Chapter 3
Larva migrans from pets and wildlife

As a result of the large number of infected dogs, cats, and raccoons around people, the most common causes of zoonotic larva migrans in people are *Toxocara canis*, *Toxocara cati*, *Baylisascaris procyonis*, and *Ancylostoma* species. Learn how you can take a preventive approach to treating pets and helping families understand these zoonotic parasites.

By Kevin R. Kazacos, DVM, PhD

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**Test your current knowledge**

Do you know the most common zoonotic parasites transmitted from pets to people? Before studying this chapter, take this pre-test to check your knowledge of helminth parasites. Answers can be found on page 31.

**True**  **False**  
1. You should deworm puppies for ascarids and hookworms beginning at 2 weeks of age, with additional treatments at 4, 6, and 8 weeks of age.

2. *Toxocara canis* is a common cause of cutaneous larva migrans in children in the United States.

3. Puppies acquire *T. canis* primarily by transplacental transmission; consequently, nearly all puppies are born infected with *T. canis*.

4. Risk factors for contracting human toxocariasis, particularly by children, include contact with puppies or soil contaminated with *T. canis* eggs.

5. Infected puppies can shed tremendous numbers of eggs in their feces, beginning as early as 6 weeks of age.

Many helminth parasites of pets and wildlife can cause zoonotic infection when people come into contact with the parasites' infective stages. In some cases, people are infected directly by ingesting infective eggs or through skin penetration by infective larvae. In other cases, people are infected indirectly by ingesting larvae in food items or through the bites of arthropod vectors. Ascarids and taeniid tapeworms, which are acquired through ingestion of infective eggs, and hookworms and *Strongyloides* species, which are acquired by skin penetration, are zoonotic helminths of greatest concern to veterinary healthcare teams. Ascarids and hookworms are particularly important because they commonly cause larva migrans in humans.

The prolonged migration and persistence of helminth larvae in the organs and tissues of people and animals is called larva migrans. Larva migrans is separated clinically and pathologically by the organ system involved, into visceral, ocular, neural, and cutaneous larva migrans. Because of the large number of infected dogs, cats, and raccoons around people, the most common causes of
zoonotic larva migrans in humans are *Toxocara canis*, *Toxocara cati*, *Baylisascaris procyonis*, and *Ancylostoma* species. Let’s review the disease aspects and prevention of each of these causes of zoonotic larva migrans.

**Toxocariasis**

*Toxocara canis*, the common ascarid of dogs, is the most common cause of zoonotic visceral larva migrans and ocular larva migrans worldwide, and it also can produce neural larva migrans in severe cases. People also can become infected with *T. cati*, but this occurs less often. Infection with *Toxocara* occurs when people, primarily children, ingest infective eggs from contaminated areas or items, including soil, hands, and fomites such as toys. Sources of infection include homes, parks, playgrounds, and public places contaminated by dogs or cats.\(^5\)

Despite the widespread availability of effective anthelmintics, a high prevalence of *T. canis* still exists in the dog population in North America and worldwide. *Toxocara* infections are most common in puppies less than 3 to 6 months old, and prevalences greater than 90% and approaching 100% have been reported in puppies less than 3 months of age.\(^6\)^ Adult dogs also can be a source of infection.\(^10,14\) A national survey found that 15% of dogs overall and 10.6% of dogs 3 to 7 years of age were infected with *T. canis*.\(^14\) Previous studies that involved nearly 42,000 dogs worldwide and 6,621 dogs in North America also showed an overall prevalence of *T. canis* of 15%.\(^9,10\)

*Toxocara canis* can be transmitted to dogs in a variety of ways.\(^2,13\) Puppies acquire it from their mothers by transplacental transmission; consequently, nearly all puppies may be born infected with *T. canis*.\(^9,13\) Additionally, some larvae are acquired postnatally in the mother’s milk, and puppies are very susceptible to infective eggs. Infected puppies can shed tremendous numbers of eggs in their feces, beginning as early as 2 1/2 to 3 weeks of age. Nursing mothers also are susceptible and acquire late-stage larvae from ingesting their puppies’ feces. When an older puppy or adult dog ingests infective eggs, the larvae typically undergo somatic migration and enter various tissues, where they lie dormant until becoming reactivated in the pregnant female. Even in older dogs, some larvae undergo hepatic-tracheal migration and mature into adult worms; thus, mature dogs also may be a source of environmental contamination.\(^7\)

The extent of environmental contamination possible with *Toxocara*, mostly by puppies, is striking. One adult *T. canis* female can produce more than 100,000 eggs per day. Heavily infected puppies may pass 100,000 eggs per gram of feces, shedding millions of eggs into the environment daily.\(^9,13\) A Purdue University study found that two puppies with low worm burdens still shed an average of 10,983 *T. canis* eggs per gram of feces, amounting to 294,454 eggs per defecation. In one week, these puppies shed an estimated 20,545,459 eggs, extensively contaminating a 2,800-square-foot backyard.\(^7\) At suitable temperatures, *Toxocara* eggs develop to infectivity in 2 to 4 weeks and can remain viable in the soil for years (Figure 1). Because *Toxocara* eggs are very sticky, they will adhere to various objects, increasing their spread and eventual transmission to other animals and people (Figure 2).

When people ingest infective eggs, the larvae hatch in the small intestine. Larvae then penetrate the intestinal wall and migrate to the liver and lungs. From the lungs, larvae enter the systemic circulation and distribute throughout the body, migrating into a variety of tissues.\(^8,11\) *Toxocara* larvae measure about 400 μm long, and their migration causes mechanical damage, tissue necrosis, and intense eosinophilic inflammatory reactions.\(^9\) Migration continues until the larvae become encapsulated in eosinophilic granulomas, in which the larvae may survive for years. Clinical signs vary and depend on the intensity and frequency of infection, the distribution of larvae in the body, and the intensity of the ensuing inflammatory response. Inflammatory reactions are directed against larval excretory-secretory antigens, which consist of enzymes, cuticular proteins, and metabolic wastes released by the larvae during migration.\(^7,8\)

Large numbers of *Toxocara* larvae migrating in internal organs produce the condition called visceral larva migrans, which may be acute or chronic.\(^2,3,7,9,11-13\) Children 1 to 4 years old who exhibit pica or geophagia are most commonly affected, with an average patient age of about 2 years. Children may ingest a large number of eggs at one time or be repeatedly infected. Although rarely fatal, visceral larva migrans can make children very sick, and the damage could affect them for years. The liver and lungs are the main organs affected in visceral larva migrans. Affected children exhibit abdominal pain, fever,
FIGURE 3

3. Enucleated eye from a patient with toxocarial endophthalmitis, showing a large retrolental mass associated with funnel-shaped retinal detachment.

FIGURE 4

4. Cutaneous larva migrans caused by hookworms. (Courtesy of Dr. Allen Paul, University of Illinois, Urbana, Ill.)

hepatomegaly, respiratory signs, and high eosinophilia. Inflammatory reactions result in the trapping of large numbers of Toxocara larvae in internal organs, particularly the liver. Fatalities usually result from massive invasion of the brain or heart, or from an exaggerated immune response.\(^3\)\(^,\)\(^6\)\(^,\)\(^7\)\(^,\)\(^8\)\(^,\)\(^9\) Visceral larva migrans is typically treated with a combination of anthelmintic drugs and corticosteroids.

Ocular larva migrans results from larval invasion of the eye via the systemic circulation (Figure 3).\(^3\)\(^,\)\(^7\)\(^,\)\(^9\)\(^,\)\(^10\)\(^,\)\(^11\)\(^,\)\(^13\) Typically, patients are children or young adults who develop unilateral ocular disease. They have no history of pica or geophagia and no evidence of visceral larva migrans. Most cases of ocular larva migrans result from infection with few larvae, as suggested by low or absent Toxocara-specific antibody titers and eosinophilia. Migration of a single larva into the eye produces ocular damage, inflammation, and loss of vision. Some patients are asymptomatic, and the infection is detected during a routine eye exam. Other patients may have strabismus, decreased vision, or leukokoria.\(^2\) On ocular examination, retinchoroiditis, vitritis, papillitis, granulomatous masses, or endophthalmitis with or without retinal detachment may be seen.

Ocular larva migrans is treated with anthelmintics and steroids, and if a larva is seen in the retina on ophthalmoscopic examination, it can be killed using laser photocoagulation.\(^7\)

Most cases of human toxocariasis are asymptomatic or clinically inapparent.\(^3\)\(^,\)\(^11\)\(^-\)\(^13\) In some children and adults, the infection is covert and manifested as a variety of nonspecific symptoms, all in the presence of elevated Toxocara antibody titers.\(^7\) Although the true incidence of infection is not known, a high level of seropositivity to Toxocara exists in human populations worldwide. When 8,457 people in the United States were tested, an overall Toxocara seroprevalence of 3% was found.\(^9\) Infection rates are higher among lower socioeconomic groups and rural residents, reaching 23% or higher in some studies.\(^5\) In a group ophthalmology practice in Atlanta, 41 cases of toxocarial ocular larva migrans were diagnosed during an 18-month period, accounting for 37% of all retinal disease seen in children.\(^2\)

As a veterinary healthcare provider, you need to realize that Toxocara is still common in the dog population in North America. Risk factors for contracting toxocariasis, particularly by children, include contact with puppies or soil contaminated with T. canis eggs. Your intervention could limit or help prevent human infection from these or other sources.

**Hookworms (Ancylostoma species)**

Hookworms are common intestinal helminths of dogs and cats throughout the world. In a U.S. survey, 19% of dogs were found infected with *Ancylostoma caninum*.\(^4\) Infective larvae of the cat and dog hookworms, *Ancylostoma braziliense* and *A. caninum*, penetrate and migrate within the skin of people. This produces a condition called cutaneous larva migrans, or creeping eruption (Figure 4).\(^3\)\(^,\)\(^5\)\(^,\)\(^8\) Hookworm larvae are typically found in damp, sandy soil, including shady areas under bushes, crawl spaces under houses and porches, in sandboxes, and on beaches. The risk for human infection is associated with contact with contaminated areas containing the larvae. *Ancylostoma braziliense* infection occurs in dogs and cats in coastal regions of the southeastern United States and tropics. Travelers returning from tropical vacations are being diagnosed with cutaneous larva migrans with increasing frequency. Although cutaneous larva migrans is an annoying condition that is intensely pruritic, it is usually self-limiting and easily treated.

The zoonotic importance of *A. caninum* increased greatly after an adult worm was recovered from the intestine of an Australian patient with eosinophilic enteritis in 1988.\(^15\) By 1994, more than 200 cases had been diagnosed clinically and serologically in northeastern Australia, and solitary adult *A. caninum* infections were seen in at least 15 patients with eosinophilic enteritis.\(^4\)\(^,\)\(^10\) Recently in the southeastern United States, two probable cases were diagnosed in children,\(^9\) and it is likely that more cases will be identified wherever *A. caninum* is found. Eosinophilic enteritis may be acute or chronic, and clinical signs include recurrent abdominal pain, small bowel thickening, eosinophilia, elevated IgE levels, and foci of inflammation or ulceration in the distal ileum and colon.\(^4\)\(^,\)\(^15\) Eosinophilic enteritis due to *A. caninum* is easily treated with anthelminetics such as mebendazole.

**Raccoons and baylisascariasis**

*Baylisascaris procyonis*, the raccoon ascarid, is the most common and widespread cause of clinical larval migrans in animals. The parasite typically produces clinical neural larva migrans, resulting in fatal or severe neurologic disease
Baylisascaris procyonis migration has killed more than 90 species of birds and mammals, including people, in North America.\textsuperscript{17}

Raccoons are well adapted to living and interacting with people in urban and suburban areas. Raccoons are commonly infected with \textit{B. procyonis}, with prevalence rates as high as 68% to 82% in different areas of the United States.\textsuperscript{17} Similar to the situation with \textit{T. canis} in dogs, infected raccoons can shed millions of \textit{B. procyonis} eggs per day in their feces. Raccoons typically establish communal latrines at the bases of trees or on raised horizontal structures, including large logs, stumps, woodpiles, and even decks and rooftops. Various small mammals and birds become infected with \textit{B. procyonis} by foraging for undigested seeds in raccoon feces at these latrines.\textsuperscript{17}

When people or animals are infected with \textit{B. procyonis}, the larvae undergo aggressive somatic migration, entering various internal organs and tissues, including the brain and eyes.\textsuperscript{3,16,17} Size is a key factor in their pathogenicity, and the larvae grow considerably following infection, reaching a final size of 1,500 to 2,000 \textmu m long. Larvae that enter the brain can cause significant damage, leading to clinical neurologic disease (Figure 6). The severity and progression of clinical disease depends on the number of eggs ingested, the number of larvae entering the brain, and the location and extent of migration damage and inflammation.\textsuperscript{8,16,17} Encephalitis due to \textit{B. procyonis} has been diagnosed in 11 young children and a 17-year-old with fatal or severe neurologic disease, and the condition is suspected in another child and in a 21-year-old. The parasite also is a well-known cause of ocular larva migrans in people, causing lesions and clinical disease similar to toxocarial ocular larva migrans (Figure 7).\textsuperscript{5,17}

The overall seroprevalence of \textit{Baylisascaris procyonis} in people has not been investigated, so it is unknown just how common infections in people are. As with toxocarasis, however, clinically normal individuals have been found to be seropositive for \textit{Baylisascaris}, indicating that low-level, asymptomatic infection occurs.\textsuperscript{7} Thus, \textit{B. procyonis} may cause a wide spectrum of human disease, depending on the level of infection and particular organ systems involved. Because the parasite is so widespread in raccoons and the likelihood of human contact with raccoon feces is great, the risk of human infection with \textit{B. procyonis} is considered to be high.\textsuperscript{2,17} Researchers recently found that \textit{B. procyonis} also can mature in domestic dogs, which is a clear cause for concern.\textsuperscript{17} More than 24 dogs with intestinal infection with \textit{B. procyonis} adults have been identified in the midwestern United States. Several of these dogs had mixed infections with \textit{T. canis} or other intestinal helminths. Canine infection with \textit{B. procyonis} is probably more common and widespread than is presently known and deserves diagnostic vigilance by veterinary professionals. The indiscriminate defecation habits of dogs would likely result in more widespread domestic contamination with the eggs of this dangerous parasite, thereby increasing risk of human infection.\textsuperscript{7} Differentiation of \textit{B. procyonis} and \textit{T. canis} eggs in dogs is important so appropriate treatment and control methods can be initiated promptly. \textit{Baylisascaris} eggs are ellipsoidal, brown, and contain a large single-celled embryo. They have a thick shell with a finely granular surface. \textit{Baylisascaris} eggs are smaller than the coarsely pitted eggs of \textit{Toxocara} species and range in size from 63 to 88 \textmu m by 50 to 70 \textmu m (Figure 8).\textsuperscript{3,16,17} By comparison, \textit{T.}}
canis eggs are about 85 to 90 μm by 75 to 80 μm, and toxocariasis leonina eggs are 75 to 85 μm by 60 to 75 μm.

References

Action step: Developing strategies for prevention and control.
Prevention is clearly the key to protecting people from zoonotic helminths. Veterinary teams have a responsibility to not only control these parasites in their patients, but also to work with other health professionals to help protect children and other family members from infection. The three most important issues concerning prevention of human infection are:

1. Educating the public about the health risks of zoonotic helminths.
2. Reducing environmental contamination with infective eggs and larvae from animal feces.
3. Limiting or preventing contact between children and contaminated environments.

Your public health program should include these proactive elements:
- Educate people about health risks associated with contaminated environments.
- Implement strategic deworming of dogs, cats, and wild animals kept as pets.
- Reduce the number of stray dogs, cats, and nuisance wildlife.
- Enforce leash laws and fecal cleanup laws for dogs.
- Exclude dogs from playgrounds and park areas where children play.
- Keep children away from contaminated environments.
- Teach children to recognize and avoid raccoon latrines.
- Cover sandboxes when not in use.
- Wash hands after handling animals or having contact with their feces.
- Emphasize routine veterinary care of pets.
- Promote responsible pet ownership.

The Centers for Disease Control and Prevention (CDC) and the American Association of Veterinary Parasitologists recommend deworming puppies for ascarids and hookworms beginning at 2 weeks of age, with additional treatments at 4, 6, and 8 weeks of age. Some recommend extending this biweekly treatment regimen to 3 months of age.

Because prenatal transmission of intestinal parasites doesn’t occur in cats, treatment of kittens may begin at 6 weeks of age and be repeated at 8 and 10 weeks. Puppies and kittens should be dewormed even if fecal examinations are negative. This ensures the removal of prepatent intestinal worms before they begin shedding eggs. A strategic deworming program begun early in life should continue with monthly treatments until the pet is at least 6 months old, followed by a retreatment interval tailored to the individual animal or situation. Several safe and effective anthelmintics are available, including monthly heartworm preventives that treat and control intestinal nematodes in dogs and cats of appropriate age. For maximum protection and control, strategic deworming should be combined with a program of environmental cleanup and decontamination of contaminated areas.

Zoonotic diseases are on the rise worldwide because people are having increased contact with domestic and wild animals. Along with other healthcare professionals, veterinary teams play a key role in providing patient care and information to help prevent and combat zoonotic diseases. Through public education and strategies designed to eliminate parasites and contaminated environments, veterinary teams can prevent human infections with zoonotic helminths.
18. How to prevent transmission of intestinal roundworms from pets to people. Atlanta, Centers for Disease Control and Prevention/National Center for Infectious Diseases and the American Association of Veterinary Parasitologists, 1996.
Chapter 2
Understanding your legal liability and treatments for zoonotic diseases

Get advice on developing medical protocols, standards of care, and consent/release forms that limit your legal liability while also giving clients the information they need to know.

By James F. Wilson, DVM, JD

Test your current knowledge
Is your veterinary healthcare team using consent/release forms and making sure every client knows about the risks of zoonotic diseases? Before studying this chapter, take this pre-test to check your awareness of veterinary legal issues regarding client education and consent. Answers can be found on page 42.

True False

1. The presence of single-sex parasite infections, testing during the period before roundworms and hookworms become fully mature, or testing during a period of reduced egg shedding by parasites can produce false-negative results.

2. Failure to diagnose and treat a pet with a zoonotic disease or to warn the owner(s) of the risks of such diseases could pose a legal liability.

3. If clients elect not to follow your recommendations and also refuse to sign the practice’s release form, you don’t need to document their decision in the medical record.

4. Even as the public’s awareness of zoonotic disease rises, it is unlikely that veterinary healthcare teams will be considered healthcare professionals responsible for preventing such infections because they take care of animals, not humans.

5. For a professional negligence action to be sustained, a plaintiff only needs to prove that the veterinarian failed to follow a standard of care provided by other veterinarians in the community.

During the last decade, the veterinary profession has seen major advances in the recognition and value of the human-animal bond. The Argus Institute at Colorado State University in Fort Collins, Colo., has established criteria for bond-centered veterinary practices, and mounting volumes of research show the value of animals in the physical, psychological, and emotional health of humans. Pets have moved from the backyard to the bedroom and from the side yard to the sofa. Because pets may transmit serious zoonotic diseases to humans, veterinary healthcare teams must emphasize the prevention of zoonotic diseases with the same passion they show for such wellness care as vaccines and dentistry.

Growing awareness and understanding of the human-animal bond and increased use of animal-assisted therapy have led to new perceptions of the veterinary professional’s role as a public health worker. This role is expanding and evolving to include responsibility for the health of pet owners, animal caregivers, children, occupants of and caregivers in nursing homes and medical facilities, neighbors, family members, veterinary
that also treat and control zoonotic intestinal parasites routinely, despite the increasing availability of safe and effective broad-spectrum anthelmintics for companion animals. Veterinary professionals should review their broad-spectrum preventive of choice to ensure treatment of common zoonotic parasites.

Physicians’ awareness of the threat of zoonotic infections is belated but growing. Diagnostic testing in human healthcare has improved remarkably while also becoming more readily available. These include advances in the sensitivity of MRI and CT scans and their interpretations and immunologic tests for parasitic infections. Because of these improvements, a definitive diagnosis of these infections can be made more easily. In addition, growing urbanization and increased densities of human populations have enhanced people’s exposure to companion animals and their excrement. Contaminated soil has traditionally been the principal source of infection in people. Children are especially at risk, because they often play in soil and put dirt and other contaminated objects in their mouths. Other high-risk individuals include electricians, plumbers, and workers who come in contact with soil in crawl spaces beneath buildings, as well as beachgoers whose bare skin contacts wet sand.

Soil analyses in the United States, Great Britain, Germany, Brazil, and Czechoslovakia have shown the presence of *Toxocara* eggs in 10% to 32% of soil samples taken from public places. Additionally, the incidence of *Ancylostoma caninum* (hookworms) (Figure 1) in stray dogs has been reported to be as high as 60% to 70% in the eastern and midwestern United States. In the southeastern United States, a remarkable 86% of dogs examined at one veterinary hospital were infected with *A. caninum.* A recent study of more than 40,000 dogs worldwide, 6,621 of which were from North America, showed a remarkable stability of *T. canis* in the dog population, despite major advances in companion animal parasitic treatments and controls.

**FIGURE 1**

1. *Ancylostoma caninum* (hookworms).

2. An example of ocular larva migrans.

**Which are the guilty parasites?**

*Giardia* is the most common intestinal parasite found in people and commonly causes diarrhea in people and animals. This disease can be transmitted to people from other people or from wild or domestic animals, most commonly from contaminated water. The protozoan parasite, *Toxoplasma gondii*, also is considered a parasite that infects people, especially during pregnancies, in which case the parasite may be transmitted to various organs in the developing human fetus.

The more common helminthic (parasitic worms) zoonoses include visceral and ocular larva migrans (Figure 2), due to *Toxocara cati* and *Toxocara cati*, and cutaneous larva migrans, due to *Ancylostoma braziliense*, *Acanthamoeba castellanii*, *Uncinaria stenocephala*, and *Strongyloides stercoralis*. Blindness is the most common result of ocular larva migrans, while facial and other scarring occur with cutaneous larva migrans. An emerging threat comes from the raccoon roundworm, *Baylisascaris procyonis*, which causes fatal or severe neurologic disease in people. This dangerous parasite has been linked to the deaths of more than 90 species of birds and animals, including people. Increasingly, common urban-based raccoons and backyard raccoon lardines pose special risks for children.

*A. caninum* also has been linked to cases of enterocolitis and eosinophilic enteritis in humans. Affected adults and children may develop diarrhea, abdominal cramps and pain, and eosinophilia, or they may be asymptomatic. Generally, these infections are not patent in people, making diagnosis by fecal examination unlikely. Occurring less frequently, but often with dire consequences, are hydatid cysts associated with the tapeworms *Echinococcus granulosus* and *Echinococcus multilocularis*. Dipylidiasis (infection with *Dipylidium caninum*), another type of tapeworm, also may cause digestive disorders, mainly in infants and young children.

As the number of immunosuppressed individuals in our society increases, more people may face an increased risk for zoonotic parasitic
disease. Among them are patients with human immunodeficiency virus (HIV) infection or the more advanced sequel to this disease, acquired immunodeficiency syndrome (AIDS), as well as those with malnutrition, diabetes mellitus, chronic kidney and liver disease, and congenital immunodeficiencies. Another group includes people receiving immunosuppressive therapy for cancer, autoimmune disease, and organ or bone marrow transplants. Immuno-compromised individuals are especially susceptible to infectious organisms, including certain protozoa that may be transmitted by pets, such as *Toxoplasma gondii* (cats), Cryptosporidium (dogs, rodents, wild birds, and pigeons), and *Giardia* (dogs and cats), as well as bacteria (*e.g.*, *Bordetella bronchiseptica* [dogs] and *Mycobacterium marinum* [rodents, fish]).

Surveys show that of the several million immunocompromised patients in the United States, 30% to 40% own companion animals. The dilemma for these patients is clear. If they keep their pets, they may run an increased risk of infection. If they give up their pets, as physicians often advise, they may lose their best friends and final source of comfort and companionship. One survey showed that more than 60% of pet owners infected with HIV were advised by physicians that they should not own pets. Frequently, these patients are isolated from friends and family, yet they share a close bond with their pets and receive daily doses of love, affection, and companionship. The loss of their pets may have devastating psychological and physical effects on these already ailing individuals.

**Your vital role**

Your role as a veterinary professional includes:

1. **Passing on information you receive through your interactions with clients to veterinarians at your practice (without invading individual rights to privacy).**
2. **Assisting with the development of client-education materials and using them to warn clients of the risks of zoonotic disease.**
3. **Performing accurate diagnostic tests and administering or dispensing correct doses of medications when treating parasitic diseases in pets.**
4. **Educating owners about how to minimize the risk of zoonotic diseases after they leave your practice.**

As a veterinary team member, you serve a critical role in counseling pet owners and helping minimize the risks of zoonotic infection. By assisting your practice in the design and implementation of an effective zoonotic prevention program, you can help ensure that pets are not surrendered needlessly. Your role is especially important when pet owners are immunocompromised or severely ill. In such cases, preserving the human-animal bond may be vital to the emotional and physical health of these pet owners.

Fecal examinations have been the traditional approach to diagnosing parasites. Historically, only pets with confirmed parasitic infections have received anthelmintic drugs. This requirement for a definitive diagnosis before administering medication is problematic because of the number of positive young puppies and kittens and the volume of pets that may exhibit false-negative test results. False-negatives are found in samples that are too old, of inadequate volume, or improperly preserved. False findings also occur because veterinary technicians or assistants may be inexperienced or undertrained, or they don't understand the importance of what frequency has been considered a mundane, smelly laboratory test. This can lead to the use of improper or inadequate techniques to isolate and identify parasitic eggs or larvae. In addition, the presence of single-sex parasite infections, testing during the prepatent period (before the parasites start laying eggs or passing larvae), or testing during a period of reduced egg shedding by parasites can produce false-negative results.

**What are the consequences of false-negative fecal exams?** The repercussions include failure to diagnose and treat pets for infections, increased exposure of caregivers and veterinary staff members, increased contamination of neighborhood environments, damage to the pet's health from parasites, and heightened potential for veterinary liability based on human injury. Because owners rarely have the scientific or medical training to assess the meaning of negative fecal exams, and because attorneys may question diagnostic protocols, contemporary veterinary teams need to adopt a different approach to managing parasitic infections in companion animals.

**New guidelines on preventive deworming**

The growing trend toward preventive parasitic treatment began with heartworm preventive drugs. Today’s situation with companion animals should continue to move closer to that of large animal practice, where preventive deworming has been routine for decades. Within the last 14 years, pharmaceutical companies have added intestinal anthelmintics to heartworm medications. Combination drugs like Heartgard® Plus (ivermectin/pyrantel) have paved the way for acceptance of preventive parasitcides.

Client acceptance of preventive deworming must come from the veterinarians at your practice and you. Every staff member needs to understand the risks and help educate clients about the need and value of such treatments. Your job must include teaching pet owners and new staff members about:

- the incidence of parasitic diseases in pets,
- the nature of disease transmission to people and other pets,
- the risks to pets and people from such infections, and
- how clients can minimize their own health risks and help reduce environmental contamination.

The educational process needs to start at staff meetings, where all team members receive information about the risks of zoonotic parasitic infections. A great way to enlighten your staff is to invite pharmaceutical representatives to present continuing-education sessions on this topic. During training meetings, you should evaluate the quality and quantity of existing client handouts, assess the value of materials you may obtain from pharmaceutical companies, and
The issue of liability
The legal risk for veterinary professionals is rising because of the increasing volume of research and literature showing the connection between animal parasites and human infections. Such knowledge, coupled with diagnostic capabilities of parasitologists, pathologists, epidemiologists, and physicians, generates a growing legal duty for veterinary teams to foresee such risks and warn clients and family members. Moreover, guests of those families, or neighbors who frequent parks, sand boxes, and yards used by your clients' pets, also might contract these zoonotic parasitic diseases, further extending your liability risks. The worst case scenario: It's only a matter of time until scientists link the DNA of a parasite or larva infecting a person with the DNA of a parasite infecting a pet that's under the care of a veterinarian at your practice.

As awareness of zoonotic disease rises, veterinary healthcare teams will likely be considered part of the professionals who are responsible for preventing such infections. This is an increasing concern because of the threat of legal liability for a veterinary practice's failure to diagnose and treat a pet with a zoonotic disease, in addition to warning the owner(s) of the risks of such diseases.

The only legal case illustrating the magnitude of this risk occurred several years ago in New Haven, Conn., where a child sustained permanent vision loss due to ocular toxocariasis. Medical bills surpassed $70,000, and the pet shop that sold the puppy ultimately settled out of court for $1.5 million. The court addressed only the issue of product liability, ruling that the pet was a product. Therefore, the judge enforced a strict liability standard. The pet shop owner decided to settle the dispute out of court. The court never addressed the issue of negligence, although it undoubtedly would have had the case continued. The pet shop owner allegedly was negligent for failing to deworm the puppy, failing to have any deworming program in place, and failing to keep appropriate medical records of the pets. While the defendant in this case was a pet shop owner, veterinary professionals could easily become targets in similar cases.

Although such litigation hasn't yet implicated veterinarians, at least one suit involving zoonotic parasites has been brought against a human medical center. The case cited medical malpractice for improper treatment of a patient who was suspected of having toxocariasis, probably contracted from her dog. In addition to suing physicians for failure to diagnose and treat parasitic diseases in people, plaintiffs are increasingly likely to bring actions against veterinary professionals for their negligent actions as well.

The most common avenues for plaintiff retribution include legal actions for professional negligence and adverse public relations in the media. For a professional negligence action to be sustained, plaintiffs must prove the existence of four elements:

1. Showing that veterinarians and their staff members had a duty to protect the injured person.
2. Proving that the practice failed to comply with a standard of care comparable to accepted standards for reasonably skilled and prudent veterinarians faced with similar circumstances (including standards created by the CDC with respect to the deworming of puppies and kittens).
3. Convincing a judge or jury that the veterinary practice's negligence was the proximate cause of the injured person's injuries. Thus far, the near impossibility of proving this element has been the profession's "saving grace." If DNA testing of parasitic and larval genetic materials becomes a reality, however, it will go a long way toward overcoming this evidentiary obstacle.
4. Showing proof of damages incurred by the injured party. The diagnostic and long-term medical care expenses alone for a person with chronic central nervous system damage could be enormous.

Equally troubling, adverse media coverage linking a child's chronic zoonotic enterocolitis (diarrhea) to a veterinarian's failure to diagnose and treat hookworms in the child's puppy, or encephalitis from an ascarid larva transmitted from a pet raccoon, could be devastating to a practice and the veterinary profession.

To avoid liability, your veterinary healthcare team should follow these steps:

1. Identify resources to educate the entire staff about zoonotic parasitic diseases. Contact pharmaceutical representatives to serve as part of your educational team.
2. View pets as family members and acknowledge the integral role of companion animals in family members' health status.
3. Educate clients about the health risks of parasitic infections in pets and humans. Supplement your conversations with client handouts that provide detailed information and document your efforts in medical records.
4. Develop preventive parasite control programs and recommend them to all pet owners.
5. Record all medical treatments given to pets, as well as the recommended diagnostic tests and treatments that owners decline.
6. Make sure you and your healthcare team perform accurate fecal examinations on appropriate samples. If you think a fecal sample is mostly mucus, primarily grass or other
foreign material, inadequate in volume, or so dried out as to be suspect, notify the attending veterinarian of your suspicions. Make sure your training and continuing education are adequate so you and other team members are confident with the microscopic findings you provide. If you are not, ask another staff member or a veterinarian to help you evaluate and correctly identify what you are seeing under the microscope.

7. As deemed appropriate by your practice manager, practice owner(s), or attending veterinarian, ask clients to sign consent forms releasing your practice from liability if they do not consent to recommended diagnostic procedures or deworming treatments.

In today’s climate of zoonotic awareness, your veterinary team may be practicing below current medical standards if they fail to deworm all puppies and kittens, regardless of fecal examination results. Alternatively, team members could be contributing to the practice’s liability if they have been educated but fail to recommend and perform follow-up fecal exams three to four weeks after initial treatment.

Using consent and release forms
A properly drafted consent/release form is a written document through which the signer agrees to waive the right to pursue legal action for harm resulting from a designated act. Although consent/release forms are not essential in everyday practice, their use in adversarial situations with clients is very helpful. Many times the mere request that clients read and sign such forms results in their agreement to proceed with the recommended action.

The consent/release process serves three purposes:
1. It objectifies the request, making the veterinary professional seem less of an adversary.
2. Many people will immediately accept your recommendation rather than sign a consent/release form.
3. It educates clients and provides substantial evidence that clients were informed of the seriousness and potential consequences of refusing treatment. Such proof constitutes a formidable legal defense against a lawsuit for negligence.

If clients elect not to follow your recommendations and also refuse to sign a release form, you have two options:
1. Refuse service and ask those clients to seek veterinary care elsewhere.
2. Note refusals in the patients’ record and retain the client as a non-compliant client.

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**Action step: Tailor a consent form to fit your clinic’s needs.**

A consent/release form helps clients understand the consequences of refusing heartworm testing and preventives as well as fecal examinations and deworming treatments. When your veterinarians and staff counsel clients who decline tests and treatments for zoonotic diseases, ask them to sign a form like the one below that releases your veterinary hospital from liability:

**Example**

Client Refusal to Authorize and/or Pay for Recommended Canine and Feline Fecal Analyses and/or Parasiticides

I, the undersigned owner of the pet identified below, hereby decline the fecal parasite analysis and/or treatment for that animal recommended by [practice name]. I understand that this fecal analysis and treatment for intestinal parasites is aimed primarily at improving or maintaining the health of my pet. I have been informed that eliminating intestinal parasites from my pet also is important for the health of my family and the community.

According to the Centers for Disease Control and Prevention, some dog and cat parasites may be transmitted to people, especially small children and immunosuppressed family members, and may potentially cause serious health problems, ranging from skin rashes to intestinal disease, blindness, seizures, encephalitis, and meningitis.

In the event that any individual, including myself, contracts a medical problem that could have been diagnosed and treated by conducting this fecal analysis and/or prevented by administering the recommended parasiticide to my pet, I agree to hold the staff of this practice harmless for any of the fees related to the diagnosis or treatment of such symptoms, or for any temporary or permanent injuries related to such a parasite infection that might have been prevented had such test or treatment been performed.

Pet’s Name

Owner’s Signature

Date
For a sample form, see the "Action step" on the previous page, which illustrates one of nearly 50 consent/release forms published in Legal Consent Forms for Veterinary Practices (AAHA Press, 2001).

**Developing preventive deworming protocols**

To meet clients' needs, your team must become better informed about zoonotic parasitic diseases and assist in establishing preventive deworming programs. Deworming puppies, kittens, and their mothers is one of the most effective ways to help prevent environmental contamination and human illness because young animals and their mothers have the highest worm burdens and produce the most infective larvae.3,16

Consider this advice when establishing a preventive deworming program:

1. **Set guidelines for deworming puppies and kittens.** According to the CDC, puppies should receive anthelmintic drugs at 2, 4, 6, and 8 weeks of age if both ascarids and hookworms are commonly transmitted in your geographic area. Anthelmintic drugs may be administered at 3 weeks of age if only ascarids are present. When treating kittens, the CDC recommends administering anthelmintics at 6, 8, and 10 weeks of age. In all cases, nursing mothers should be treated concurrently.3 In the absence of the above deworming program, you should deworm puppies and kittens on the first, second, and third vaccination visits, regardless of fecal examination results.

2. **Establish strategic deworming protocols for adult dogs and cats.** The deworming regimen for adult pets depends on the incidence of parasitism in your community and the degree of risk for zoonotic transmission in the pet's environment. For dogs already receiving heartworm preventives, the use of a product that contains effective ingredients against intestinal parasites is recommended. In areas endemic for zoonotic parasites, cats and dogs belonging to non-immunocompromised owners should be dewormed at least annually with broad-spectrum anthelmintics. Pets owned by immunocompromised clients should be dewormed at least three times annually with broad-spectrum anthelmintics.

**Conclusion**

Immunocompromised pet owners and parents of young children should be especially aware of zoonotic parasitic diseases. Veterinarians and paraprofessionals are among the healthcare practitioners who should be informing them of these risks. Because of this, your healthcare team should implement client education and preventive deworming protocols for companion animals. Each of you should consider yourself as a key educator and counselor regarding the risks and benefits of pet ownership. With a comprehensive, safe, and effective parasite prevention program, pets, owners, the public, your veterinary staff, and the veterinary community end up winners.

**References**

5. How to prevent transmission of intestinal roundworms from pets to people (brochure). Centers for Disease Control and Prevention/National Center for Infectious Diseases and the American Association of Veterinary Parasitologists, Atlanta, 1996.

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**Pre-test answers**

1. True
2. True
3. False
4. False
5. False