



# Hookworms

## Hookworms for Cat Last updated:

Oct 1, 2016

## Synopsis

### CAPC Recommends

CAPC recommends testing all cats for hookworms by fecal flotation with [centrifugation](#). Fecal tests for specific parasite antigens have been optimized for use in companion animals and are also available to aid in identification of infection.

Kittens should be tested more frequently than adult cats. CAPC recommends testing for intestinal parasites, including hookworms, at least four times in the first year of life and at least two times per year in adults depending on patient health and lifestyle factors.

Administer year-round broad-spectrum parasite control with efficacy against hookworms, and reduce exposure by timely removal of feces from the environment.

As a parasite with zoonotic potential, control of hookworms is essential.

## Species

### Feline

*Ancylostoma tubaeforme*

*Ancylostoma braziliense*

*Uncinaria stenocephala* (rare in cats in the United States)

## Overview of Life Cycle

Adult hookworms live in the small intestine and shed eggs in feces and into the environment, where they larvate, hatch, and develop into infective third-stage larvae. This development occurs in approximately 2 to 9 days, depending on temperature and humidity.

Cats become infected with hookworms via ingestion of the third-stage larvae from a contaminated environment, larval penetration of the skin, and/or ingestion of other vertebrate hosts with infective larvae in their tissues. Cats may also become infected by eating cockroaches that contain infective larvae.

*A. tubaeforme* is not transmitted to nursing kittens but is acquired only after birth through environmental contamination. Migration of hookworms within the host is complex. After penetrating the skin, larvae are carried by the bloodstream to the lungs where they migrate up the respiratory tree to the trachea. Larvae are coughed up and then swallowed, and then make their way to the small intestine, where they mature, mate, and produce eggs. Eggs are first found in the feces 2 to 3 weeks after infection.

When infective larvae are ingested, some may penetrate the oral cavity and the gastro-intestinal tract mucosae and migrate as described; many of these larvae, however, remain in the alimentary tract and mature to adults in the small intestine.

Larvae that infect other animals (paratenic/transport hosts) do not develop further in these hosts but become dormant (hypobiosis/arrested development) in various host tissues. When a cat ingests these larvae in animal tissues, the larvae travel to the small intestine, where they are released and mature into adult worms.

Immature and adult worms attach to the mucosa of the small intestine, digest the tissue, inject anticoagulants, and suck blood. Worms may detach and move to new sites and reattach. Small bleeding ulcers form where the worms once fed.

Adult worms may live for 4 to 24 months in the small intestine.

## Stages

Morulated hookworm eggs are passed in the feces of infected cats; the most commonly seen species is *A. tubaeforme* in the cat.

Adult hookworms in the small intestine of infected cats are attached to the intestinal villi by a large mouth cavity (buccal cavity).

Male hookworms have a posterior copulatory bursa, and it is not uncommon to observe worms in copula in the small intestine.

The anterior ends of both males and females are bent dorsally, giving them a "fishing hook" appearance. *Ancylostoma tubaeforme* has three pairs of teeth in the buccal cavity. *Ancylostoma braziliense* has one pair of teeth (although some references mention a second, inconspicuous pair). *Uncinaria stenocephala* has cutting plates instead of teeth.

Cat hookworms range in size from 10 to 20 mm by 0.4 to 0.5 mm.

Eggs range in size from 55 to 90  $\mu\text{m}$  by 30 to 55  $\mu\text{m}$ , depending on the species. *Ancylostoma* spp. eggs are 55 to 75  $\mu\text{m}$  by 34 to 47  $\mu\text{m}$ ; *U. stenocephala* eggs are 71 to 93  $\mu\text{m}$  by 35 to 58  $\mu\text{m}$ .

## Disease

All hookworms suck blood. *Ancylostoma tubaeforme*, is a voracious bloodsucker and can cause anemia, diarrhea, and weight loss in kittens. Large numbers of these hookworms can be fatal.

Respiratory disease and pneumonia may occur in kittens when large numbers of larvae migrate through the lungs. Respiratory signs may also be associated with hookworm-induced anemia.

*A. tubaeforme* is more pathogenic than *U. stenocephala* and *A. braziliense* because it is a voracious bloodsucker and consumes much more blood than the latter two species.

Penetration by larval hookworms occasionally causes a dermatitis with erythema, pruritus, and papules. These lesions are most commonly seen on the animal's feet, particularly in the interdigital spaces. *A. braziliense* are most often the culprits.

## Prevalence

*A. tubaeforme* is a common parasite of cats throughout the United States and is found in most tropical and subtropical environments.

Both young and adult feline hosts can harbor hookworms and pass eggs in their feces.

In ongoing U.S. studies, prevalence of *Ancylostoma* spp. in ownerless cats ranged from 1.1% in the northeast (New York) to 20% in the southeast (Tennessee).

The geographic distributions of *A. braziliense* and *U. stenocephala* are more limited.

In the United States, *A. braziliense* occurs in warm coastal areas; however, this parasite is most common in tropical and subtropical regions of Central and South America and the Caribbean.

*Uncinaria stenocephala*, or the northern carnivore hookworm, prefers colder climates and is most common in the northern United States, Canada, and Europe.

Infection with hookworms occurs in all cats, but infection rates are likely to be higher in pets kept outdoors

[Click here to view our Prevalence Maps](#) and to sign up for updates on reported cases in your area

## Host Associations and Transmission Between Hosts

Cats become infected with hookworms through ingestion of infective larvae from a contaminated environment, larval skin penetration, and/or ingestion of larvae in the tissues of vertebrate hosts (usually rodents).

## Prepatent Period and Environmental Factors

In general, the prepatent periods are 18 to 28 days for *A. tubaeforme* and 13 to 27 days for *A. braziliense* and *U. stenocephala*.

Most hookworm eggs larvate, hatch, and develop into infective third-stage larvae in the environment in approximately 2 to 9 days, depending on temperature and humidity. In general, the environmental stages thrive best away from direct sunlight in warm, moderately moist, aerated soils. Freezing kills *Ancylostoma* spp. eggs, but *Uncinaria* eggs are hardier.

Unlike ascarid eggs, hookworm larvae do not persist in the environment for years. Under optimal conditions, infective hookworm larvae can survive in the soil for a few months until their metabolic reserves are depleted. In addition, larvae usually are killed by freezing temperatures.

## Site of Infection and Pathogenesis

Most hookworm species can penetrate the skin. As noted previously, occasionally the penetration of larval hookworms causes a dermatitis with erythema, pruritus, and papules. These lesions are most commonly seen on the pet's feet, particularly in the interdigital spaces.

After skin penetration, hookworm larvae move via the lymphatics to the veins and lungs where they penetrate alveoli and migrate up the respiratory tree to the trachea. They are swallowed and return to the small intestine where they attach to the mucosa and mature into adults. Respiratory disease and pneumonia may occur in kittens when large numbers of larvae migrate through the lungs. Respiratory signs also may be associated with hookworm-induced anemia.

Hookworms in the small intestine attach and secrete enzymes and anticoagulants to digest intestinal mucosa and facilitate bloodsucking. Hookworm platelet inhibitor decreases platelet aggregation and adhesion. Intestinal villi are damaged and villus blunting occurs, resulting in malabsorption and diarrhea. Adult hookworms move to new feeding sites, leaving small bleeding ulcerations behind. Enteritis and diarrhea may develop during this intestinal phase.

The major disease syndrome produced by hookworms is acute or chronic anemia from blood loss.

## Diagnosis

CAPC recommends testing all cats for hookworms by fecal flotation with [centrifugation](#). Fecal tests for specific parasite antigens have been optimized for use in companion animals and are also available to aid in identification of infection.

Kittens should be tested more frequently than adult cats. CAPC recommends testing for intestinal parasites, including hookworms, at least four times in the first year of life and at least two times per year in adults depending on patient health and lifestyle factors.

Cats of any age may have subclinical infections and show no signs of disease. However, when hookworm infections are allowed to persist, contamination of the environment with these potentially zoonotic parasites can occur.

*A. tubaeforme* begin sucking blood before eggs are produced.

Fecal flotation with centrifugation

Diagnosis of patent hookworm infections via fecal flotation is straightforward. Hookworm eggs float readily in most flotation solutions.

Mix 1 to 5 g feces and 10 ml of flotation solution ( $ZnSO_4$  sp.gr. 1.18; sugar sp. gr. 1.25) and filter/strain into a 15-ml centrifuge tube.

Top off with flotation solution to form a slightly positive meniscus, add coverslip, and centrifuge for 5 minutes at 1500 to 2000 rpm.

Examine for characteristic eggs.

Eggs of *Ancylostoma* spp. can be differentiated from those of *Uncinaria stenocephala* by size (see images under Life Cycle) although the ranges overlap somewhat. Mixed infections sometimes occur.

*Ancylostoma* spp.: 52-79 $\mu$  x 28-58 $\mu$

*Uncinaria stenocephala*: 71-92 $\mu$  x 35-58 $\mu$

Fecal test for hookworm antigen

Commercial assays are available for detection of antigen produced by immature and adult hookworms in the lumen of the small intestine. Both male and female worms can be detected, and antigen production is not linked to egg production.

Diagnosis by detection of antigen allows identification of prepatent and single sex infections, supporting use of preventives and allowing earlier treatment.

To ensure the widest breadth of detection of intestinal parasites in cats, fecal tests for antigen should be combined with microscopic examination of feces for eggs.

## Treatment

In severely affected animals, anthelmintic treatment must be combined with supportive therapy to keep the animal alive until the drugs can kill the worms. In addition to keeping the patient warm, supportive treatment can include electrolyte and fluid therapy, iron supplements, a high-protein diet, and when clinically indicated, blood transfusions.

Routine anthelmintic therapies do not kill arrested third-stage larvae in tissues.

Emodepside, ivermectin, milbemycin oxime, moxidectin, pyrantel, and selamectin are approved for adult *A. tubaeforme*.

Emodepside and moxidectin are approved for fourth-stage (L4) and young adult *A. tubaeforme* in the intestine.

*Ancylostoma tubaeforme*: The following products are approved for the treatment (and in some cases control\*) of adult *A. tubaeforme* infections in cats:

Advantage Multi® Topical Solution for Cats (imidacloprid + moxidectin) (Bayer Animal Health)\*

HEARTGARD® Chewables for Cats (ivermectin)(Merial)\*

Interceptor® Flavor Tabs® for Dogs & Cats (milbemycin oxime)(Elanco)

Paradyne® (selamectin) (Zoetis)\*

Profender® Topical Solution (emodepside/praziquantel) (Bayer Animal Health)

Revolution® (selamectin) (Zoetis)\*

Additionally, the following products are approved for fourth-stage (L4) larvae and young adult *A. tubaeforme* in the intestine:

Advantage Multi® Topical Solution for Cats (imidacloprid/moxidectin) (Bayer Animal Health)

Profender® Topical Solution (emodepside/praziquantel) (Bayer Animal Health)

*Ancylostoma braziliense*: The following product is approved for treatment and control of adult and immature *A. braziliense* in cats:

HEARTGARD® Chewables for Cats (ivermectin) (Merial)

Click here to view [CAPC's Parasite Product Applications](https://capcvet.org/guidelines/parasite-product-applications/) page

## Control and Prevention

Kittens require more frequent anthelmintic administration than adult cats because (1) they often are serially reinfected from the environment and (2) they often harbor migrating parasite larvae that later mature and commence laying eggs.

Hookworm infections in kittens may cause serious illness or even death before a diagnosis is possible by fecal examination.

In light of the hookworm prepatent periods kittens, and their queens should be treated with appropriate anthelmintics when the young are 2, 4, 6, and 8 weeks of age. Kittens should be put on monthly preventives as soon as label recommendations allow. If kittens are not treated until 6 to 8 weeks of age or later, they should be put on a monthly preventive according to label recommendations, dewormed again in 2 weeks, and then maintained on monthly preventives thereafter.

Beginning treatment when kittens are 2 weeks of age will help minimize environmental contamination.

Efficacy of the initial dewormings, effectiveness of the monthly control product, and client compliance should be monitored by performing a fecal examination 2 to 4 times in the first year and 1 to 2 times annually thereafter, depending on the age of the animal and its prior history of infection.

Preventing predation and scavenging activity by keeping cats indoors will limit the opportunity for cats to acquire infection with hookworms through ingestion of vertebrate hosts (usually rodents) or from an environment contaminated with feces from untreated animals.

Prompt removal of feces from the yard or litter box will also help prevent hookworm eggs from hatching and larvae developing and dispersing into the environment.

Enforcing leash laws and requiring owners to remove feces deposited by their pets can protect public areas from contamination with hookworm larvae

## Public Health Considerations

Animal hookworms are well-documented zoonotic disease agents and are the most common cause of cutaneous larva migrans (CLM) in people. The larvae migrate in the skin, producing intensely pruritic, serpentine lesions. Usually these infections are self-limiting. *Ancylostoma braziliense* migrates more extensively in the skin than do the other hookworms.

Humans are most likely to be infected with the hookworms of dogs and cats via direct skin penetration of infective larvae. *Ancylostoma caninum* can penetrate into deeper tissues and may arrest. On occasion, *A. caninum* can cause visceral larva migrans (VLM) when larvae migrate to the intestine and produce an eosinophilic enteritis. The worms do not mature to adults and no eggs are produced, but infected people may experience severe abdominal pain and eosinophilia.

Most CLM and other hookworm-associated syndromes are diagnosed in the southeastern and Gulf Coast states. People at higher risk include individuals in contact with larvae-contaminated soils such as electricians, plumbers, exterminators, and other workers who crawl beneath raised buildings; farmers and gardeners with close soil contact; sunbathers reclining on larvae-contaminated sand; and children playing in contaminated areas.

CLM is the most common travel-related skin infection in tourists to tropical areas.

Early and regular deworming is essential in preventing contamination of the environment with hookworm eggs and larvae.

Strict adherence to leash laws and prompt removal of feces from environments where pets defecate are key to protecting public areas from contamination; receptacles for the disposal of feces should be provided.

Children's sandboxes should be covered when not in use; outbreaks have occurred where larvae have developed to the infective stage in sandboxes and caused CLM in children.

To avoid larval penetration, individuals should wear shoes and gloves when gardening.

People whose occupations may require contact with moist soil for extended periods of time should cover the contact area with a waterproof liner.

## Selected References

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