Canadian Parasitology Expert Panel

FOR COMPANION ANIMALS

Canadian Guidelines for the Treatment of Parasites in Dogs and Cats

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Canadian Parasitology Expert Panel (CPEP)

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Guidelines for the Treatment of Parasites in Dogs and Cats

These guidelines are the consensus opinion of the Canadian Parasitology Expert Panel (CPEP) which is comprised of six Canadian-based veterinary parasitologists and two general practice veterinarians. The guidelines are intended to provide Canadian veterinarians and dog and cat owners with information about the treatment and prevention of parasitic infections including gastrointestinal helminths and protozoans, heartworm, fleas and ticks. In preparing the guidelines, CPEP took into account the limited available Canadian data and opinions where data do not exist, on the occurrence of the parasites of interest in dogs and cats, on zoonotic parasitic infections and the incidence of these diseases in people. Other factors affecting parasite prevalence, including but not limited to, variations in the Canadian climate, were also included. It is also important to realize that it is very difficult to identify direct links between parasite prevalence and the optimal frequency for antiparasitic treatments.

Veterinarians should use the available data, together with their local knowledge to apply and align these guidelines to the realities of their practice. Veterinarians may recommend more frequent treatments based on an assessment of a pet's risk factors such as lifestyle, location, health status, and individual needs. The major objectives of all treatment and control programs are, however, to remove parasites, or to prevent their establishment, to eliminate or significantly reduce environmental contamination with life cycle stages that can infect other animals and people, and minimize the risk of development of drug resistance in parasites.

The available evidence indicates that parasitic zoonotic infections associated with dogs and cats are rare in people in Canada. However, it is very important for veterinarians to educate pet owners about parasites, especially those that are zoonotic, as well as about the risks of human infection and how treatment and control programs can reduce overall parasite burdens in dogs and cats and reduce the likelihood of the transmission of zoonotic parasites to people. Implementation of these programs, and owner compliance, are likely to be enhanced by at least an annual health examination of the pet by a veterinarian, regular pet fecal monitoring, and the design of appropriate parasite control programs suited to each pet based on their age, location, health status and lifestyle. Veterinarians and pet owners should also remember that it is always important to ensure proper hygiene while handling patients and conducting fecal examinations. These include:

- **washing hands with soap and water, particularly children's hands, after outdoor activities, handling pets, pet feces disposal and before meals**
- **wearing gloves while gardening**
- **promptly removing and properly disposing pet feces**
- **limiting pet defecation areas**
- **reducing pet interaction with stray and wild animals**
- **covering sandboxes when not in use**

This introductory information will provide context and rationale for the following recommendations on comprehensive parasite treatment and prevention protocols. Your local CPEP member may be available to answer your questions on the guidelines and local parasite prevalence.

Parasite Treatment Protocols for Canada

Puppies and kittens less than six months of age:

- Puppies and kittens should be treated with an anthelmintic with activity against Toxocara spp. at two, four, six and eight weeks of age and then monthly to six months of age. This early start schedule ensures prompt removal of T. canis acquired prenatally and T. cati acquired through the milk. [1,2]
- Nursing bitches and queens should be treated concurrently with their offspring since they often develop patent infections along with their young following the ingestion of pre-adult larvae or infective eggs from the feces of the puppies and kittens.
- Alternatively, when puppies or kittens are first brought home by their owner, they should be dewormed for a minimum of three treatments spaced two weeks apart and then monthly up to six months of age.[2,3]
- Appropriately conducted fecal examinations should be performed at least twice in the first year of the animal's life (e.g. at two to three months and seven to nine months of age) and the choice of products and scheduling of future treatments based on the parasites detected and their abundance in a given geographic area. [4,5]
- Dogs and cats with access to the outdoors in areas endemic for fleas or that might come into contact with fleas or infested animals in other ways, should receive preventive treatment(s) during the at risk season which is typically late spring, summer and early fall.
- Puppies in areas endemic for heartworm, or travelling to or through endemic areas, should receive monthly heartworm preventive treatments beginning at a maximum of two months of age.[6]
- Comprehensive tick control should also be based on a regional and seasonal risk assessment.[11-14]

Dogs and cats over six months of age:

- All dogs and cats over six months of age should have at least an annual fecal examination and be assessed for risk of parasitic infection including gastrointestinal helminths, heartworm, fleas, and ticks.
- Veterinarians should consider the pet's lifestyle, location, health status, other particular needs and the household in which it lives and ask pet owners the following questions to assess the animal's risk level:
  - Are there young children in the house?
  - Are there individuals with compromised immune systems in the house?
  - Are there multiple dogs and/or cats in the house?
  - Do these dogs and/or cats hunt or eat animals such as rodents, rabbits, and birds?

LOW RISK HOUSEHOLD
(If answer is "no" to all of the above questions)

Assessment and Treatment:
- Conduct fecal examinations one to two times per year. 4,5
- Treat based on fecal examination results and prevention needs, particularly if the animal rarely goes outdoors or routinely deworm one to two times per year with no fecal examination.

HIGH RISK HOUSEHOLD
(If answer is "yes" to one or more of the above questions)

Assessment and Treatment:
- Conduct fecal examinations three to four times per year. 4,5
- Prophylactically deworm and treat based on fecal examination results and prevention needs at least two times per year, preferably three to four times per year.

- Dogs and cats with access to the outdoors in areas endemic for fleas or that might come into contact with fleas or infested animals in other ways, should receive preventive treatment(s) during the at risk season which is typically late spring, summer and early fall.
- Dogs in areas endemic for heartworm or travelling to or through endemic areas, should receive a heartworm preventive treatment during the at risk season and these treatments should continue until after the transmission season has finished.[6]
- Dogs in endemic heartworm areas that receive a heartworm preventive treatment with activity against Toxocara typically receive six treatments per year from June to November. In such animals, fecal monitoring should be carried out one to two times per year.[6]
- Comprehensive tick control should also be based on a regional and seasonal risk assessment. For some adult dogs and cats in Canada, treatments may be required more frequently. [11-14]

Parasite Prevention Protocols for Canada

Heartworm

- Preventive therapy is necessary in heartworm endemic areas and recommended for dogs traveling to or through these areas. In low risk areas, clients need to make an informed decision about the need for use of preventives. [6]
- Monthly prevention should be given during the at risk period and continue until after the transmission season has finished.[6]
- The monthly macrocyclic lactone preventives (i.e. ivermectin, milbemycin, moxidectin, selamectin) have a one month retroactive efficacy against infective larvae acquired from mosquitoes.
- Veterinarians in endemic areas should evaluate the risk of infection on an annual basis (e.g. compliance in previous year, travel to high risk areas) and make the decision on whether or not to test on a case by case basis. If an antigen test is required, it should be conducted in the spring, ideally 7 months after the last possible exposure to infected mosquitoes in the previous year. This will enable detection of infections acquired during the previous transmission season. In low prevalence areas many positive antigen tests will likely be false positives. As a result, testing less frequently than annually is justifiable. [7,8,9]

- Annual testing may have rationale in highly endemic areas even if the dog was on a heartworm preventive during the previous season because:
  - While heartworm preventives are highly effective, all products have reports of lack of efficacy.
  - There may be compliance issues such as missed doses of preventive.
  - Annual testing ensures early and timely detection of a positive case.
  - The risk of adverse reactions following administration of a preventive to a heartworm positive dog varies with the preventive used.
- Dogs from non-endemic areas should be tested if they have a history of travel to or through endemic areas at least seven months previously or if they are to be placed on preventives.
- Once heartworm is endemic in a region it is very difficult to eliminate because not all dogs will be placed on preventive medications. Wildlife such as coyotes, wolves, and foxes are hosts of heartworm infection, and can act as reservoirs for pets.

Fleas

- Due to climate variations across the country, Canada has highly variable distributions and abundance of flea infestation.[10]
- Dogs and cats in multi-pet households with access to outdoors are particularly at risk.
- Flea infestations may be introduced into neighbourhoods through wildlife, particularly in much of Western Canada where wildlife is the major source of fleas. Ideally, pets should be kept away from wildlife and stray animals.
- All pets in a household should be treated with preventives.
- Flea allergic pets or those susceptible to flea-allergy should be treated regularly with an adulticide.
- Flea prevention is recommended for the entire at-risk period.[10]
- When fleas are diagnosed on a dog or cat, all pets in the household should be treated to remove adult fleas and to prevent re-infestation.
- Eliminating flea infestations may require five to six months of treatment, especially if the environment is not addressed. Environmental treatment may be required for a heavy infestation or if flea allergic pets and/or people live in the house.
- To establish correct and realistic expectations, pet owners should be educated by their veterinarian on flea lifecycles and how various products work.

Ticks

- The distribution and abundance of ticks in Canada varies with tick species.[11]
- In recent years, an increasing number of ticks have been observed on people and pets. The geographic range of ticks is expanding. [12]
- In a few of the endemic areas of Canada, 6% to 10% of Ixodes scapularis ("deer" or "black-legged") ticks are infected with Borrelia burgdorferi, the causative agent of Lyme disease. Elsewhere, the prevalence is much less. The incidence of tick-borne diseases, in particular Lyme disease and anaplasmosis, among dogs and people who have not traveled outside Canada appears to be marginal, except in some areas of Canada with endemic populations of I. scapularis.
- Antibody testing detects the presence of antibodies, not necessarily current infection. Many dogs that seroconvert to B. burgdorferi do not develop clinical signs. [13]
- Dogs and cats at greatest risk are outdoor pets in areas with high abundance of suitable tick vectors.
- The performance of tick products is variable and no tick control product provides 100% efficacy for the entire inter-treatment period. Veterinarians should advise pet owners that they will probably see ticks on treated animals.
- None of the products are labelled to prevent transmission of B. burgdorferi.
- A comprehensive plan, based on regional risk assessment, is recommended to reduce risk.[14]

Baylisascaris procyonis:

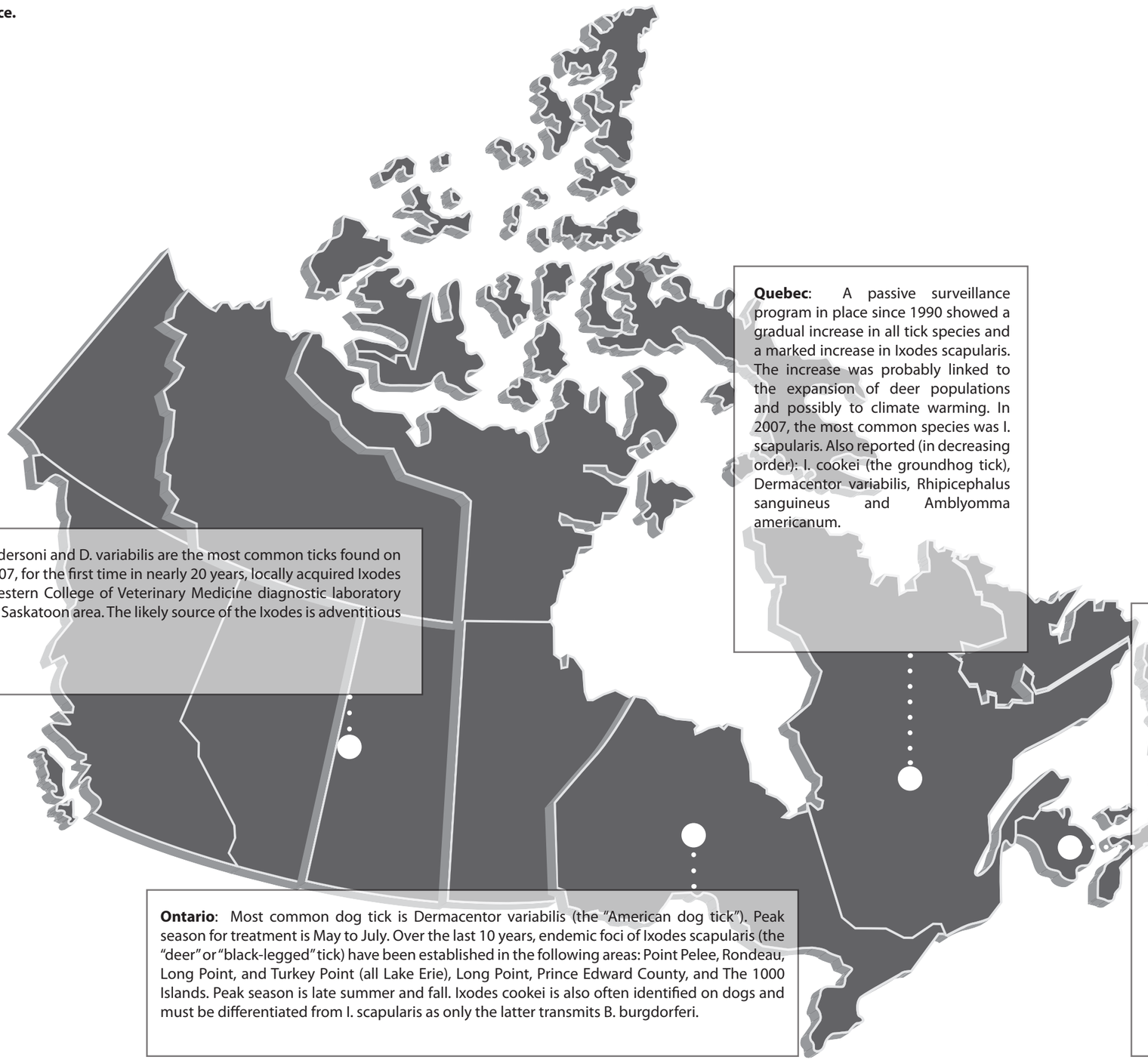
- In Canada, raccoons are commonly infected with Baylisascaris procyonis, an intestinal nematode resulting in a significant egg burden contaminating the environment frequented by raccoons. The larvated eggs are the infective stage. Ingestion of these eggs by many species of birds and mammals, including people, has resulted in clinical disease associated with larval migrations, particularly in the central nervous system. While the risk of zoonotic transmission is very low, it can result in severe central nervous system disease. To date, two confirmed cases of human disease associated with B. procyonis have been reported in Canada, both in southern Ontario.
- In the limited numbers of human infections reported globally to date, raccoon and not dog feces were implicated as the source of infection.
- Although dogs can develop patent infestinal infections and B. procyonis eggs have rarely been recovered from the feces of dogs in Canada and the USA, the major source of infective eggs in the environment is raccoons not dogs.
- Baylisascaris procyonis and Toxocara canis eggs appear very similar on a fecal exam but it is possible to distinguish them microscopically on the basis of size and morphology.[15]
- In situations where there is good circumstantial evidence to suggest that a dog may be infected (e.g. frequent contact with raccoon latrines/areas used by raccoons for defecation, with infected intermediate hosts, in an area where B. procyonis is known to occur), examination of repeat fecal samples may be required. This will determine whether the eggs represent a true (patent infection) or spurious parasitism, following ingestion of an infective intermediate host, raccoon, or raccoon feces. Dogs can become truly infected with B. procyonis either by ingesting infective eggs from the environment, or larvae in intermediate hosts. The latter route provides greater efficiency and likelihood of infection.
- There is no licensed efficacious treatment for Baylisascaris infection in dogs.
- To minimize the risk of exposure to Baylisascaris procyonis, raccoons should not be kept as pets and should be kept out of yards. Veterinarians should remind pet owners to keep dogs away from raccoons, raccoon latrines and raccoon feces, to cover sandboxes not in use, to wear gloves while gardening or picking up raccoon feces, to safely dispose of raccoon feces as quickly as possible and to wash hands with soap and water after disposal of the feces.
- Since almost all the human cases have occurred in very young children, such individuals should be kept away from raccoon latrines.

Notes for Parasite Treatment and Prevention Protocols

In addition to the notes below, please refer to the Frequently Asked Questions about Parasites in Canada and Canadian Parasite Prevalence Data by Region for additional information.

1. Biweekly treatment for gastrointestinal helminths may begin at three weeks in kittens. Transmammary transmission is the major route of infection of kittens. However, because most puppies and kittens do not have contact with a veterinarian until six to eight weeks of age, it may be necessary to provide anthelmintics to the breeder for earlier treatments.
2. The two week interval for deworming ensures frequent removal of parasites, especially T. canis in dogs, as soon as possible after they arrive in the gut lumen following either prenatal infection, transmammary infection, or from ingestion of infective eggs from the environment. These treatments reduce the risk of environmental contamination, re-infection and zoonotic transmission.
3. A heartworm preventive with activity against Toxocara species can be used for monthly deworming in heartworm endemic areas during the season of heartworm transmission and continue until after the transmission season has finished.
4. Information on properly conducting a fecal examination is available at www.capcvet.org. Click on Resources at the top of the page and follow the link to "Fecal Examination Procedures". Techniques that include centrifugation have a higher sensitivity than those that do not.
5. Fecal examinations may be performed at convenient times. For example, at the time of the first examination, spay or neuter, heartworm antigen testing, annual health exam and/or during the summer months.
6. For further information refer to Q3 in the Frequently Asked Questions About Parasites in Canada and to the Canadian Parasite Prevalence Data by Region.
7. Antigen testing is the primary screening test for heartworm. Further information is available from the American Heartworm Society at www.heartwormsociety.org.
8. Ontario veterinarians should follow The College of Veterinarians of Ontario (CVO) Veterinarian's Act and recommendations from CVO Update Volume 23(4), December 2007 pgs. 8-9, 18-19 on heartworm testing and dispensing of heartworm preventives (www.cvo.org).
9. Antigen tests in dogs do not reliably detect heartworm until seven months after infection.
10. In Canada, flea distribution and abundance rates vary. For further information refer to Q7 in the Veterinarian Frequently Asked Questions about Parasites in Canada and the Canadian Parasite Prevalence Data by Region.

11. Regional tick prevalence.



Western Canada: Dermacentor andersoni and D. variabilis are the most common ticks found on dogs and cats. In the summer of 2007, for the first time in nearly 20 years, locally acquired Ixodes scapularis was identified at the Western College of Veterinary Medicine diagnostic laboratory from two dogs that had not left the Saskatoon area. The likely source of the Ixodes is adventitious ticks from migratory birds.

Quebec: A passive surveillance program in place since 1990 showed a gradual increase in all tick species and a marked increase in Ixodes scapularis. The increase was probably linked to the expansion of deer populations and possibly to climate warming. In 2007, the most common species was I. scapularis. Also reported (in decreasing order): I. cookei (the groundhog tick), Dermacentor variabilis, Rhipicephalus sanguineus and Amblyomma americanum.

Ontario: Most common dog tick is Dermacentor variabilis (the "American dog tick"). Peak season for treatment is May to July. Over the last 10 years, endemic foci of Ixodes scapularis (the "deer" or "black-legged" tick) have been established in the following areas: Point Pelee, Rondeau, Long Point, and Turkey Point (all Lake Erie), Long Point, Prince Edward County, and The 1000 Islands. Peak season is late summer and fall. Ixodes cookei is also often identified on dogs and must be differentiated from I. scapularis as only the latter transmits B. burgdorferi.

Atlantic Canada: Ixodes scapularis ticks have been recovered from dogs, occasionally cats, and some people in all provinces and is the primary tick in P.E.I. although overall risk is low. Other Ixodes spp. ticks have been recovered from both dogs and cats. Dermacentor variabilis is the primary tick in Nova Scotia and New Brunswick, in areas with the right habitat, along with a small amount of Rhipicephalus sanguineus. Ixodes scapularis and Dermacentor variabilis activity follows a bimodal pattern. Peak activity is May/June and October/November. Tick control programs should be used for the whole season.

12. For further information refer to Q12 and Q13 in the Frequently Asked Questions about Parasites in Canada and to the Canadian Parasite Prevalence Data by Region.

13. Canada seroprevalence data from Idexx Laboratories for 2007 indicates the percentage incidence of B. burgdorferi seroprevalence from a total of 94,928 submitted dog samples from Incidence of Heartworm, Ehrlichia Canis, Lyme Disease, Anaplasmosis in dogs across Canada as determined by the IDEXX SNAP® 3Dx® and 4Dx® Tests – 2007 National Incidence Study Results, IDEXX, Markham, ON):

Province	B. burgdorferi seroprevalence
British Columbia	0.53%
Alberta	0.35%
Saskatchewan	0.58%
Manitoba	2.1%
Ontario	0.58%
Quebec	0.6%
New Brunswick	2.24%
Nova Scotia	2.38%
Prince Edward Island	4.55%

These data should be interpreted carefully as they indicate exposure and not necessarily current infection. Many dogs that seroconvert for B. burgdorferi do not develop clinical signs. In addition, the true prevalence of exposure within Canada is likely to be much lower than the reported estimates for several reasons: there is no evidence that confirmatory tests were done for any of the samples; the travel history of dogs is not given; and, in light of the very low prevalence of infection in most areas, many positive results might be false positive. A useful reference on this topic is Littman,M.P., Goldstein,R.E., Labato,M.A., Lappin,M.R., and Moore,G.E. ACVIM small animal consensus statement on Lyme disease in dogs: diagnosis, treatment, and prevention. Journal of Veterinary Internal Medicine 20(2) (2006): 422-434.

14. A comprehensive tick control program includes: Avoidance of tick infested areas, overgrown grass and brush in yards. Consistently use a tick control product for dogs and people in at risk areas. People should also wear protective clothing in tick infested areas such as long pants, long sleeves and socks. Check for ticks on skin after being in tick-infested areas. A daily body inspection and prompt removal (e.g. within 18 to 24 hours) of attached ticks can reduce the risk of infection. To remove a tick, use tweezers to grasp its head and mouth parts as close to the skin as possible. Pull slowly until the tick is removed. Do not twist or rotate the tick and try not to damage or crush it during removal. After removing the ticks, wash the site of attachment with soap and water or disinfect it with alcohol or household antiseptic.

(Reference **http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/diseases-maladies/lyme-eng.php#mi**)

15. Information from: Averbeck et al. 1995 Differentiation of Baylisascaris species, Toxocara canis and Toxascaris leonina infection in dogs. CCEPV 17, 475-511.

Canadian Parasite Prevalence Data by Region

This section contains regional prevalence data for gastrointestinal parasites, heartworm, fleas, and ticks for the Maritimes, Quebec, Ontario and western Canada. Veterinarians should note that in many areas these data are limited and/or dated. In other areas, Canadian Parasitology Expert Panel (CPEP) members have provided their impressions of prevalence based on their experiences and discussions with local veterinarians. Therefore, the data should be considered a guideline for veterinarians and not a precise measure of parasite occurrence. In addition, the species composition of parasitic infections can be expected to vary with location, a pet's lifestyle and its level of veterinary care. Veterinarians are encouraged to use the information provided here in conjunction with their own data and knowledge of their local community when making decisions about parasite treatment and control.

Note: *Heartworm transmission start and end times are taken from Slocombe, J.O. D., Bhartendu, S., Surgeoner, G. "The transmission period for heartworm in Canada." Proceedings of the Heartworm Symposium Auburn, Alabama (1995): 43-48. This information can be used to provide general guidelines on choosing start and end times for preventive use. However, these dates are based on temperature data for 1963-1992. While we know that Canada has experienced warming due to climate change since then the implications for heartworm transmission are not yet known.*

Atlantic Canada Parasite Prevalence and Impressions

Gastrointestinal Parasites
Fecal flotation examination of samples from 555 Prince Edward Island Humane Society dogs revealed the following ranking:

Parasite	All Ages (% positive)	Dogs < one year of age (% positive)	Dogs > one year of age (% positive)
Toxocara canis	10%	17%	6%
Uncinaria stenocephala	4%	4%	4%
Isospora spp.	3%	6%	0%
Trichuris vulpis	1%	0.6%	1%
Alaria spp.	1%	0.6%	2%

Giardia canis, Ancylostoma caninum, Baylisascaris procyonis, Capillaria spp., Crenosoma vulpis, Taenia spp., and Sarcocystis spp. were detected at 0.4%. It is important to note the following about these parasites:

- Giardia canis infection was underestimated in this study due to the excessive length of time of sample storage. Giardia is highly prevalent in young dogs. A current study at Atlantic Veterinary College has found 38% prevalence in Maritime dogs less than one year of age.
- Fecal flotation is a poor indicator of tapeworm and lungworm (Crenosoma vulpis) infection; these numbers are an underestimate.
- Eggs of Taenia cannot be differentiated from those of Echinococcus. Prince Edward Island is not within the endemic range for Echinoccocus, therefore these are presumed to be Taenia spp.

The prevalence of lungworm (Crenosoma vulpis) commonly referred to as the fox lungworm, is unknown in dogs in Nova Scotia, New Brunswick and Newfoundland but is highly prevalent in the red fox population (50% to 90%). In Prince Edward Island, post-mortem data from Humane Society cases shows that 3% of the general dog population has this lungworm. A similar rate is likely in Newfoundland. Based on fecal diagnostics about 20% of dogs in Atlantic Canada suffering from chronic coughing are infected with C. vulpis.

Fecal flotation examination of samples from 145 Prince Edward Island Humane Society cats revealed the following ranking:

Parasite	All Ages (% positive)
Toxocara cati	9.7%
Isospora spp.	9.0%
Taenia spp.[1]	2.1%
Cheyletiella spp.	2.1%
Giardia cati	1.4%
Toxoplasma gondii/Hammondia hammondi[2]	0.7%
Capillaria spp.	0.7%

1. Presumed to be Taenia spp. (same reasons as above)
2. Toxoplasma gondii oocysts cannot be differentiated based on morphology from those of Hammondia hammondi.

Fecal analysis can underestimate the true prevalence. For instance the true prevalence of tapeworms is much higher than the ranking based on fecal analyses.

Heartworm
Heartworm has been endemic in and localized to the Tracadie area of New Brunswick for some time and has not spread, although prevalence monitoring should occur. The transmission season typically begins in July and for assurance, the last dose of monthly preventive should be given at the beginning of November.

The last systematic survey of heartworm in Canada was carried out in 2002. Of the 354 canine cases diagnosed only one case was in the Maritimes, a dog in Nova Scotia. Anecdotally, the total number of cases diagnosed in Canada each year does not seem to have changed since 2002.

French heartworm (Angiostrongylus vasorum) is present in Newfoundland with the potential to expand to the rest of Atlantic Canada.

Fleas
There are no prevalence data for fleas in Canada, though based on their experiences, veterinary practitioners in Atlantic Canada assess the prevalence as relatively high.

Fleas are not typically a problem year round. The risk period is typically May to October. However, some households have experienced flea problems throughout the year (e.g. unoccupied and infested apartments).

Ticks
Ticks are reported to be an issue in most of Atlantic Canada. Ixodes scapularis ticks have been recovered from dogs and occasionally cats, as well as from some people in all Atlantic Canada provinces.

Ixodes scapularis is the primary tick in Prince Edward Island although the overall risk of ticks is low. Other Ixodes spp. ticks have been recovered from both dogs and cats. Some recent tick-flagging survey work indicates that are small endemic pockets of Ixodes scapularis in both New Brunswick and Nova Scotia.

Dermacentor variabilis is the primary tick in Nova Scotia, particularly in the Annapolis Valley, and in New Brunswick, in areas with the right habitat. Rhipicephalus sanguineus is present at low levels.

Ixodes scapularis and Dermacentor variabilis activity follows a bimodal pattern with peaks in May/June and again in October/November. Realistically, tick control programs should be used for the whole season.

There is no information on the incidence of tick borne disease in Atlantic Canada.

Seroprevalence data from Incidence of Heartworm, Ehrlichia Canis, Lyme Disease, Anaplasmosis in dogs across Canada as determined by the IDEXX SNAP® 3Dx® and 4Dx® Tests – 2007 National Incidence Study Results, IDEXX, Markham, ON indicates that in 2007 the percent incidence of B. burgdorferi seroprevalence from the 94,928 dog samples submitted across Canada were:

Province	*B. burgdorferi* seroprevalence
New Brunswick	2.24%
Nova Scotia	2.38%
Prince Edward Island	4.55%

These data should be interpreted carefully as they indicate exposure and not current infection. Many dogs that seroconvert for B. burgdorferi do not develop clinical signs. The true prevalence of exposure is likely to be much lower than the reported estimates for several reasons: there is no evidence that confirmatory tests were done for any of the samples; the travel history of dogs is not given; and, in light of the very low prevalence of infection in most areas, many positive results might be false positive.

Quebec Parasite Prevalence and Impressions

Gastrointestinal Parasites
Fecal analyses performed in 1,108 client-owned dogs (416 dogs < than 1 year of age and 652 dogs > than 1 year of age) in 2008 at Dr. Alain Villeneuve's laboratory at the Université de Montréal revealed the following prevalence of infection with specific intestinal parasites:

Table 1: Prevalence of gastro-intestinal parasites in dogs in Quebec – fecal examinations, 2008

Gastrointestinal parasite	*% Positive*
Giardia	11.5
Cryptosporidium	10.5
Isospora	8.0
Toxocara	4.1
Ancystolostoma	1.9
Sarcocystis	1.8
Trichuris	1.7
Toxascaris	0.8
Alaria	0.3
Dipylidium	0.1
Taenia	0.1
Strongyloides	0.1

Fecal analyses performed in 442 client-owned cats in 2008 (189 cats < than 1 year of age and 188 cats > than 1 year of age) at Dr. Alain Villeneuve's laboratory at the Université de Montréal revealed the following prevalence of infection with specific intestinal parasites:

Table 2: Prevalence of gastro-intestinal parasites in cats in Quebec – fecal examinations, 2008

Gastrointestinal parasite	*% Positive*
Isospora	7.9
Cryptosporidium	6.5
Giardia	5.6
Toxocara	5.2
Ancylostoma	1.1
Taenia	0.9
Capillaria	0.4
Alaria	0.2

Note: Centrifugal flotation with zinc sulphate methods were used to examine fecal samples for all parasites.

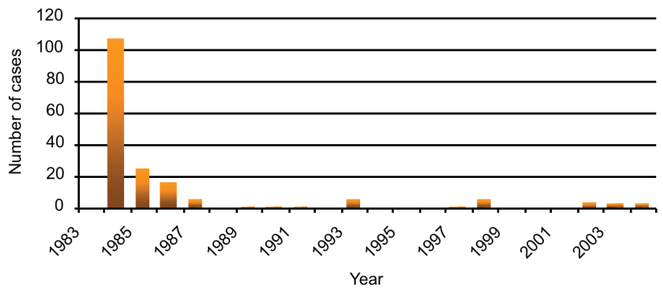
Heartworm
The heartworm endemic areas are in southwestern Quebec. The transmission season typically begins in July and finishes in the first week of September.

The last systematic survey of heartworm in Canada was carried out in 2002. Of the 354 canine cases diagnosed, 21 (6%) were in Quebec. Quebec demonstrates a specific trend as more than half of the reported cases involved dogs living permanently in the country, suggesting that wild canines constitute a major reservoir of infection. In fact in 1993, necropsies performed on 77 coyotes from the Monteregia region near Montreal revealed that seven were infected and two had more than 50 worms. Once heartworm is successfully cycling in a region it is very difficult to eliminate because not all dogs will be placed on preventive medications and wildlife such as coyotes, foxes and wolves are appropriate hosts and can act as a reservoir of infection.

While the canine population in the area is low, the Hudson/Saint-Lazare area, west of Montreal, is also an environment conducive to the transmission of this infection and 25 years of preventive action has not succeeded in eradicating heartworm. From 1983 to 2004, 182 dogs were found to be infected (see Figure 1). The vast majority of these cases do not have a history of travel.

In 1984, upon testing clinical cases, approximately 100 dogs were found to be infected. The annual follow-up revealed the presence of at least a few cases during most of the subsequent years. This trend suggests that it is impossible to eradicate the infection from a given region. With the use of preventives, the prevalence rates decreased over time. Without ongoing prevention strategies, the necessary conditions will develop for prevalence rates to explode to 5% to 10% of unprotected dogs, as was the case in the region in 1984 (see Figure 1). The risk of an epidemic will vary depending on climatic conditions. The reservoir of infection in wild canines is certainly growing over time and represents an additional threat to our pets. Another important point is the fact that this infection is zoonotic. There have been three reported Canadian cases (two published, JAMC 2003,169(7), 696-697 and Pediatric Dermatol 2008, 25(2), 230-232) of human heartworm infection, two in Quebec and one in Ontario.

Figure 1: Annual cases of canine heartworm disease in the Hudson/Saint-Lazare area. Data taken from Canadian postal surveys.



Fleas
There are no prevalence data for fleas in Canada, though based on their experiences, veterinary practitioners assess the prevalence as relatively high.

Fleas are not typically a problem year round. The at-risk period is typically May to October though some households have experienced flea problems throughout the year.

Ticks
The tick season typically starts at the end of April and concludes by early December. A passive surveillance program in place since 1990 showed a gradual increase in all tick species and an exponential increase in Ixodes scapularis in Quebec. The source of the I. scapularis ticks were people, dogs, and cats. The increase is probably linked to the expansion of deer populations and possibly to climate warming. However, in absolute values, the numbers are not worrisome (see Table 3).

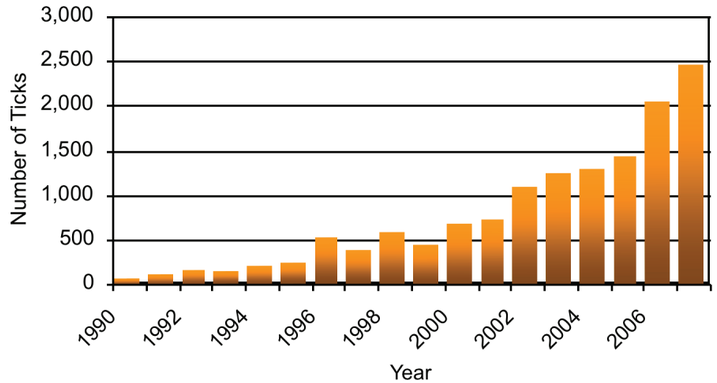
Table 3: Number and species of ticks submitted to the Quebec Public Health Laboratory for identification (1990 – 2006).

Species	Number	%
Ixodes cookei	5 839	51.0
Ixodes scapularis	3 050	26.6
Dermacentor variabilis	1 236	10.8
Rhipicephalus sanguineus	624	5.4
Amblyomma americanum	245	2.1
Ixodes muris	147	
Dermacentor albipictus	73	
Haemaphysalis leporispalustris	39	

In 2007, the most commonly found species in the surveillance program was Ixodes scapularis. I. cookei (the groundhog tick), Dermacentor variabilis, Rhipicephalus sanguineus and Amblyomma americanum were also reported. Of the 1,137 I. scapularis ticks identified, 91 (8%) were infected with Borrelia burgdorferi and 15 (1.3%) with Anaplasma phagocytophylum.

The incidence of tick-borne diseases, including Lyme disease, anaplasmosis and ehrlichiosis, is marginal. In the surveillance program, animals and humans found carrying a black-legged tick (capable of transmitting Borrelia burgdorferi) were checked more than a month later for the presence of specific immunoglobulins. Although, there are incomplete data on the breakdown of the total number of people, cats, and dogs carrying a black-legged tick, dogs are more often infested than humans and cats. Of those checked between 1990 and 2006, 33 dogs, 14 cats and six people were seropositive. In 2007, Borrelia-infected Ixodes scapularis were found on 54 dogs, 29 cats and six people. Of these, 26 dogs, seven cats and four people were tested for antibody response and two dogs, one cat but no people were positive. The low seroprevalence is expected as it represents the low risk of exposure. The results of SNAP tests performed in Quebec veterinary clinics showed seropositivity of 0.44% (28 positive responses of 6,415 tests) and 0.60% (65 positive responses in 10,787 tests) in 2006 and 2007, respectively.

Figure 2: Number of ticks submitted to the Quebec Public Health Laboratory for identification.



Ontario Parasite Prevalence and Impressions

Gastrointestinal Parasites
In southern Ontario, Giardia, Isospora and Toxocara canis and are the most common gastrointestinal parasites diagnosed in dogs, followed by hookworms and Trichuris vulpis. Disease due to hookworms is very uncommon, presumably due to the low burdens of parasites.

Fecal analyses performed on samples from 1,110 client-owned dogs at the Animal Health Laboratory, University of Guelph (AHL), between 2007 and 2008 (McEwen, B., personal communication), revealed the following prevalence of infection with specific intestinal parasites:

Intestinal parasite	% Positive
Giardia	7.8%
Isospora	5.6%
Toxocara canis	4.0%
Hookworms	1.7%
Trichuris vulpis	1.2%
Taenia type eggs	0.6%

Note: Centrifugal flotation methods were used to examine fecal samples for all parasites except Giardia, for which a commercial antigen detection test was used. Information is not available on the prevalence of Cryptosporidium as fecal samples are not routinely examined for this parasite.

Overall, Toxocara cati is the most common gastrointestinal parasite diagnosed in cats in southern Ontario, followed by Isosopora, Taenia sp. and hookworms. The prevalence of Giardia in cats is unknown as no surveys have been carried out, though data from elsewhere in North America suggests that it is likely as common an infection as in dogs - recent examination of 36 cat fecal samples for Giardia antigen by the AHL demonstrated the parasite in 4 (11%) samples (McEwen, B., personal communication). As with dogs, hookworm infections in cats are rarely associated with overt clinical signs.

Fecal analyses performed on samples from 360 client-owned cats at the Animal Health Laboratory, University of Guelph, between 2007 and 2008 (B. McEwen, personal communication), revealed the following prevalence of infection with specific intestinal parasites:

Intestinal parasite	% Positive
Toxocara cati	4.7%
Isospora	4.0%
Taenia type eggs	3.1%
Hookworms	0.3%

Note: Centrifugal flotation methods were used to examine fecal samples for all parasites. Information is not available on the prevalence of Cryptosporidium as fecal samples are not routinely examined for this parasite.

Heartworm
The heartworm endemic area is in southern Ontario. However, the risk of infection is greatest south of the 403/402/401 highways that run between Sarnia and Hamilton where 80% of all the Ontario cases occur. Transmission season typically begins in early June and finishes no later than the second week in October. The overall prevalence of heartworm in Ontario dogs appears to be approximately 0.1%. However, in discrete areas within southern Ontario the prevalence of infection in dogs not on a heartworm preventive can be as high as 5% to 10%.

The last systematic survey of heartworm in Canada was carried out in 2002. Of the 354 canine cases diagnosed, 268 (76%) were in Ontario.

Fleas
There are no prevalence data for fleas in Canada, though based on their experiences, veterinary practitioners assess the prevalence as relatively high.

Fleas are not typically a problem year-round. The at-risk period is typically May to October, though some households in the Toronto area have experienced flea problems throughout the year.

Ticks
The most common tick seen on dogs is Dermacentor variabilis (the "American dog tick"). The peak season for preventive treatment is typically May to July.

Over the last 10 years, endemic foci of Ixodes scapularis (the "deer" or "black-legged" tick) have been established in Point Pelee, Rondeau, Long Point, and Turkey Point (all Lake Erie), Prince Edward County, and the 1000 Islands. The peak season is late summer and fall. While relatively uncommon, adventitious ticks (e.g. ticks dropping from migrating birds) may be encountered anywhere in Ontario.

Over the last few years, the Public Health Agency of Canada (PHAC) has carried out passive surveillance of Ixodes scapularis that have been submitted to them from across Canada. Submitted ticks have been examined for the presence of both Borrelia burgdorferi and Anaplasma phagocytophilum using molecular diagnostic tests.

In 2007, PHAC received 745 Ixodes scapularis from dogs in Ontario. Only 45 ticks (6%) were infected with B. burgdorferi, and only one (0.1%) was infected with A. phagocytophilum. Of those 45 infected ticks, only 38 were fed to the point where transmission would have occurred. Therefore, only 38 (5.1%) of 745 tick encounters could have resulted in exposure to B. burgdorferi, leading PHAC to conclude that the risk of exposure of dogs to ticks infected with B. burgdorferi remains low in non-endemic areas of Ontario (e.g. excluding Long Point, Point Pelee, Rondeau, Turkey Point, Prince Edward Point, Presqu'ile and parts of the 1000 Islands). The risk of exposure is higher in some of the tick-endemic areas (e.g. Long Point, parts of the 1000 Islands), but only marginally so in other endemic areas (Lindsay, R., PHAC).

For most regions close to enzootic areas of the United States, B. burgdorferi is not yet enzootic, and the main source of I. scapularis in these areas is migratory birds which mainly bring nymphs here. Even if infected, nymphs feed only in the late fall when they become adult making them easier to detect because of their size. Winter temperatures destroy the majority of these ticks in most regions of the country.

The incidence of tick-borne diseases in dogs and people that have not travelled outside Ontario is very low. A 2006 study by IDEXX Laboratories (2006 Canadian Incidence Study) examined 40,015 dogs in Ontario using a Snap® 3Dx® Test. Since the test simultaneously checks for heartworm antigen along with antibody to two tick-borne pathogens, the tested dogs are likely representative of those routinely screened for heartworm. In the study, 145 dogs (0.36%) tested positive for the antibody to Borrelia burgdorferi while 14 dogs (0.03%) tested positive for antibody to Ehrlichia canis. However, since travel history and confirmatory testing were not provided for these dogs, the true prevalence of the antibodies to these two pathogens in dogs that do not travel outside Ontario is likely lower than these figures. Furthermore, since many dogs seroconvert to tick-borne pathogens and do not develop clinical disease, the overall incidence of disease due to both B. burgdorferi and E. canis in Ontario is likely much lower than these figures.

Western Canada Parasite Prevalence and Impressions

Gastrointestinal Parasites
GI parasites in dogs in most areas of western Canada are rare. Based on the minimal available data the most commonly observed helminth parasites in dogs in western Canada are Toxascaris leonina, taeniid tapeworms, Uncinaria sp. and finally Toxocara canis. This is based on a study conducted in urban centers on fecal samples (flotation technique not described) from pound dogs in various Saskatchewan cities and towns in 1969 (Anvik et al 1972) as well as anecdotal experience from the diagnostic parasitology laboratory at the Western College of Veterinary Medicine (WCVM). The diagnostic laboratory uses a centrifugal flotation method and samples represent a range of ages and both male and female animals.

More recent surveys conducted on a small number of rural dogs in northern Alberta and southern Northwest Territories indicate that these parasite genera are present in dog populations receiving minimal veterinary care (Salb et al 2008). Ancylostoma caninum infection is rare in western Canada, and is generally seen only in imported dogs (Wojnarowicz 2007). Dogs can also be infected with Echinococcus granulosus and E. multilocularis, although rarely diagnosed, in part because the eggs are indistinguishable from each other and from the eggs of Taenia species. It is important to note that both species of Echinococcus are zoonotic.

The advent of newer drugs and improved veterinary care over the past 40 years has probably lowered the incidence of parasitic infections in dogs and cats.

Common protozoan parasites seen in dogs include Isospora which is not zoonotic, as well as Giardia and Cryptosporidium which are both possibly zoonotic depending on the species and genotype.

There is even less information regarding the prevalence and intensity of parasites of cats in western Canada. A 1999 study on 52 euthanized shelter cats in Saskatoon, Saskatchewan, found the following:

Gastrointestinal parasite	Cats Infected	% Positive
Toxocara cati	9	17.3%
Taenia spp.	8	15.4%
Physaloptera spp.	2	3.8%
Dipylidium caninum	1	1.9%
Ancylostoma sp.	1	1.9%

In all cases, parasite numbers were low (Pomroy 1999). Cats can also acquire Toxascaris leonina and rarely Echinococcus multilocularis. The latter has been found in cats in Saskatoon (Wobeser 1971).

The diagnosis of parasitic protozoans in cats in western Canada is rare, although they can acquire Isospora, Toxoplasma, Giardia and Cryptosporidium.

Heartworm
Manitoba: The endemic area is in southern Manitoba. Transmission season typically begins in July and ends in the first week of September.

The last systematic survey of heartworm in Canada was carried out in 2002. Of the 354 canine cases diagnosed, 53 (15%) were in Manitoba. Anecdotally, the total number of cases diagnosed in Canada each year has not changed since 2002, although there may have been an increase in the number of cases diagnosed in Manitoba.

British Columbia: The transmission area is in the Southern Okanagan Valley. Transmission season typically begins between June 18 and July 2 and ends between September 22 and October 6.

The last major change in heartworm status for British Columbia occurred in 1991 when the parasite was discovered in dogs in the southern Okanagan valley near Oliver, British Columbia (Mackenzie and Waldie, 1991). It is thought that a heartworm positive dog from the United States was imported to the region in the mid-1980's and diseased dogs were first recognized in 1991. At that time, the region had all the ecological features required for heartworm to be introduced successfully including appropriate mosquito intermediate hosts, a population of naive dogs and summer temperatures consistently warm enough to allow for complete larval development in the intermediate hosts.

The last systematic survey of heartworm in Canada was carried out in 2002. Of the 354 canine cases diagnosed, 2 (0.56%) were in British Columbia. Anecdotally, the total number of cases diagnosed in Canada each year does not seem to have changed since 2002.

Fleas
There are no prevalence data for fleas in Canada.

Dogs and cats in the lower mainland of British Columbia are at risk almost year round especially with infestations with Ctenocephalides felis.

On the prairies and into eastern British Columbia, the prevalence of flea infestation of pets and households is quite low and is not usually associated with Ctenocephalides felis (cat flea), which is the most common flea of dogs and cats in many parts of the world. Infestations in this area of western Canada are usually associated with wildlife species (e.g. foxes, coyotes, skunks, birds) that have established themselves in a neighborhood or on a farm, from pets that have access to infested wildlife or areas frequented by wild mammals and birds.

Ticks
Dermacentor andersoni and D. variabilis are the most commonly found ticks on dogs and cats. In summer 2007, Ixodes scapularis was identified for the first time in nearly two decades from two local dogs in Saskatoon. The likely source is from migratory birds.

WCVM's diagnostic parasitology laboratory reports a marked increase in telephone queries about ticks over the last several years. Climate change models for North America suggest the increases in mean summer temperatures may allow ticks species previously confined to warmer areas of the continent to expand their ranges. In addition I. scapularis can be found in all areas of Canada. In areas where breeding populations have not been previously observed, it is assumed that these ticks have dropped from migratory birds. There is, however, an established population of I. scapularis in SE Manitoba (Ogden et al. 2008).

Overall in western Canada, less than 5% of the I. scapularis ticks are infected with the Lyme disease agent, Borrelia burgdorferi. While it is possible for an infected I. scapularis to feed on a person or a dog anywhere in the country, the odds are considered low in areas where populations of this tick species are not established. (Health Canada http://www.hc-sc.gc.ca/iyh-vsv/diseases maladies/lyme_e.html). In British Columbia's lower mainland, the Gulf Islands and southern Vancouver Island, I. pacificus is the vector for Lyme disease, though it is probably not very effective.

In western Canada the incidence of tick borne disease is not precisely known. There is minimal published survey data to indicate prevalence but it is considered to be very low. A study in 1995 found 2.5% of 240 dogs tested in Saskatchewan and Alberta had antibodies to the organism that causes Rocky Mountain Spotted Fever (Leighton et al 1995). More recently there was a published report of Anaplasma phagocytophilum infection and disease in a British Columbia dog (Lester et al 2005) and an as yet unpublished report of Anaplasma phagocytophilum infection and disease in Saskatoon dogs in the summer of 2007. The travel histories of the dogs suggest that in both areas the infection was probably locally acquired. In Saskatoon the Ixodes ticks that normally transmit this infection were probably transported on migratory birds. It is estimated that over 300,000 ticks are brought into Canada by migrating birds annually (Dr. Neil Chilton personal communication.2008).

Seroprevalence data from Incidence of Heartworm, Ehrlichia Canis, Lyme Disease, Anaplasmosis in dogs across Canada as determined by the IDEXX SNAP® 3Dx® and 4Dx® Tests – 2007 National Incidence Study Results, IDEXX, Markham, ON indicates that in 2007 the percent incidence of B. burgdorferi seropositivity rates from the 94,928 dog samples across Canada submitted were:

Province	B. burgdorferi seroprevalence
British Columbia	0.53%
Alberta	0.35%
Saskatchewan	0.58%
Manitoba	2.1%

These data should be interpreted carefully as they indicate exposure and not current infection. Many dogs that seroconvert for B. burgdorferi do not develop clinical signs. The true prevalence of exposure is likely to be much lower than the reported estimates for several reasons: there is no evidence that confirmatory tests were done for any of the samples; the travel history of dogs is not given; and, in light of the very low prevalence of infection in most areas, many positive results might be false positive.

Frequently Asked Questions about Parasites in Canada

Note to readers: *The following frequently asked questions and answers reflect information collected from members of the Canadian Parasitology Expert Panel (CPEP) based on inquiries from the Canadian veterinary community. The information is intended for veterinarians as a complement to the Guidelines for the Treatment of Parasites in Dogs and Cats.*

1. Based on the data and information available, what are the most common gastrointestinal (GI) parasites seen in dogs?
Toxocara canis, Isospora, Giardia and Cryptosporidium are the most common GI parasites in dogs. Regional and age differences exist for other types of parasites and should be kept in mind. Veterinarians are encouraged to review the regional data included with the Guidelines for the Treatment of Parasites in Dogs and Cats for additional information.

2. Based on the data and information available, what are the most common GI parasites seen in cats?
Toxocara cati, Isospora, Giardia, Cryptosporidium and Taenia spp. are the most common GI parasites seen in cats. As with dogs, regional and age differences exist. Veterinarians are encouraged to review the regional data included with the Guidelines for the Treatment of Parasites in Dogs and Cats for additional information.

3. What is the prevalence of heartworm in Canada? Has it changed over the years?
The prevalence of heartworm in dogs in Canada is very low and highly dependent on geographical location. Transmission is confined to the following regions:

- the Tracadie area of New Brunswick
- southern Ontario
- southwestern Quebec
- southern Manitoba
- southern Okanagan Valley in British Columbia

Within these endemic areas the prevalence of infection is quite low – generally less than 1% of tested dogs (Klotins et al 2000). French heartworm (Angiostrongylus vasorum) is also present in Newfoundland, with high potential to spread to the rest of Atlantic Canada.

The last systematic survey of heartworm in Canada was conducted in 2002 (http://www2.ovc.uoguelph.ca/PathoBio/Heartworm/HEARTWORM.html). Following are the data for various regions from the 354 canine cases that were diagnosed in 2002:

Province	Heartworm Cases
Ontario	268 (76%)
Manitoba	53 (15%)
Quebec	21 (6%)
Atlantic Canada	4 (1%)
Alberta	4 (1%)
British Columbia	4 (1%)

Anecdotally, the total number of cases diagnosed in Canada each year does not seem to have changed since 2002, although there may have been an increase in the number of cases diagnosed in Manitoba.

Climate change models predict warming to occur in much of the country and increases in mean summer temperatures may impact the transmission patterns of heartworm and allow for the expansion of its geographic range. However, to date, there is no evidence that this has occurred.

4. Is heartworm prevention still necessary?
Although heartworm prevalence is low in Canada the parasite can cause serious problems in infected dogs. Without preventive use, the prevalence can increase in unprotected dogs, as has been shown in certain regions in Quebec and Ontario. Furthermore, dogs that acquire the parasite become reservoirs of infection for other dogs in the region. Therefore, preventives are necessary in areas of Canada where heartworm is endemic. They are also recommended for any dogs travelling to and through endemic areas.

5. Is resistance developing to heartworm preventives?
The preventives used in Canada are safe and with good compliance are usually highly efficacious. There is no documented resistance to heartworm preventives in Canada or USA and current protocols used to prevent heartworm transmission in Canada (i.e. six preventive treatments a year) should also help to prevent the development of resistance to preventives.

It is important to remember that the main factor believed to determine the rate of development of resistance in parasites is the proportion of the total parasite population that is exposed to a preventive at any given time. In Canada, a relatively low number of the dog population is medicated. The reservoir of infection in wild canids means that only a small proportion of the parasite population is likely exposed to preventives, therefore there are reduced odds of resistance.

It should be noted that in parts of Ontario, based on cases seen over the last two years, it is believed that resistance to macrocyclic lactones has been seen in microfilariae (not third-stage larvae – the infective stage in mosquitoes). Similar anecdotal observations have also been made in the USA.

6. When and how should veterinarians test for heartworm in Canada?
Veterinarians in endemic areas should evaluate the risk of infection on an annual basis (e.g. compliance in previous year, travel to high risk areas) and make the decision on whether or not to test on a case by case basis. If an antigen test is required, it should be conducted in the spring, ideally seven months after the last possible exposure to infected mosquitoes in the previous year. This will enable detection of infections acquired during the previous transmission season. In low prevalence areas many positive antigen tests will likely be false positives. Therefore, testing less frequently than annually is justifiable.

Dogs from non-endemic areas should be tested if they have a history of travel to or through endemic areas more than seven months previously or if they are being placed on preventives.

Since the transmission season for heartworm in Canada currently appears to be no longer than 4.5 months, seasonal testing is recommended. Testing should ideally begin at the beginning of May and finish within four to eight weeks as the transmission season typically finishes no later than the second week in October.

Antigen tests are considered to be the most sensitive and specific tests available. A positive antigen test should be confirmed using other diagnostic means, especially in areas where the parasite is not endemic. In Canada, given the low prevalence of infection, blood microfilaria concentration tests are suitable confirmatory tests although they will not detect occult infections and may not detect low levels of microfilaremia.

7. What is the prevalence of fleas in Canada?
There are no prevalence data for fleas in Canada although anecdotal reports from veterinarians indicate that the prevalence is relatively high except for the Prairie provinces. Prevalence varies however, with region and many practitioners indicate that prevalence is decreasing with the generalized use of effective preventives. Veterinarians are encouraged to review the regional data included with the Guidelines for the Treatment of Parasites in Dogs and Cats for additional information.

8. What pets are most at risk for fleas?
Infestations are transmitted mainly by frequenting locations conducive to the development and survival of fleas and flea pupae. These include areas well protected from temperature fluctuations, the sun and excessive humidity, the latter maximizing development of environmental stages.

Pets living in multi-pet households and those that spend a great deal of time outdoors in areas frequented by a large number of other pets are at greatest risk. Roaming dogs and cats that hunt in areas where flea infested wildlife are found are also at risk. Transmission can also occur through prolonged contact with an infested animal, but less effectively. Since most fleas are not host specific, interspecies transmission is entirely possible and outdoor pets can bring fleas from wild animals and birds into the house.

9. What are the key recommendations to prevent fleas?
Veterinarians should consider the typical duration of the flea season and risk of flea infestation in their area and advise pet owners accordingly. Veterinarians should also remind pet owners of the following:

- Recognize the risk of pets from associating with untreated cats and dogs (e.g. at dog day cares, off leash areas, etc.)
- Do not allow pets to roam in areas where they can contact animal dens or nest sites and prevent contact with wildlife (e.g. raccoons, rats, skunks, weasels) by keeping wildlife out of yards used by pets.
- Use adulticide and preventive medication for pets in areas where flea infestations are a continuous problem. Flea prevention should be carried out for the entire at-risk period. In households with multiple dogs and/or cats, treat all dogs and cats with a flea preventive. If the pet or owner has flea allergy dermatitis, aggressive flea prevention is also required.

10. What are the key recommendations to treat flea infestations?
Treating flea infestations is a long-term undertaking and it is essential to educate pet owners so that they have realistic expectations about the risk of new infestations. It is also important to first identify the origin of the infestation.

In the event of an infestation, all dogs and cats in a household should be treated, ideally with a product that has residual activity as this will be far more effective than non-residual products and typically does not require treatment of the household environment. If a significant infestation has developed, or if dogs, cats or people in the house have a significant allergy to flea bites, treatment of the house environment as well as the pets may be required.

11. Is resistance developing to flea products?
There is no record of resistance to the newer flea control products available in Canada. Flea populations have been collected from problematic parts of the USA to characterize their susceptibility to flea products under standardized laboratory conditions. To date, there is no indication of resistance in these studies.

12. Are ticks becoming more prevalent?
The distribution and abundance of ticks in Canada varies with tick species. In recent years, it seems that in several areas of Canada there have been more ticks observed on people and pets and that the geographic range of ticks is expanding. It is unclear whether this increase is due to the fact that people are more aware of tick-borne illnesses and are therefore looking more diligently, or an actual increase in tick abundance and range.

Veterinarians are encouraged to review the regional data included with the Guidelines for the Treatment of Parasites in Dogs and Cats for additional information.

13. What is the incidence of tick borne disease in Canada?
The incidence of tick borne disease is quite low, though there is regional variation. Veterinarians are encouraged to review the regional data included with the Guidelines for the Treatment of Parasites in Dogs and Cats for additional information.

14. What measures should be taken to minimize the risk of dogs contracting tick borne disease in Canada?
The prevalence of tick borne disease in Canada's dog population remains quite low and dogs are generally at very low risk of acquiring them. However, the risk very much depends on geographic location and veterinarians should remind pet owners of the following measures to avoid ticks and tick borne diseases:

- Avoid tick infested areas including overgrown grass and brush in yards
- Check for ticks on skin after being in tick infested areas. A daily body inspection and prompt removal (e.g. within 18 to 24 hours) can reduce the risk of infection. To remove a tick, use tweezers to grasp its head and mouth parts as close to the skin as possible. Pull slowly until the tick is removed. Do not twist or rotate the tick and try not to damage or crush it during removal. After removing the ticks, wash the site of attachment with soap and water or disinfect it with alcohol or household antiseptic. (Reference http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/diseases-maladies/lyme-eng.php#mi)
- Use a tick control product on dogs to minimize infestation by preventing attachment of the ticks or by killing them shortly after they begin feeding on the animal.

Veterinarians are encouraged to review the regional data included with the Guidelines for the Treatment of Parasites in Dogs and Cats for additional information.

15. What can we expect from tick treatment products?
Products generally require monthly usage. However, they do not always provide 100% protection for the entire month and may need to be applied more frequently to maintain efficacy in areas where ticks are plentiful. Pet owners should also be advised that they may see a low number of ticks on an animal even after treatment, particularly at the end of the month.

16. What parasitic zoonotic diseases are of greatest concern in Canada? What measures should we take to minimize the risks of humans contracting these diseases?
Although there are few published national data, zoonotic parasitic diseases acquired from pets appear to be rare in people in Canada and to be considerably less common than reported in the USA. Those of greatest concern would likely include:

- Visceral and ocular larval migrans from Toxocara canis and T. cati
- Cystic and alveolar hydatid disease (Echinococcus granulosus and E. multilocularis). Both are very rare but serious. Cases of locally acquired cystic hydatid are still reported from time to time in Canada. To date, cases of human alveolar hydatid in Canada were most probably acquired elsewhere.
- Baylisascaris infection in people is very significant, but most usually associated with the presence of raccoons (B. procyonis) in people's environment rather than pets. There have been no proven human cases of B. columnaris (skunks) although it is a potential cause of human disease.
- Three potential zoonotic infections due to protozoan are Giardia, Cryptosporidium and Toxoplasma.
    - Two of the four genotypes of Giardia that can infect dogs can also infect people. In contrast, only two Giardia genotypes have been identified in cats, one of which is zoonotic. Since the full range of genotypes of Giardia infecting dogs and cats have yet to be determined, the true zoonotic risk remains unknown. However, Giardia prevalence data for dogs and people in Ontario suggest that zoonotic transmission is an uncommon event.
    - For Cryptosporidium, dogs and cats each have their own host-specific genotype (species) and infection with other genotypes in these hosts is rare.
    - For Toxoplasma, life cycle stages infective for people, and other animals, can sometimes be found in the feces of cats, but tissue cysts in meat are another, and perhaps more important, source of this parasite for people. While infection with Toxoplasma is probably not uncommon in the human population in Canada, most infections are asymptomatic. Exceptions are those affected by immunosuppression (including people with HIV/AIDS) and pregnant women infected with the parasite for the first time while pregnant. This pre-natal infection can have a range of sometimes serious effects on the fetus.
- Dog and cat hookworm and dirofilarial infections, while a theoretical risk, appear to be very rare in people in Canada.

Veterinarians are encouraged to review the regional data included with the Guidelines for the Treatment of Parasites in Dogs and Cats for additional information. Veterinarians should also educate pet owners on measures to reduce infection risks. These include:

- washing hands, particularly children's hands, after outdoor activities, handling pets, pet feces disposal and before meals
- wearing gloves while gardening
- prompt removal and proper disposal of pet feces
- limiting pet defecation areas
- reducing pet interaction with stray and wild animals
- covering sandboxes when not in use
- at least annual health examination of the pet by a veterinarian
- regular pet fecal monitoring
- appropriate parasite control programs suited to each pet based on their age, location, health status and lifestyle factors

17. In the United States, the Companion Animal Parasite Council (CAPC) recommends that dogs and cats in the United States be on a year-round anti-parasitic program. What are your recommendations for Canada?
In Canada, for many parasites, the seasons during which pets can become infected are limited because of our climate. For example, even in our mildest regions, heartworm season is less than five months and flea season rarely exceeds six months. In the case of gastrointestinal parasites, transmission is most likely in the warmer months. The potential for infection is greatly reduced during the winter months. This means that in Canada treatment and control measures are often focused on spring, summer, and fall.

Some pets may require parasite treatment and control for more of the year, up to 12 months, depending on factors such as lifestyle, location, health status and needs. Some examples include:

- Animals that spend considerable time outdoors in the winter in parts of the country experiencing mild winters.
- Pets that travel to the southern United States or Caribbean for several months during the winter each year.
- Pets in some coastal areas of Western Canada, may need flea prevention for longer than six months.

18. Despite years of educational efforts, less than 50% of all dog owners and even fewer cat owners place their pets on a parasite prevention program. What suggestions to you have to help us convince the owners of at risk animals?
Parasite control programs have several direct positive effects on pet health, and are an important part of the prevention of zoonoses, a factor which is often overlooked by pet owners. Veterinarians are encouraged to talk to pet owners about parasites, the sometimes serious health implications for their pets and the public health risks.

Parasite control also requires broader public education as parasites are both a public health and an animal health problem. While the veterinarian's role is central to the educational process, ideally, many people should be involved including breeders, pet owners, veterinarians, physicians, and public health officials.

The Canadian Parasitology Expert Panel (CPEP), encourages veterinarians to share information from CPEP's Guidelines for the Treatment of Parasites in Dogs and Cats with pet owners. This document is useful in educating pet owners about the importance of keeping animals on a parasite prevention and treatment program, and it may help to reassure pet owners that the recommended protocols are consistent with the consensus opinion of veterinary experts.

References

Anvik, J.O., Hague, A.E., Rahaman, A.A. Method of estimating urban dog populations and its application to the assessment of canine fecal pollution and endoparasitism in Saskatchewan. Can Vet. J 1974; 15: 219-223.

Averbeck et al. Differentiation of Baylisascaris species, Toxocara Canis and Toxascaris Leonina infection in dogs. CCEPV 1995, 17, 475-511.

Brophy, J. and Peregrine, A.S. Parasite zoonoses of dogs and cats: a medical and veterinary perspective in Canada. In: Proceedings, Ontario Veterinary Medical Association Conference, 30th January 2009, Toronto, Ontario.

Chilton, N, Department of Biology, University of Saskatchewan.

Ghadirian E, Viens P, Strykowski H, Dubreuil F. Epidemiology of Toxocariasis in the Montreal area. Prevalence of Toxocara and other helminth ova in dogs and soil. Canadian Journal of Public Health. 1976 67(6):495-498.

Klotins, K.C., Martin, S.W., Bonnett, B.N., Peregrine, A.S., Canine heartworm testing in Canada: Are we being effective? Can Vet J 2000; 41:929-937.

Lefebvre, S.L., Waltner-Toews, D., Peregrine, A.S., Reid-Smith, R., Hodge, L., Arroyo L.G.,. Weese, J.S. Prevalence of zoonotic agents in dogs visiting hospitalized people in Ontario: implications for infection control Journal of Hospital Infection 2006 62(4):458-466.

Leighton, F.A., Artsob H.A., Chu, M.C., Olson, J.G. A serological survey of rural dogs and cats on the southwestern Canadian prairies for zoonotic pathogens. Can J Pub Health; 2001; 92, 67-71.

Lester, S.J., Breitschwerdt, E.B., Collis, C.D., Hegarty, B.C. Anaplasma phagocytophilum infection (granulocytic anaplasmosis) in a dog from Vancouver Island. Can Vet J 2005; 46:825–827.

Littman, M.P., Goldstein,R.E., Labato,M.A., Lappin,M.R., and Moore,G.E. "ACVIM small animal consensus statement on Lyme disease in dogs: diagnosis, treatment, and prevention." Journal of Veterinary Internal Medicine 20, no. 2 (2006): 422-434.

Mackenzie, G.W., Waldie, J.M. Heartworms in dogs in British Columbia. Can Vet J 32; 1991: 501.

Malloy,W.F., Embil,J.A. Prevalence of Toxocara spp. and other parasites in dogs and cats in Halifax, Nova Scotia. Canadian Journal of Comparative Medicine 1978 42(1):29-31.

Ogden, N.H., Lindsay, L.R., Sockett, P.N., Morshed, M., and Artsob, H. The rising challenge of Lyme disease in Canada. Can Commun Dis Rep 2008; 34: 1-19.

Pomroy, W.E. A Survey of helminth parasites of cats from Saskatoon. Can Vet J 1999; 40: 339-340.

Pritchard, R.K. Is anthelmintic resistance a concern for heartworm control? What can we learn from the human filariasis control programs? Vet Parasit 2005; 133: 243–253.

Rust, M.K. Advances in the control of Ctenocephalides felis (cat flea) on cats and dogs. Trends in Parasitology 2005; 21:232-236.

Salb, A.L., Barkema, H.W., Elkin, B.T., Thompson, A.R.C., Whiteside, D.P., Black, S.R., Dubey, J.P., and Kutz, S.J., Dogs as sources and sentinels of parasites in humans and wildlife, northern Canada. Emerging Infectious Diseases 2008; 14: 60-63.

Shukla,R, Giraldo.P., Kraliz,A., Finnigan,M., Sanchez,A.L. Cryptosporidium spp. and other zoonotic enteric parasites in a sample of domestic dogs and cats in the Niagara region of Ontario. Canadian Veterinary Journal 2006 47:1179-1184.

Slocombe, J.O.D., Sugeoner, G.A., Srivastava, B., 1989. Determination of heartworm transmission period and its use in diagnosis and control. In: Otto, G.F. (Ed.), Proceedings of the Heartworm Symposium 1989. American Heartworm Society, Washington, DC, pp. 19–26.

Threlfall W. Further records of helminths from Newfoundland mammals.

Canadian Journal of Zoology 1969 Mar; 47(2):197-201.

Unruh,D.H.A., King,J.E., Eaton,R.D.P., Allen,J.R. Parasites of dogs from Indian settlements in northwestern Canada: a survey with public health implications. Canadian Journal of Comparative Medicine 1973 37(1):25-32.

Wobeser, G The Occurrence of Echinococcus multilocularis (Leukart, 1863) in cats near Saskatoon, Saskatchewan. Can Vet J,1971; 12:65-68.

Wojnarowicz, C. Ancylostoma caninum infection in a Texas-born Blue Lacy dog — Alberta. Can Vet J 2007; 48; 1185-1186.

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