

## PARASITE PROTOCOLS FOR YOUR PRACTICE

# CANINE INTESTINAL HELMINTHS

## Recommendations from the Companion Animal Parasite Council

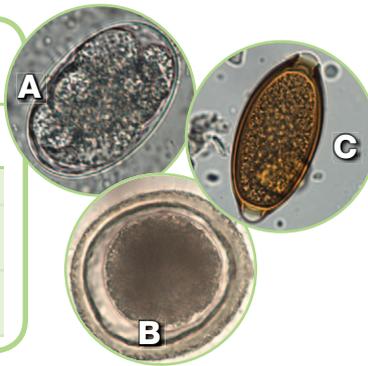
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The mission of the **Companion Animal Parasite Council (CAPC)** is to foster animal and human health, while preserving the human–animal bond, through recommendations for the diagnosis, treatment, prevention, and control of parasitic infections. For more information, including detailed parasite control recommendations, please visit [capcvet.org](http://capcvet.org).

Table 1. National Prevalence of Common Canine Nematode Parasites

HELMINTH	NATIONAL PREVALENCE	POSITIVE/TESTED DOGS	DIAGNOSTIC STAGE
Hookworm	2.23%	1/43	Figure A
Roundworm ( <i>Toxocara canis</i> )	1.86%	1/54	Figure B
Whipworm ( <i>Trichuris vulpis</i> )	1.23%	1/81	Figure C



**H**elminth parasites are regularly diagnosed in dogs in the U.S. (Table 1). Despite approximately 2 decades of excellent anthelmintic therapeutics, large numbers of dogs are still infected with common hookworms, roundworms, whipworms, and tapeworms.<sup>1</sup> Many dogs are also affected by helminths that occur locally or sporadically in the U.S. These helminths may not be controlled by the different products available for prescribed broad-spectrum parasite control, which highlights the importance of an annual fecal examination.

While helminths can affect many different systems and organs, such as the heart and lungs, this article will focus on those that affect the gastrointestinal (GI) system.

### HOOKWORMS

*Ancylostoma caninum*, *Ancylostoma braziliense*, & *Uncinaria stenocephala*

**Distribution.** Hookworms are found in dogs throughout the U.S. (Figure 1). Prevalence in the southeast is about twice the national prevalence; numbers are lower than the national average in the southwest and upper Midwest.

- A *caninum* is the most significant agent of hookworm-induced anemia,<sup>2</sup> and its eggs account for the preponderance of positive samples represented in Figure 1.
- *U stenocephala* is thought to occur more commonly in northern climates.
- A *braziliense* is found in the Caribbean and southeastern U.S., and along the Gulf and Atlantic coasts.

**Clinical Signs.** In puppies infected via transmammary transmission, sometimes fatal anemia may develop as early as 2 to 3 weeks of age, usually occurring before eggs appear in the feces. Affected puppies may present with pale mucous membranes, anemia, ill thrift, failure to gain weight, poor haircoat, dehydration, and melena. Puppies harboring many worms develop an acute normocytic, normochromic anemia, followed by hypochromic, microcytic anemia due to iron deficiency.

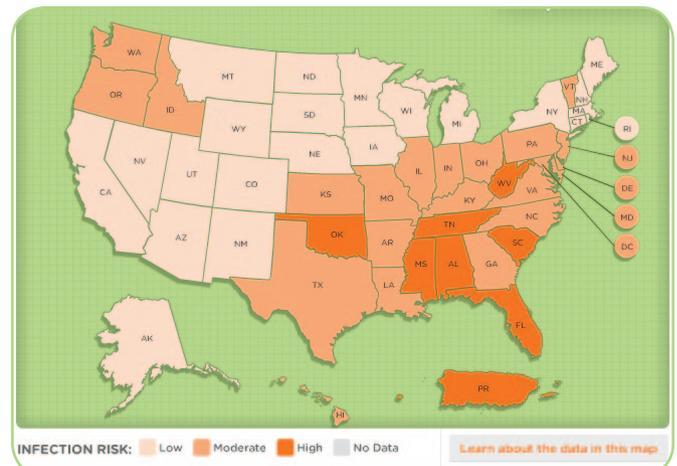


Figure 1. Map from the CAPC website showing the prevalence of hookworm eggs in submitted fecal specimens.

TABLE 2. U.S. Canine Intestinal Helminths: Transmission, Diagnostics, Treatment, & Prevention

HELMINTH	TRANSMISSION	DIAGNOSIS	TREATMENT	PREVENTION
<b>HOOKWORMS</b>				
<i>Ancylostoma caninum</i>	Ingestion of paratenic hosts or infective larvae, transcutaneous, transmammary	Fecal flotation	<b>Bayer:</b> Advantage Multi, Drontal Plus <b>Elanco:</b> Trifexis <b>Merck:</b> Panacur C, Tri-Heart Plus <b>Merial:</b> Heartgard Plus <b>Novartis:</b> Sentinel <b>Virbac:</b> Iverhart Plus, Virbanel <b>Zoetis:</b> Nemex, Nemex 2, ProHeart 6	<b>Bayer:</b> Advantage Multi <b>Elanco:</b> Trifexis <b>Merck:</b> Tri-Heart Plus <b>Merial:</b> Heartgard Plus <b>Novartis:</b> Sentinel <b>Virbac:</b> Iverhart Plus
<i>Ancylostoma braziliense</i>	Ingestion of paratenic hosts or infective larvae, transcutaneous	Fecal flotation	<b>Merial:</b> Heartgard Plus <b>Virbac:</b> Iverhart Max, Iverhart Plus, Virbanel	<b>Merial:</b> Heartgard Plus <b>Virbac:</b> Iverhart Max, Iverhart Plus
<i>Uncinaria stenocephala</i>	Ingestion of infective larvae	Fecal flotation	<b>Bayer:</b> Advantage Multi, Drontal Plus <b>Merck:</b> Panacur C, Tri-Heart Plus <b>Merial:</b> Heartgard Plus <b>Virbac:</b> Iverhart Plus, Virbanel <b>Zoetis:</b> Nemex, Nemex 2, ProHeart 6	<b>Bayer:</b> Advantage Multi, Drontal Plus <b>Merck:</b> Tri-Heart Plus <b>Merial:</b> Heartgard Plus <b>Virbac:</b> Iverhart Plus
<b>ROUNDWORMS</b>				
<i>Toxocara canis</i>	Ingestion of parasite hosts or infective egg, transplacental	Fecal flotation	<b>Bayer:</b> Advantage Multi, Drontal Plus <b>Elanco:</b> Trifexis <b>Merck:</b> Panacur C, Tri-Heart Plus	<b>Bayer:</b> Advantage Multi <b>Elanco:</b> Trifexis <b>Merck:</b> Tri-Heart Plus
<i>Toxascaris leonina</i>	Ingestion of egg or paratenic hosts	Fecal flotation	<b>Merial:</b> Heartgard Plus <b>Novartis:</b> Sentinel <b>Virbac:</b> Virbanel <b>Zoetis:</b> Nemex, Nemex 2	<b>Merial:</b> Heartgard Plus <b>Novartis:</b> Sentinel
<i>Baylisascaris procyonis</i>	Ingestion of egg or paratenic hosts	Fecal flotation	Most drugs used to treat <i>Toxocara</i> and <i>Toxascaris</i> are likely to be effective*	
<b>WHIPWORMS</b>				
<i>Trichuris vulpis</i>	Ingestion of infective egg	Fecal flotation	<b>Bayer:</b> Advantage Multi, Drontal Plus <b>Elanco:</b> Trifexis <b>Merck:</b> Panacur C <b>Novartis:</b> Sentinel	<b>Bayer:</b> Advantage Multi <b>Elanco:</b> Trifexis <b>Novartis:</b> Sentinel
<b>TAPEWORMS</b>				
<i>Dipylidium caninum</i>	Ingestion of intermediate host (flea)	Finding worm segments, fecal flotation	<b>Bayer:</b> Droncit, Drontal Plus <b>Novartis:</b> Sentinel Spectrum <b>Virbac:</b> Iverhart Max, Virbanel <b>Zoetis:</b> Cestex	<b>Novartis:</b> Sentinel Spectrum is a possible choice for prevention <b>Virbac:</b> Iverhart Max
<i>Taenia species</i>	Ingestion of intermediate host (mammalian)	Finding worm segments, fecal flotation	<b>Bayer:</b> Droncit, Drontal Plus <b>Merck:</b> Panacur C <b>Novartis:</b> Sentinel Spectrum <b>Virbac:</b> Iverhart Max, Virbanel <b>Zoetis:</b> Cestex	<b>Novartis:</b> Sentinel Spectrum <b>Virbac:</b> Iverhart Max
<i>Echinococcus multilocularis</i>	Ingestion of intermediate host (rodent)	Fecal flotation	<b>Bayer:</b> Droncit, Drontal Plus <b>Novartis:</b> Sentinel Spectrum	<b>Novartis:</b> Sentinel Spectrum <b>Virbac:</b> Iverhart Max is a possible choice for prevention*
<i>Echinococcus granulosus</i>	Ingestion of intermediate host (ungulate)	Fecal flotation		
<i>Diphyllobothrium latum</i>	Ingestion of intermediate host (piscine)	Fecal flotation	Praziquantel, 25 mg/kg for 2 consecutive days*	None
<i>Spirometra mansonioides</i>	Ingestion of intermediate host (terrestrial vertebrate)	Fecal flotation		
<b>TREMATODES</b>				
<i>Alaria species</i>	Ingestion of intermediate host (vertebrate)	Fecal flotation	<b>Bayer:</b> Droncit,* Drontal Plus* <b>Merck:</b> Panacur C* <b>Virbac:</b> Iverhart Max,* Virbanel* <b>Zoetis:</b> Cestex*	<b>Novartis:</b> Sentinel Spectrum is a possible choice for prevention* <b>Virbac:</b> Iverhart Max is a possible choice for prevention*
<i>Nanophyetus salmincola</i>	Ingestion of intermediate host (fish)	Fecal flotation	<b>Bayer:</b> Droncit,* Drontal Plus*	

\* Not approved product for control of this helminth

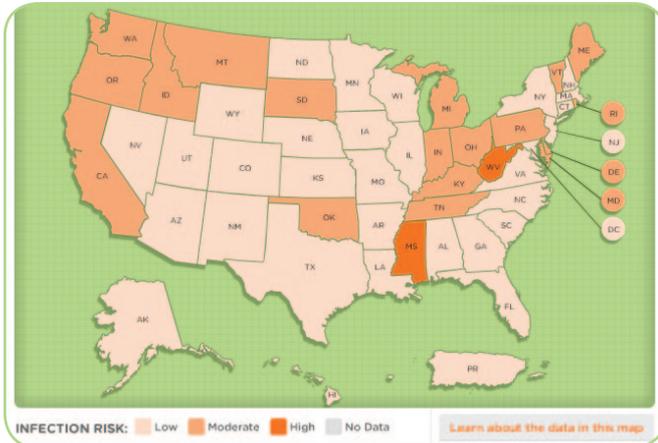


Figure 2. Map from the CAPC website showing the prevalence of roundworm eggs in submitted fecal specimens.

Without immediate intervention, these animals may die. Those that survive usually continue as “poor doers,” with chronic anemia. Respiratory disease and pneumonia may occur in puppies when large numbers of larvae migrate through the lungs.

**Diagnosis.** Eggs are found in the feces of dogs, and are best identified by centrifugal fecal flotation. The eggs of *U. stenocephala* are larger than those of *Ancylostoma* species; most laboratories can now distinguish the eggs on fecal examination.

**Treatment & Prevention.** See Table 2.

## ROUNDWORMS

### *Toxocara canis*, *Toxascaris leonina*, & *Baylisascaris procyonis*

**Distribution.** As shown in Figure 2, *T. canis* is found in dogs throughout the U.S., with areas in the northeastern and western U.S. above the national average. *T. leonina* is less common, but considered to be more common in the colder areas of the U.S. *B. procyonis* is commonly found in raccoons throughout much of the U.S. but, fortunately, infections in dogs are rare.<sup>3</sup>

**Transmission.** Puppies are often infected with *T. canis* *in utero* via transplacental transmission.<sup>2</sup> After birth, dogs primarily become infected with ascarids via ingestion of:

- Larvated eggs from a contaminated environment (all ascarid species)
- Other vertebrate hosts that have consumed larvated eggs and, thus, have larvae in their tissue.

**Clinical Signs.** Disease caused by infection with *T. canis* is most severe in young puppies, and can occur before eggs are present in the feces. Puppies infected *in utero* may present with ill thrift, failure to gain weight, and a poor haircoat; a pot-bellied appearance is also common. Those with heavy infections may expel a large mass of worms in vomitus at 4 to 6 months of age, causing the owner distress as the worms are large and usually alive.

Severe infections in neonatal pups can result in acute

death at a few days of age because the large numbers of larvae acquired *in utero* cross the alveoli en route to the small intestine. Adult dogs—even those infected *in utero*—can be repeatedly infected with adult *T. canis* if the dog is orally exposed to even a few (25–100) infective eggs.

**Diagnosis.** Eggs are identified in the feces of dogs by centrifugal fecal flotation. The eggs of all 3 species can be readily observed in a fecal sample; the eggs of *B. procyonis* are smaller and darker than eggs from other roundworm species (Figure 3).

**Treatment & Prevention.** See Table 2.

## WHIPWORMS

### *Trichuris vulpis*

**Distribution.** *T. vulpis* eggs are found throughout the U.S. (Table 1). Prevalence rates are lower in the north central and mountain states, but *T. vulpis* is present in more than 1% of canine fecal samples from Washington and Michigan (Figure 4).

**Clinical Signs.** Some *T. vulpis* infections result in hemorrhagic typhilitis or colitis, characterized by diarrhea streaked with mucus and fresh blood.<sup>2</sup> Severe infections due to the presence of thousands of worms may occur when a dog lives in a highly contaminated area, resulting in bloody diarrhea, weight loss, dehydration, anemia and, in the most extreme cases, death.

**Diagnosis.** Eggs are identified in the feces of dogs by centrifugal fecal flotation, and require a flotation solution of higher specific gravity than hookworms and roundworms to insure maximal recovery.

**Treatment & Prevention.** See Table 2.

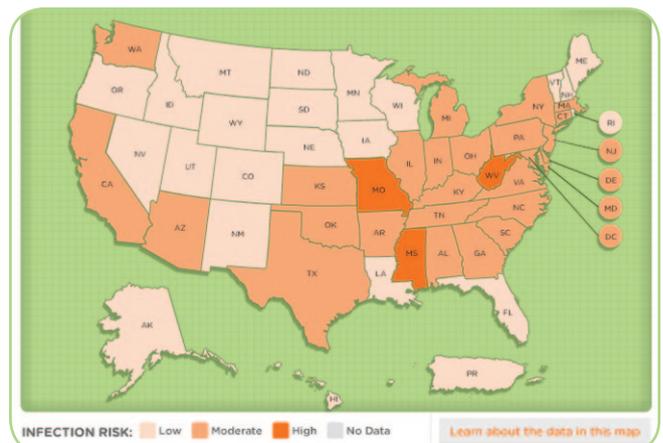


Figure 4. Map from the CAPC website showing the prevalence of whipworm eggs in submitted fecal specimens.

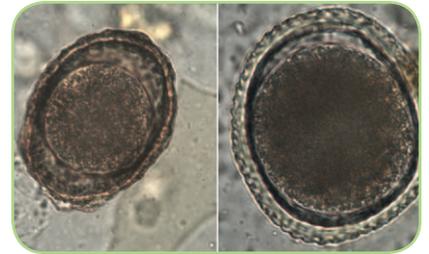


Figure 3. Eggs of *Baylisascaris procyonis* (left) and *Toxocara canis* (right) from a canine fecal specimen; magnification, 40x.

**TAPEWORMS****Cyclophyllidean**

- *Dipylidium caninum*
- *Taenia* species
- *Echinococcus* species

**Diphyllobothriidean**

- *Diphyllobothrium latum*
- *Spirometra* species

**Distribution & Transmission.** CAPC does not collect data on tapeworm prevalence because the common species found in dogs are unlikely to be diagnosed by simple fecal examination, and fecal flotation alone almost certainly underestimates the frequency of infection. This difficulty is due to the focal distribution of proglottids (and, thus, eggs) in fecal material and the eggs' weight, which keeps them from readily floating. Even in the presence of infection, a fecal sample may be negative for tapeworm segments—called *proglottids*—or eggs. Based on various published studies, prevalence of canine tapeworms varies from 4% to 60%.<sup>4</sup>

***D caninum* & *Taenia* species.** The 2 most common tapeworms in U.S. dogs and cats are *D caninum* (associated with fleas) and *T pisiformis* (acquired from rabbits). Other *Taenia* species are found throughout North America and may infect dogs that ingest sheep or wild ungulates.<sup>4</sup> All *Taenia* species in North America utilize mammals as intermediate hosts, and dogs as final hosts.

Intermediate hosts of tapeworms become infected from eggs in a dog's feces.

- *D caninum*: The egg is eaten by a flea larvae; the dog becomes infected when it eats an adult flea containing the fully mature larval stage. After a dog ingests an infected flea, it begins shedding proglottids in its feces approximately 3 weeks later.
- *Taenia* species: The rabbit or ungulate intermediate host becomes infected by ingesting eggs while grazing; then the dog becomes infected when it ingests the viscera (or muscles) that contains larval stages of the tapeworm. *Taenia* species need 6 to 8 weeks to mature before they begin shedding segments in the dog's feces.

***E multilocularis* & *E granulosus*.** These parasites are found in the northern U.S. and Canada. *E multilocularis* cycles through small rodents and foxes; *E granulosus* cycles through large, wild ruminants, such as moose and wolves. The ranges of both are expanding, and concern exists that these dangerous zoonotic agents may begin affecting domestic dog populations.

***D latum* & *Spirometra* species.** Infections with *D latum* are acquired from ingestion of freshwater fish and tend to sporadically occur in the northern U.S. and Canada. *S mansonioides* occur in the eastern U.S. and are acquired from ingestion of larvae in tissues of a variety of vertebrate intermediate hosts.

**Clinical Signs.** Disease resulting from adult tapeworms is probably underappreciated.

Humans with adult *Taenia* infections may report vague abdominal discomfort, hunger pains, loss of appetite,

**Zoonotic Disease Risk Posed by Helminths**

***Toxocara canis*:** Of the zoonotic helminth parasites discussed, *T canis* is considered the most common infectious agent in humans.

In the 1950s, it was realized that, if children ingested the embryonated eggs of *T canis*, they could develop severe systemic disease caused by larval migration into their livers and lungs. A small percentage of children and young adults also developed retinal lesions from the larvae entering their eyes after migration through the body.

When these larvae enter human hosts, they persist in the tissues for years. Ingestion of these embryonated eggs appears to be fairly common in the U.S. because approximately 14% of the U.S. population demonstrate antibodies to larvae. This statistic suggests that humans, like dogs, have larvae sequestered in their tissues, although overt human disease is less commonly seen.

***Baylisascaris procyonis*:** The raccoon roundworm, *B procyonis*, can develop into adults within dogs, and is much more worrisome than *T canis*.

When *B procyonis* larvae infect warm-blooded hosts (birds or mammals), the results can be devastating. Since this disease was first recognized in the 1950s, *B procyonis* has killed over 100 different species of animals,<sup>9</sup> and 18 human deaths have been ascribed to this infection. Death results from migration of the larvae into tissues of the body, including the brain. Unlike *T canis* larvae, these larvae mature and cause significant neurologic disease.

Raccoons routinely deposit their feces in similar places called *latrines*. While this precludes most humans from contact with *B procyonis* eggs, dogs, with their indiscriminate defecation habits, are much more worrisome hosts. The seroprevalence of larval toxocarosis in humans demonstrates that other animals and humans are at risk if dogs are shedding *Baylisascaris* eggs.

***Ancylostoma caninum* & *Ancylostoma braziliense*.** In the U.S., dogs can be infected with the zoonotic hookworms, *A caninum* and *A braziliense*. The larvae of *A caninum* and *A braziliense* can penetrate human skin, migrating around for weeks to months if left untreated; this disease is known as *cutaneous larva migrans*. It is critical that all dogs be treated routinely to control hookworm infections and prevent contamination of areas frequented by people.

***Echinococcus multilocularis* & *Echinococcus granulosus*.** The ranges of the tapeworms *E multilocularis* and *E granulosus* are expanding, raising concerns that these dangerous zoonotic agents may move into local dog populations. Thus, in areas where this worm is present in canids—the northern U.S. and Canada—products effective against this agent need to be considered when planning helminth preventive strategies.



**Figure 5.** Segments of *Dipylidium caninum* (left) and *Taenia pisiformis* (right); these specimens are backlit. The *D caninum* segment has 2 genital pores on the left and right and contains egg packets; the *T pisiformis* segment has a single pore on the right, and left and right branching uterine segments with eggs, which are fairly indistinct.

chronic indigestion, persistent diarrhea, or alternating diarrhea and constipation.<sup>5</sup> However, dogs are infected with different *Taenia* species than humans.

Tapeworms cause marked thickening of the intestinal mucosa in dogs, and cases of fatal impaction have been reported in young puppies with fleas and massive tapeworm infections. When examined at necropsy, the intestines of a dog with 50 *T pisiformis* are usually packed to the intestinal lumen's full capacity.

Infections with *S mansonioides* have been associated with GI disease in dogs and cats.<sup>4</sup> Reported clinical signs include diarrhea, weight loss, and vomiting, which usually resolve following appropriate anthelmintic therapy.

**Diagnosis.** A *D caninum* egg packet or taeniid egg in a fecal sample is diagnostic of tapeworm infection, and proglottids can be readily identified as either *Dipylidium* or *Taenia* (Figure 5). However, the chances of finding an egg in the feces are minimized because eggs are intermittently shed in segments and are usually too dense to float in common flotation solutions.

Because *Echinococcus* and *Taenia* are morphologically similar, and *Echinococcus* is a significant and dangerous zoonotic agent, there is cause for concern if a taeniid egg, but no proglottids, is identified in the feces of a dog located where *Echinococcus* is also found.

Tests are available in Europe that distinguish *Echinococcus* eggs from *Taenia* eggs, but these tests are not yet available in the U.S.

The eggs of *D latum* and *Spirometra* species are also found in the feces, and resemble a trematode egg (Figure 6). These eggs are shed from the tapeworm strobila within the dog's intestine rather than being passed in terminal segments.

**Treatment.** See Table 2.

## TREMATODES

*Alaria canis*, *Alaria marcianae*, & *Nanophyetus salmincola*

**Distribution.** *Alaria* species are found throughout the U.S.,<sup>6</sup> while *N salmincola* is found in the coastal northwest.<sup>7</sup>

**Clinical Signs.** *Alaria* alone does not cause signs in dogs. However, dogs that contract *N salmincola*, es-

pecially those new to or visiting endemic areas of Oregon and Washington, may present with fever, diarrhea, and thrombocytopenia, which results from the rickettsial agent, *Neorickettsia helminthoeca*.

**Diagnosis.** Dogs become infected with *N salmincola* by ingesting metacercariae in salmonid fish; these flukes often begin shedding eggs within a short time after infection, and a fecal examination with a direct smear revealing eggs in a dog with clinical signs of neorickettsiosis will help verify the clinical diagnosis.

*N salmincola* (Figure 7) eggs are small and heavy (they float best in a saturated sugar solution and centrifugal flotation), while *Alaria* eggs are larger.

**Treatment.** See Table 2. Tetracyclines are considered the treatment of choice for neorickettsial disease associated with *N helminthoeca*. Short-acting corticosteroids may be used supportively.

**Prevention.** See Table 2.



**Figure 7.** Egg of *Nanophyetus salmincola* in canine fecal specimen. Courtesy Dr. J. Stewart, Aumsville Animal Clinic, Aumsville, Oregon

### Are Intestinal Helminths Developing Resistance?

Concern has been raised about development of resistance of intestinal helminths to the active ingredients of various preventives included in broad-spectrum year-round parasite control.

While the concern about resistance is real, the chance of resistance developing is minimal—as long as success of prevention/treatment is monitored. Monitoring includes annual fecal examinations and confirming worm burden removal post treatment. If a dog returns to the clinic and tests positive, deworm it again with a different product and follow up to confirm treatment success.

The veterinary practice team has a responsibility to the pet and the public to make certain that treatments are efficacious.

## APPLICATION TO CLINICAL PRACTICE

Few things are as disruptive to the human–animal bond as a puppy or adult dog passing a worm in its stool, vomiting a wad of worms, or depositing a tapeworm proglottid on the owner's lap. Since some intestinal helminths also have zoonotic potential, control and prevention of these parasites are imperative to preserve this bond.

**Prevalence.** Intestinal helminths are common in all dogs, especially stray dogs and dogs found in shelters. Surveys of shelter dogs in the U.S. demonstrate higher numbers of helminths than the numbers seen in the general canine population.<sup>8</sup>

(Continued on page 56.)

- In the northeast, 1 or more of every 10 dogs has roundworms, hookworms, and whipworms.
- These numbers are higher in the Midwest, approaching 1 in every 5 dogs, and highest in the South, ranging from 1 in 5 to 1 in every 2 dogs.
- Even in western states, 1 in 10 to 1 in 20 dogs sampled are positive for these parasites.

**Because roundworm and whipworm eggs can persist in the environment for several years, clients need to understand that their pets are at risk for infection when outside.** In addition, stray dogs defecating in the yard or park are not receiving treatment and likely infected.

**Diagnosis.** Dogs should have fecal examinations performed 2 to 4 times during their first year of life and 1 to 2 times per year as adults, depending on patient health and lifestyle factors.

**Treatment & Prevention.**

- Routinely deworm puppies beginning at 2 weeks of age, with deworming repeated every 2 weeks.
- Begin administering a monthly control product with efficacy against intestinal helminths when puppies reach 4 to 8 weeks of age (Table 2).
- Broad spectrum parasite control products should be administered monthly year round.

**Inform clients that routine parasite control typically results in negative fecal examinations, confirming the efficacy of routine parasite prevention.** Other preventive measures they can implement include:

- Keeping dogs on a leash or in a fenced yard to prevent predation and scavenging activities; this limits the opportunity for dogs to acquire infection via ingestion of vertebrate hosts (ascarids) or from a feces-contaminated environment.
- Promptly removing feces from the yard to prevent eggs from being released from fecal material or dispersing into the environment.
- Preventing contamination with eggs of *B. procyonis* by not keeping raccoons as pets and avoiding areas frequented by dogs and wildlife. ■

GI = gastrointestinal

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