org). Reviewed July 29, 2020. Accessed April 10, 2020

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Hookworm Treatment

Dogs – Approved Drugs

Pyrantel Pamoate
Milbemycin Oxime
Moxidectin
Fenbendazole

Cats – Approved Drugs

Pyrantel Pamoate
Milbemycin Oxime
Moxidectin
Ivermectin
Selamectin
Emodepside

Companion Animal Parasite Council | Hookworms (capcvet.org). Reviewed July 29, 2020. Accessed April 10, 2022

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Public Health Considerations

Humans are most likely to be infected with the hookworms of dogs and cats via direct skin penetration of infective larvae.

Most common cause of cutaneous larva migrans (CLM) in people.

The larvae migrate in the skin, producing intensely pruritic, serpentine lesions.

Companion Animal Parasite Council | Hookworms (capcvet.org, Reviewed July 29, 2020, Accessed April 10, 2022)

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Human Hookworm Infection

People may become infected with dog or cat hookworms

- Walking barefoot
- When exposed skin comes in contact with contaminated soil or sand



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Cutaneous Larva Migrans due to hookworms



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Cutaneous Larva Migrans Treatment in Humans

Hookworm larvae usually die after 5 - 6 weeks in the human host

- **Considered self-limiting.**

Treatment may be indicated to help control symptoms and to resolve secondary bacterial infections.

- **Albendazole**
- **Ivermectin**

Common Intestinal Parasites in Dogs and Cats



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10. Dipylidium infection. Center for Disease Control and Prevention. Updated September 17, 2020. Assessed January 18, 2022. [CDC - Dipylidium - Frequently Asked Questions \(FAQs\)](#)

11. *Dipylidium caninum*. Companion Animal Parasite Counts. Updated November 1, 2016. Accessed January 18, 2022. [Companion Animal Parasite Council | Dipylidium caninum \[capcvet.org\]](#)

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Tapeworm Life Cycle

Dogs and cats infected with the adult tapeworms shed egg-laden proglottids in their feces.

The eggs are consumed by the FLEA

Larval cysts develop in the FLEA

Dogs and cats are infected when they ingest the FLEA with larval cysts

Companion Animal Parasite Council | [Dipylidium caninum \(capcvet.org\)](#), Reviewed November 1, 2016. Accessed April 10, 2022.

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Dog and Cat Tapeworms

Once the flea is digested by the dog or cat, the larval tapeworm is able to develop into an adult tapeworm.¹

Adult tapeworms can be 15 to 70 cm in length.²

Passage of proglottids may be associated with perianal irritation.²
Tape worm infection may result in pet scooting.

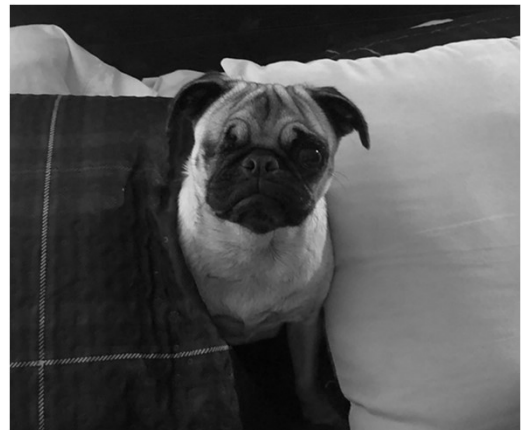


Photo Credit: Heather Lindell

1. Dipylidium infection. Center for Disease Control and Prevention. Updated September 17, 2020. Assessed January 18, 2022. [CDC - Dipylidium - Frequently Asked Questions \(FAQs\)](#)

2. *Dipylidium caninum*. Companion Animal Parasite Council. Updated November 1, 2016. Accessed January 18, 2022. [Companion Animal Parasite Council | Dipylidium caninum \(capcvet.org\)](#)

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Tapeworm Treatment in Dogs and Cats

Praziquantel¹

- Oral
- Subcutaneous injection

Epsiprantel¹

- Oral

Counseling Points...

Dogs, cats and humans get tapeworms from swallowing fleas infected with tapeworm larvae.

Flea control is essential for tapeworm prevention.²

- Flea control for your pet.
- Flea control for your pet's indoor and outdoor environments.



Photo Credit: Spencer Tally

1. *Dipylidium caninum*. Companion Animal Parasite Councils. Updated November 1, 2016. Accessed January 18, 2022. Companion Animal Parasite Council | *Dipylidium caninum* (capcvet.org)

2. *Dipylidium* infection. Center for Disease Control and Prevention. Updated September 17, 2020. Accessed January 18, 2022. CDC - *Dipylidium* - Frequently Asked Questions (FAQs)

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Public Health Considerations

Dipylidium caninum can infect humans via accidental ingestion of an infected flea.

The disease is generally mild and readily treated.

Companion Animal Parasite Council | *Dipylidium caninum* (capcvet.org). Reviewed November 1, 2016. Accessed April 10, 2022.

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Treatment for Tapeworms in Humans
(Dipylidium caninum)

Praziquantel

The most effective way to prevent infections in pets and humans is through flea control.

CDC - Dipylidium - Resources for Health Professionals. Reviewed May 21, 2020. Accessed April 10, 2022.

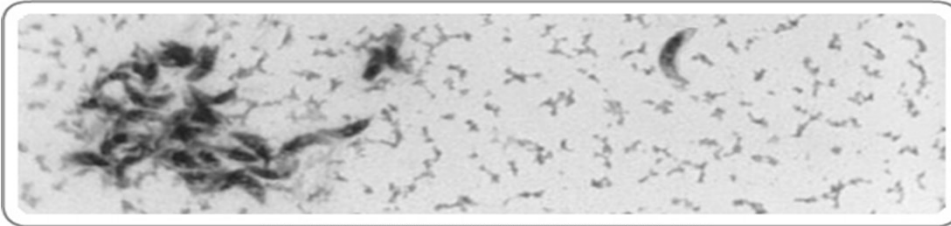
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Toxoplasmosis

- **Toxoplasmosis is caused by the protozoan parasite *Toxoplasma gondii*.**



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Toxoplasmosis

- **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 95% of some populations have been infected with *Toxoplasma*.**

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

Healthy people often do not have symptoms.

Illness can result in flu like symptoms.

Damage can occur to the unborn.

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

Three principal routes of transmission:

Foodborne

Animal-to-Human (Zoonotic)

Mother-to-child (congenital)

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

Foodborne transmission

Eating undercooked, contaminated meat (especially pork, lamb, and venison)

Eating other foods that had contact with raw, contaminated meat

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis



Oocysts

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Toxoplasmosis

Mother-to-child (congenital) transmission

A woman who is newly infected with *Toxoplasma* during pregnancy can pass the infection to her unborn child.

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

**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.**

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

Table II. Guidelines for treatment of *T. gondii* infection in the pregnant women.

	Medication	Dosage	Duration of therapy
Pregnant woman with suspected or documented infection (< 18th week of gestation)	Spiramycin	1 g (3 million U) every 8 h (for a total of 3 g or 9 million U per day)	Spiramycin treatment should be continued until delivery in women with low suspicion of fetal infection or those with documented negative on ultrasounds at follow-up
Pregnant women with confirmed infection (>18th week of gestation)	Pyrimethamine	Loading dose: 100 mg per day in two divided doses for 2 days, then 50 mg per day	Until birth
	Sulfadiazine	Loading dose: 75 mg/kg per day in two divided doses (maximum 4 g per day) for 2 days, then 100 mg/kg per day in two divided doses (maximum 4 g per day)	Until birth
	Leucovorin	10-20 mg daily	During and for 1 wk after pyrimethamine therapy

Spiramycin can be obtained from the U.S. Food and Drug Administration, telephone 301-796-1400

The table is adapted from information appearing in: Daffos F, Forestier F, Capella-Pavlovsky M, et al. Prenatal management of 746 pregnancies at risk for congenital toxoplasmosis. *N Engl J Med* 1988; 31: 271-275.

<https://www.europeanreview.org/article/891>; https://www.cdc.gov/parasites/toxoplasmosis/health_professionals/

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Toxoplasmosis

Reduce the Risk:

- **Wear gloves when gardening and during any contact with soil or sand.**
- **Wash hands with soap and warm water after gardening or contact with soil or sand.**

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

Reduce the Risk :

- **Keep outdoor sandboxes covered when not in use.**
- **Have someone else clean the litter box if you are pregnant or immunocompromised.**
- **Do not feed cats raw or undercooked meats.**

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

Reduce the Risk :

Change the litter box daily if you own a cat...

- **The *Toxoplasma* parasite does not become infectious until 1 to 5 days after it is shed in a cat's feces**

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Toxoplasmosis

Reduce the Risk:

If you are pregnant or immunocompromised:

Avoid changing cat litter if possible.

- **If no one else can perform the task, wear disposable gloves and wash your hands with soap and warm water afterwards.**
- **Keep cats indoors.**
- **Do not get a new cat while you are pregnant.**

<http://www.cdc.gov/parasites/toxoplasmosis/epi.html>

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Concept of One Health

Zoom in on Zoonoses

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Zoonotic Disease Almost Always Fatal

Summary and Conclusion

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Comment

Animals most likely to transmit rabies in the United States include bats, coyotes, foxes, raccoons and skunks.

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Rabies

The rabies virus infects the central nervous system, ultimately causing disease in the brain and death.

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Rabies

The rabies virus is spread to people from the saliva of an infected animal.

Usually transmitted through a bite.

The incubation period for rabies is typically 1-3 months, but may vary from <1 week to >1 year.

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Rabies

Symptoms:

- The first symptoms of rabies may be very similar to those of the flu including:
 - General weakness or discomfort
 - Fever
 - Headache
- These symptoms may last for days.

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Rabies

Symptoms:

- As the disease progresses, the person may experience:
- Delirium
- Abnormal Behavior
- Hallucinations
- Insomnia
- There can also be difficulty swallowing, excessive salivation and fear of water (hydrophobia).

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Rabies

Symptoms:

Once clinical signs of rabies appear, the disease is nearly always fatal, and treatment is typically supportive.

VPEG,LLC

Rabies Treatment

Thoroughly wash the wound immediately.

Rabies postexposure vaccinations:

A dose of human rabies immune globulin and rabies vaccine given on the day of the exposure.

Rabies vaccine given again on days 3, 7, and 14.

This set of vaccinations is highly effective at preventing rabies if given as soon as possible following an exposure.

VPEG,LLC

Rabies Prevention

- Rabies is a vaccine-preventable disease.
- Keep rabies vaccinations up-to-date for all cats, ferrets, and dogs.
- ** Rabies vaccination is required by state law.

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Concept of One Health

Zoom in on Zoonoses

Common Zoonotic Diseases in Companion Animals

Zoonotic Disease Almost Always Fatal

Summary and Conclusion

VPEG,LLC

Summary

One Health

Collaborative transdisciplinary approach recognizing the interconnection between people, animals, plants, and their shared environment.¹

Zoonotic diseases are very common, both in the United States and around the world.²

Many pet owners are not aware of the zoonotic diseases their pets can transmit to them.

Healthcare providers should counsel patients on prevention practices, including how to stay safe and healthy around animals.³

1. [One Health Basics | One Health | CDC](#), reviewed: February 7, 2022, accessed April 8, 2022

2. [Zoonotic Diseases | One Health | CDC](#). Reviewed July 1, 2021. Accessed April 10, 2022

3. [Information for Healthcare Providers | Healthy Pets, Healthy People | CDC](#). Reviewed March 8, 2022. Accessed April 10, 2022..

Thank you!

