

Tick Repellents

Insect (and tick) repellents applied to skin and/or clothing can be broadly grouped as synthetic chemical or botanical chemical-based compounds.

There are about 150 repellent products registered with the U.S. Environmental Protection Agency (EPA)



for use on human skin. The primary active ingredient in most insect/tick repellents today is DEET (N, N-diethyl-m-toluamide). For blacklegged ticks, DEET concentrations around 20-30% applied to clothes are about 86-92% effective in preventing tick bites. Other repellents at appropriate concentrations for use against ticks include picaridin (20%), oil of lemon eucalyptus (30%), and IR3535 (20%). For use only on clothing, products with permethrin, a pyrethroid insecticide, work primarily by killing ticks on contact, although it also has some repellent activity. Available as an aerosol spray or

on pre-treated clothing, it can provide a high level of protection. Botanical, herbal or other natural-based repellents



include one or several plant essential oils, most providing a more limited duration of protection. However, many are not effective against ticks and are not labeled for use against ticks. More information on repellents is available in a fact sheet at www.ct.gov/caes under publications.

Tick Bite Risk

- Nymphal blacklegged ticks are very small (pinhead size), difficult to notice, and are active during the late spring and summer months. Roughly 70-80% of human Lyme disease cases occur in the summer months.
- The majority (about 75%) of Lyme disease cases are associated with activities (play, yard or garden work) around the home and about 21% in activities away from the home. Adult blacklegged ticks are active in the fall, warmer days in the winter, and in the spring when outdoor activity and exposure is more limited. They are larger, easier to notice, and therefore associated with fewer cases of Lyme disease (even though infection rates may be higher.)
- Ticks do not jump, fly or drop from trees, but grasp passing hosts from the leaf litter, tips of grass, etc. Most ticks are probably picked up on the lower legs and then crawl up the body seeking a place to feed. Adult ticks will seek deer and other larger animals at the shrub level several feet above the ground, about or above the height of a child.
- Children 5-13 years of age are particularly at risk for tick bites and Lyme disease as playing outdoors has been identified as a high-risk activity. Take notice of the proximity of woodland edge or mixed grassy and brushy areas from public and private recreational areas and playing fields. While ticks are unlikely to be encountered in open fields, children chasing balls off the field or cutting through woods to school may be entering a high-risk tick area.
- Pets can bring ticks into the home, resulting in a tick bite without the person being outdoors. A veterinarian can suggest methods to protect your pets. Engorged blacklegged ticks dropping off a pet will not survive or lay eggs in the house as it is too dry.

Steps to Reduce Risk of Tick-Borne Diseases

1. Wear long pants tucked in socks
2. Consider using EPA-registered repellents
3. Bathe, look and feel for ticks after leaving tick habitats, and remove any ticks
4. Have ticks properly identified or tested
5. Check pets for ticks, use tick control products; consult with veterinarian about canine Lyme disease vaccine



Further information on tick biology, tick-bite prevention and environmental tick control is available in the Tick Management Handbook and tick factsheets on the CAES website.

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Ticks, Lyme Disease, and other Tick-Borne Diseases

Northeastern United States



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Lyme Disease

Lyme disease is an infection caused by the spirochete bacterium *Borrelia burgdorferi*, transmitted by blood feeding of the blacklegged tick, *Ixodes scapularis*. Early infection is noted by an expanding red rash in 70-80% of patients within 7-14 days at the site of the tick bite. With or without the rash, non-specific "viral-like" symptoms include fatigue, muscle and joint pain and maybe a fever. Rashes vary in size, shape, and appearance. The rash is often red, but may have central clearing, or a "bull's eye" appearance. As the infection spreads, it can cause arthritis, malaise, fatigue, and neurologic or cardiac problems.



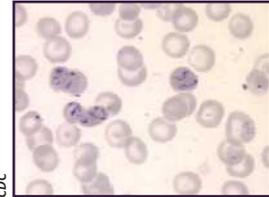
Pfizer



CDC/James Gathany

Babesiosis

Babesiosis is a malaria-like illness that is caused by the protozoan *Babesia microti*, propagating in red blood cells. Human infection can range from subclinical to mild flu-like illness, to severe life-threatening disease in the elderly, the immune-suppressed, and people without spleens.



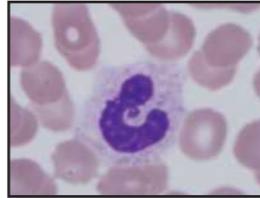
CDC

Babesia microti in red blood cells

Symptoms include fever, fatigue, chills, sweats, headache, and muscle pain. Co-infection of this pathogen with *B. burgdorferi* can result in overlapping clinical symptoms, more severe disease, and a longer recovery than either disease alone.

Anaplasmosis

The bacterium *Anaplasma phagocytophilum* invades a type of white blood cell, forming colonies (morulae) that may be observed in a stained peripheral blood smear. Clinical symptoms are non-specific and may include fever, headache, chills, muscle aches, nausea, vomiting, and malaise. Most cases are mild, resolving without treatment within 30 days, but cases may also be moderate or severe in elderly or immunocompromised individuals.



Sheldon Campbell/Yale

Hard Tick Relapsing Fever

Borrelia miyamotoi was first found in the blacklegged tick in Connecticut in 2001. The first human cases in North America were described in 2013 in patients presenting with a viral-like illness, some of whom also had Lyme disease or babesiosis. Symptomatic cases appear to be highest in people during July and August. Symptoms include fever, chills, fatigue, headache, and muscle and joint pain. Fever and other symptoms may occur in cycles separated by periods of feeling better. The prevalence of *B. miyamotoi* in blacklegged ticks appears low (1-5%). Unlike Lyme disease agent, this pathogen can be transovarially transmitted (female tick to egg), raising the possibility of transmission by larval ticks feeding on people.

Powassan Virus

Powassan virus (POWV) is a tick-borne encephalitis virus. Cases of Powassan encephalitis are relatively rare (7-12 cases reported in the US each year). The principal tick vector is the blacklegged tick and occasionally the "woodchuck tick," *Ixodes cookei*. Approximately 2.0% of adult blacklegged ticks carry the virus. While some people may not develop any symptoms, POWV can lead to meningitis or meningoencephalitis associated with fever, convulsions, headache, disorientation, lethargy, partial coma, and paralysis in some patients. The disease has a fatality rate of 10% and about half of survivors may develop long-term or permanent neurological and other problems.

The Ticks

Blacklegged Tick (aka deer tick) *Ixodes scapularis*



USDA/Scott Bruer

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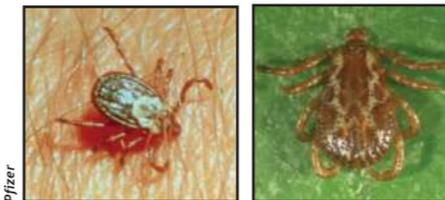
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Male, pin, female and engorged female blacklegged tick (left to right).

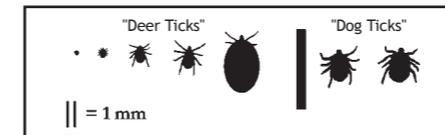
American Dog tick, *Dermacentor variabilis*



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Kirby Stafford

Female dog tick (left) and male dog tick (right).



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Actual Size (left to right) of larva, nymph, adult male, adult female, and engorged adult female *Ixodes* ("Deer Ticks") and adult male and female *Dermacentor* ("Dog Ticks")

Pathogen Transmission

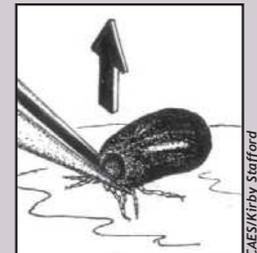
Ticks attach and feed slowly over a period of several days. Most Lyme disease cases are associated with the bite of the nymphal stage of the blacklegged tick. The probability of transmission of Lyme spirochetes increases as the feeding duration of an infected tick increases (0% at 24 hours, 12% at 48 hours, 79% at 72 hours, and 94% at 96 hours). Similarly, it takes at least 24 hours for the agents of babesiosis and anaplasmosis to be transmitted by the tick. On average, 30% of blacklegged ticks are infected with Lyme disease bacterium. Ticks can also carry multiple pathogens, although the rate of co-infection is low (0.1-6.0%). Prompt removal of an attached tick will reduce the chance of infection. However, the Powassan virus can be transmitted in as little as 15 minutes after tick attachment. American dog ticks, on the other hand, do not transmit the pathogens associated with the blacklegged tick but are vectors of pathogens responsible for Rocky Mountain spotted fever and tularemia, cases of which are rarely reported in Connecticut.

Tick Removal

To remove a tick, use thin-tipped tweezers or forceps to grasp the tick as close to the skin surface as possible. Pull the tick straight upward with steady even pressure. Disinfect the area with rubbing alcohol or another skin disinfectant; a topical antibiotic also may be applied. Save the tick for identification or testing and evidence of tick bite.



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CAES/Kirby Stafford

Engorged nymph of *I. scapularis* with straight pin for size comparison (left) and removal of a tick with forceps (right).