

Ticks and tick-borne diseases: risk, prevention, and treatment



There is no question that tick-borne diseases are on the rise, based on both human case reports and canine serologic surveys. As well, novel pathogens continue to be identified, including *Borrelia* spp., *Ehrlichia* spp., and *Rickettsia* spp., making Lyme disease (*Borrelia burgdorferi*) just one part of the growing concern. Comprehensive tick control remains the best way to minimize the risk of infestation and infection.

An in-depth look at what we know about ticks and tick-borne disease was presented by Susan Little, DVM, PhD, Dipl. ACVM at a series of lectures held in Ontario, Canada in February, 2014. This report provides a summary of the key teachings presented by Dr. Little, Regents Professor and Krull-Ewing Chair in Veterinary Parasitology at the Centre for Veterinary Health Sciences at Oklahoma State University.

In North America, the most common canine tick-borne diseases (and associated causative agents) are Lyme disease (*Borrelia burgdorferi*), ehrlichiosis (*Ehrlichia canis*, *Ehrlichia ewingii*, *Ehrlichia chaffeensis*), anaplasmosis (*Anaplasma phagocytophilum*, *Anaplasma platys*), Rocky Mountain spotted fever (*Rickettsia rickettsii*), babesiosis (*Babesia vogeli*, *Babesia gibsoni*), and canine hepatzoonosis (*Hepatozoon americanum*, *Hepatozoon canis*).

Dr. Little noted that a single tick can transmit more than one pathogen, infestations can include more than one tick species, and dogs can be co-infected with more than one pathogen. Since dogs can serve as a reservoir for human infection, people are also at risk. Dr. Little stressed the public health benefit, saying “By treating dogs for ticks, we’re not only keeping them from getting infected, but we’re also helping to limit the number of ticks around the home that create a health risk to the human family members.” Dr. Little says that comprehensive tick control remains the best way to minimize infection.

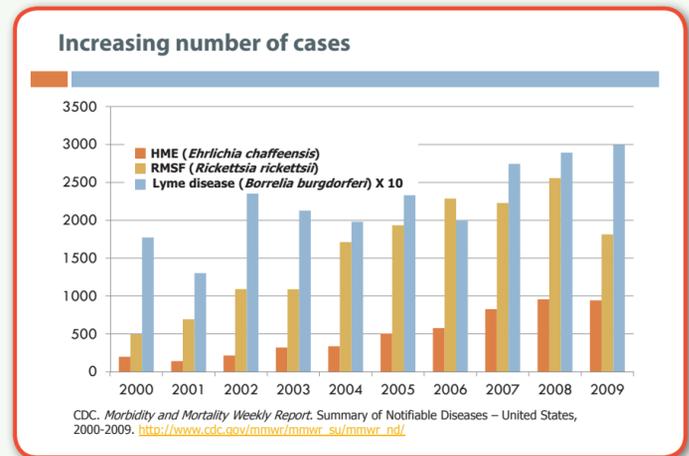
Ticks are both tenacious and pervasive – one female brown dog tick produces up to 4,000 eggs leading to thousands of tick larvae. Ticks can survive outdoors in wintery weather, though activity waxes and wanes throughout the year, according to temperature. As a result, the Companion Animal Parasite Council (www.capvet.org) recommends that every dog be on tick control every month all year long, because infestations can occur year-round and infections can be fatal.

Dr. Little endorses vaccination for Lyme disease in endemic areas, including Ontario, although “vaccination gives some clients a false sense of security that their dog is now protected from ticks, while in fact there are many other ticks and diseases they can become infected with.” As vaccines are not 100% effective, there is still a risk of infection. The most important part of protecting a dog, she says, is tick control, because it will protect against all the infections, including Lyme disease.

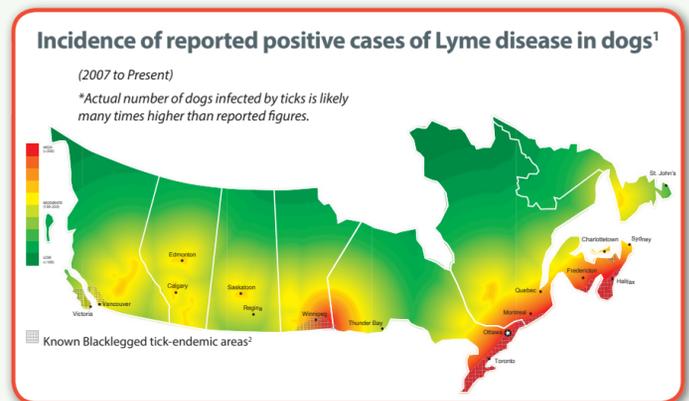
Tick-borne infections on the rise

Since 2000, the number of reported cases caused by these agents has increased dramatically. Although approximately 30,000 cases of human Lyme borreliosis are reported to Center for Disease Control (CDC) annually, the agency estimates that there are actually closer to 300,000 new cases of Lyme disease in people each year. A similar increase was seen in canine seroprevalence, with antibodies to *B. burgdorferi* detected in 5.1% of dogs tested in the United States from 2001-2007, but 7.2% tested from 2010-2012. In fact, Lyme disease has been reported more frequently than any other tick-borne infection. The most heavily affected areas, based on canine data, are the northeastern United States, the Great Lakes region, and California. But, Dr. Little says the number of cases is expanding in all areas, and this is likely attributed to increasingly

warmer, wetter climates. According to Google Trends, online searches for “Lyme disease” in the United States peak seasonally in June and October, which coincide with the appearance of nymphal ticks and adult ticks, respectively. Indeed, the presence and activity of adult ticks increases in October through March, a time when people may stop treating their dogs due to a belief that ticks are no longer a threat as temperatures decline.



In Canada too, ticks are increasing in abundance and expanding in geographical range. Incidences of reported cases of Lyme disease in dogs from 2007 to present is highest in southern Ontario and Quebec, areas of New Brunswick and Nova Scotia, and southeastern Manitoba.



Tick diversity

Evidence shows that many species of ticks are expanding throughout North America. For example, *Ixodes scapularis* (Deer tick) has established populations in parts of southeastern and central Manitoba, southern and eastern Ontario, and southwestern Quebec. Isolated populations are found in southern New Brunswick and along the South Shore in Nova Scotia. *Amblyomma americanum* (Lone Star tick) was historically considered a southern USA tick, but has recently established itself in the eastern two-thirds of the United States. It has also been reported with increasing frequency in southern Ontario.

In one study³, researchers documented canine infection with, or exposure to, *Borrelia burgdorferi*, *Ehrlichia canis*, *Dirofilaria immitis*, and *Anaplasma phag-*

Tick populations in Canada

Blacklegged (Deer) Tick <i>Ixodes scapularis</i>	Populations established in parts of southeastern and central Manitoba, parts of southern and eastern Ontario and southwestern Quebec. Isolated populations are found in southern New Brunswick and along the south shore in Nova Scotia (including Pictou country).
Western Blacklegged Tick <i>Ixodes pacificus</i>	Found along the Pacific Coast, mainly in southern B.C. (Fraser Delta), the Gulf Islands and Vancouver Island. Occasionally reported in Alberta, but populations of this species are not known to be established.
American Dog Tick <i>Dermacentor variabilis</i>	Well established populations in southeastern Saskatchewan through much of southern Manitoba, and in western and central Nova Scotia. Isolated populations found in parts of southern and eastern Ontario and sporadic records of this species from Quebec and New Brunswick.
Rocky Mountain Wood Tick <i>Dermacentor andersoni</i>	Found from central B.C. through southern Alberta to southwestern Saskatchewan.
Brown Dog Tick <i>Rhipicephalus sanguineus</i>	Found sporadically across much of Canada, usually in localities frequented or housing dogs (kennels).
Lone Star Tick <i>Amblyomma americanum</i>	Populations of this tick are not established in Canada, although small numbers of this species can be occasionally found from Manitoba to Newfoundland.

ocytophilum to assess geographic trends in rates of positive tests, using the SNAP[®] 3DX[®] Test and SNAP[®] 4Dx[®] Plus Test (IDEXX Laboratories). While the percent positive test results varied by agent in different regions of the United States, evidence of at least one agent was found in dogs from every state considered. Dr. Little says, “This highlights the fact that while we’re concerned about Lyme disease, there are so many other vector-borne diseases that can cause serious infections. In fact, it is widely thought that there likely are more tick-borne diseases that we don’t know about than we do know about.” She reiterated that since we don’t have vaccines for all of the diseases, “tick control is the best measure we have.”

Tick control measures

Dr. Little says that proactive year-round use of tick control agents in hyper-endemic areas is the best way to prevent infection. Even in the winter there are times when conditions will be ripe for ticks to be present.

Ticks are particularly challenging to control because while there are peak seasons for activity, different species are active at different times of the year. Unlike fleas, ticks mainly live outdoors, so controlling their reproduction and survival is next to impossible. As well, the different species vary to such a degree that there isn’t a one-size-fits-all tick control strategy. There are very few compounds that are effective against a broad spectrum of species; the most effective are the pyrethroids (e.g. permethrin), amitraz, and fipronil (fipronil is not available in Canada). Only the pyrethroids have a repellency effect.

Bayer’s Seresto[®] collar (not available in Canada) combines two active ingredients, imidacloprid and flumethrin, in a sustained release technology to ensure that the active ingredients are released in low concentrations over 8 months.

Other products are also available but their spectrum of efficacy may be more limited. A new Merial oral flea and tick product is available in the United States, but to date is only labeled for *dermacentor variabilis*. Similarly, canine Revolution[®] (selamectin, Zoetis) is labeled for the treatment of *Rhipicephalus sanguineus* and as an aid in the control of *dermacentor variabilis* (in the US, Revolution[®] is only labeled against *D. variabilis*).

K9 Advantix[®] II (Bayer) is registered for all major tick species. It works on contact, killing the tick and preventing it from attaching to the skin and trans-



mitting infection. This is important because some ticks can transmit pathogens in as little as four hours. Therefore, prevention of tick attachment, biting, and feeding is critical to help protect dogs from tick-borne diseases.



K9 Advantix[®] II may also help to reduce the risk of Lyme disease transmission. In each of two studies, eight dogs were treated with imidacloprid/permethrin, and eight dogs in the control group were untreated. All dogs were infested with 100 *I. scapularis* (Deer ticks) on study day 7 or 25 post-treatment depending on the protocol. Ten mL of whole blood was drawn on multiple days in both the day 7 and day 25 challenge protocols. Results of the 7-day challenge study showed that none (0%) of the treated dogs tested positive for *B. burgdorferi*. In comparison, all of the untreated dogs tested positive for this pathogen. In the 25-day challenge study, again none of the treated dogs tested positive. Yet, 7 out of 8 (88%) of the untreated dogs tested positive.

Borrelia spp. antibody response^{4,5}

	Group A (treated with imidacloprid and permethrin)	Group B (Not Treated)
7-day challenge study		
No. of dogs testing positive for <i>B. burgdorferi</i>	0 out of 8	8 out of 8
% of positive dogs	0%	100%
25-day challenge study		
No. of dogs testing positive for <i>B. burgdorferi</i>	0 out of 8	7 out of 8
% of positive dogs	0%	88%

Other control measures include limiting tick habitat by removing leaf litter, burning debris, and creating a barrier between the yard and wooded areas. Dogs should be prevented from roaming, and wildlife should be discouraged from nesting close to the house.

Treating and controlling infection

About 95% of dogs that test seropositive to *B. burgdorferi* will never develop symptoms of Lyme disease. In the 5% that do become ill, most will present with arthritis (develops about 5 months after infection), shifting-leg lameness, and lethargy. About 10% of the dogs showing symptoms may develop Lyme nephritis, and these cases are very difficult to recover.

Treatment for infection is based on the dog’s history, symptoms, and test results. The American College of Veterinary Internal Medicine (ACVIM) recommended treatment for Lyme borreliosis (dogs showing symptoms or proteinuria) is doxycycline 10 mg/kg/day for 4 weeks. Dr. Little explained that doxycycline is also effective against *Rickettsia rickettsii*, *Anaplasma* spp., and *Ehrlichia* spp. She added that dogs that fail to respond to Lyme disease treatment should be tested for other diseases since those with tick-borne disease often have multiple infections and/or may be more susceptible to re-infection.

1. IDEXX Laboratories. Diseases in your area. Dogs and Ticks. Available at: www.dogsandticks.com.
2. Public Health Agency of Canada. Lyme disease and other tick-borne diseases: Information for health professionals. Available at: www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php.
3. Bowman D, Little SE, Lorentzen L, et al. *Veterinary Parasitology*, 2009;160:138-148.
4. Spenser JA, Butler JM, Stafford KC, et al. Evaluation of permethrin and imidacloprid for prevention of *Borrelia burgdorferi* transmission from blacklegged ticks (*Ixodes scapularis*) to *Borellia burgdorferi*-free dogs. *Parasitol Res*. 2003;90(Suppl):S106-S107.
5. Blagburn BL, Spencer JA, Butler JM, et al. Prevention of transmission of *Borrelia burgdorferi* and *Anaplasma phagocytophilum* from ticks to dogs using K9 Advantix and Frontline Plus applied 25 days before exposure to infected ticks. *Intern J Appl Res Vet Med* 2005;3(2):69-75.

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